Polar Station Integration, Systems & Power

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IRIS PASSCAL POLAR PROGRAM

Next Generation Seismic Station

Goals

- Light, small stations
- Rapid installation and removal
- Plug and play design

Solution

- Customized enclosure that reduces footprint and weight
- Primary batteries used in the winter to reduce weight and size
- Solar panel mount that is stable in snow WITHOUT rigging or additional anchoring
- Direct bury sensor with increased tolerance for tilt

Next Generation Seismic Station

Power

Lead Acid AGM
- 1360Wh in 65lbs
- 21Wh/lb
- Rechargeable
- Non-hazardous
- High current source
- **Winter station = 570lbs**

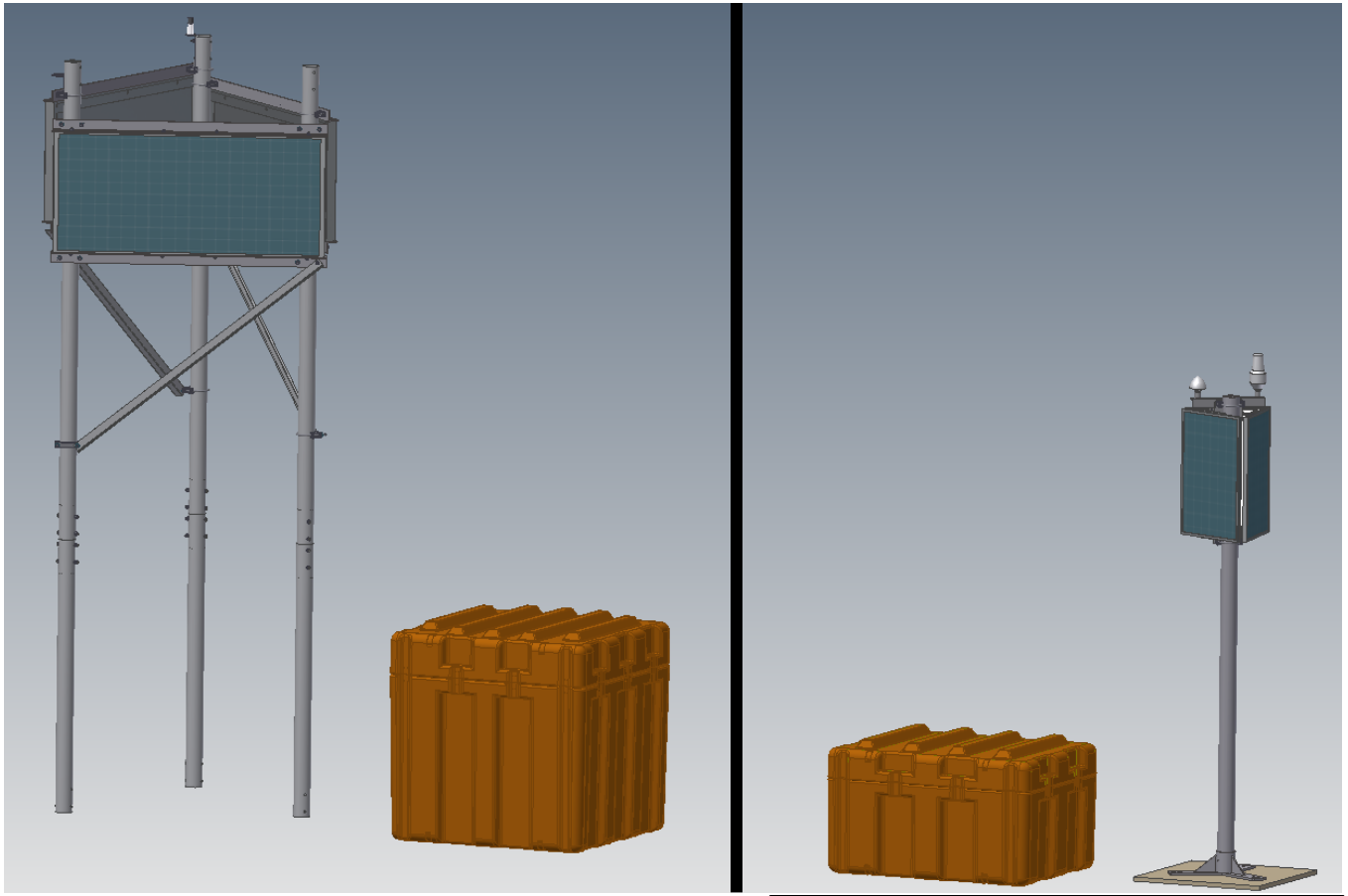
Lithium Thionyl Chloride
- 3040Wh in 11lbs
- 276Wh/lb
- Non-rechargeable
- Hazardous
- Low current source
- **Two year station = 113lbs**

LTC Batteries are ideal for limited length deployments – vastly reduce weight of power system and have excellent cold weather performance

Are combined with a small AGM and solar array for summer time operation

Next Generation Seismic Station

Enclosure and Solar



Weight: 365lbs
Volume: 35ft^3

Weight: 115lbs
Volume: 19ft^3

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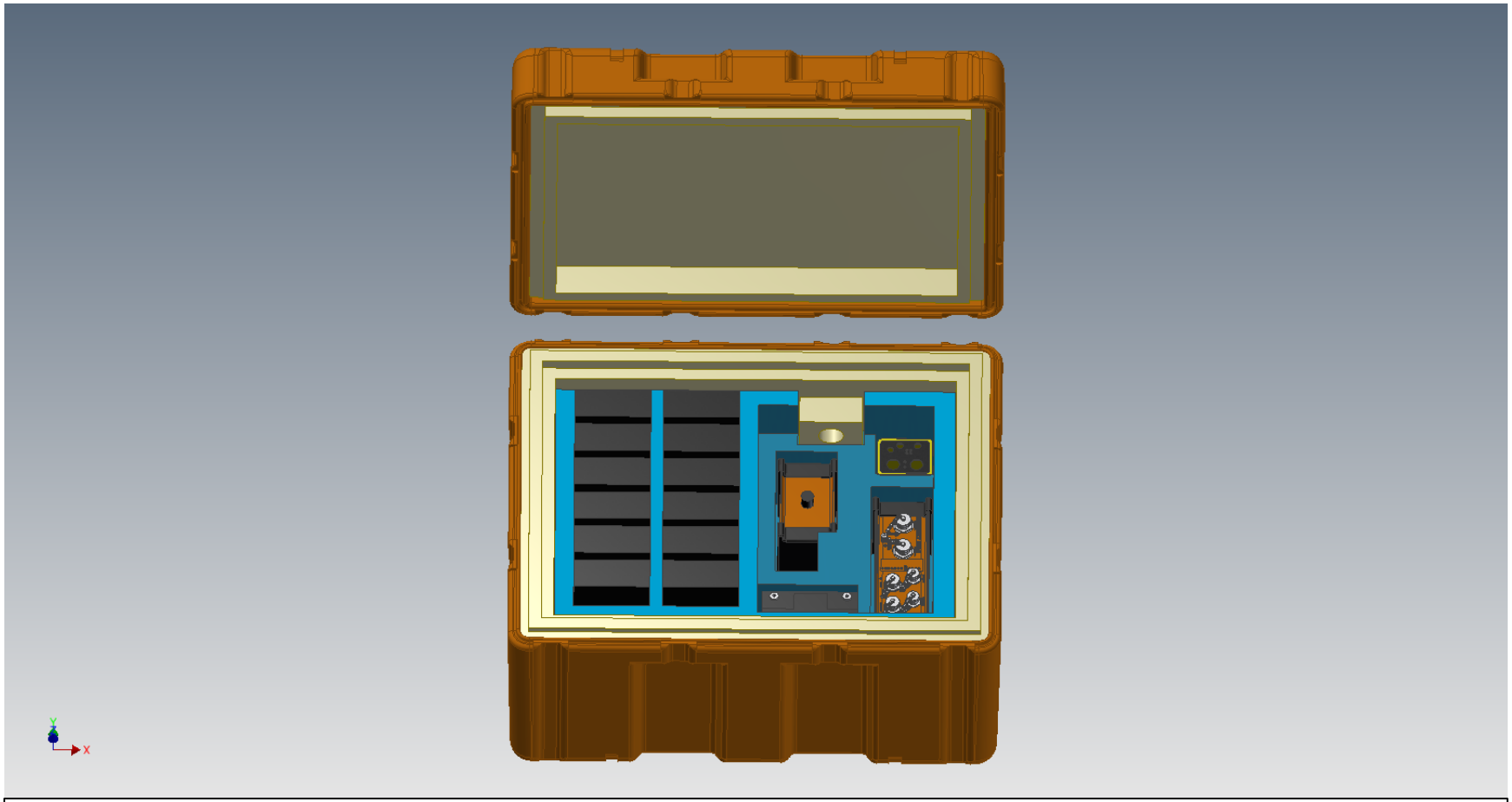
Next Generation Seismic Station



- Injection molded insulation reduces cost, construction time and complexity of the enclosure
- Custom foam liner stabilizes the components during travel

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Sensor

Standard Sensor Installation

Weight: 73.5lbs
Volume: 16ft^3

Post Hole Sensor Installation

Weight: 40lbs
Volume: 1ft^3

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Next Generation Seismic Station

Year Round AGM Station

Run time = indefinite
Total weight = 1070lbs
Total cube = 51ft^3

Installation:
- Station must be completely built on the ground
- >3 hours with three person team

Rapid Deploy Station

Run time = 2 years
Total weight = 350lbs
Total cube = 20ft^3

Installation:
- Enclosure and solar panel mount preassembled
- <1 hours with three person team

>40 rapid deploy stations will be installed during 2014-2015 Antarctic season

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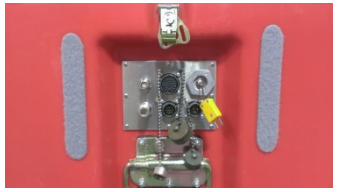
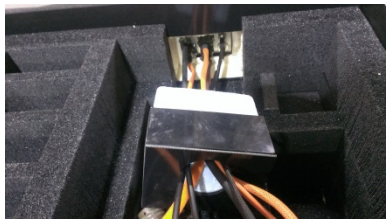
Next Generation Seismic Station





Next Generation Seismic Station

Design and Fabrication Process:

1. 3/18/2014 – Introduction of parties: Pelican, CaseTech, PASSCAL
2. 5/2/2014 – Initial PASSCAL design drawings sent to CaseTech
3. 5/22/2014 – Initial quote received from CaseTech
4. 6/3/2014 – Pelican visit and revised quote
5. 6/20/2014 – PO submitted to CaseTech
6. 6/25/2014 and 7/15/2014 – Design revisions
7. 8/1/2014 – First article of foam insert received at PASSCAL. Minor design modifications made
8. 9/15/2014 – First 36 full units ready at Pelican (PASSCAL visits to inspect and mount cables)
9. 10/1/2014 – Remaining 20 units ready at Pelican

Costs:

Off the shelf case: $600

Modified RIS Enclosure:

1-3	$1,743.00
4-9	$1,699.00
10-49	$1,584.70

Foam Liner:

1-3	$175.10
4-9	$161.65
10-49	$140.10

Tooling and setup charge: $1425.00

NRE Fees: $1235.00

Not included: Bulkhead plate with cables

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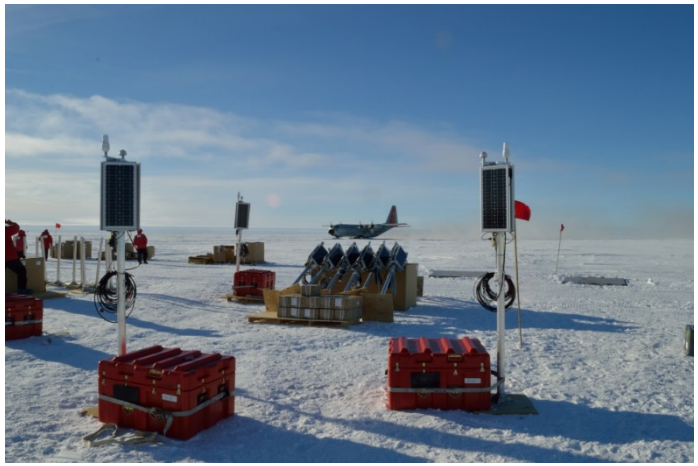
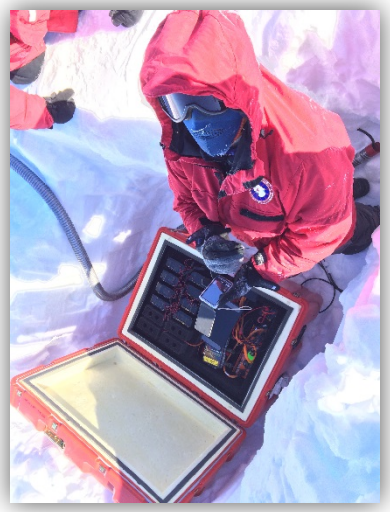
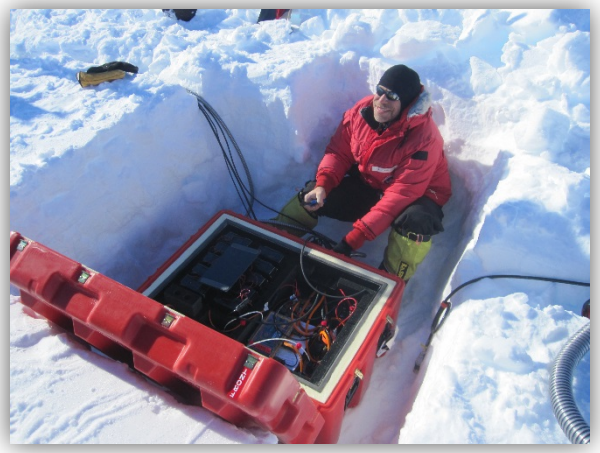
Next Generation Seismic Station

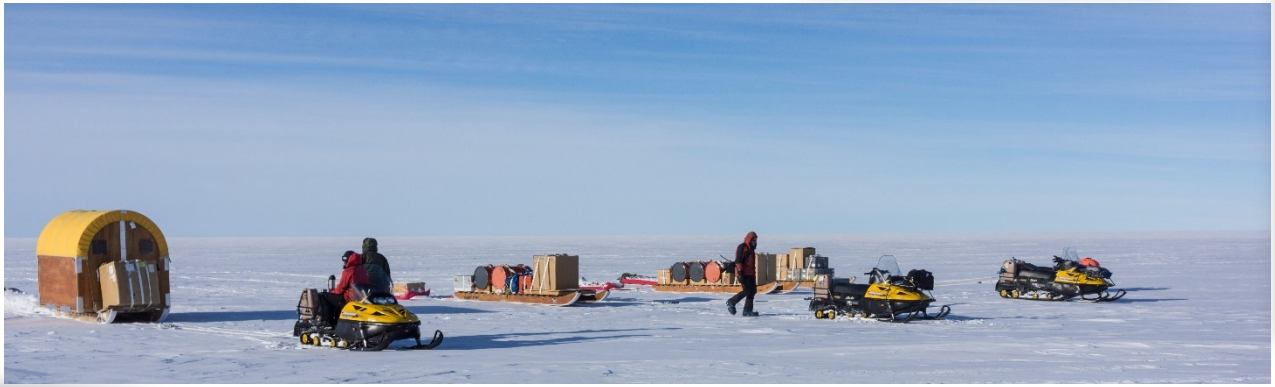
44 RIS Enclosure Systems installed in the 2014-2015 Antarctic Season

Benefits of system:









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GeoIce MRI

MRI – Partnership between Central Washington University and IRIS to develop new instrumentation specifically for polar regions. Will include a mixed phase array consisting of broadband and intermediate band seismometers complete with power systems and enclosures.

- Low power, both types integrate a digitizer and post hole seismometer for installation in snow/ice
- Environmentally sealed, built for limited and difficult logistics
- Improved tilt tolerance
- Target is 125 element array
- Two Nanometrics “All-in-one” units, a Meridian Compact, intermediate band instrument and a Meridian 120 broadband unit currently operating at South Pole SPRESSO site

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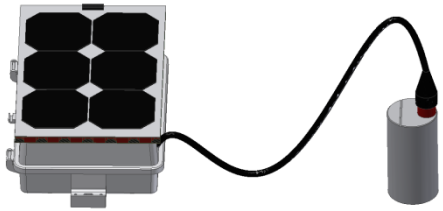
GeoIce MRI

Initial Station Design Concepts- Summer Only:

- 20Ah $LiFePO_4$ battery
- Custom high-efficiency, lightweight solar panel (Sunpower cells, 22% efficiency)
- Modular configurations for a variety of installation requirements
- Nanometrics Meridian Compact “All-in-one” sensor

Carbon Fiber “Dipod”

- Ultra-light, can be deployed on foot
- Solar and cabling raised to prevent drifting and animal damage
- 23.5lb total station weight



Box only

- Ground mounted for short deployments or sites where drifting/flooding is not a concern
- 21lb total station weight

Aluminum “Dipod”

- Can be deployed with or without supports
- 30.5lb total station weight

Plan to have prototype station testing this Summer!

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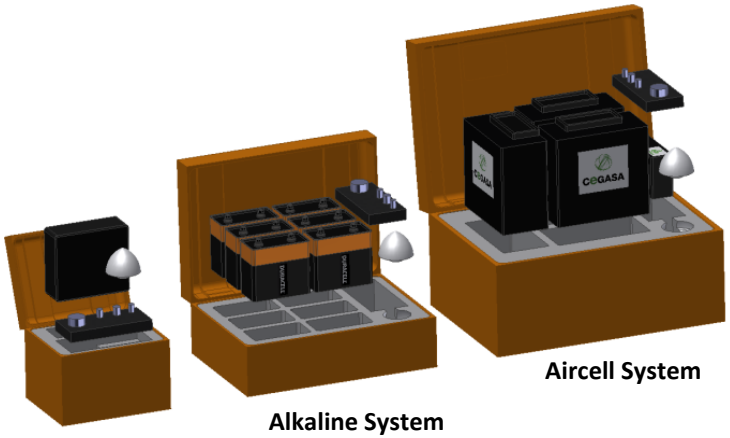
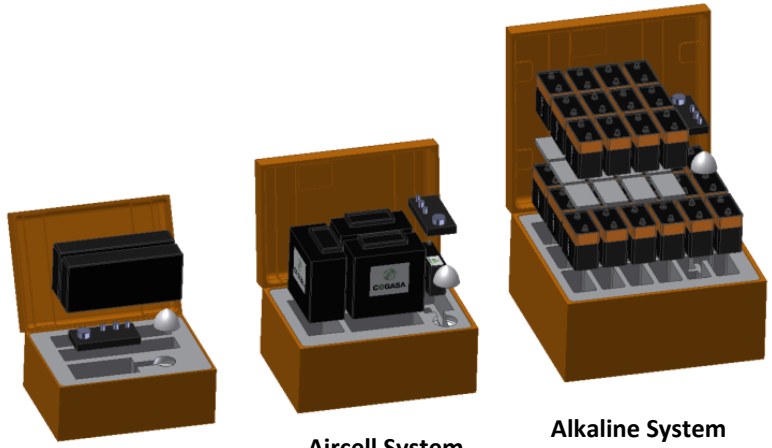
GeoIce Power System Options – Seasonal Deployments

Short term power systems



Battery Type	Total weight (lbs)	Total Volume (ft3)	Target Cost (USD)	Number in a Twin Otter
Alkaline (x6)	41	1.7	$460	34
Aircells (x3)	86	3.0	$1,010	16
Lithium Primary	25	1.4	$655	56

Three month autonomous system



Battery Type	Total weight (lbs)	Total Volume (ft3)	Target Cost (USD)	Number in a Twin Otter
Alkaline (x30)	127	5.4	$1,220	11
Aircells (x3)	86	3.0	$1,010	16
Lithium Primary	47	2.7	$1,965	30

GeoIce Power System Options – Overwinter Deployments

Hybrid winter over systems

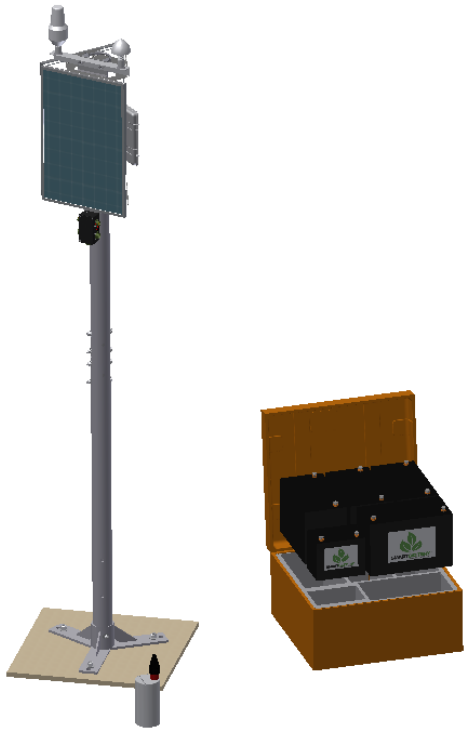
Lithium Primary System

Aircell System

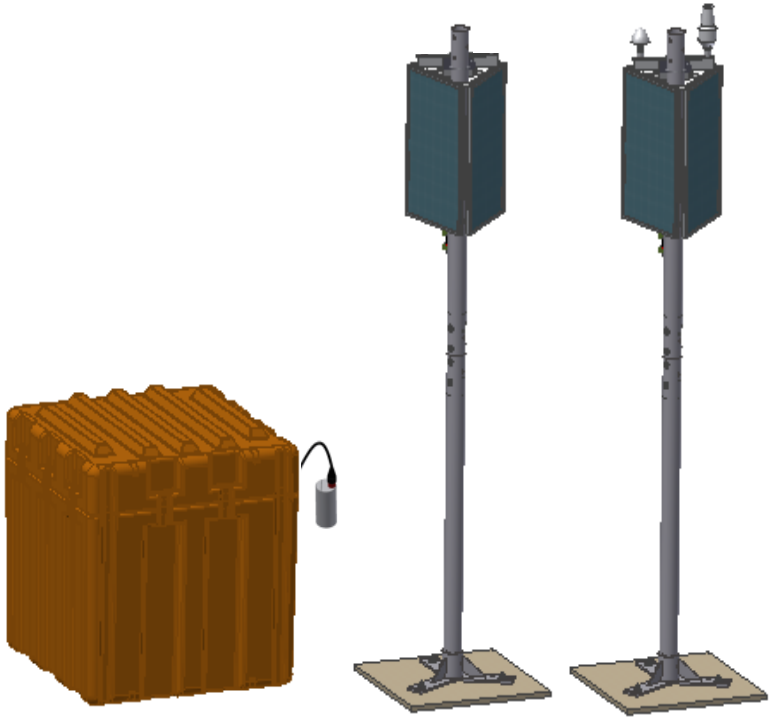
Battery Type	Total weight (lbs)	Total Volume (ft3)	Target Cost (USD)	Number in a Twin Otter
Aircells (x6)	161	5.9	$2,205	9
Lithium Primary	69	2.3	$4,370	20

GeoIce Power System Options – Overwinter Deployments

Winter over rechargeable



LiFePO4 Rechargeable System



Rechargeable Winterover System with AGM Batteries

Battery Type	Total weight (lbs)	Total Volume (ft3)	Target Cost (USD)	Number in a Twin Otter
AGM (x6.2)	646	63.1	$ 9,425	2
LiFePO4 (x4.3)	388	42.3	$14,220	4

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