



# Ice Drilling Program Office

Dartmouth – University of New Hampshire

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## Science Requirements: Sediment Laden Lake Ice Drill

### *Background:*

The IDPO Long Range Science Plan 2014 identified science goals for ice drilling that spanned a wide range of science targets. For long term ecological studies in environmentally sensitive areas such as the Dry Valleys, the ability to drill through several meters of sediment-laden ice will enable science in a variety of disciplines. Currently ice fishing type gas augers are used in the sea ice and lake ice, which are not designed for this environment. A new drill is needed to create pilot holes which could then have a hot finger inserted in them to widen the hole. This pilot hole drill should also be useful for freeing instrument cables from the ice and accessing equipment deployed beneath the ice. Using mechanical drills has caused problems by cutting cables, and especially in the Dry Valley Lakes, drill bits do not stay sharp in the dirty ice. Hot water technology will allow a new tool to enable safe servicing of science instruments deployed in the lakes and ocean, and will allow for making more sample acquisition holes which is often a limiting factor in doing research in the sub-ice environments.

From discussions organized by IDPO with iterative discussions with the scientists and with IDDO staff, the following are the science requirements for the drill:

### **Scientific Requirements**

- 1. Produce access holes through 6 m of clean ice, or ice containing some soil particles.**
- 2. The drill should be field portable, with the modules less than 50 lbs that can be carried by one person or dragged over very rough ice containing melt pools, by hand on one sled (not including the generator if needed). Upper weight of the system must be less than the weight of a 5 kW generator including its protective case.**
- 3. Diameter of holes needed will vary, with most likely in the 13-25 cm diameter.**
- 4. The drill should be operable in borehole and/or ambient temperatures down to -30 C.**
- 5. The drill should require very little water to start the drilling, and would preferably recirculate the ice melt and seed water to avoid loss or contamination to the environment.**
- 6. Setup time for the drill should be within a half hour after initial unpacking on site.**
- 7. Drilling speed should be less than 30 minutes for a 5" hole through a 6 m ice ice cover.**
- 8. The drill should be transportable inside one helicopter flight, packed in cases that can be lifted by a maximum of two people.**
- 9. The drill should have stand-alone capability for operation at small field camps at remote sites with no heavy equipment.**
- 10. Once the drill is set-up, one scientist should be able to do the drilling operations in the field.**
- 11. Permanent indicators on the hose indicating depth and the distance to the tip should be included.**



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- 12. The drill should be able to be used to free up cables frozen in the ice, including riding them down through the ice (i.e. if coupled with something like bailing wire)**
- 13. Materials used should be non-corrosive from fresh to sea water salinities.**
- 14. The downhole apparatus and interior should be easily cleansed from biological organisms with standard solvents/sterilants.**
- 15. The drill should be easily maintainable in the field by scientists to avoid freeze damage.**

### **Notes:**

- a. This drill is not intended to replace use of the existing Hotsy heaters and hotfinger type drills. Instead, this drill will be used to (i) make pilot holes 13-25 cm in diameter for the Hotsy / hotfinger setup and (ii) to free cables/wires frozen in the ice.**
- b. An ideal system would require very little starting water/use very little water overall. It is difficult on both lake ice and sea ice to come up with any starting water as there is often no snow.**
- c. The drill should recirculate with zero to minimal water loss to the environment when used on sea ice.**
- d. The drill should be easy to troubleshoot and repair by a scientist on site using common home-garage tools.**
- e. Environmental impact of the proposed drill in the out-years is covered by Record of Environmental Review (ROER) titled USE of Hot Water Drill on Lake Bonney (MCDV0800 R08; 2007), and the constructed drill will need to be reviewed under the EIA requirements by NSF before fielding, as per email from Ted Doerr to Peter Doran on 12 October 2015.**