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Fast Dry Borehole Drilling and Bulb Formation with the Askaryan Radio Array Hot Water Drill

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The Askaryan Radio Array (ARA) is a radio-based neutrino telescope that was constructed at the South Pole between the period of 2011 to 2018. Construction of the array required dry boreholes 18 cm in diameter to depths of 200 m to install the radio antenna instrumentation. The ARA Hot Water Drill (ARAHWD) was developed specifically for this task, and can achieve the required boreholes in 7 hr of drilling with a hole-to-hole turnaround time of 10-12 hr. Using hot water to create dry holes is a unique approach. Hot water drilling technology was selected because it offers the high drill speeds needed to deliver a maximum number of boreholes in a limited window of seasonal time, however it requires more personnel resources to operate than some other mechanical drilling methods. The drill system has a 300 kW thermal capacity and is packaged onto three sleds that are towed in a train configuration to maintain high mobility. In addition to drilling for ARA, the ARAHWD has become a valuable resource for other drilling activities at the South Pole, including firn drilling and subsurface bulb creation for the South Pole Station, and integration into the recently commissioned IceCube Upgrade Hot Water Drill for management of that system's dedicated Rodwell. The basic design principals of the ARAHWD and its various applications will be summarized.

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