Ice Drilling Program

Dartmouth _ University of Wisconsin-Madison _ UNH

DOCUMENT IDENTIFICATION		
Title:	**SCIENCE REQUIREMENTS: NEXT-GENERATION BLUE ICE DRILL – BOLD DRILL**	
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DOCUMENT APPROVAL	
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REV	DESCRIPTION	DATE	APPROVAL
1.0	Initial Science Requirements	August 2025	Brook, Buizert, Higgins, Shackleton
2.0	Revised Requirements	January 2026	Brook, Buizert, Higgins, Shackleton

Science Requirements: Next-Generation Blue Ice Drill: Borehole of Large Diameter (BOLD) Drill

IDP has used existing drills in the IDP inventory to drill ice cores in support of COLDEX and other science in blue ice at Allan Hills. While existing drills have successfully drilled shallow ice cores (less than 400 m deep) elsewhere, the scientists and drillers report that Allan Hills shallow core quality has been unsuitable for several types of scientific analysis, due in part to the unusual brittleness of the ice. The existing wide-diameter ice coring drill, the Blue Ice Drill, has received a lot of use but it is aging. Larger-diameter ice cores are preferable for the science community due to the greater amount of ice for analysis. A long-term solution for wide-diameter ice coring in blue ice areas is needed. Relevant to consideration of the longer-term solution is the January 2025 IDP report by Barb Birrittella, "Blue Ice Core Quality Feasibility Study", which compares and evaluates various approaches to ice core drilling in blue ice areas. In the 2025-26 Antarctic field season at Allan Hills, IDP verified the concept that a drilling fluid could improve core quality at Allan Hills, using a drill that has a 1-meter long version of the Foro 1650 core barrel (98 mm core), combined with the surface equipment and control system from the 700 Drill.

The purpose of establishing these science requirements is to identify aspects of a next-generation wide-diameter drill that could provide the quantity and quality of ice needed for scientific analysis, while also minimizing the logistical requirements for the drill, drilling fluid, and ice transport to and from blue ice areas. Through iterative discussions with IDP management, engineers, and representatives of the ice core science community, the scientific requirements for the next-generation large-diameter ice core drill are the following:

1. The target ice core diameter should be nominally 162 mm (6 ⅜ inch).
2. The target ice core length is 100 cm.
3. The target depth for the drill is 250 m for dry drilling, or 400 m for wet drilling.
4. The design process should compare the associated drill complexity and logistical burden between dry drilling to 250 m depth and wet drilling to 400 m depths.
5. The newly developed drill would be available for use in the 2027-28 field season, pending NSF approval for design and funding for construction of the drill.
6. The drill should be rated for storage down to -40 degrees C, and operational at ambient surface temperatures down to -30 degrees C.
7. Drill liquid and chip management equipment should be customized for agile use at shallow coring sites where the only shelters would be tents.
8. Set up and drilling of a 250-meter core should be possible in 21 or less single-shift operational days.
9. The complete drill system (not including generators) and tent packed for shipping should have a target weight of 6,000 lbs. or less, and individual components need to be moveable without using heavy equipment.
10. A fluid bailer is required to bail the hole.
11. The drill tent should be able to be set up in winds up to 18 knots. A search will be undertaken to find an appropriate tent having a higher manufacturer wind rating. Brief discussion of possible tents and the IDP recommendation will be included in the Conceptual Design. Appropriate space for core processing and packing the 162 mm core needs to be accommodated in the drill tent.

12. The ability to move the drill within the tent in order to drill a second core without relocating the tent is strongly desired, but the design should balance this priority with overall setup efficiency and transportability.

Notes:

1. The current core quality using dry drilling with the Blue Ice Drill and the Foro 400 Drill at Allan Hills is deficient because it has produced chipped, cracked, broken, or even fully disintegrated ice when coring below 50 to 70 m depth. Good core quality is defined as the traditional ice core quality for deep drilling using the Foro 1650 Drill (e.g. at the SPICE core site). For dry drilling, fair core quality is acceptable beginning at 200 m depth.

2. Skufa ice core boxes can fit 2 cores that are 6-3/8” diameter.

3. For wet drilling, the depth of the drilling fluid is flexible and determined on a case-by-case basis. For gas studies on the cores it is preferable to drill as deep as possible without fluid so long as the core quality is not compromised.