

Basis of Estimate

1. WBS ID 1.2.8 \$3,551,290 total cost for this WBS

2. WBS Name Drill Field Seasons

3. Estimated by Ian McEwen, Dar Gibson, Terry Benson (University of Wisconsin)

4. WBS Dictionary Description

Includes procurements, travel and labor hours associated with training prior to Antarctic deployment, deployment costs (PQ, travel costs and labor hours), South Pole labor (UW) in the three field seasons and USAP support tasks. Field Season 1 activities are focused on EHWD drill mechanical/controls refit, Field Season 2 on pre-drill activities, and Season on drilling of seven holes, installation support for 7 strings, and long-term storage/retrograde prep.

5. Assumptions and Related Documents

The estimates described in this document rely on the following assumptions, which are consistent with the Project’s “Key Assumptions” document” (1) and the “Cost Estimating Plan” (2).

- The cost estimate technique classifications (A-L) follow the US Government Accountability Office (GAO) best practices. These are summarized in the Project’s Key Assumptions document (1). The techniques are: A=Analogy; C=Engineering build-up; D=Expert opinion; E=Extrapolation from actuals; F=Parametric; L=Learning Curves.
- Contingency codes are assigned to each item: C1—C8. These reflect the estimated uncertainty in the estimate. The meanings of the contingency codes and the percentage of contingency in each case are described in the Key Assumptions document (1).

6. Scope

The scope of this BOE covers the following L4 areas:

| | | |
|---------|-------------------------------|--------------------------------------------|
| 1.2.8.1 | Off-ice field season training | Off-ice field season training (and travel) |
| 1.2.8.4 | Field Season 0 (FS0) | FS0 - Labor, travel, PQ |
| 1.2.8.5 | Field Season 1 (FS1) | FS1 - Labor, travel, PQ |
| 1.2.8.6 | Field Season 2 (FS2) | FS2 - Labor, travel, PQ |
| 1.2.8.7 | Field Season 3 (FS3) | FS3 - Labor, travel, PQ |

Basis of Estimate

7. Equipment, Materials, Supplies, Travel

7.1. Equipment

No CapEx is purchased in 1.2.8.

7.2. Materials & Supplies

Materials and Supply in 1.2.8 are the Physical Qualification costs, ECW gear for drilling personnel. Allocation are the ones established at Project level as illustrated in the Project’s “Key Assumptions” document” (1).

1.2.8 MandS ☆

Grid View | 2 Sheets | 9 Columns | 4 Filters | Group | Summarize | 1 Sort

| WBS | Activity | Subtype | 12mo Subtotal PY5 | 12mo Subtotal PY6 | 12mo Subtotal PY7 | 12mo Subtotal PY8 | Estimating Technique | Contingency |
|-----------|--------------------------------------------------------------------------|---------|-------------------|-------------------|-------------------|-------------------|----------------------|-------------|
| 1.2.8.1.2 | FS1 - Off-Ice EHWD & Safety Training - Safety Training Materials/Vendors | M & S | \$5,000 | \$0 | \$0 | \$0 | D - Expert Opinion | C1 |
| 1.2.8.1.2 | FS1 - Off-Ice EHWD & Safety Training - Safety Equipment/Consumables | M & S | \$2,200 | \$0 | \$0 | \$0 | D - Expert Opinion | C1 |
| 1.2.8.1.3 | FS2 - Off-Ice EHWD & Safety Training - Safety Training Materials/Vendors | M & S | \$0 | \$2,500 | \$0 | \$0 | D - Expert Opinion | C1 |
| 1.2.8.1.3 | FS2 - Off-Ice EHWD & Safety Training - Safety Equipment/Consumables | M & S | \$0 | \$2,500 | \$0 | \$0 | D - Expert Opinion | C1 |
| 1.2.8.1.4 | FS3 - Off-Ice EHWD & Safety Training - Safety Training Materials/Vendors | M & S | \$0 | \$0 | \$5,000 | \$0 | D - Expert Opinion | C1 |
| 1.2.8.1.4 | FS3 - Off-Ice EHWD & Safety Training - Safety Equipment/Consumables | M & S | \$0 | \$0 | \$4,500 | \$0 | D - Expert Opinion | C1 |
| 1.2.8.5.2 | Deployment Travel & PQ Costs (FS1) (Drill Team) | M & S | \$15,200 | \$0 | \$0 | \$0 | E - Extrapolation f | C1 |
| 1.2.8.6.2 | Deployment Travel & PQ Costs (FS2) (Drill Team) | M & S | \$0 | \$18,050 | \$0 | \$0 | E - Extrapolation f | C1 |
| 1.2.8.7.2 | PQ Costs (FS3) (Drill Team) | M & S | \$0 | \$0 | \$31,350 | \$0 | E - Extrapolation f | C1 |

7.3. Travel

Travel to the safety training (held at Physical Sciences Lab) and deployment travel budget are estimated at \$1,800/person according to the Project’s “Key Assumptions” document” (1). Personnel and travel type (Domestic or International) are listed in the following table season by season.

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1.2.8 Travel ☆

| WBS | Activity | 12mo Subtotal PY5 | 12mo Subtotal PY6 | 12mo Subtotal PY7 | 12mo Subtotal PY8 | Estimating Technique | Contingency |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------|-------------------|-------------------|----------------------|-------------|
| 1.2.8.1.2 | FS1 - Off-Ice EHWD & Safety Training - 5 DH Drillers (w/ 2 alternates) - (Direct Hire Travel -1 Domestic, 2 International, 2 Local) | \$6,400 | \$0 | \$0 | \$0 | D - Expert Opinion | C1 |
| 1.2.8.1.2 | FS1 - Off-Ice EHWD & Safety Training - 5 DH Drillers (w/ 2 alternates) - (Direct Hire Travel -1 Domestic, 2 International, 2 Local) | \$1,800 | \$0 | \$0 | \$0 | D - Expert Opinion | C1 |
| 1.2.8.1.3 | FS2 - Off-Ice EHWD & Safety Training - 8 DH Drillers w/ 2 alternates - (Direct Hire Travel -1 Domestic 2 International) | \$0 | \$9,600 | \$0 | \$0 | D - Expert Opinion | C1 |
| 1.2.8.1.3 | FS2 - Off-Ice EHWD & Safety Training - 6 DH Drillers w/ 2 alternates - (Direct Hire Travel -1 Domestic 2 International) | \$0 | \$5,400 | \$0 | \$0 | D - Expert Opinion | C1 |
| 1.2.8.1.4 | FS3 - Off-Ice EHWD & Safety Training - 24 Drillers (Direct Hire Travel) | \$0 | \$0 | \$19,200 | \$0 | D - Expert Opinion | C1 |
| 1.2.8.1.4 | FS3 - Off-Ice EHWD & Safety Training - 24 Drillers (Direct Hire Travel) | \$0 | \$0 | \$21,600 | \$0 | D - Expert Opinion | C1 |
| 1.2.8.5.2 | Deployment Travel & PQ Costs (FS1) (Drill Team) | \$25,200 | \$0 | \$0 | \$0 | E - Extrapolation f | C1 |
| 1.2.8.6.2 | Deployment Travel & PQ Costs (FS2) (Drill Team) | \$0 | \$30,600 | \$0 | \$0 | E - Extrapolation f | C1 |
| 1.2.8.7.2 | Travel (FS3) (Drill Team) | \$0 | \$0 | \$52,200 | \$0 | E - Extrapolation f | C1 |

8. Labor

8.1. Labor Estimate

Labor includes pre-season training, physical qualification time, travel time to/from the field, and on-ice field season work.

Labor hours for South Pole field work is estimated based on a 9 hours/day, 6 days/week work week with holiday weeks (Thanksgiving, Christmas, New Year's) as the exception. Arrival and departure dates are based on the start and end date of on-ice activities. Activities are linked to milestones such as cargo arrival, personnel arrival, and other activities to guarantee completion of deliverables by due dates. Additional labor included in this WBS is for driller training.

The basis of the field season labor is the resource-loaded field season schedule. Each activity is loaded, the summation of the field season work is adjusted to the 9x6 work week, and the result is added to the cost workbook as a lump sum by resource type. The RLS also informs the on-ice population for a given season, which drives the training, PQ, and travel costs.

Basis of Estimate

8.2. Summary of Labor Resources

1.2.8 Labor Hours ☆

| WBS | Activity | Resource ID | LPY5 | LPY6 | LPY7 | LPY8 | Estimating Technique | Contingency |
|------------|-----------------------------------------------------------------------------------------------|-------------|------|------|------|-------|----------------------|-------------|
| 1.2.8.1.2 | FS1 - Off-Ice EHWD & Safety Training - 5 Drillers (w/ 2 alternates) (Driller_PSL_DirectHire) | TE | 280 | 0 | 0 | 0 | D - Expert Opinior | C1 |
| 1.2.8.1.2 | FS1 - Off-Ice EHWD & Safety Training - 10 PSL (Driller Lead/Engineers) | EN | 300 | 0 | 0 | 0 | D - Expert Opinior | C1 |
| 1.2.8.1.3 | FS2 - Off-Ice EHWD & Safety Training - 8 Drillers (2 alternates) (Driller_PSL_DirectHire) | TE | 0 | 448 | 0 | 0 | D - Expert Opinior | C1 |
| 1.2.8.1.3 | FS2 - 10 PSL (Driller_Lead/Engineer) | EN | 0 | 300 | 0 | 0 | D - Expert Opinior | C1 |
| 1.2.8.1.4 | FS3 - Off-Ice EHWD & Safety Training - 22 Drillers (w/ 4 alternates) (Driller_PSL_DirectHire) | TE | 0 | 0 | 2688 | 0 | D - Expert Opinior | C1 |
| 1.2.8.1.4 | FS3 - Off-Ice EHWD & Safety Training - 10 PSL Staff - 2 Rotators (Engineer/Driller_PSL_Lead) | EN | 0 | 0 | 600 | 0 | D - Expert Opinior | C1 |
| 1.2.8.1.5 | FS3 - Off-Ice Logging Winch Training - 3 Drillers 1 day | EN | 0 | 0 | 24 | 0 | D - Expert Opinior | C1 |
| 1.2.8.5.11 | On-Ice Labor (FS1) (PSL Engineers) | EN | 0 | 4590 | 0 | 0 | D - Expert Opinior | C2 |
| 1.2.8.5.11 | On-Ice Labor (FS1) (PSL Contract Drillers) | TE | 0 | 1476 | 0 | 0 | D - Expert Opinior | C2 |
| 1.2.8.5.11 | On-Ice Labor (FS1) (Safety Engineer) | EN-S | 0 | 297 | 0 | 0 | D - Expert Opinior | C1 |
| 1.2.8.5.2 | Deployment Travel & PQ Costs (FS1) (Driller_PSL_Manager) | EN | 0 | 64 | 64 | 0 | E - Extrapolation f | C1 |
| 1.2.8.5.2 | Deployment Travel & PQ Costs (FS1) (Safety Engineer) | EN-S | 0 | 64 | 0 | 0 | E - Extrapolation f | C1 |
| 1.2.8.5.2 | Deployment Travel & PQ Costs (FS1) (Driller_PSL_DirectHire) x 3 | TE | 0 | 192 | 0 | 0 | E - Extrapolation f | C1 |
| 1.2.8.5.2 | Deployment Travel & PQ Costs (FS1) (PSL_Engineer) x 9 | EN | 0 | 576 | 0 | 0 | E - Extrapolation f | C1 |
| 1.2.8.6.15 | On-Ice Labor (FS2) (PSL Engineers) | EN | 0 | 0 | 4455 | 0 | D - Expert Opinior | C2 |
| 1.2.8.6.15 | On-Ice Labor (FS2) (PSL Drillers) | TE | 0 | 0 | 3375 | 0 | D - Expert Opinior | C2 |
| 1.2.8.6.15 | On-Ice Labor (FS2) (Safety Engineer) | EN-S | 0 | 0 | 381 | 0 | D - Expert Opinior | C2 |
| 1.2.8.6.2 | Deployment Travel & PQ Costs (FS2) (Driller_PSL_Manager) | EN | 0 | 0 | 64 | 0 | E - Extrapolation f | C1 |
| 1.2.8.6.2 | Deployment Travel & PQ Costs (FS2) (Safety_Engineer) | EN-S | 0 | 0 | 64 | 0 | E - Extrapolation f | C1 |
| 1.2.8.6.2 | Deployment Travel & PQ Costs (FS2) (PSL_Direct_Hire) | TE | 0 | 0 | 384 | 0 | E - Extrapolation f | C1 |
| 1.2.8.6.2 | Deployment Travel & PQ Costs (FS2) (PSL_Engineer) | EN | 0 | 0 | 576 | 0 | E - Extrapolation f | C1 |
| 1.2.8.7.13 | On-Ice Labor (FS3) (PSL Engineers) | EN | 0 | 0 | 0 | 4041 | D - Expert Opinior | C2 |
| 1.2.8.7.13 | On-Ice Labor (FS3) (PSL Contract Drillers) | TE | 0 | 0 | 0 | 10395 | D - Expert Opinior | C2 |
| 1.2.8.7.13 | On-Ice Labor (FS3) (Safety Engineer) | EN-S | 0 | 0 | 0 | 612 | D - Expert Opinior | C2 |
| 1.2.8.7.2 | Deployment Travel & PQ Costs (FS3) (Driller_Manager) | EN | 0 | 0 | 0 | 64 | E - Extrapolation f | C1 |
| 1.2.8.7.2 | Deployment Travel & PQ Costs (FS3) (Safety_Engineer) | EN-S | 0 | 0 | 0 | 64 | E - Extrapolation f | C1 |
| 1.2.8.7.2 | Deployment Travel & PQ Costs (FS3) (Driller_PSL_Direct_Hire) | EN | 0 | 0 | 0 | 1280 | E - Extrapolation f | C1 |
| 1.2.8.7.2 | Deployment Travel & PQ Costs (FS3) (Engineer_PSL) | EN | 0 | 0 | 0 | 512 | E - Extrapolation f | C1 |

1. References

[Ref-1] 1. IceCube Upgrade Project. Key Assumptions for the IceCube Upgrade Project.

[Ref-2] 2. —. Cost Estimating Plan.

Basis of Estimate

Revision History

| Date | Revised by | Summary of changes |
|------------|--------------|----------------------|
| 2022-03-15 | Terry Benson | Initialized document |
| 2022-04-11 | Terry Benson | Updated tables |
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