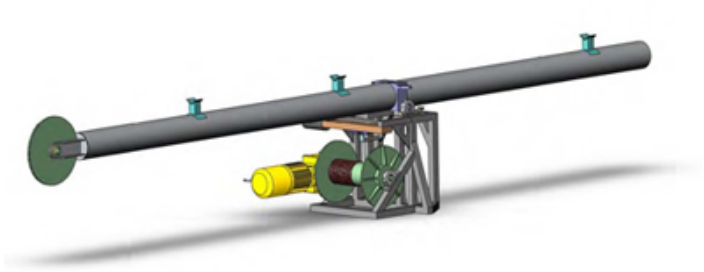
Status of Drills

1. Intermediate Depth Drill
2. Rapid Access Ice Drill (RAID)

Intermediate Depth Drill – Science Requirements

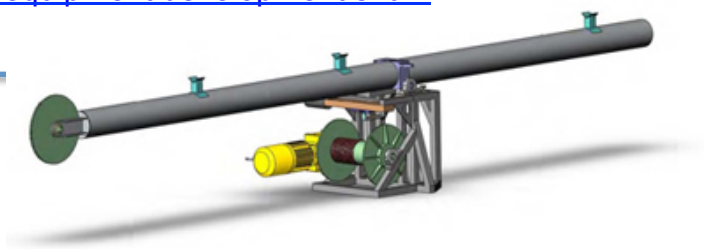


1. Target depths: up to 1,500 m
2. Ice core diameter: 98 +/- 3 mm
3. Core length: 2 m
4. Minimum 10-m temperature at the site: -55°C
5. Air transport type: Bell 212 or similar helicopter and/or Twin Otter
6. Replicate coring capability: no
7. Drilling fluid: drill should be compatible with existing fluids, e.g. Isopar-K or n-butylacetate
8. Maximum field project duration: two field seasons
9. Core quality requirements:
    1. Complete core recovery over entire borehole, as close as possible, including brittle ice
    2. Ice pieces to fit together snugly without any gaps
    3. In non-brittle ice, the packed core should have no more than 12 pieces of ice per 10-meter section of core
    4. In brittle ice there may be a lot of pieces in a single ~ 1m core segment, but the pieces must fit together retaining stratigraphic order; more than 80% of the ice volume must be in pieces that each have a volume > 2 liters
10. Absolute borehole depth measurement accuracy: 0.2% of depth
11. Sonde inclination will not to exceed 5°
12. Field set-up time: the minimum that is realistically possible with a three-person effort at a small remote camp
13. System complete with receiving area for core from core barrel and ability to cut into 1-meter sections
14. A deep-field shelter for the drill should be identified

Discussion: *This drill would be a modified version of the Hans Tausen (H-T) drill, with upgrades including a 2-m core length. The core quality requirements are those of the DISC drill. The requirements above can be achieved without use of a fiber optic cable; the drill could be built with a cable similar to the cable typically used by the H-T drill.*

Intermediate Depth Drill

http://icedrill.org/equipment/development.shtml



STATUS

- Winch: 75% complete
  - Winch will be designed to pivot with tower. Specifications for winch drum completed and quote on drum requested. Basic design complete; components (level wind actuator, position sensor, etc.) identified
- Tower: 75% complete
  - Preliminary design of tower. Received preliminary drawing from truss manufacturer; Initial structural analysis of tower configuration completed. Potential linear actuator located.
- Sondes: 10% complete
  - Organizing drawings and working with Steffen Bo Hansen to get “hand drawn” drawings. Checking with vendors on possible barrel materials. Tanner Kuhl working on anti-torque design.

PLANS

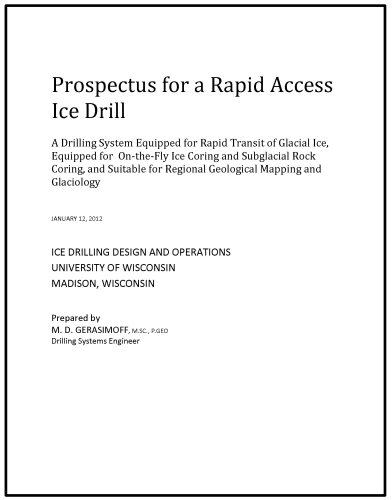
- 2012: Finish design of drill and sub systems
- 2013: Build the drill system
- 2014: Test system, possibly in Greenland and possibly in collaboration with the Danes, and have it ready for deployment to Antarctica (South Pole) in the fall.
- 2014-15 and 2015-16 field seasons: South Pole (Saltzman et al.)

Rapid Access Ice Drill

http://icedrill.org/equipment/development.shtml

STATUS

- Need for a rapid access ice drilling (RAID) system articulated during April 2011 Ice Drilling Science Community Planning Meeting
- From a planning meeting organized by IDPO in October 2011 and follow-up teleconferences, discussions with the research community, logistics providers, industry, and IDDO staff, science requirements and overall design features of the RAID were identified.
- Science requirements finalized
- Finished conceptual design, and completed RAID Prospectus document.
- Assisted John Goodge with his proposal.
- All work scheduled for this fiscal year has been completed and is coming in under budge



Prospectus for a Rapid Access Ice Drill

A Drilling System Equipped for Rapid Transit of Glacial Ice, Equipped for On-the-Fly Ice Coring and Subglacial Rock Coring, and Suitable for Regional Geological Mapping and Glaciology

JANUARY 12, 2012

ICE DRILLING DESIGN AND OPERATIONS
UNIVERSITY OF WISCONSIN
MADISON, WISCONSIN

Prepared by
M. D. GERASIMOFF, M.SC., P.GEO
Drilling Systems Engineer

PLANS

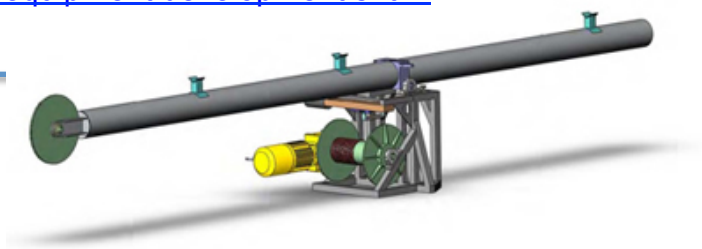
- John Goodge (U. Minnesota Duluth) to submit unsolicited proposal to OPP for construction of RAID
- Field-test RAID somewhere in North America and then ship RAID to Antarctica

Rapid Access Ice Drill – Science Requirements

1. Produce 3300 m bore to base of ice in ≤ 200 hours of drilling operation, including drilling and retrieval of at least one 50 cm-long ice core and at least 25 m of sub-glacial rock and / or unconsolidated, frozen sediment core
2. Minimize bore-fluid and rod weight requirements by producing ≤ 3” diameter ice borehole, and ideally 2.75" diameter ice borehole (nominal BQ size). Minimize complexity by avoiding stepped borehole diameter.
3. Ice drilling through dry, frozen-bed conditions (i.e., “clean access” system not required)
4. Retrieve short ice cores (~50 cm long) of ≥ 1.4" diameter at up to 3300 m depths
5. Retrieve at least 25 m of bedrock cores of ≥ 1.4” diameter (nominal BQ size)
6. Borehole walls must be left clean and essentially free of debris for borehole logging measurements
7. System is equipped with drilling-fluid recirculation, chip-removal and disposal system
8. Stand-alone, traverse-capable, over-ice system (not reliant on a fixed support camp)
9. Minimal staff for drilling operations in the field, with an objective of 24-hour-per day operations; 3 shifts per day; each shift consisting of 2 or 3 dedicated and experienced drillers; other field staff in support of drilling operations to be provided separately
10. Keep borehole open for up to 5 years, allowing for some deformation and/or decrease in diameter; tolerances will be determined separately for each borehole as determined by ice conditions and fluid density requirements
11. Completion of bore, including the provision of a suitably dense, bore-filling fluid, to allow for logging:
    a) immediately after ice drilling is complete and before rock coring is initiated (requiring the removal of the drill string so as not to interfere with borehole logging), and
    b) subsequent to rock coring for purposes of logging *only, as determined in item 10 above*
12. Non-freezing, non-ice-reactive (“hydrophobic”) drilling fluid will have a density similar to water ice and provide pressure stabilization, but this fluid system need not provide perfect hydrostatic compensation (consistent with materials and safety requirements covered elsewhere, and consistent with long-term observation requirements)
13. Drilling fluid or a fluid “system” (to be determined) will be compatible with borehole logging (i.e. transparent; ideally has a refractive index similar to that of water ice, for the light wavelength(s) of observation)

Intermediate Depth Drill

http://icedrill.org/equipment/development.shtml



Major Milestones in the Development of the US Intermediate Depth Drill

Milestone Description	Expected Completion Date
Approval of Intermediate Drill Conceptual Design	05/31/11
Submission of IDPO-IDDO FFY 2012 Annual Plan to NSF	08/31/11
Begin Detailed Design of the Drill Based on Conceptual Design	10/01/11
Submission of Formal Conceptual Design Document to IDPO for Approval	11/30/11
IDD System Design Verification Review – Major Drill Subsystems	07/20/12
Complete Detailed Design	12/31/12
IDD System Design Review – Ancillary Systems	01/18/13
Complete Fabrication of the Drill	09/30/13
Draft of Operating and Maintenance Documentation	12/31/13
Integration of Drill System (including integration test)	03/31/14
Complete Field Testing	06/15/14
Review of Test and Needed Improvements	06/25/14
Complete Improvements and Modifications after Testing	08/31/14
Finalize Operating and Maintenance Documentation	09/30/14

PLANS - GENERAL

- 2012: Finish design of drill and sub systems, and reviews
- 2013: Build the drill system
- 2014: Test system, possibly in Greenland, and have it ready for deployment to Antarctica (South Pole) in the fall.
- 2014-15 and 2015-16 field seasons: South Pole (Saltzman et al.)