Sediment Laden Lake Ice Drill

Concept Review

April 5, 2017

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Science Requirements Highlights

- Drilling speed should be less than 30 minutes for a 5" hole through a 6 m ice cover
- Setup time for the drill should be within a half hour after initial unpacking on site
- Modules less than 50 lbs that can be carried by one person
- Upper weight of the system must be less than the weight of a 5 kW generator including its protective case [300 lbs based on prior BID shipping to Summit]
- Materials used should be non-corrosive from fresh to sea water salinities
- Easily maintainable in the field by scientists to avoid freeze damage
- 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

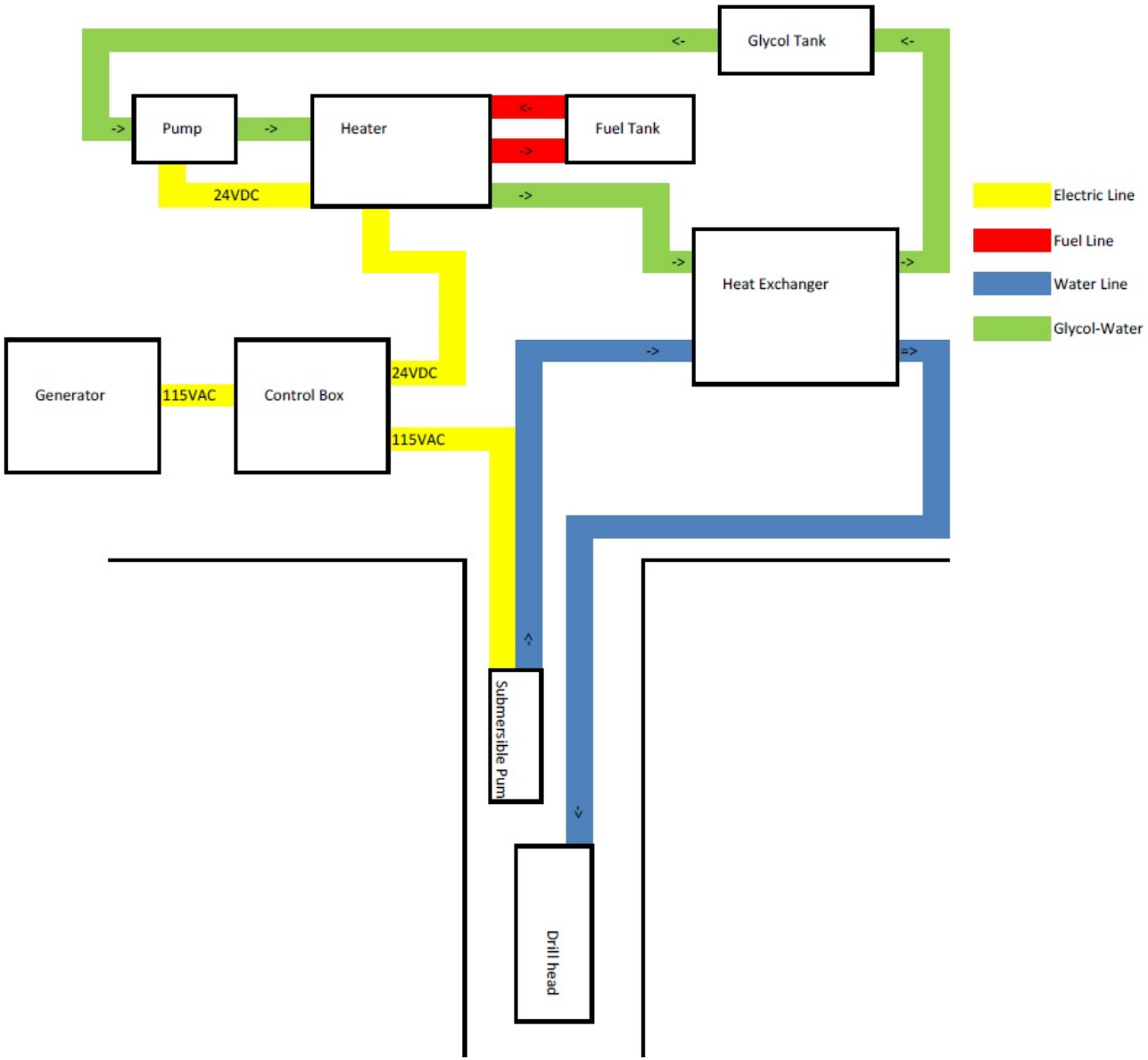
Design Necessities

- At least 30 kW of heating power to create required hole in required time
- Modularize all components
- Use stainless and aluminum components
- Easy draining
- Pump for recovering ice melt from borehole

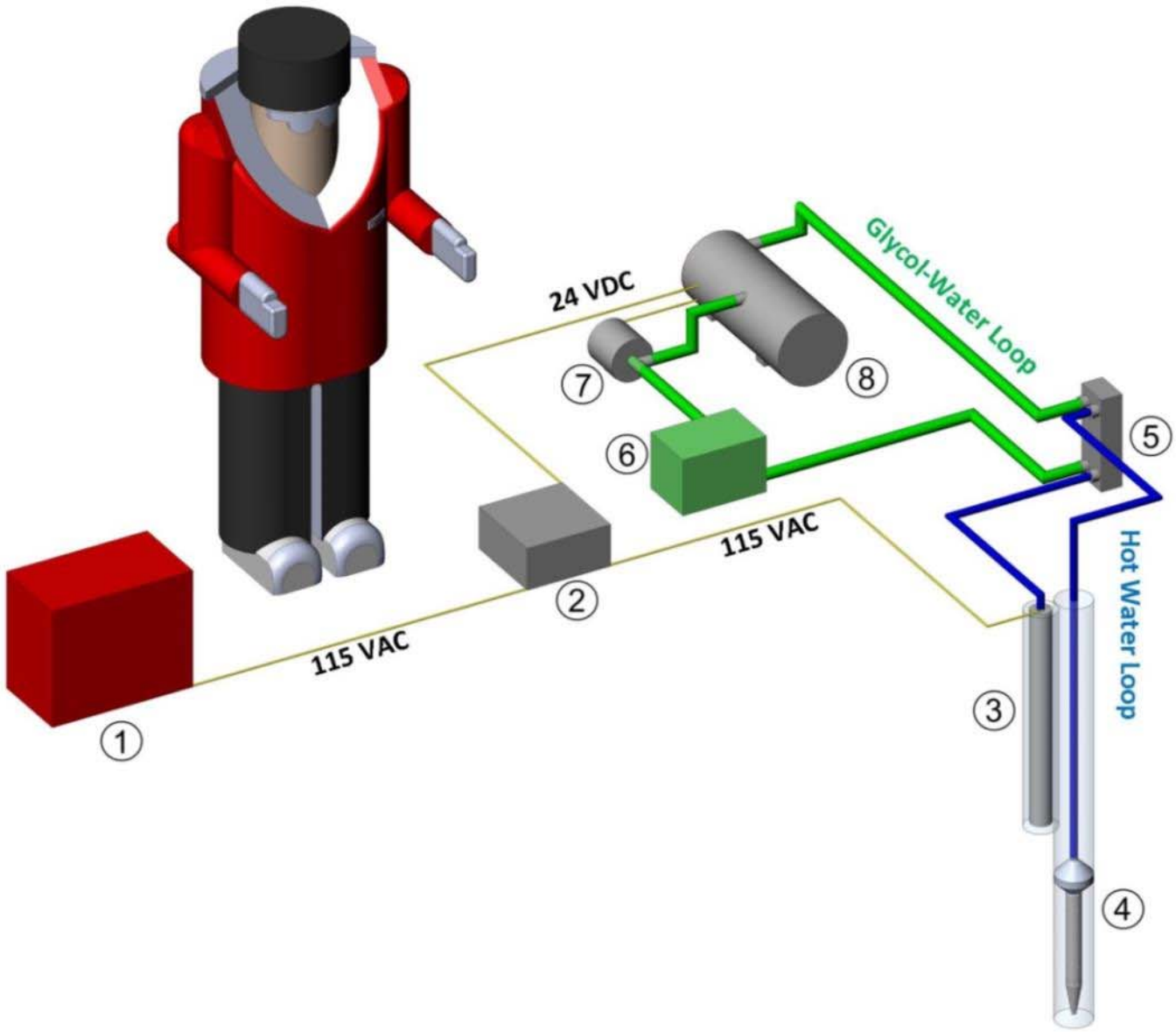
Options Considered

- Steam drill
  - Not feasibly scalable to this size, Heucke steam drill is 5% of our required borehole area
- Custom lightweight pressure washer heater
  - Can't get weight below 65 lbs
- One loop hydronic vehicle heater
  - 30 psi max, designed for glycol mixture only, 20 gpm
- Two loop heat exchanger with hydronic vehicle heater

Proposed Schematic



Site Layout



Key

1 - Generator
2 - Control box
3 - Submersible pump
4 - Drill head
5 - Heat exchanger
6 - Glycol tank
7 - Heater pump
8 - Heater

Heater + Pump

- Espar Hydronic L-II 35
- Espar Flowtronic 6000 SC
- 35 kW heating power
- 40 lbs - 24” x 10” x 10”(heater)
- 5 lbs - 9” x 6” x 6” (pump)
- Diesel fired, electric powered
- Fuel usage: 1.11 gal/hr
- Draws 330 W (combined) on 24 VDC
- Temperature output: 85 C to 118 C
- Flow: 26 gpm

Heat Exchanger

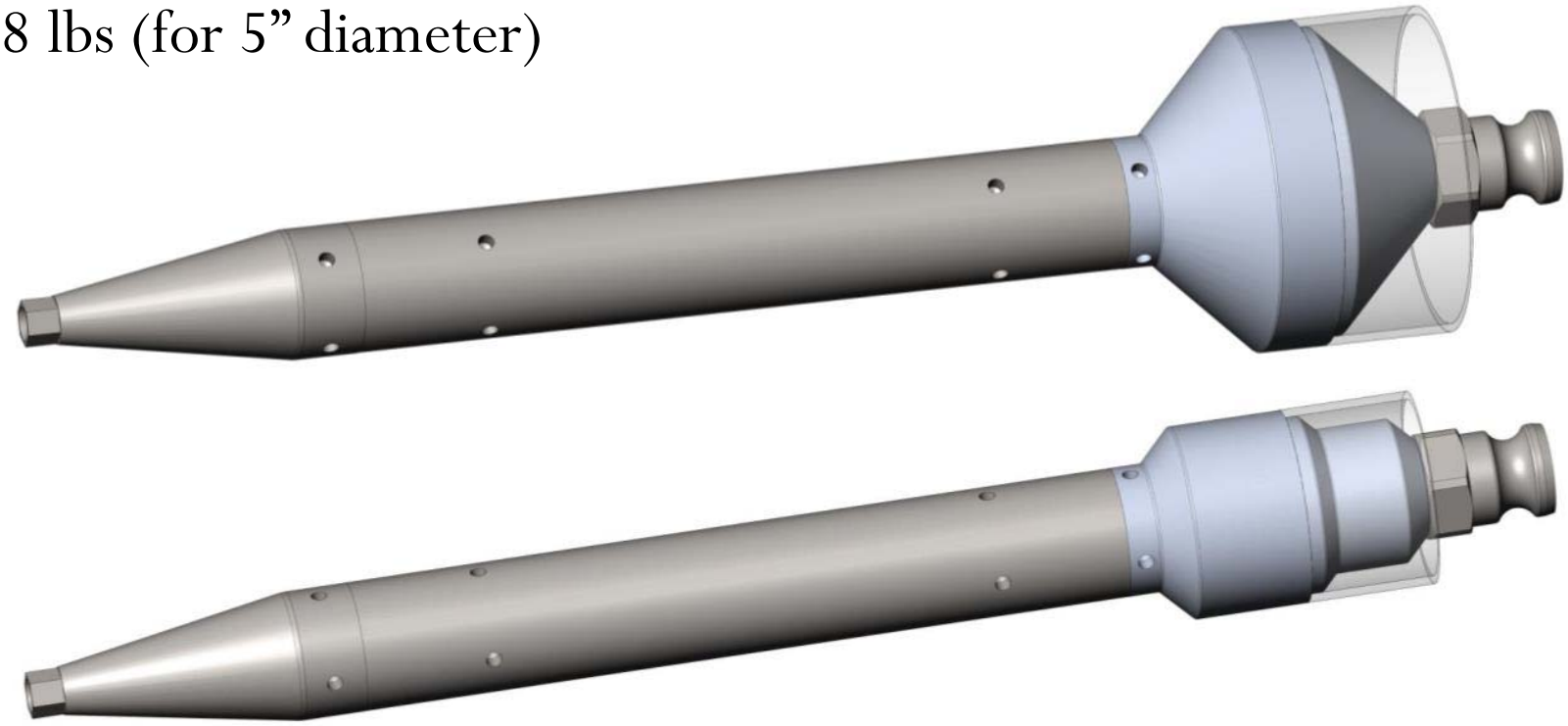
- Duda Diesel B3-32A-40
- 14 lbs
- 11.3” x 4.6” x 3.0”
- Limit of 435psi
- 20gpm 40%glycol transfers 43kW to 2gpm water at 83°C outlet

Submersible Pump

- Grundfos 5SQ05-180
- Rated 2gpm at 125 psi
- 12 lbs
- 30.4” L x 2.9” D
- Stainless steel
- Draws 440 W on 115 VAC

Drill Head

- Stainless steel and aluminum
- Same design as SmHWD (interchangeable parts)
- 3” and 5” top fittings
- Sediment collecting cup
- 18 lbs (for 5” diameter)



Hoses and Connections

- Lay-flat hose in water loop
- Chemical hose in glycol loop
- Cam-lock hose couplings

Generator (supplied by ASC)

- Honda EU2000i or similar
- 2 kW
- 46 lbs (dry)
- 20.2” x 11.4” x 16.7”
- Fuel usage: 0.28 gal / hr
- Nominal system draw: 1000W

Pilot hole

- Nils USA High Velocity Hand Auger
- 4.5” diameter hole by 30” deep
- 7 lbs
- Can drill 30” deep within a few minutes
- Pilot hole using hot water optional

Transport

- Zarges Cases
  - To be sized after receiving components in order to ensure best fit
  - Easily manageable by one or two people

Weights (lbs)

- Heater + Pump – 45
- Heat Exchanger – 14
- Submersible – 12
- Control Box – 15*
- Glycol tank – 8*
- Drill head – 18
- Cases – 30*
- Hoses – 20*
- Valves/gauges – 20*
- Tools – 30*
- Spares – 30*
- Generator – 46
- Drill system weight – 242*
- Generator – 46
- Liquid weight – 130**
- Field weight – 418*,**
- Heaviest piece – 45

- Seed water (2.5 gal**) – 25
- Diesel (6 gal**) – 45
- Gasoline (2 gal**) – 15
- Glycol (2 gal**) – 20
- Water for glycol loop (2.5 gal**) – 25

* estimated

** project dependent (5 holes, 5”x6m, no water/snow at first site)