

Large-Diameter Firn Drilling with the IceCube Independent Firn Drill

The Independent Firn Drill (IFD) was developed to improve firn hole quality and operational efficiency of the drilling campaign for the IceCube Project. The IFD is used to create an initial 60 cm borehole through the firn layer at the South Pole to a depth of approximately 40 m, where melt water begins to pool in the borehole. At that point, the deep hot water drill (Enhanced Hot Water Drill, now the IceCube Upgrade Drill) is used to continue drilling the borehole to the required total depth of 2500-2600 m. The top 40 m of firn is permeable to water and using lost-water hot water drill techniques for this section is highly inefficient, and therefore a hot point technique is preferred. The IFD uses a closed-loop water-glycol system that electrically heats the fluid in a local reservoir and circulates it through a coiled copper tube cone-shaped hot point. Drill rates are slow, however designing the system to be independent from the main hot water drill operations allows the IFD to begin making firn holes well ahead of main drilling activities, in some cases a year or more ahead of time. Coupled with a mobile generator, the IFD system is completely standalone and highly mobile. It requires 1 person to operate during drilling, but can also be left unattended for extended periods because the system is fully electric. A functional description of the IFD system will be presented.

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