

IceCube Upgrade: Logistics Breakout

IceCube Upgrade NSF Rebaseline Review
April 26-28, 2022

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Outline

- OPP/AIL Logistics Capacity vs. ICU Requirements refresher
- Intercontinental cargo
- Intracontinental cargo
- Cargo float
- Overland cargo load plan
- Fuel transport assumptions/delivery/contingency
- Population charts
- Tour of Cargo Master, Population Sheet, & Sensitivity Analysis

OPP/AIL Logistics Capacities vs Project Requirements

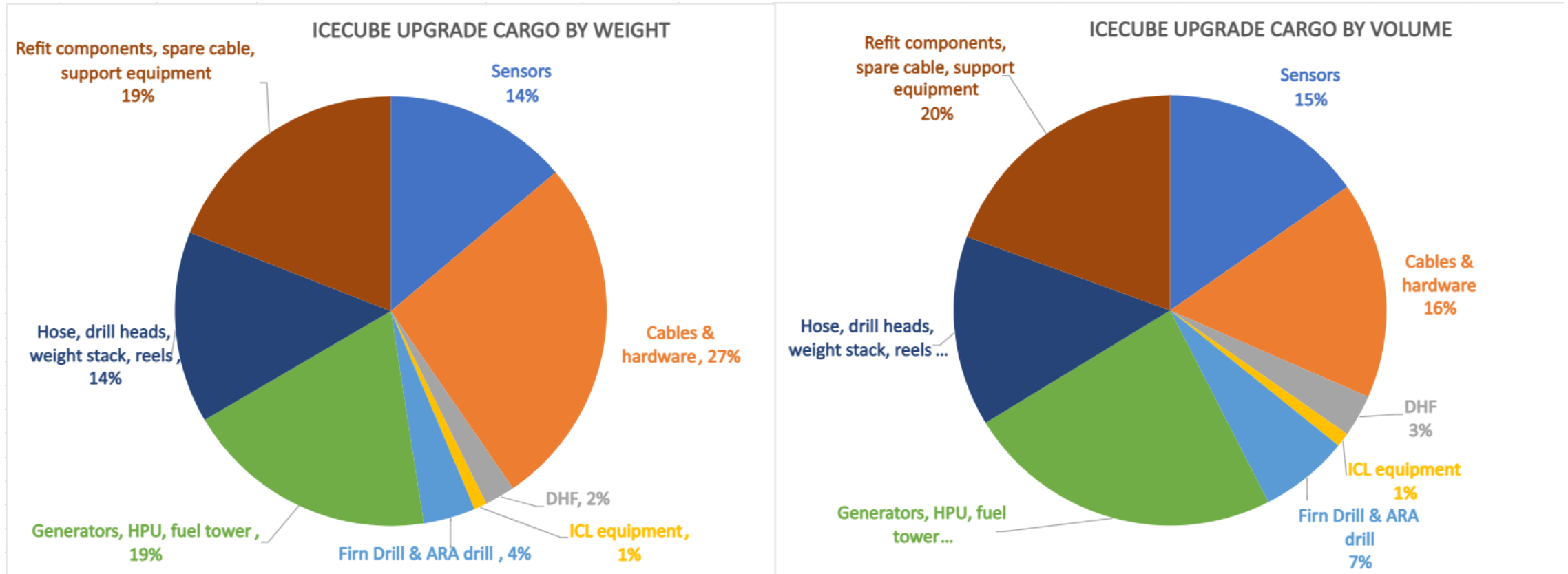
Year	FY23 Capacity	FY23 Planned	FY24 Capacity	FY24 Planned	FY25 Capacity	FY25 Planned	FY26 Capacity	FY26 Planned	FY27 Capacity	FY27 Planned
Vessel South (TEU)	18	6.25	as needed	5.25	as needed	3.25	n/a	n/a	n/a	n/a
Vessel North (TEU)	n/a	-	17	0.5 (EST)	50	0.5 (EST)	17	-	50	TBD
LC-130: Flights / Cargo [lbs]	2 missions	0/0	19 missions	0.6/11,445	10 missions	2/43,103	7 missions	3.6/73,939	6 missions	TBD
LC-130: Flights / Fuel [gallons]		2/6,000		18.4/55,200		8/24,000		3.4/10,200		TBD
SPOT-1 (Sleds/lbs)	3/180,000	3/21,601	3/180,000	2/56,900	3/180,000	2.9/56,143	3/180,000	2.5/110,362	3/180,000	TBD
SPOT-2 (Sleds/lbs)	3/180,000	3/109,405	3/180,000	0/0	3/180,000	0.45/16,302	3/180,000	0/0	3/180,000	TBD
SPOT-3 (Sleds/lbs)	3/180,000	1/28,000	3/180,000	0/0	3/180,000	0/0	3/180,000	3/46,791 R	3/180,000	TBD
Pole Population (Nov-Jan)	0	0	11	11	21	21	46	46	4	TBD

Cargo

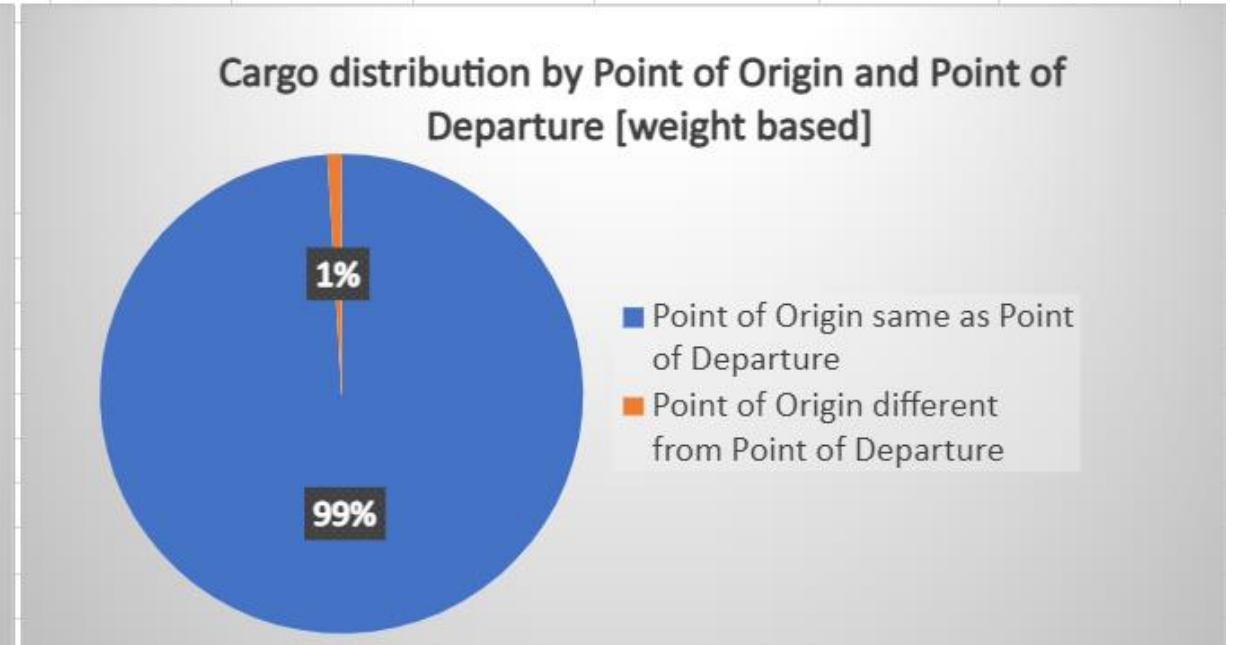
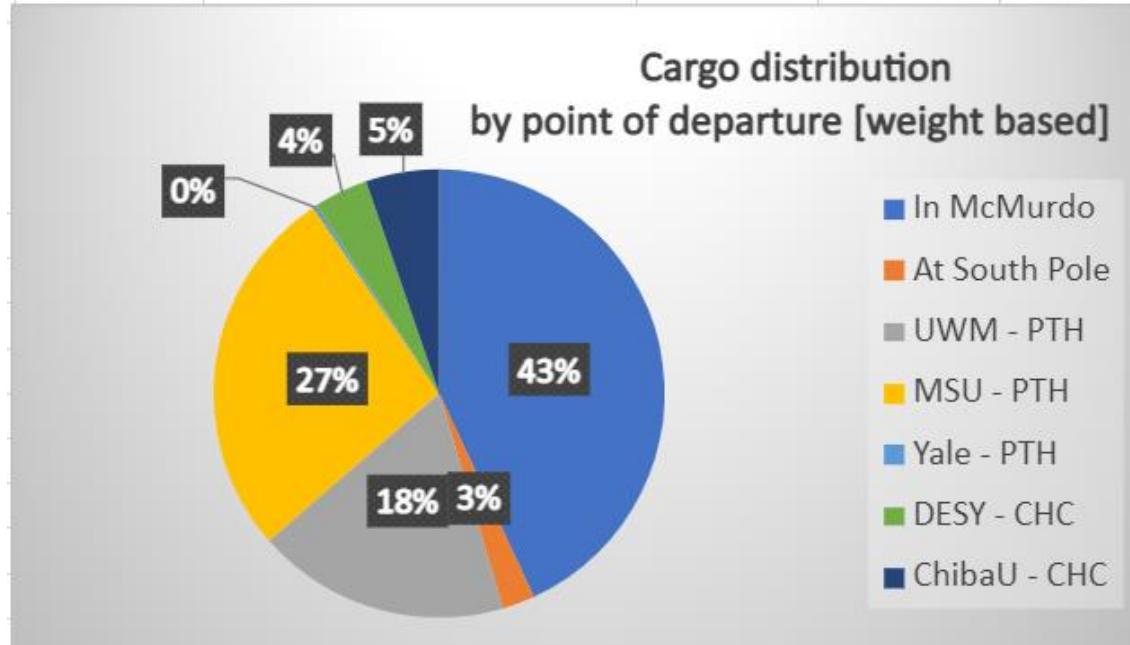
Overview of Intercontinental Cargo Movement

Intercontinental leg	volume [cu ft]	weight [lbs]	Vessel Container Allocation 40F	Vessel Container Allocation 40D	Vessel Container Allocation 20D	Vessel Container Allocation 20F	TEU Count	C-17 Pallet Allocation
In McMurdo	20,513	205,787	0.00	0.00	0.00	0.00	0.00	0.00
At South Pole	733	12,241	0.00	0.00	0.00	0.00	0.00	0.00
FY23 Vessel	5,470	73,632	0.00	0.00	5.75	0.50	6.25	0.75
FY23 ComSur	2	10	0.00	0.00	0.00	0.00	0.00	0.02
FY24 Vessel	4,704	121,302	0.00	0.00	5.00	0.25	5.25	0.00
FY24 ComSur	128	3,000	0.00	0.00	0.00	0.00	0.00	0.50
FY25 Vessel	1,022	12,362	0.00	0.25	3.00	0.00	3.25	0.00
FY25 ComSur	2,953	37,553	0.00	0.00	0.00	0.00	0.00	8.75
FY26 Vessel	0	0	0.00	0.00	0.00	0.00	0.00	0.00
FY26 ComSur	4,958	62,549	0.00	0.00	0.00	0.00	0.00	16.56
Total	40,483	528,436	0.00	0.25	13.75	0.75	14.75	26.58

Cargo by Weight/Volume



Cargo Distribution



Overview of Intracontinental Cargo Movement

Intracontinental leg	volume [cu ft]	weight [lbs]	#SPOT Sleds	#263 Pallets
At South Pole	733	12,241	0.00	0.00
FY23 LC-130	0	0	0.00	0.00
FY23 SPOT 1	5,654	21,601	3.00	
FY23 SPOT 2	7,989	109,405	3.00	
FY23 SPOT 3	2,720	28,000	1.00	
FY24 LC-130	576	10,380	0.00	2.15
FY24 SPOT 1	4,119	56,900	2.00	
FY24 SPOT 2	0	0	0.00	
FY24 SPOT 3	0	0	0.00	
FY25 LC-130	3,145	39,553	0.00	9.25
FY25 SPOT 1	5,055	56,143	2.90	
FY25 SPOT 2	1,120	16,302	0.45	
FY25 SPOT 3	0	0	0.00	
FY26 LC-130	5,438	67,549	0.00	17.56
FY26 SPOT 1	3,934	110,362	2.50	
FY26 SPOT 2	0	0	0.00	
FY26 SPOT 3	0	0	0.00	
Total	40,483	528,436	14.85	28.96

DNF & Seasonal Resupply

Drill heads, drill refit components, & resupply

ICL power & timing electronics, FieldHubs, patch cables, 87 & 88 sensors/calibration/special devices, drill refit components, & resupply

89-93 sensors, calibration & special devices, breakout cables, resupply, & logging winch

Charge Question L-1, L-2

CargoMaster Demonstration

[illegible]

Cargo Master provides:

- Shipment description
- Special handling requirements
- Dimensional information
- Origin/Guardian
- Completion dates
- Shipment dates
- Route information
- Float calculations
- Validation sign-offs
- Formatted to dovetail w/ USAP contractors cargo planning techniques

Clearly links between shipment & on-ice efforts

Float Tables

Item description	Special Handling?	SHIPMENT FLOAT: Time between completion and ship-by-date to USAP	FLOAT AT NPX (delivery to required) [days]	Total Time Between Ship-By-Date and Latest Arrival Date at NPX [days]
ARA Drill System Components - Crate #1	DNF	30	16	412
Computing/controls components Shipment #1	DNF	14	0	396
Computing/controls components Shipment #2	DNF	31	0	106
Computing/controls components Shipment #3	DNF	31	0	106
20' Refit Container C: Bull Wheel, Spare Combo & Drill Cables, Hose Heating System Components, ARA Drill System Components Crate #2	-	31	418	830
Driller resupply/refit components - 8' Container FS2	-	31	0	106
Drill refit components FS2	DNF	31	0	106
Driller resupply/refit components - 8' Container FS3	-	31	0	106
Drill refit components FS3	DNF	31	0	106
Drill Heads - X	DNF	409	648	1127
Drill Heads - Y	DNF	409	648	1127
Drill Heads - R	DNF	409	648	1127
Load member cable reel [placeholder, may not be required]	-	136	151	595
Accelerometer Loggers SPoT 1	-	62	0	91
Accelerometer Loggers SPoT 2	-	62	0	122
ICL power and timing electronics	DNF	462	1	122
ICL patch cables and patch panels	DNDF [TBD]	624	1	122
DOM Handling Facility (DHF)	-	50	368	780
Installation Hardware 87-93	-	97	321	765
Installation Weights 87-93	-	110	321	765
Misc. Science Equipment - FS2 (FY25)	DNF	50	1	122
Misc. Science Equipment - FS3 (FY26)	DNF	25	16	122
Calibration/Special Devices 87-88	DNDF [-40C]	2	13	149
Special Devices 87-88	DNDF [-40C]	2	13	149
Special Devices 89-93	DNDF [-40C]	61	15	131
Calibration/Special Devices 89-93	DNDF [-40C]	61	15	131
Dust logging device	DNF	61	15	131

Item description	Special Handling?	SHIPMENT FLOAT: Time between completion and ship-by-date to USAP	FLOAT AT NPX (delivery to required) [days]	Total Time Between Ship-By-Date and Latest Arrival Date at NPX [days]
Dust logging device	DNF	61	15	131
Dust logging device	DNF	61	15	131
Dust logging device	DNF	61	15	131
Logging winch	0	61	15	131
Logging winch control box	DNF	61	15	131
Surface Junction Boxes	-	2	380	792
Surface Cable Assemblies	DNDF [-55C]	106	14	792
Breakout cables for strings 87-88	DNDF [-40C](*)	477	298	421
Breakout cables for strings 89-93	DNDF [-40C](*)	379	15	421
Main (downhole) load members 87- 93 [placeholder, may not be required]	DNDF [-40C](*)	563	1	413
Main (downhole) cables 87-93	DNDF [-40C](*)	31	1	779
String Sensors 89-93 (mDDMs MSU)	DNDF [-40C]	688	-	-
String Sensors 89-93 (mDDMs MSU)	DNDF [-40C]	-	-	-
DM-Ice	DNDF [-40C]	-	-	-
String Sensors 87-88 (mDDMs DESY)	DNDF [-40C]	-	-	-
String Sensors 87-88 (mDDMs DESY)	DNDF [-40C]	-	-	-
Special Devices 87-88 (Europe)	DNDF [-40C]	-	-	-
Calibration Devices 87-88 (Europe)	DNDF [-40C]	-	-	-
FieldHub electronics	DNF	-	-	-
String Sensors 89-93 (mDDMs DESY)	DNDF [-40C]	-	-	-
Special Devices 89-93 (Europe)	DNDF [-40C]	-	-	-
Calibration Devices 89-93 (Europe)	DNDF [-40C]	-	-	-
String Sensors 87 & 88 (D-Eggs- 12x)	DNDF [-40C]	-	-	-
String Sensors 87 & 88 (D-Eggs- 12x)	DNDF [-40C]	-	-	-
String Sensors 87 & 88 (D-Eggs- 12x)	DNDF [-40C]	-	-	-
String Sensors 89-93 (D-Eggs-8x)	DNDF [-40C]	-	-	-
String Sensors 89-93 (D-Eggs-12x)	DNDF [-40C]	-	-	-

Float Table:

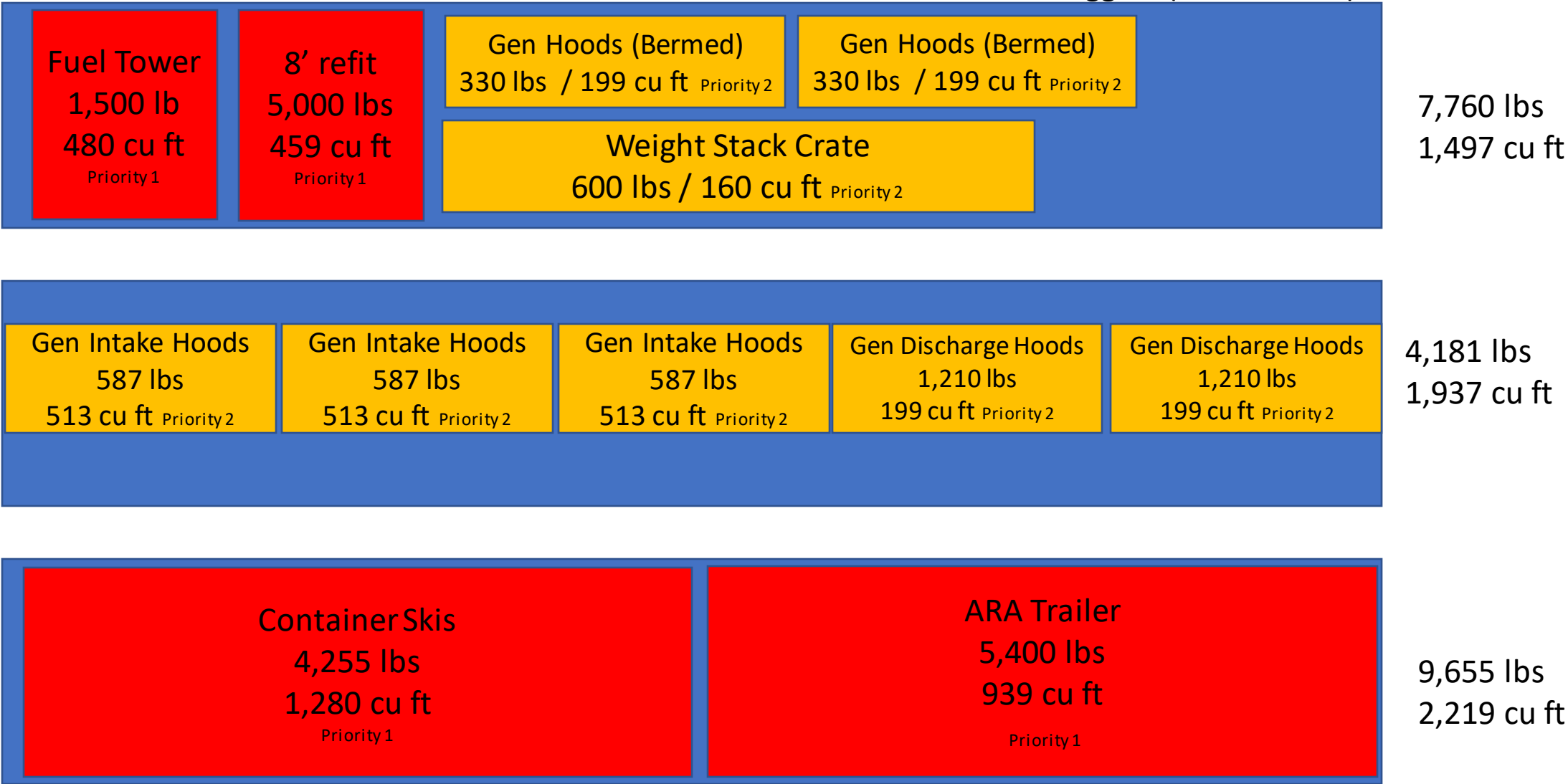
- Generated from Cargo Master
- Provides:
 - Shipment float
 - South Pole float
 - Total time between shipment and latest South Pole arrival

ICU Overland Ground Rules/Assumptions

- Rough arrival dates:
 - SPOT 1: 12/1
 - SPOT 2: 1/1
 - SPOT 3: 2/1(actual arrival may be 7-10 days beyond planned date of arrival)
- 3 40' sleds each traverse w/ 180k lbs available capacity for IceCube Upgrade cargo
- Preference for load distribution:
 - Lighter loads on both SPoT1/ SPoT3
 - SPOT 2 heavy hauler
- Offloads requiring a crane should be consolidated and ship on SPOT 2
 - Crane support needs to be called out in the ICU schedule and coordinated with the USAP contractor
- Sensitive cargo and hazardous materials are not suitable for overland transport

Overland Capacity Analysis - FY23 SPOT 1 South

+ Accelerometer Data Loggers (5 lbs, 1 cu ft)

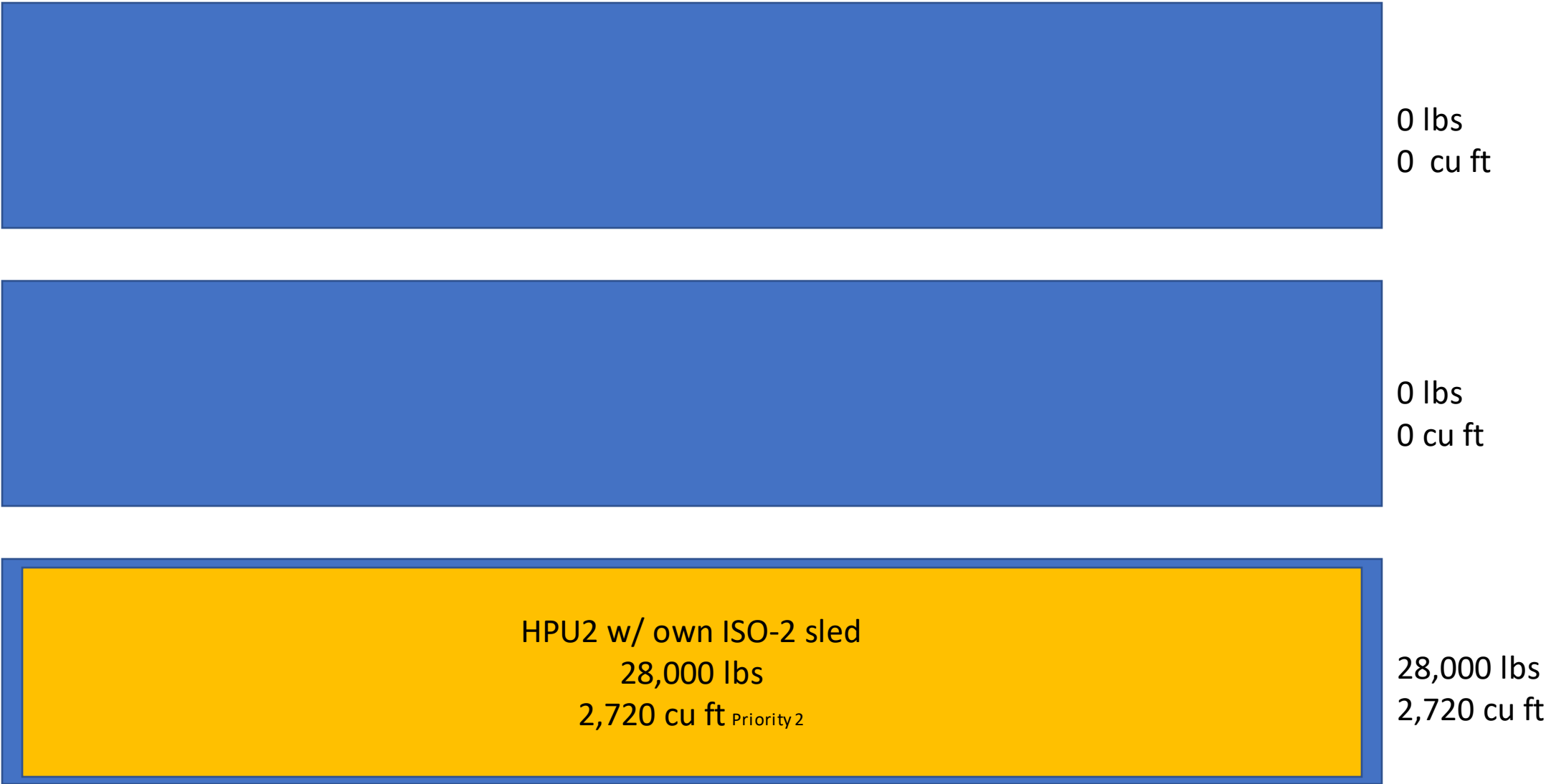


Overland Capacity Analysis - FY23 SPOT 2 South

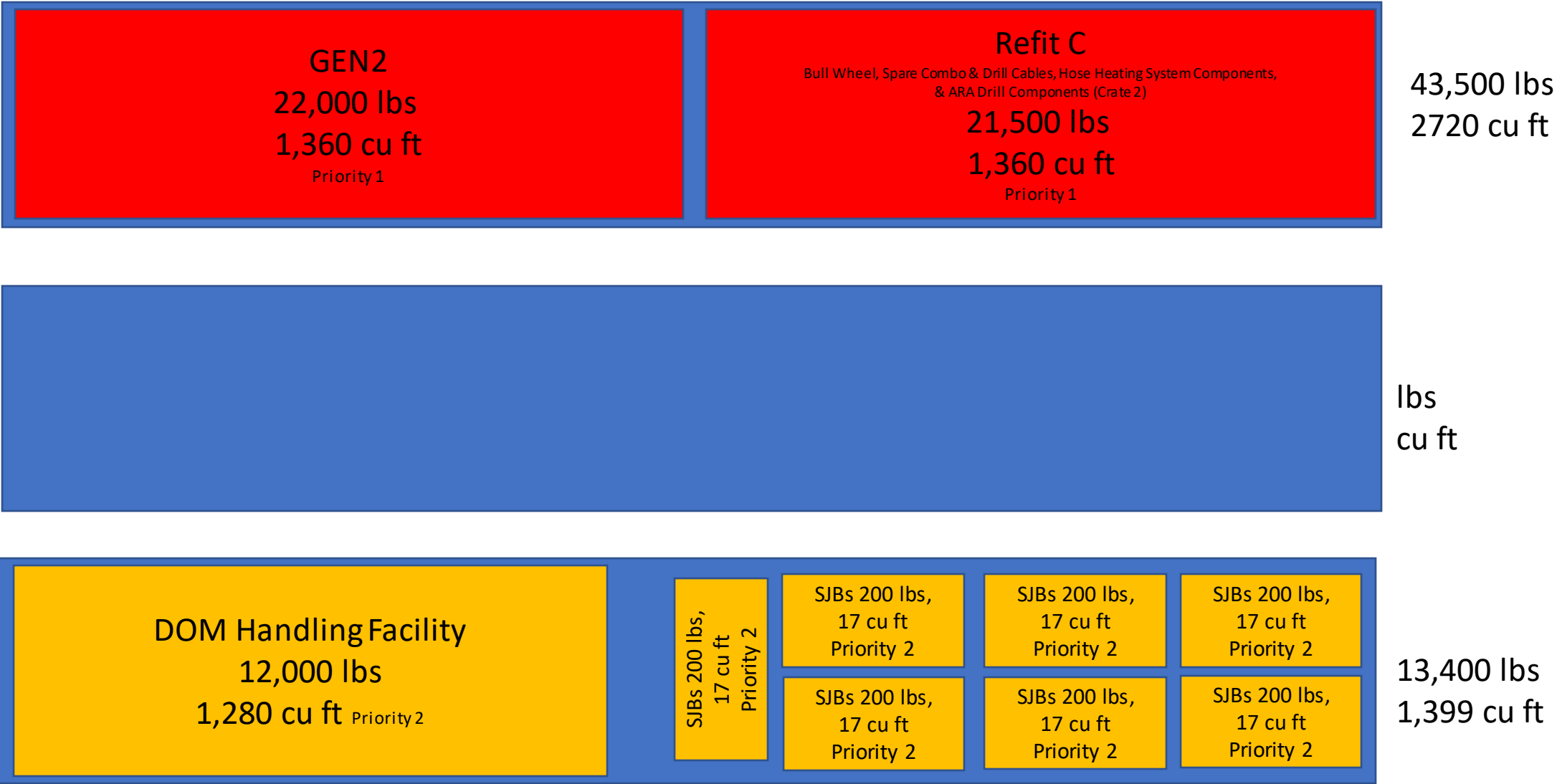
+ Accelerometer Data Loggers (~5 lbs, 1 cu ft)



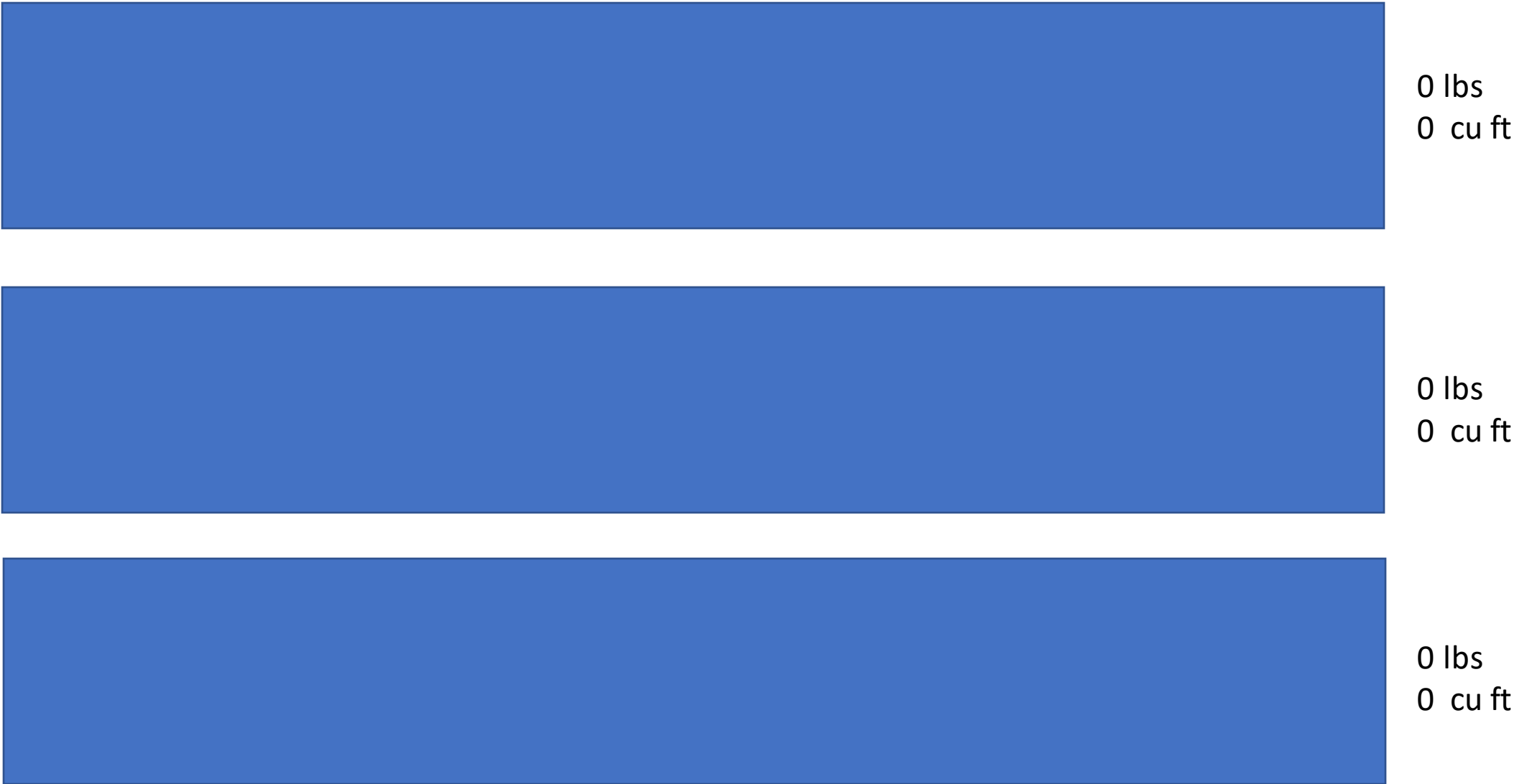
Overland Capacity Analysis - FY23 SPOT 3 South



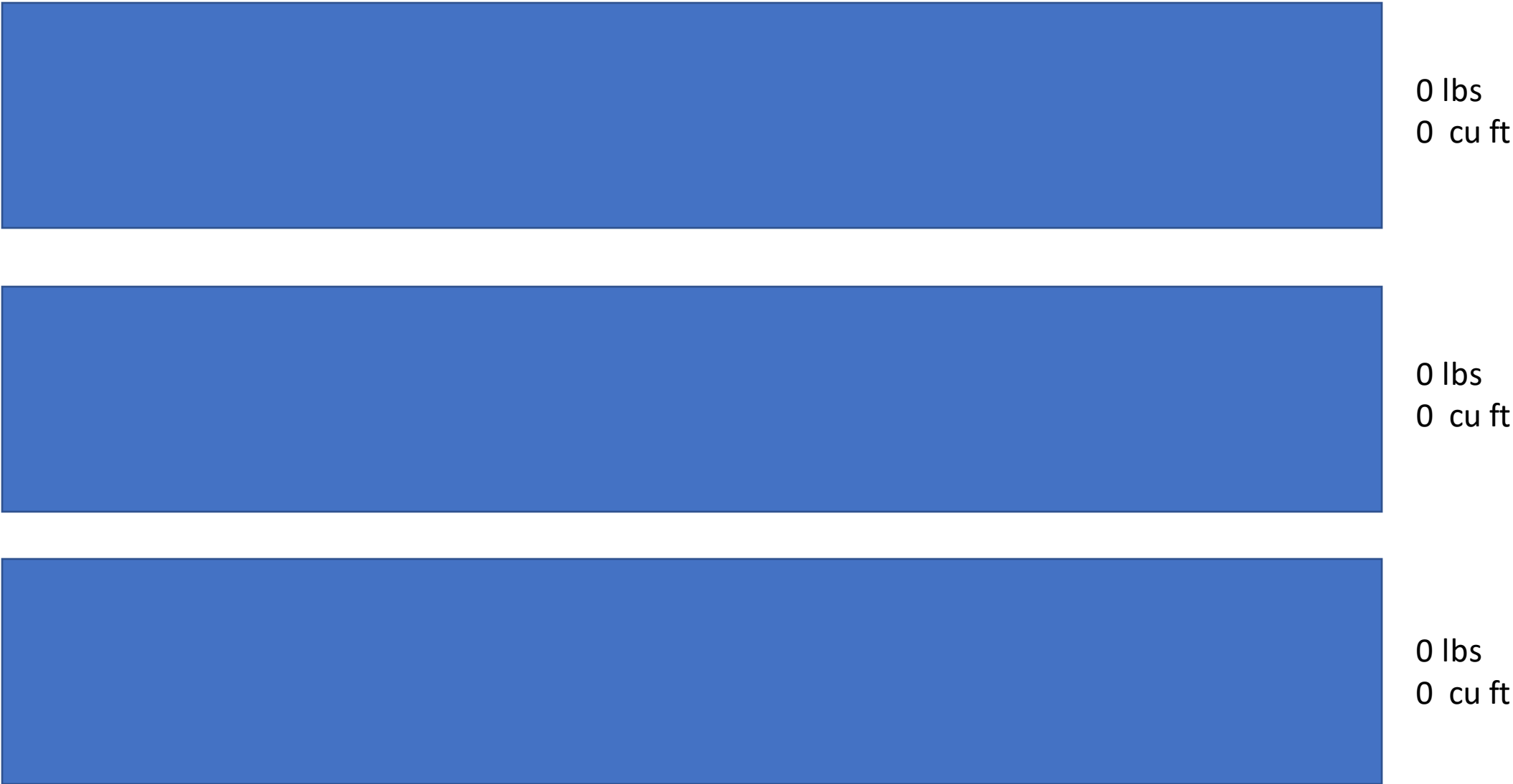
Overland Capacity Analysis - FY24 SPOT 1 South



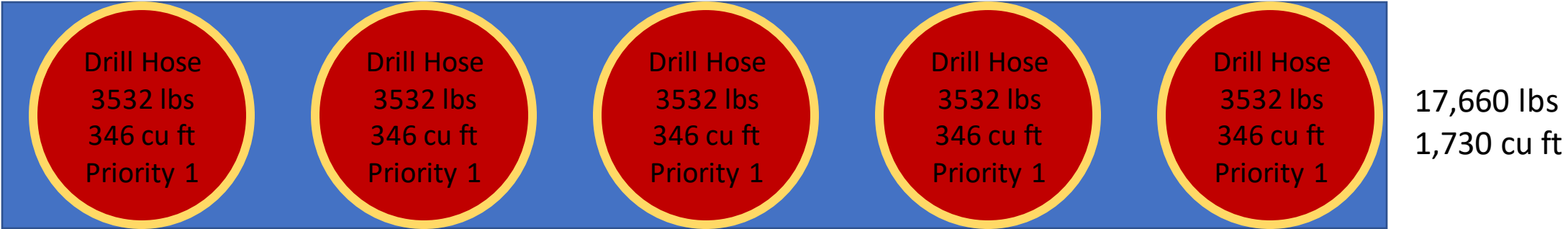
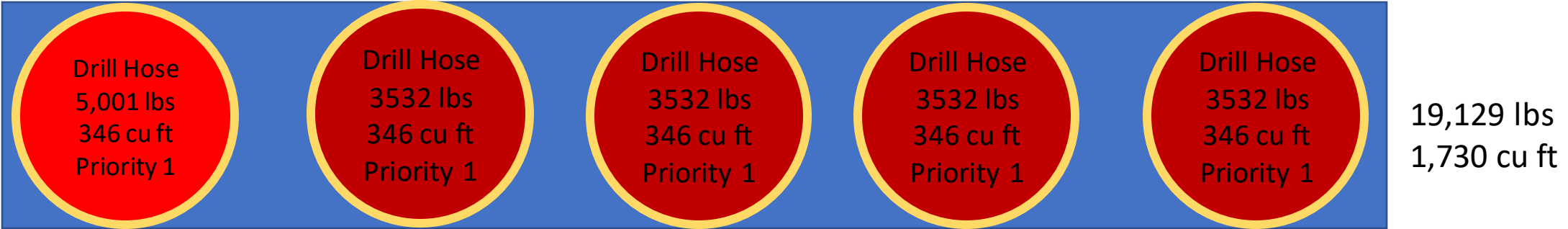
Overland Capacity Analysis - FY24 SPOT 2 South



Overland Capacity Analysis - FY24 SPOT 3 South



Overland Capacity Analysis - FY25 SPOT 1 South



Overland Capacity Analysis - FY25 SPOT 2 South



Overland Capacity Analysis - FY25 SPOT 3 South



0 lbs
0 cu ft



0 lbs
0 cu ft



0 lbs
0 cu ft

Overland Capacity Analysis - FY26 SPOT 1 South



Overland Capacity Analysis - FY26 SPOT 2 South



0 lbs
0 cu ft



0 lbs
0 cu ft



0 lbs
0 cu ft

Overland Capacity Analysis - FY26 SPOT 3 South



0 lbs
0 cu ft

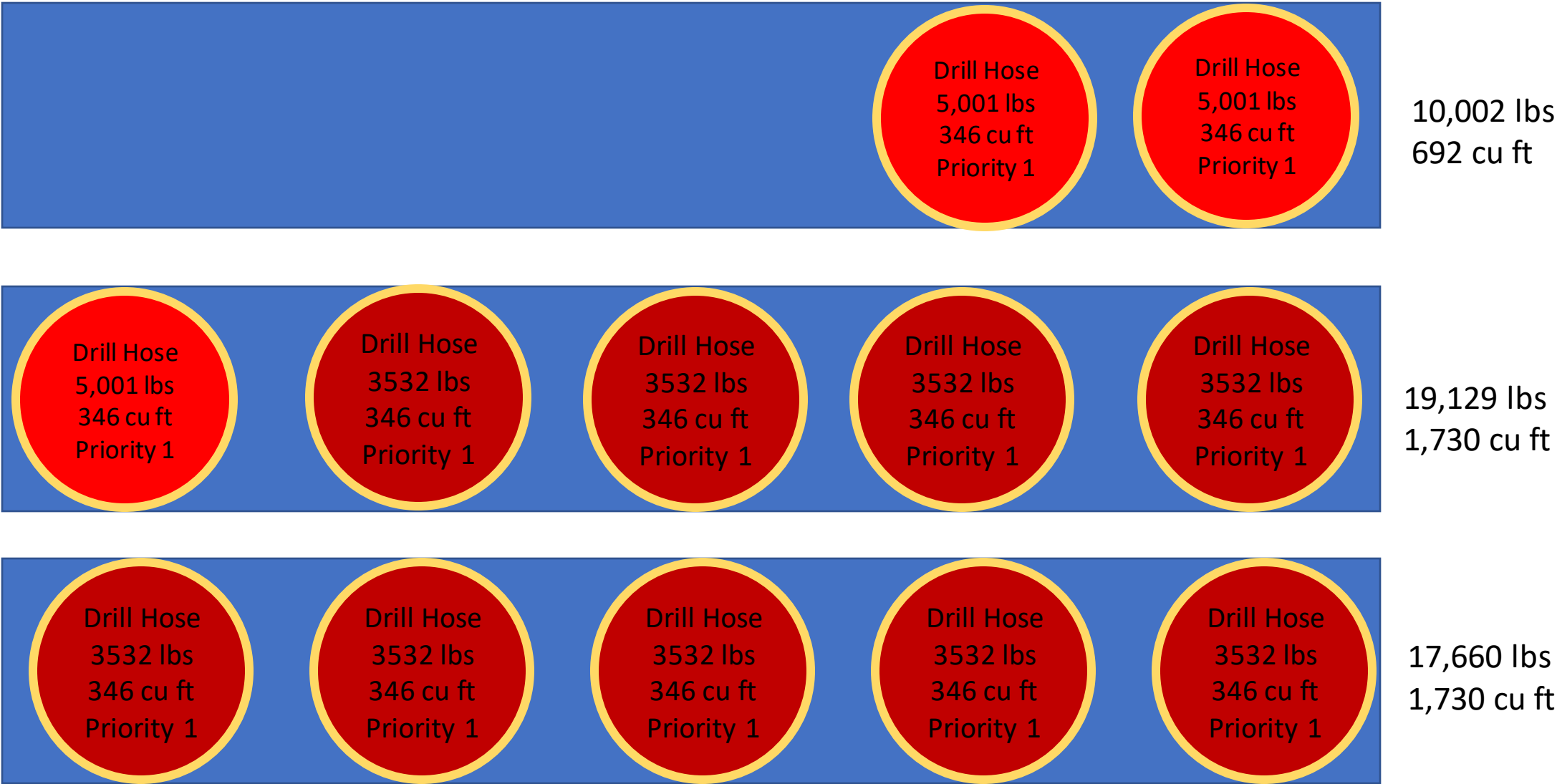


0 lbs
0 cu ft



0 lbs
0 cu ft

Overland Capacity Analysis - FY26 SPOT 3 North



Fuel

IceCube Upgrade Fuel

Units = Gallons
(A) = Actual



	18-19	19-20	20-21	21-22	Field Season 1	Field Season 2	Field Season 3	Total
						9 firn holes	7 deep holes	
Deep Drilling			X	X			53583	53583
Firn Drilling						3900		3900
Base Fuel	250 (A)	1000 (A)			3643	12346	17584	34823
Winter Heating						4305		4305
Total	250 (A)	1000 (A)			3643	20551	71167	96612

Fuel Estimate Analysis Includes the following categories:

- **Deep Drilling** – Fuel consumed during deep drilling/reaming, calculated in conjunction with thermal hole modeling. Hole modeling produces a drill and ream speed strategy based on requirements of a given hole, and in turn yield drill and ream durations, from which fuel consumption can be calculated given a well established steady-state fuel burn rate at full system power.
Ref. Greenler L and 6 others (2014) Modeling hole size, lifetime and fuel consumption in hot-water ice drilling. Ann. Glaciol., 55(68), (doi: 10.3189/2014AoG68A033)
- **Firn Drilling** – Fuel to support firn drilling, based on historical records.
- **Base Fuel**
 - *Startup and Rodwell development* – To commission the system, melt snow, and develop a mature Rodwell. Historical basis that is a function of number of deep holes and supported by estimate calculations.
 - *Shutdown* – After drilling operations are complete; camp idle, equipment operations, mothball activities; historical basis.
 - *Other* – General equipment operations, TOS furnace day tank fills, etc. Historical basis but also includes condensate bulb creation in FS2
 - *Testing* – Fuel specifically budgeted for planned system and subsystem tests in FS1 and FS2.
 - *Idle* – Fuel consumed during deep drilling campaign, but between holes. Also generator consumption during non-drill seasons. Historical supported by estimate calculations.
- **Winter Heating** – Electrical heating to sustain suitable storage temperature of DNF equipment and main drill hose during the winter after FS2

NOT INCLUDED – Fuel at station to support population, fuel used to supply electricity when feeding drill equipment from Station power (i.e. @ Cryo), gasoline and premix for vehicles.



4/22/2022
10/14/2021

NSF Rebaseline Review - Logistics Breakout
IceCube Upgrade Fuel - T. Benson



26
2

IceCube Upgrade Fuel Contingency

Units = Gallons
(A) = Actual



- Contingency is added into each major component of the fuel budget
 - Deep drilling: 20%
 - Firn drilling: 20% on fuel per hole, + 4 extra firn holes = 73% contingency
 - Base: Has many subcomponents estimated from engineering judgement. For purposes here, we will assume 0% contingency.
 - Winter heating: 20%
- We can back out an overall contingency:

	No Contingency	Contingency	With Contingency
Deep Drilling	44653	8930 (20%)	53583
Firn Drilling	2250	1650 (73%)	3900
Base	34823	0 (0%)	34823
Winter Heating	3588	717 (20%)	4305
Total	85314	11298 (13%)	96612

- And then distribute across each field season, for fuel left to go:

	Field Season 1	Field Season 2	Field Season 3
No Contingency	3191	18178	62694
Contingency	452	2373	8473
Total	3643	20551	71167

Total contingency

95361 gal to go



10/14/2021

IceCube Upgrade Fuel - T. Benson

4/22/2022



7

Fuel Transport Assumptions

- No overland fuel hauling capacity for ICU
- LC-130 McMurdo→NPX Available Cargo Load : 23800 lbs, max of 5+1 463L pallets
- LC-130 Tanker Capacity: 3000 gallons

Fuel Transport Proposed Schedule

- All fuel requested can be flown into NPX in time

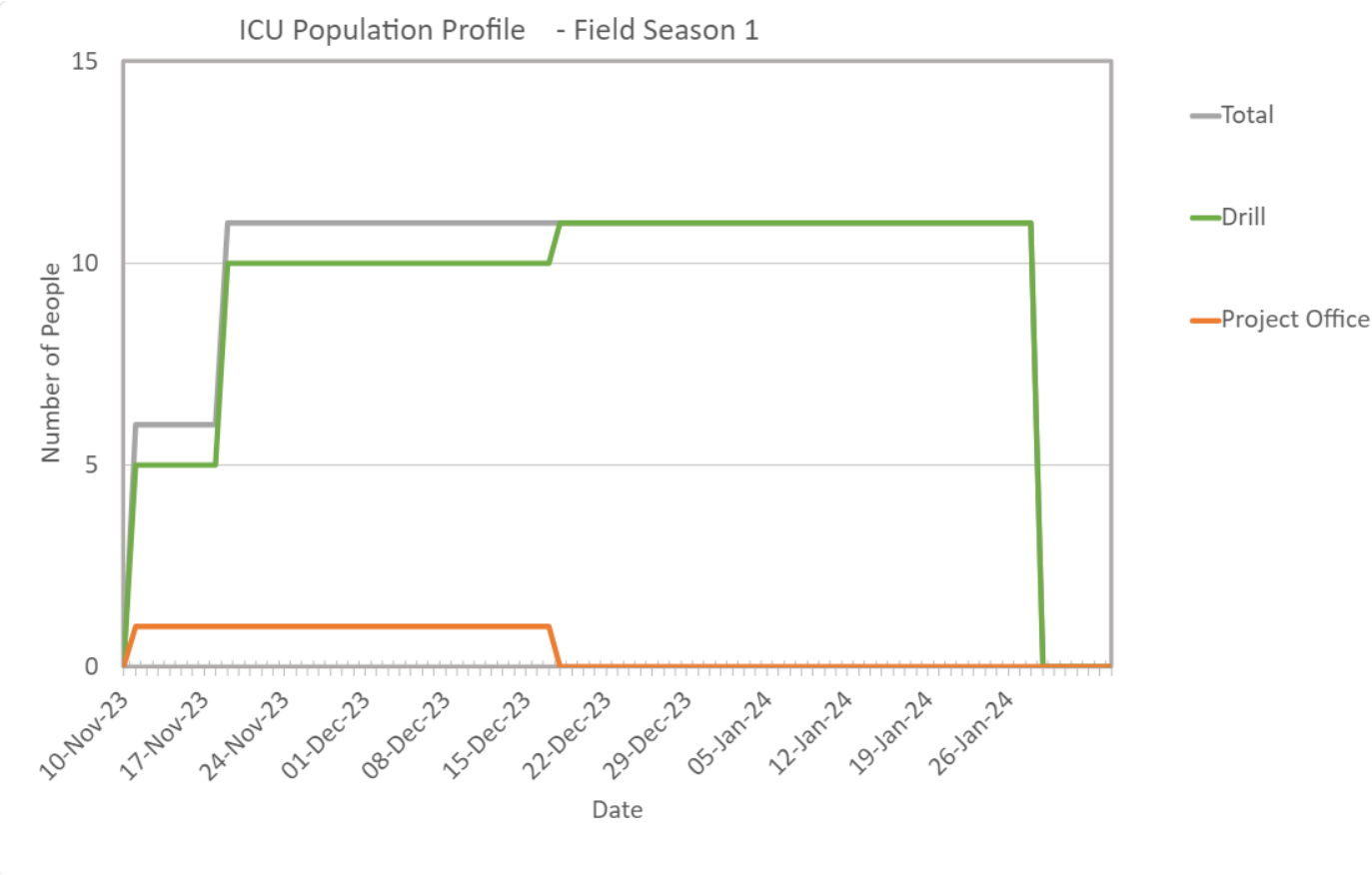
Fiscal Year	Intracontinental leg	Needed Fuel [Gallons]	# 263 Pallets (ROUND UP)	Cargo Weight including Pallets and TDE [lbs]	Available LC Flights	LC Cargo	LC Tanker (use conservative 3000 gallon/flight)	Fuel delivered by LC -130 for ICU [Gallons]
FY23	FY23 LC-Tanker	0	0	0	2	0.0	2.0	6,000
FY24	FY24 LC-Tanker	3,643	3	11,445	19	0.6	18.4	55,200
FY25	FY25 LC-Tanker	20,551	10	43,103	10	2.0	8.0	24,000
FY26	FY26 LC-Tanker	71,167	18	73,939	7	3.6	3.4	10,161
Total	Total	95,361	31	128,487	38	6	32	95,361



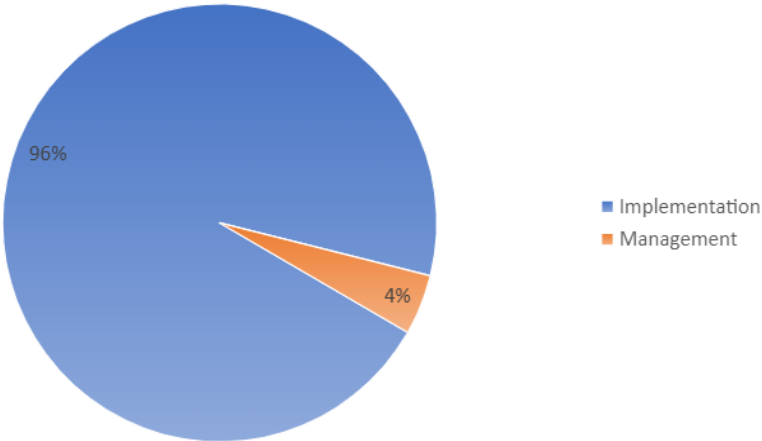
Population

Population: FS1

A-334-S By L3		FS1 Population	Deployments	Billets
A - 3 3 4 - S	Drill		13	10.6
	Project Office		1	0.4
A-334-S By LABOR CODE		Total	14	11
A - 3 3 4 - S	EN-EE		6	4.0
	EN-ME		4	4.0
	SE		1	0.4
	TE		3	2.6



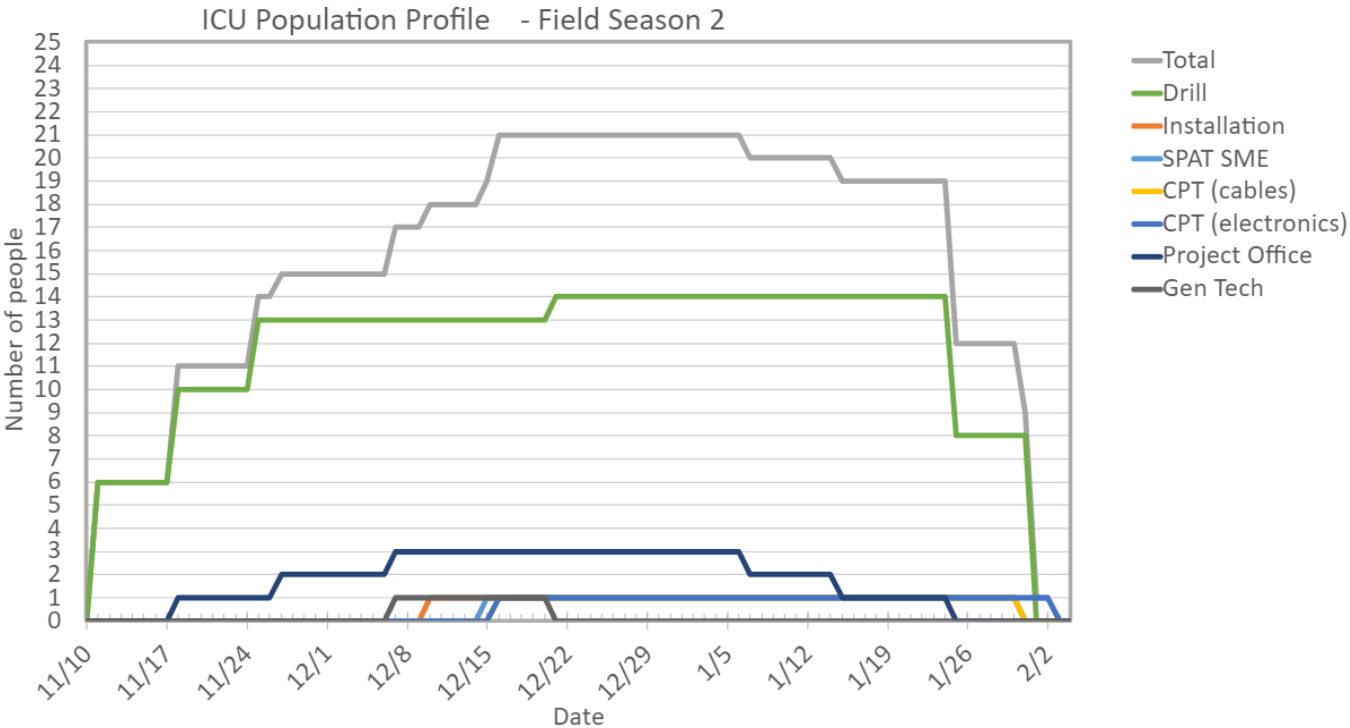
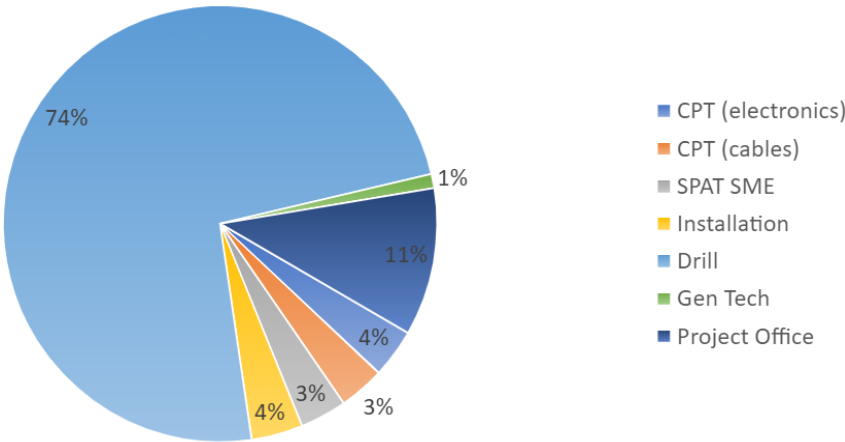
Field Season 1 IceCube Upgrade On-Ice Days by Role



Population: FS2

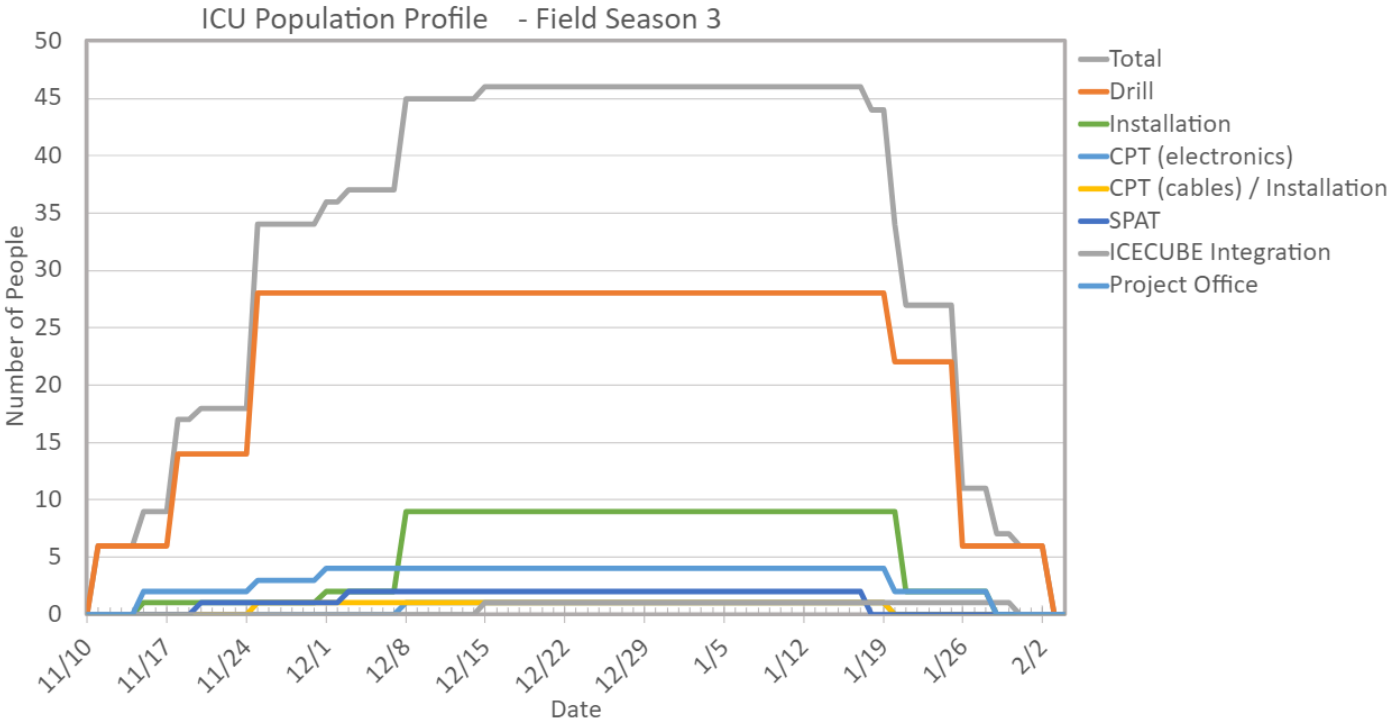
A-334-S By L3		Deployment		Billet
A - 3 3 4 - S	CPT (electronics)	2	1.0	
	CPT (cables)	2	1.0	
	SPAT SME	1	1.0	
	Installation	1	1.0	
	Drill	16	13.8	
	Gen Tech	1	0.2	
	Project Office	4	3.0	
A-334-S By LABOR CODE		Totals	27	21
A - 3 3 4 - S	EN	1	0.2	
	EN-EE	7	5.0	
	EN-ME	5	5.0	
	GR	1	0.0	
	MA	2	1.0	
	PO	1	0.0	
	SC	1	1.0	
	SE	3	0.0	
	TE	6	0.0	

Field Season 2 IceCube Upgrade On-Ice Days by Role

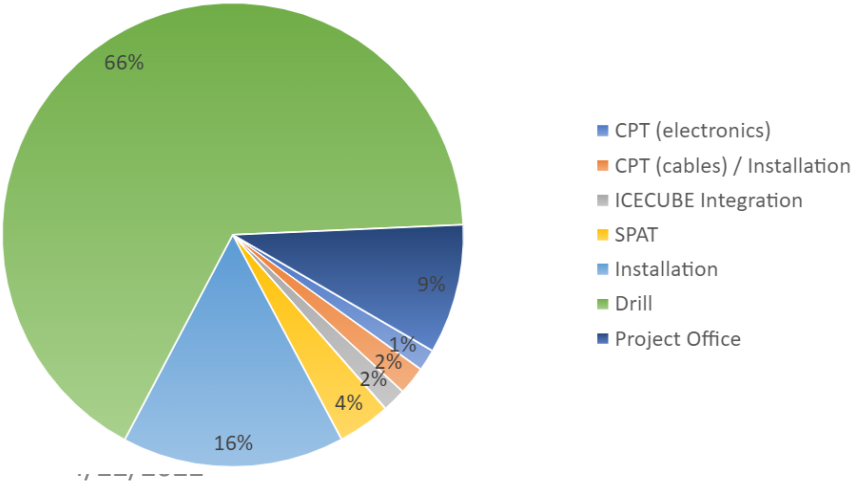


Population: FS3

A-334-S By L2 & L3		Deployments	Billets
A - 3 3 4 - S	CPT (electronics)	2	1.0
	CPT (cables) / Installation	2	1.0
	ICECUBE Integration	1	1.0
	SPAT	2	2.0
	Installation	9	9.0
	Drill	28	28.0
	Project Office	6	4.0
A-334-S By LABOR CODE		Total	50
			46
A - 3 3 4 - S	MA	3	1.4
	KE	1	0.6
	SE	3	3.0
	SC	1	1.0
	IK	9	9.0
	SS	3	2.0
	EN-ME	3	2.0
	TE	20	0.0
	EN	7	0.0



Field Season 3 IceCube Upgrade On-Ice Days by Role



Population Sheet Demonstration

ICECUBE UPGRADE NPX 2025/2026 Field Season 3 - Population vs. Category Plan														Start date	11/10/2025	End date	2/4/2026
PROJECT NUMBER	WBS	L3 Category	Member #	Team Members	Institution	Labor Code	Total days On Ice	Total working days	Total paid hours (November)	Total paid hours (December)	Total paid hours (January)	Total paid hours (February)	"On Ice"	"Off Ice"	Role		
									11/1/2025 11/30/2025	12/1/2025 12/31/2025	1/1/2026 1/31/2026	2/1/2026 2/28/2026					
A-334-S	1.1	Project Office	1b	Vivian O'Dell	UW-Madison	MA	24	22	0	0	198	0	1/5/2026	1/29/2026	Project Mgr		
A-334-S	1.1	Project Office	1a	Albrecht Karle	UW-Madison	KE	35	29	0	234	27	0	12/1/2025	1/5/2026	Assoc. Director, Icecube Science and Instrumentation		
A-334-S	1.1	Project Office	2	Mike Zernick	UW-Madison	SE	66	54	108	234	144						
A-334-S	1.2.1	Project Office	3a	Ian McEwen	UW-Madison	MA	51	41	108	234							
A-334-S	1.1	Project Office	3b	Farshid Feyzi	UW-Madison	MA	24	22	0	0							
A-334-S	1.1	Project Office	4	Perry Sandstrom	UW-Madison	SE	56	46	36	234							
A-334-S	1.2.10	Installation	1	Delia Tosi	UW-Madison	SC	75	62	108	234							
A-334-S	1.2.10	Installation	2	TBD	Munich	IK	44	37	0	180							
A-334-S	1.2.10	Installation	3	TBD	Chiba	IK	44	37	0	180							
A-334-S	1.2.10	Installation	4	TBD	DESY	IK	44	37	0	180							
A-334-S	1.2.10	Installation	5	Gary Hill	Adelade	IK	59	50	0	234							
A-334-S	1.2.10	Installation	6	TBD	Chiba	IK	44	37	0	180							
A-334-S	1.2.10	Installation	7	TBD	MSU	IK	44	37	0	180							
A-334-S	1.2.10	Installation	8	TBD	Wuppertal/Mainz	IK	44	37	0	180							
A-334-S	1.2.10	Installation	9	TBD	TBD	IK	44	37	0	180							
A-334-S	1.4	CPT (electronics)	1a	John Kelley	UW-Madison	SS	29	24	0	180							
A-334-S	1.4	CPT (electronics)	1b	CPT SME	MSU	SS	14	13	0	0							
A-334-S	1.4	CPT (cables) / Installation	2a	Chris Ng	MSU	EN-ME	39	32	36	234							
A-334-S	1.4	CPT (cables) / Installation	2b	CPT SME	MSU	EN-ME	17	15	0	0							
A-334-S	1.6	ICECUBE Integration	1	Erik Blaufuss	Maryland	SS	47	40	0	126							
A-334-S	1.6	SPAT	2	Jeff Weber	UW-Madison	SE	59	48	72	234							
A-334-S	1.6	SPAT	3	Install (Rotation)	TBD	IK	46	38	0	216							
A-334-S	1.2	Drill	1	Dar Gibson	UW-Madison	EN-ME	84	70	144	234							
A-334-S	1.2	Drill	2	Jonas Kalin	UW-Madison	TE	84	70	144	234							
A-334-S	1.2	Drill	3	TBD	TBD	TE	69	57	90	234							
A-334-S	1.2	Drill	4	TBD	TBD	TE	69	57	90	234							
A-334-S	1.2	Drill	5	TBD	TBD	TE	56	46	36	234	144						
A-334-S	1.2	Drill	6	TBD	TBD	EN	56	46	36	234	144	0	11/25/2025	1/20/2026	Shift 1 Driller		
A-334-S	1.2	Drill	7	TBD	TBD	TE	56	46	36	234	144	0	11/25/2025	1/20/2026	Shift 1 Driller		
A-334-S	1.2	Drill	8	TBD	TBD	TE	56	46	36	234	144	0	11/25/2025	1/20/2026	Shift 1 Driller / Installation DOM SUPPLIER #2		
A-334-S	1.2	Drill	9	TBD	TBD	TE	56	46	36	234	144	0	11/25/2025	1/20/2026	Shift 1 Driller / Installation DOM SUPPLIER #2		

Population Sheet:

- Personnel by season, role, WBS
- On-ice/off-ice dates
- Work day & total on-ice duration calculations
- Bed occupancy vs. time (billet)
- Population charts
- Monthly hours crosschecked with Smartsheet hours reports

Backup Slides

Float Tables

Item description	Special Handling?	SHIPMENT FLOAT: Time between completion and ship-by-date to USAP	FLOAT AT NPX (delivery to required) [days]	Total Time Between Ship-By-Date and Latest Arrival Date at NPX [days]
ARA Drill System Components - Crate #1	DNF	30	16	412
Computing/controls components Shipment #1	DNF	14	0	396
Computing/controls components Shipment #2	DNF	31	0	106
Computing/controls components Shipment #3	DNF	31	0	106
20' Refit Container C: Bull Wheel, Spare Combo & Drill Cables, Hose Heating System Components, ARA Drill System Components Crate #2	-	31	418	830
Driller resupply/refit components - 8' Container FS2	-	31	0	106
Drill refit components FS2	DNF	31	0	106
Driller resupply/refit components - 8' Container FS3	-	31	0	106
Drill refit components FS3	DNF	31	0	106
Drill Heads - X	DNF	409	648	1127
Drill Heads - Y	DNF	409	648	1127
Drill Heads - R	DNF	409	648	1127
Load member cable reel [placeholder, may not be required]	-	136	151	595
Accelerometer Loggers SPoT 1	-	62	0	91
Accelerometer Loggers SPoT 2	-	62	0	122
ICL power and timing electronics	DNF	462	1	122
ICL patch cables and patch panels	DNDF (TBD)	624	1	122
DDM Handling Facility (DHF)	-	50	368	780
Installation Hardware 87-93	-	97	321	765
Installation Weights 87-93	-	110	321	765
Misc. Science Equipment - FS2 (FY25)	DNF	50	1	122
Misc. Science Equipment - FS3 (FY26)	DNF	25	16	122
Calibration/Special Devices 87-88	DNDF [-40C]	2	13	149
Special Devices 87-88	DNDF [-40C]	2	13	149
Special Devices 89-93	DNDF [-40C]	61	15	131
Calibration/Special Devices 89-93	DNDF [-40C]	61	15	131
Dust logging device	DNF	61	15	131

Float Tables

Item description	Special Handling?	SHIPMENT FLOAT: Time between completion and ship-by-date to USAP	FLOAT AT NPX (delivery to required) [days]	Total Time Between Ship-By-Date and Latest Arrival Date at NPX [days]
Dust logging device	DNF	61	15	131
Dust logging device	DNF	61	15	131
Dust logging device	DNF	61	15	131
Logging winch	0	61	15	131
Logging winch control box	DNF	61	15	131
Surface Junction Boxes	-	2	380	792
Surface Cable Assemblies	DNDF [-55C]	106	14	792
Breakout cables for strings 87-88	DNDF[-40C](*)	477	298	421
Breakout cables for strings 89-93	DNDF[-40C](*)	379	15	421
Main (downhole) load members 87-93 [placeholder, may not be required]	DNDF[-40C](*)	563	1	413
Main (downhole) cables 87-93	DNDF[-40C](*)	31	1	779
String Sensors 89-93 (mDOMs MSU)	DNDF [-40C]	686	15	131
String Sensors 89-93 (mDOMs MSU)	DNDF [-40C]	686	15	131
DM-Ice	DNDF [-40C]	426	20	126
String Sensors 87-88 (mDOMs DESY)	DNDF [-40C]	440	13	149
String Sensors 87-88 (mDOMs DESY)	DNDF [-40C]	440	13	149
Special Devices 87-88 (Europe)	DNDF [-40C]	578	13	149
Calibration Devices 87-88 (Europe)	DNDF [-40C]	792	13	149
FieldHub electronics	DNF	304	1	108
String Sensors 89-93 (mDOMs DESY)	DNDF [-40C]	721	15	131
Special Devices 89-93 (Europe)	DNDF [-40C]	578	15	131
Calibration Devices 89-93 (Europe)	DNDF [-40C]	1157	15	131
String Sensors 87 & 88 (D-Eggs-	DNDF [-40C]	736	13	149
String Sensors 87 & 88 (D-Eggs-	DNDF [-40C]	736	13	149
String Sensors 87 & 88 (D-Eggs-12x)	DNDF [-40C]	736	13	149
String Sensors 87 & 88 (D-Eggs-12x)	DNDF [-40C]	736	13	149
String Sensors 89-93 (D-Eggs-8x)	DNDF [-40C]	812	15	131
String Sensors 89-93 (D-Eggs-12x)	DNDF [-40C]	812	15	131

Sensitivity Analysis Tour

Cargo Item #	WBS L2	Item Description	Contents	Date Item expected or arrived to MCM	Date/Month for Items needed at South Pole	Logistical Mode	48hrs		168hrs (1 wk)		336 hrs (2 wks)		672 hrs (4 wks)		1 week delay impact notes	2 week delay impact notes	4 week impact notes
							Probability	Estimated Cost Impact	Probability	Estimated Cost Impact	Probability	Estimated Cost Impact	Probability	Estimated Cost Impact			
1	1.2	Gen 1 - housed in 20' container	Power generation unit 1 housed in 20' shipping container	In McMurdo	12/1/2023	SPoT	Moderate	0	Low	12420	Low	72460					Full position add in following year to overcome (505 hours)
2	1.2	Gen 2 - housed in 20' container	Power generation unit 2 housed in 20' shipping container	2/6/2023	12/1/2023	SPoT	Moderate	0	Low	12420	Low	72460					Position add in following year to overcome (505 hours)
3	1.2	Gen 3 - housed in 20' container	Power generation unit 3 housed in 20' shipping container	In McMurdo	12/1/2023	SPoT	Moderate	0	Low	40000	Low	80000					Personnel returns following year
4	1.2	Gen hoods Discharge Hoods	Generator air discharge hoods , sheet metal, loose - stored on berm at SPOTSA	In McMurdo	12/12/2023	SPoT	Moderate	0	Low	0	Low	0					
5	1.2	Firn Drill	Bermed in McM - will require McM fork or crane support.	In McMurdo	12/15/2023	SPoT	Moderate	0	Low	6210	Low	12420					Additional labor - 216 hours
6	1.2	Weight stack and crates	Bermed in McM - will require McM fork support. Drill head weight stack and remaining bermed crates at SPOTSA	In McMurdo	12/1/2025	SPoT	Moderate	0	Low	0	Low	0					
7	1.2	Fuel Tower	Bermed in McM - will require McM fork or crane support.	In McMurdo	12/5/2023	SPoT	Moderate	0	Low	6210	Low	12410					Additional driller hours
8	1.2	HPU 2	HPU 1 (University of Nebraska - Lincoln asset) - 40' container housing heating plant on ISO sled	In McMurdo	1/17/2024	SPoT	Moderate	0	Low	6210	Low	12420					Asset to be used is delivered late assume 20% in drilling efficiency
9	1.2	Container Ski Stack (comprised of 5 sleds)	Five sets of aluminum skis for 20' containers - stacked. Aluminum skis for drill containers. Required onsite for local movement of Gens and PDM.	In McMurdo	1/1/2023	SPoT	Moderate	0	Low	0	Low	9200					Personnel with work around - 2 hours to recover
10	1.2	Generator Intake Hood	Light weight large volume sheet metal stacks for generator ventilation	In McMurdo	12/12/2023	SPoT	Moderate	0	Low	0	Low	0					
11	1.2	Generator Discharge Hoods	Light weight large volume sheet metal stacks for generator ventilation	In McMurdo	12/12/2023	SPoT	Moderate	0	Low	0	Low	0					
12	1.2	Drill Hose	Drill hose - 9 Spools - 348 cf / 3532 lbs each - Shipped from Italy	In McMurdo	12/15/2024	SPoT	Moderate	0	Low	3450	Low	25875					no longer possible.
13	1.2	Drill Hose	Drill hose - 3 Spools - 348 cf / 5001 lbs each - Shipped from PSL	In McMurdo	12/15/2024	SPoT	Moderate	0	Low	3450	Low	25875					no longer possible.
14	1.2	8' Refit Container	Priority rent materials including tools, flowmeter assemblies, motor drive installation kits, hardware, fittings, sensors, & consumables	In McMurdo	11/14/2023	SPoT	Moderate	0	Low	49680	Low	99360					work contingent on 8' containers 1296 hours lost if container A arrived 12/1
15	1.2	20' Refit Container A	Refit materials incl. submersible pumps, hardware, filtration components, fail arrest	In McMurdo	12/14/2023	SPoT	Moderate	0	Low	50000	Low	100000					Large 8 people 12 days or

Logistics Sensitivity Analysis:

- Impact of 48 hr, 1 week, 2 week, & 4 week, delays on schedule/cost for each cargo shipment considered
- Impact of 48 hr, 1 week, 2 week, & 4 week, delays on schedule/cost personnel delays considered
- Provided avenue for Logistics specific Monte Carlo Analysis to crosscheck Risk Register

Project Roll Up (FY23-FY24)

FY23 Intercontinental								
Vessel Container Allocation 40F	Vessel Container Allocation 40D	Vessel Container Allocation 20D	Vessel Container Allocation 20F	TEU Count	C-17 Pallet Allocation	COMAIR Pounds	COMSUR Pounds	
0.00	0.00	5.75	0.50	6.25	0.77		10	
FY23 Intracontinental								
Vessel Container Allocation 40F	Vessel Container Allocation 40D	Vessel Container Allocation 20D	Vessel Container Allocation 20F	TEU Count	LC-130 Pallet Allocation	LC-130 Missions	LC-130 Flight Hours	SPOT Sled Allocation
n/a	n/a	n/a	n/a	n/a	0.00	2	12	7.00
FY24 Intercontinental								
Vessel Container Allocation 40F	Vessel Container Allocation 40D	Vessel Container Allocation 20D	Vessel Container Allocation 20F	TEU Count	C-17 Pallet Allocation	COMAIR Pounds	COMSUR Pounds	
0.00	0.00	3.00	0.25	3.25	0.50		3,000	
FY24 Intracontinental								
Vessel Container Allocation 40F	Vessel Container Allocation 40D	Vessel Container Allocation 20D	Vessel Container Allocation 20F	TEU Count	LC-130 Pallet Allocation	LC-130 Missions	LC-130 Flight Hours	SPOT Sled Allocation
n/a	n/a	n/a	n/a	n/a	2.15	19	112	2.00

Project Roll Up (FY25-FY26)

FY25 Intercontinental								
Vessel Container Allocation 40F	Vessel Container Allocation 40D	Vessel Container Allocation 20D	Vessel Container Allocation 20F	TEU Count	C-17 Pallet Allocation	COMAIR Pounds	COMSUR Pounds	
0.00	0.25	5.00	0.00	5.25	8.75		37,553	
FY25 Intracontinental								
Vessel Container Allocation 40F	Vessel Container Allocation 40D	Vessel Container Allocation 20D	Vessel Container Allocation 20F	TEU Count	LC-130 Pallet Allocation	LC-130 Missions	LC-130 Flight Hours	SPOT Sled Allocation
n/a	n/a	n/a	n/a	n/a	9.25	10	59	3.35
FY26 Intercontinental								
Vessel Container Allocation 40F	Vessel Container Allocation 40D	Vessel Container Allocation 20D	Vessel Container Allocation 20F	TEU Count	C-17 Pallet Allocation	COMAIR Pounds	COMSUR Pounds	
0.00	0.00	0.00	0.00	0.00	16.56		62,549	
FY26 Intracontinental								
Vessel Container Allocation 40F	Vessel Container Allocation 40D	Vessel Container Allocation 20D	Vessel Container Allocation 20F	TEU Count	LC-130 Pallet Allocation	LC-130 Missions	LC-130 Flight Hours	SPOT Sled Allocation
n/a	n/a	n/a	n/a	n/a	17.56	7	41	2.50

Project Roll Up (Totals)

Total Intercontinental Movements for project- vessel/air								
Total 40F	Total 40D	Total 20D	Total 20F	Total TEU	Total 463L	COMAIR Pounds	COMSUR Pounds	
0.00	0.25	13.75	0.75	14.75	26.58		103,112	
Total Intracontinental Movements for project- LC-130								
Total 40F	Total 40D	Total 20D	Total 20F	Total TEU	Total 463L	Total LC-130 Missions	Total LC-130 Flight Hours	Total SPOT Sleds
n/a	n/a	n/a	n/a	n/a	29.0	38	224	14.9