THE DEVELOPMENT OF A HOT WATER DRILL TO ACCESS SUBGLACIAL LAKE ELLSWORTH

Subglacial Lake Ellsworth Antarctica

SUBGLACIAL LAKE ELLSWORTH
TOPICS

- **Why and where for Lake Ellsworth**
- **Programme activities**
- **Drill outline and components**
- **Logistics**
- **Drilling activities**
- **Cleanliness**

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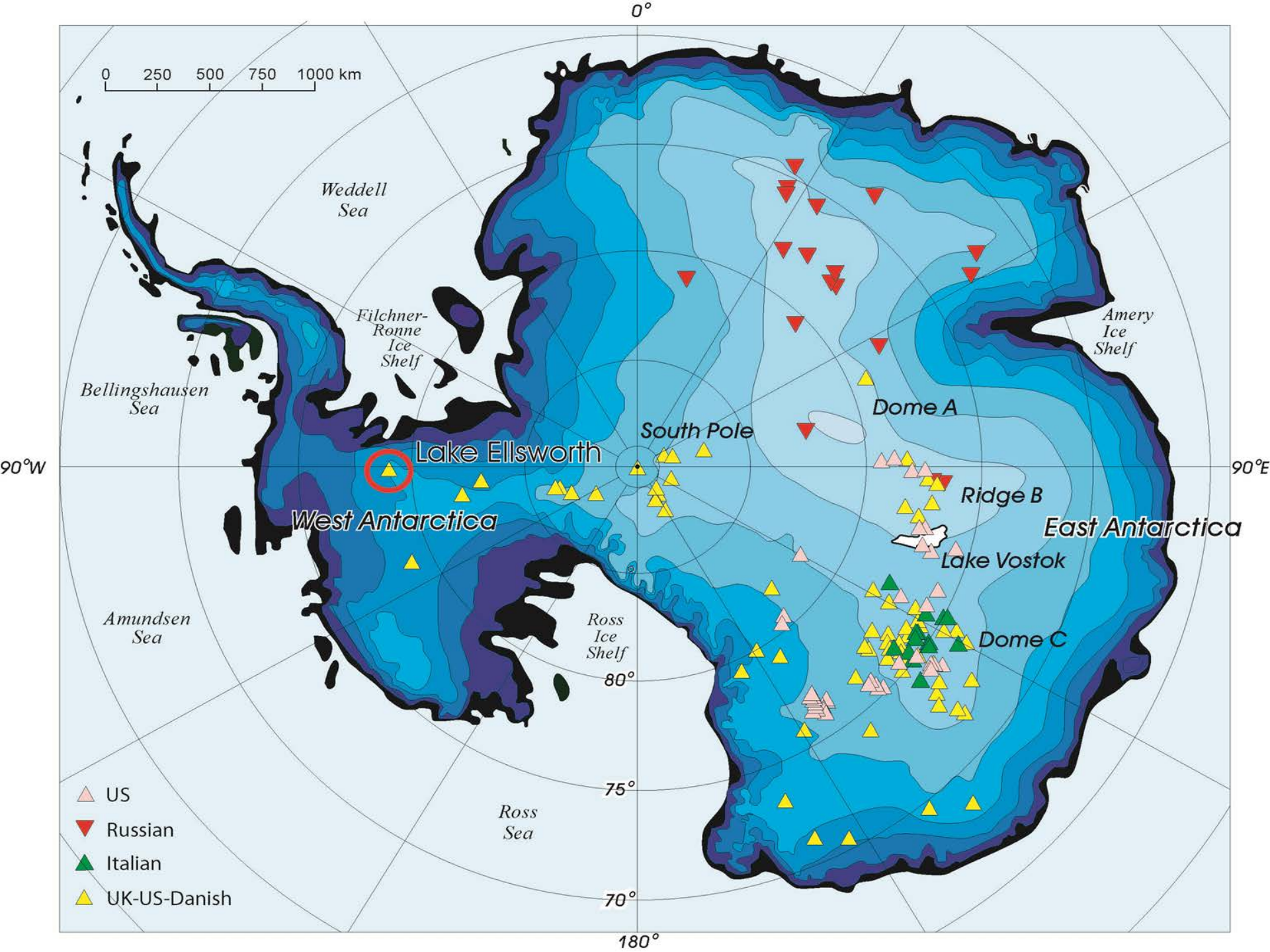
0°
0 250 500 750 1000 km
Weddell Sea
Filchner-Ronne Ice Shelf
Amery Ice Shelf
Bellingshausen Sea
Dome A
South Pole
90°W
Lake Ellsworth
90°E
Ridge B
West Antarctica
East Antarctica
Lake Vostok
Amundsen Sea
Ross Ice Shelf
Dome C
80°
75°
Ross Sea
70°
180°
US
Russian
Italian
UK-US-Danish

SUBGLACIAL LAKE ELLSWORTH
PROGRAMME AIMS

- **To determine the origins, evolution and maintenance of life in Antarctica subglacial lake though direct measurement, sampling and analysis of the environment.**
- **To uncover the paleoclimate and glacial history of the West Antarctica ice sheet, including date of its last decay, by recovering a sedimentary record from the lake floor.**

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SUBGLACIAL LAKE ELLSWORTH
WHY LAKE ELLSWORTH?

- **Small and easy to comprehend.**
- **Located near an ice divide where lake access is not complicated by ice flow.**
- **Enclosed topographically and therefore resistant to ice-sheet changes that might occur over glacial cycles.**
- **Near to the logistics hub at Union Glacier.**

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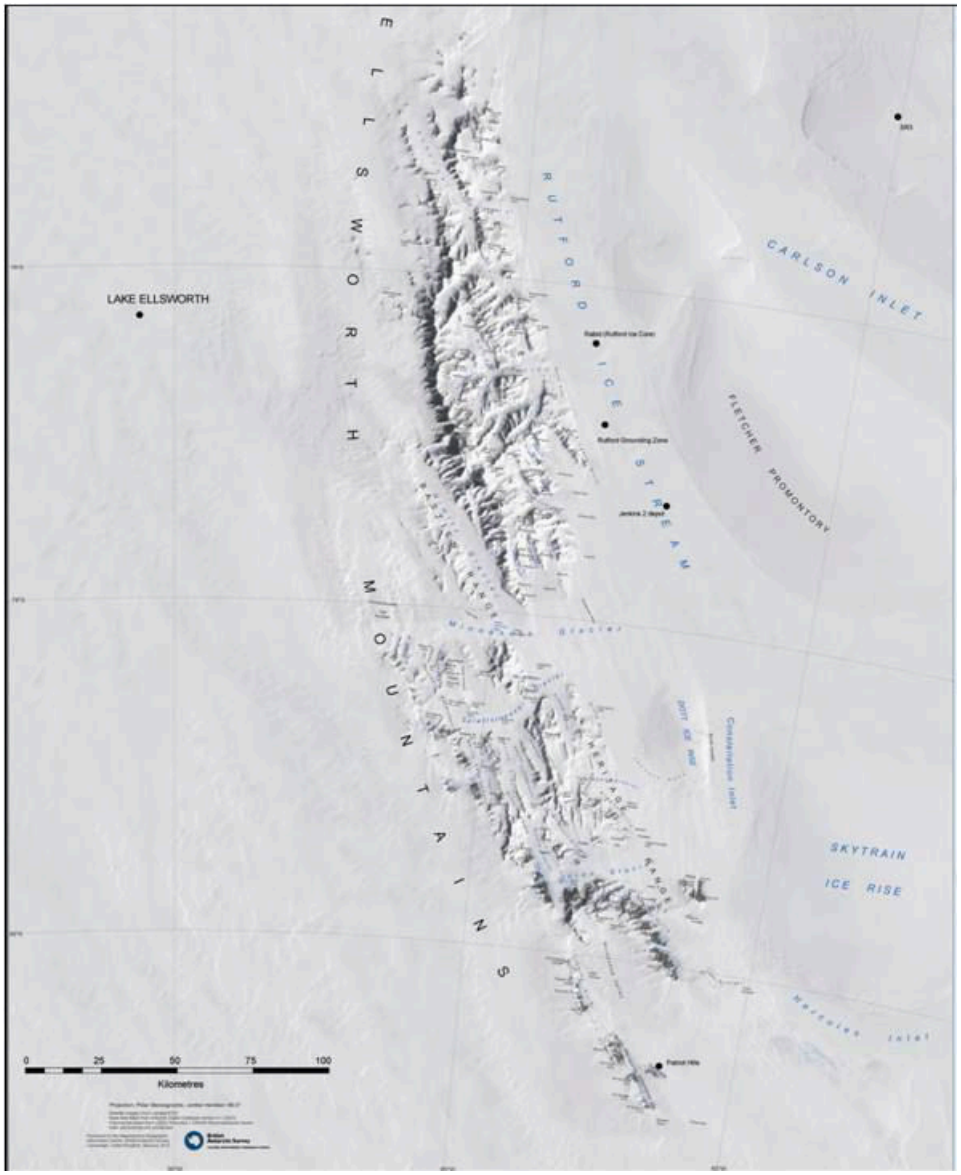
LAKE ELLSWORTH



LOCATION
SITED AT 99.5W, 79S

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PROGRAMME ACTIVITIES

- **Undertake survey of area – radar and sesimics complete**
- **Design and produce hot water drill, probe, corer**
- **Produce CEE**
- **Delivery of equipment 2011/12 season**
- **Access the lake in the 2012/13 season**
- **Analysis of samples**

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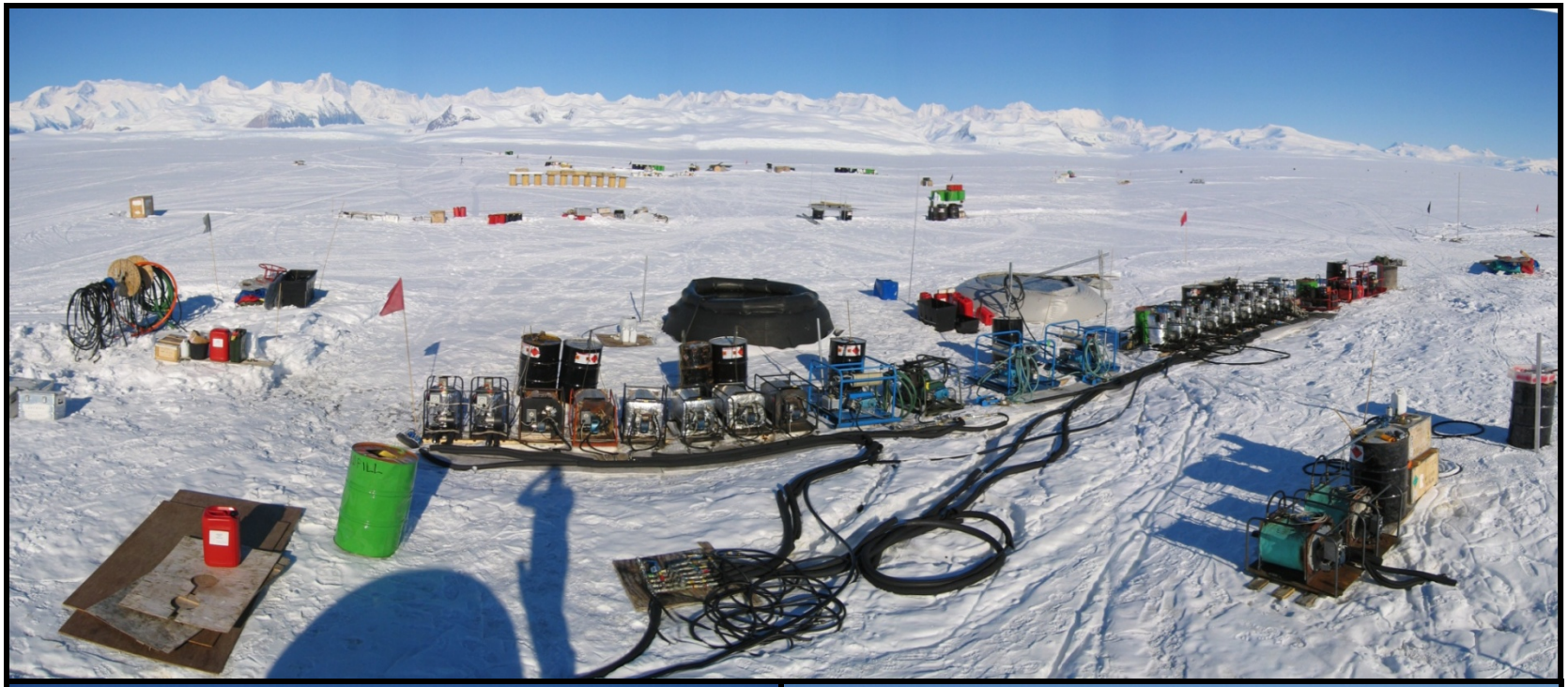
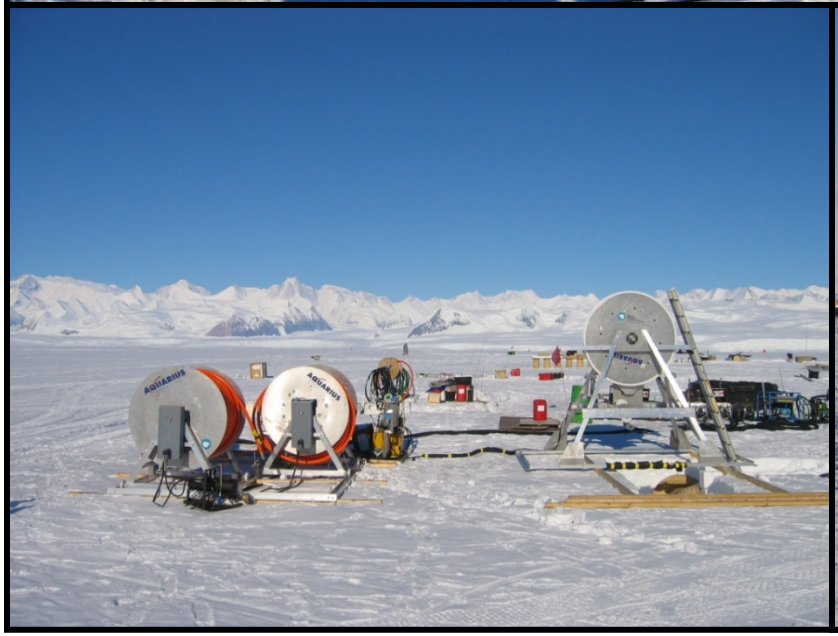
RUTFORD ICE STREAM (RABID)

- Drilling in 2004/05 season
- Drill weight 13 tonnes
- 29 tonnes of equipment and personnel deployed via Twin Otter
- 200 drums of fuel in addition
- 35cm diameter hole to 2000 metres achieved
- Budget of £150K
- 7 field staff
- Challenges with hose couplings




AQUARIUS
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LAKE ELLSWORTH DRILL OUTLINE

- **Initial hole diameter of 36cm to depth of 3155 metres**
- **Drilling time of approximately 80 hours using 15000 litres fuel**
- **Time needed to setup initial recirculation**
- **Hole reduces to 22cm after 24 hours unless reamed**
- **Eleven hours to recover the hose**
- **Fuel on site to drill two holes**
- **Deliver 3.0 litres per second at 2000 psi**
- **Temperature of the water at 90^{o}C, reducing to 55^{o}C at 2200 metres, 40^{o}C at the lake**

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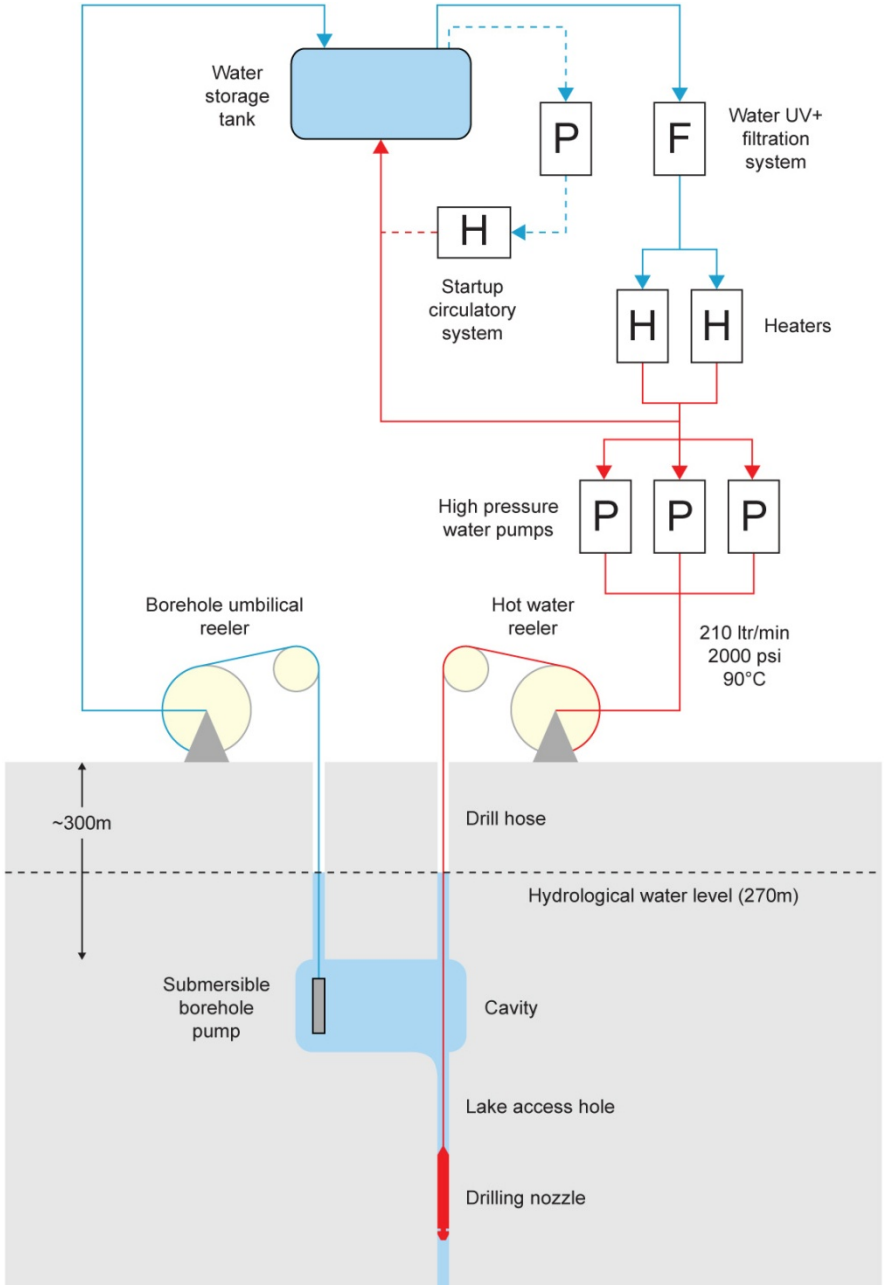
Drill System Concept



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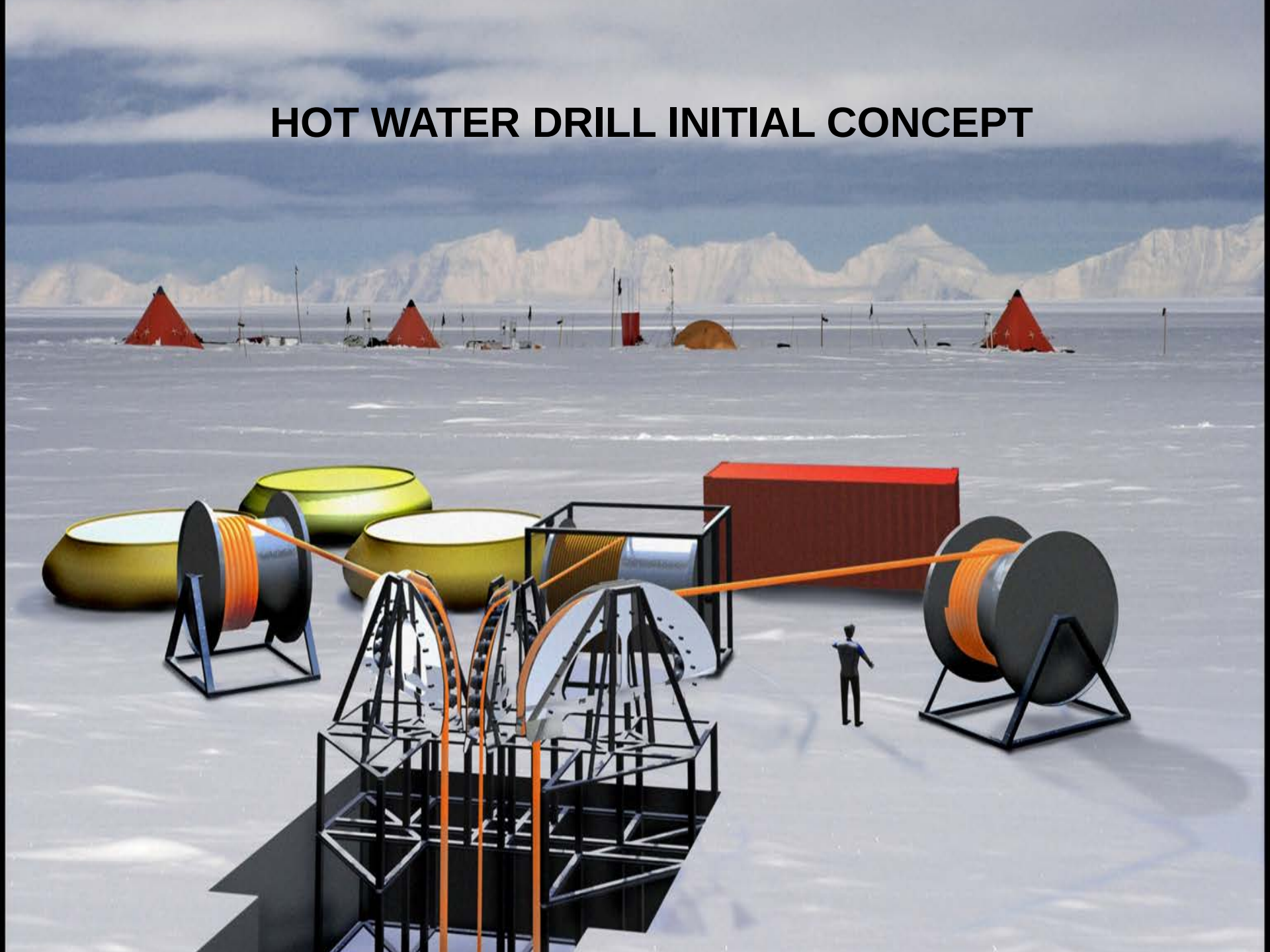
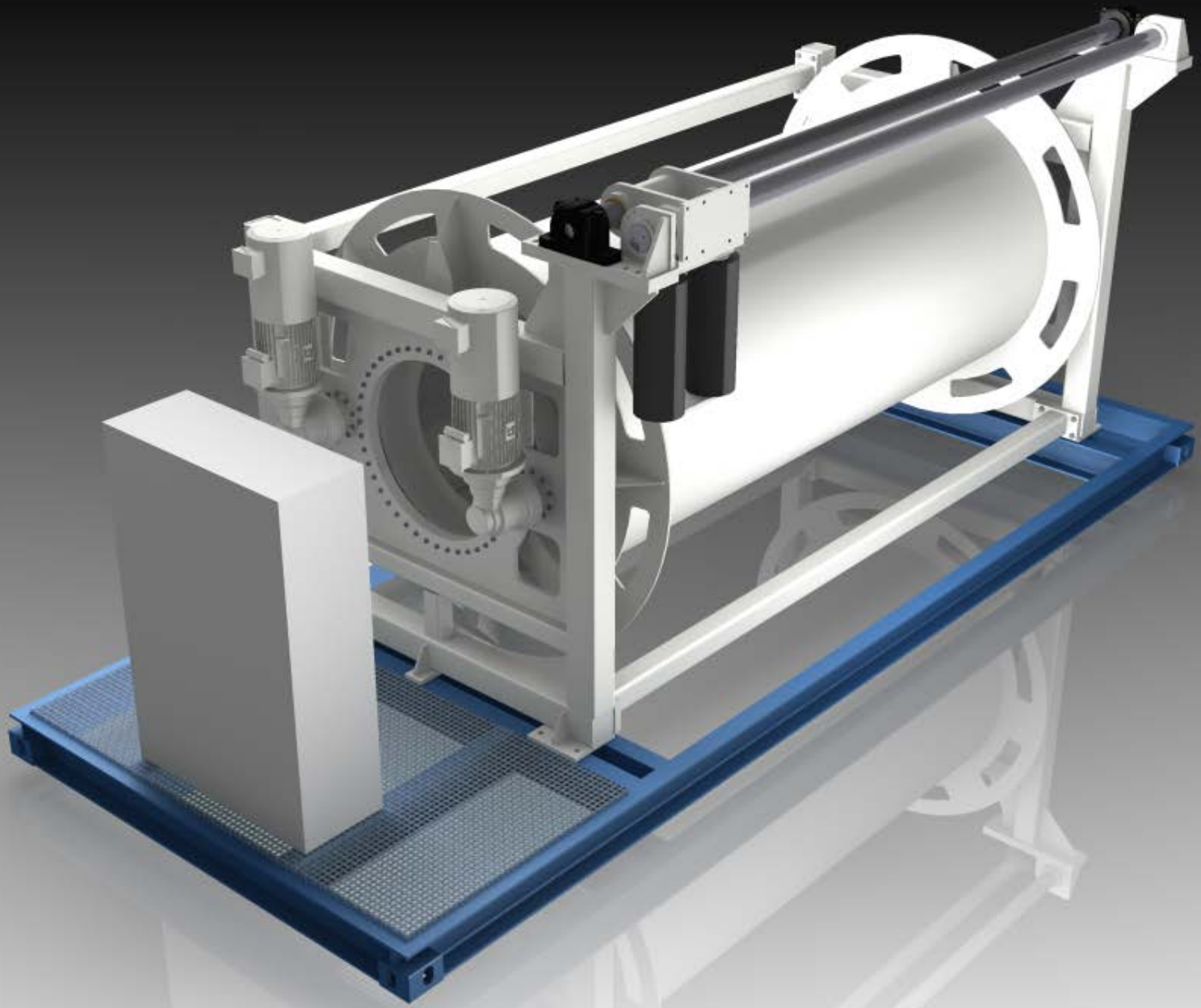
HOT WATER DRILL INITIAL CONCEPT





LAKE ELLSWORTH DRILL SYSTEM COMPONENTS

- **Collection of snow with plant and shovels**
- **Water tanks and heater – 90K litre capacity**
- **Filtration System – 0.2 micron filter**
- **UV filter**
- **High pressure pumps – 2000 psi**
- **Water heaters – 1800 kWatts**
- **Borehole pumps – 22 kWatts**
- **Generators – 250 kVA**

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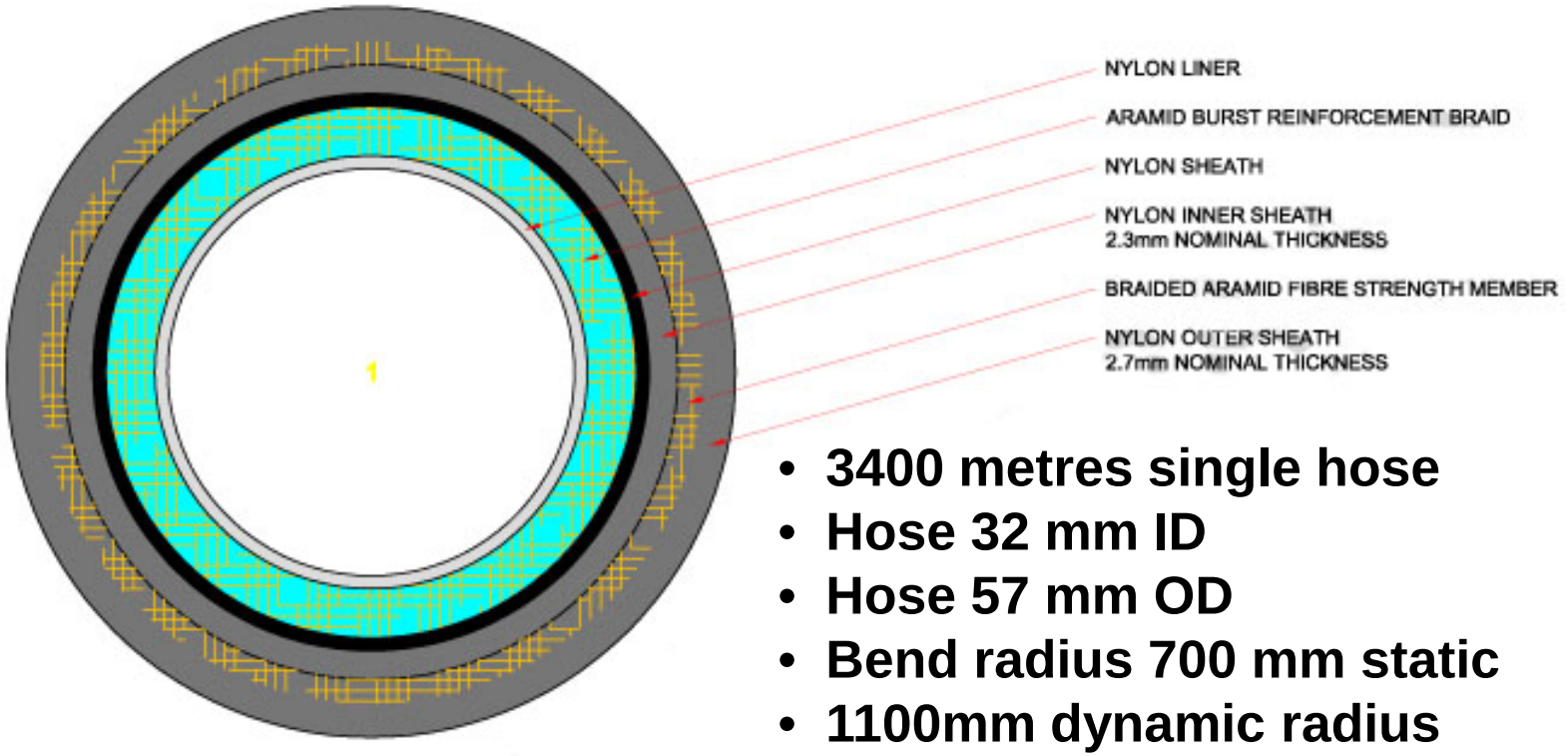
HOSE ASSEMBLY



- **3400 metres single hose**
- **Hose 32 mm ID**
- **Hose 57 mm OD**
- **Bend radius 700 mm static**
- **1100mm dynamic radius**

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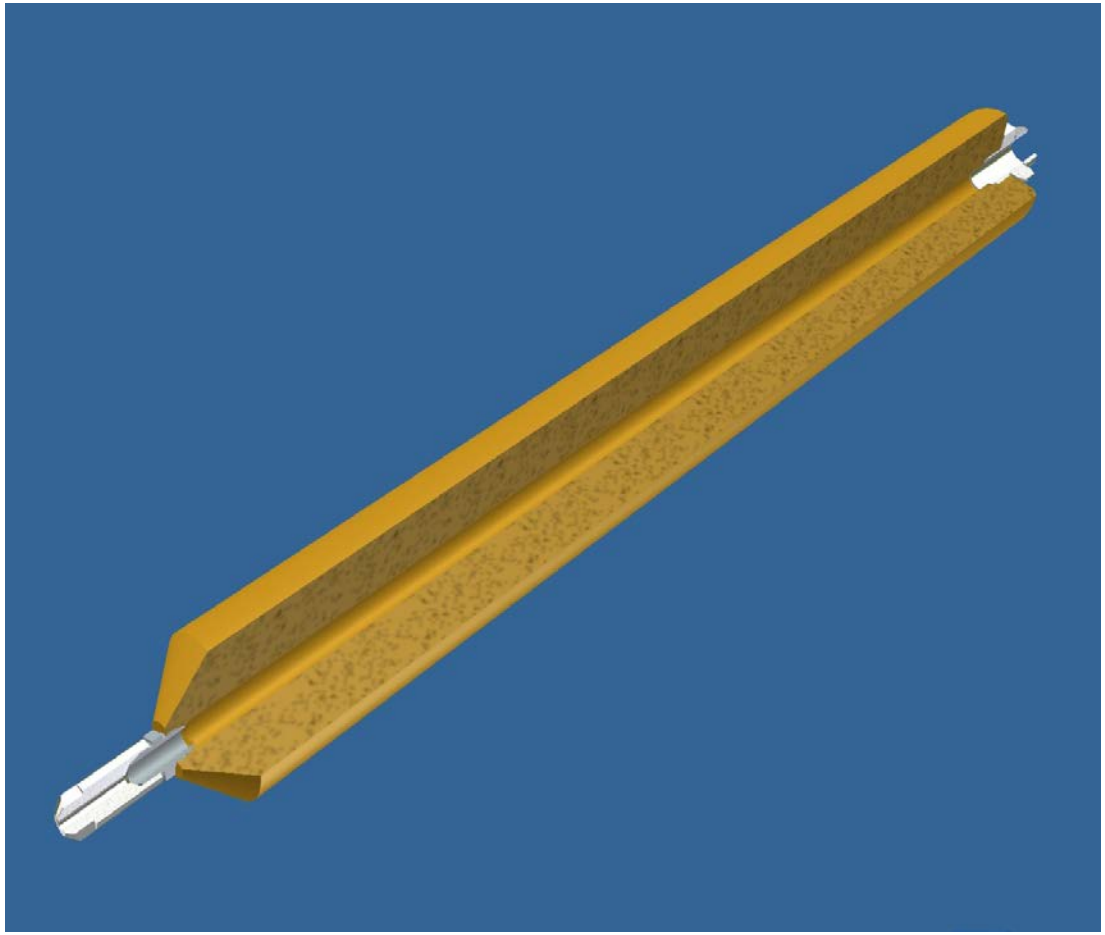
NOZZLE ASSEMBLY



- Brass body
- 1400 mm long
- 200 Kg
- Forward facing jet
- COTS fittings

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LAKE ELLSWORTH LOGISTICS

- **Hot water drilling equipment estimated at 45 tonnes**
- **Each separate item where feasible will be 1 tonne or less**
- **Transport to Antarctica from South America using an Ilyushin 76 aircraft**
- **Aircraft can carry 17 tonnes. 25 tonnes pull winch on board**
- **In Antarctica, all equipment transportable on sledges or ski mounts**
- **Contractor providing aircraft and ground transport**
- **BAS will supplement with cranes and sledges**

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STAFF


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4106 13
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LAKE ELLSWORTH CAMP

- **Envisaged time on site 12 weeks**
  - **7 weeks set-up**
  - **3 weeks drilling**
  - **2 weeks decommission**
  - **Waste removal**
  - **Samples and personnel via Rothera**

- **10 personnel on site**
  - **3 engineers**
  - **5 scientists**
  - **2 assistants**

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CEE AND CLEANLINESS

- **Outline application submitted to the UK Foreign Office**
- **The CEE for the SLE programme including drill to ATCM in 2011**
- **Components will cleaned and sealed in the UK**
- **Hose will go through a scrubber and UV system**
- **Hose will be immersed in hot water**
- **Samples will be taken before and after the filter to determine the composition of the water**


ANY QUESTIONS?