Ice Drilling Program Office

Dartmouth – University of New Hampshire

DOCUMENT IDENTIFICATION	
Title:	**SCIENCE REQUIREMENTS: SCALABLE HOT WATER ACCESS DRILL**
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DOCUMENT APPROVAL	
Science Community:	Das, Holland, Scambos
IDPO:	Albert, Twickler

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Science Requirements: Scalable Hot Water Access Drill

Background:
The IDPO Long Range Science Plan 2013 identified science goals for ice drilling that spanned a wide range of science targets. Rapid changes in speed of fast—flowing tide-water glaciers, outlet glaciers and ice streams observed over the past decade create urgency to understand their dynamics. Properties of the ice-bed interface exert strong control on the flow of glaciers and ice sheets. Scalable hot water access drills that are portable and capable of drilling to the bed of glaciers and ice sheets in much less than one season are needed to make basic measurements, including temperature, heat flux, and pressure. From virtual discussions organized by IDPO in December 2013, and follow-up teleconferences and discussions with the research community and with IDDO staff, the following are the science requirements for the drill:

Scientific Requirements

1. Produce access holes through ice depths between approximately 50 – 1000 m.

2. The drill should be modular, with built-in redundancy, so that one of the modules is used for shallow depths and small diameter holes, and other replicate modules are added for deeper access holes or for larger diameter holes.

3. Diameter of holes needed will vary, with most likely in the 10-30 cm diameter. Small diameter holes can be drilled deeper than large diameter holes (e.g. 10 cm diameter hole could be drilled to 1000 m in 35 hours, while a 30 cm diameter hole could be drilled to 600 m in 35 hours of drilling, for example).

4. Drill should be operable in borehole and/or ambient temperatures down to -30 C.

5. The drill should be agile on site, in order to drill multiple holes within 500 m of emplacement, possibly moved around by skidoos.

6. Setup time for the drill on site should be within 48 hours.

7. The design should include the ability to maintain a 30 cm diameter, 600 m deep hole and keep it open for 8 hours after initial drilling.

8. The drill should be able to be transported by helicopter sling load, Twin Otter, Basler or light ground traverse.

9. The drill should have stand-alone capability for operation at small field camps at remote sites

10. Minimal staff (4 pax for setup, working 2 per shift for drilling and reaming) should be required for drilling operations in the field; other field camp staff in support of drilling operations to be provided separately

11. Drilling depth and rate of drilling progress should be recorded.

12. The design does not require "clean" access for most applications, but the drill should be designed and constructed with fittings and components that will facilitate adapting the system to "clean" drilling in the future.

13. The design does not require operation to depths beyond 1,000 m for a 10 cm diameter hole, but to allow for future expansion of the system, the hoses and fittings shall be suitable for the operating pressures required to achieve a 1,500 m, 10 cm diameter hole.

14. Consider the BAS hot water modular drill system (Anker and Makinson) as a starting point.

Discussion: The modular system will have some inherent flexibility allowing, for example, a deeper depth for a longer drilling time or smaller diameter hole; for example if the drilling time is extended to 40 hours, a 30 cm hole could be drilled to 700m. The amount of energy needed for depths beyond 1,000 m and energy above 600 kW would require a larger hose diameter and bigger high-pressure pump, which is counter to the intent of an agile modular drill. For logistical considerations, an indication of the number of twin otter flights, space needed on a traverse sled, etc for transporting the drill to the site will be useful in planning for drill use; this documentation should consider several different categories of drilling depth/energy (e.g. 100, 200, and 400 kW).