Sullarniq ARC (Appropriate Resource Construction)
Subsurface Storage on the Greenland Ice Sheet
Polar Technology Conference, 26 March 2015

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Common Practice:

1. **Plan, procure, and ship materials** from CONUS to Summit via ANG ($).
2. **Excavate** a trench in the snow via D6 (if local) or Yanmar snow blower.
3. **Cover** with a combination of timbers and SIPs (or steel beams and decking).
4. Observe deflection of roof and **abandon** when deformation is of concern.
5. **Recover materials** (equipment intensive) or leave behind within the snow.
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Compressive slumping dynamic of all four surfaces
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**Approach:** “*Sullarniq*” - Greenlandic for “blown-in snow”

- An inflatable fuel storage balloon later removed to leave a **cavernous subsurface storage** space is a concept initially introduced by Tracy Dahl in 2011 -- citing advantages, challenges, and future potential for NSF applications on the Greenland Ice Sheet.

- Concurrently, the Univ. of Copenhagen making the same plans for the upcoming 2012 NEEM site establishment. *A report on the test project has been shared and is referenced throughout this presentation.*

- This 2012 installation **has convinced the Danes to commit** to this approach for all subsurface needs for their 2015 EGRIP camp establishment.
**Proposed Sullarniq Approach:**

1. Plan, procure, and ship fuel balloon *(initial cost only)*.
2. **Excavate** a trench in the snow via D6 (if local) or Yanmar snow blower.
3. **Inflate** balloon and use Yanmar to **cover** in multiple (sintering) layers.
4. **Deflate** balloon and remove debris within resulting cavern.
5. **Carve** away intrusive snow for continued use or abandon w/o materials being left behind.
Advantages:

- **Low lifetime cost** (after initial balloon purchase), using snow for material.
- **Reduced strain on logistics chain**, greatly reduced ANG weight/cube.
- **Extended duration** of trench use by being able to reshape interior.
- **Reusable**, repairable balloon(s).
- **Scalable** – translation of balloon allows for limitless length.
- **No embodied energy**/resources left behind.
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2012 NEEM Profile Measurements - JP Steffensen
(2015 Sullarniq Eurocore dimensions in black)
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- 2 days to excavate
- 2 days to back blow
- 3 days for sintering
- Arch density of 0.55 g/cm³
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Lowering of roof heights in trenches over time.
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Potential Long Range Uses:
• **Subsurface winter berm** for both small and large objects such as tractors (reduced equipment ops & Station Open labor)
• Next generation **utilidor** (full access & extended life by reducing stress)
• **Occupied facilities**– places of work and research (Flux, Noone facility)
• **Pedestrian corridor** from skiway, to AWO & telescope (allowing for safe passage even during inclimate Wx)
• Anything over 2,000cf

Outstanding Questions:
• **Number of -30F inflations** before balloon degradation?
• **Maximum width/size** of snow bridge?
• Will there be conducive Wx?