

Basis of Estimate

1. WBS ID 1.2.3 \$128,644 total cost for this WBS

2. WBS Name Tower Operations Site (TOS) - Off-ice

3. Estimated by Terry Benson (University of Wisconsin)

4. WBS Dictionary Description

Includes the design, procurement, resurrection, construction, integration, and testing of subsystems located at the borehole: Tower Operations Structure, Drill Tower, Drillheads and controls, Main Drill Cable Reel, Main Drill Hose Reel, Main Drill Hose, Return Water Hose Reel, Return Water Cable Reel, and downhole drill cables.

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

1.2.3 is comprised of the following L4 elements. The scope of this BOE covers 1.2.3.1 - 1.2.3.3 in PY5-8. There are no costs for 1.2.3.4 - 1.2.3.6 after PY4.

1.2.3.1	TOS and Tower	Includes the design, procurement, resurrection, construction, integration, and testing of subsystems located at the borehole. Tower Operations Structure, Drill Tower, Drillheads and controls, Main Drill Cable Reel.
1.2.3.2	Drillheads	Recon, identify/procure upgrades/replacements/spares, retrofitting and testing. Drill head testing and rebuild.
1.2.3.3	Reels & Winches	Drill Supply Hose Reel, Main Drill Cable Reel, Return Water Hose Reel, Return Water Cable Reel, Tower Hoists, TU-15 reel, and TU-20 deployment reels.

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1.2.3.4	Downhole Main Drill Hose	Specify and procure new Main Drill Hose. Review, specify, and fabricate hose strain reliefs.
1.2.3.5	Downhole Main Cables	Review specifications and procure new downhole drill cables, including main drill cable and return water pump combo cable, connectorization, testing.
1.2.3.6	Design and Construct Main Hose Reel Heating System	Includes the design, procurement, construction, integration, and testing of the Main Hose Reel Heating System.

7. Equipment, Materials, Supplies, Travel

1.2.3 only contains equipment procurements, which are capitalized as part of the larger TOS subsystems. There is no M&S and no travel in 1.2.3.

7.1. Equipment

The capital equipment covered in this WBS is listed in the table below.

1.2.3 CapEx ☆

WBS	Activity	12mo Subtotal PY5	12mo Subtotal PY6	12mo Subtotal PY7	12mo Subtotal PY8	Institution	Estimating Technique	Contingency
1.2.3.1.10	Tower Ops: Identify/Procure: TOS & Tower Hardware, Repair Parts (PY7)	\$0	\$0	\$22,992	\$0	PSL	C - Engineering Builc	C3
1.2.3.1.5	Tower Ops: Crescent Emergency Repair Kit Assembly	\$0	\$2,500	\$0	\$0	PSL	D - Expert Opinion	C3
1.2.3.1.6	Tower Ops: Examine Interface between Dust Logger and Tower & Address as Needed	\$2,400	\$0	\$0	\$0	PSL	D - Expert Opinion	C4
1.2.3.1.7.2	Tower Ops: Load Cell Calibration	\$1,789	\$0	\$0	\$0	PSL	C - Engineering Builc	C2
1.2.3.1.7.3	Tower Ops: Identify/Procure: Load Cell Rigging Calibration	\$1,220	\$0	\$0	\$0	PSL	C - Engineering Builc	C2
1.2.3.1.8	Tower Ops: Identify/Procure: TOS & Tower Hardware, Repair Parts (PY5)	\$10,232	\$0	\$0	\$0	PSL	C - Engineering Builc	C3
1.2.3.1.9	Tower Ops: Identify/Procure: TOS & Tower Hardware, Repair Parts (PY6)	\$0	\$9,232	\$0	\$0	PSL	C - Engineering Builc	C3
1.2.3.3.10	Reels & Winches: TU20 Sliprings - spec, procure, test	\$8,413	\$0	\$0	\$0	PSL	D - Expert Opinion	C3
1.2.3.3.11	Reels & Winches: Reel Components & Spares (PY6). TU20 brakes)	\$0	\$8,770	\$0	\$0	PSL	D - Expert Opinion	C3

Total equipment cost is \$67,548. 67% of the total equipment cost is based on engineering buildup from quotes or catalog pricing. The remaining 33% is based on expert opinion.

7.2. Materials & Supplies

There is no M&S in this area.

7.3. Travel

No travel is included in this WBS area.

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8. Labor

8.1. Labor Estimate

Labor includes design, specification, procurement, assembly/test, and shipping preparation. The breakdown is given in the table below.

All labor estimates are based on expert opinion.

8.2. Summary of Labor Resources

 **1.2.3 Labor Hours** ☆

Grid View ▾ | C | 2 Sheets | 11 Columns | 4 Filters | Group | Summarize | 1 Sort

WBS	Activity	Resource ID	LPY5	LPY6	LPY7	LPY8	Institution	Estimating Technique	Contingency
1.2.3.1.10	Tower Ops: Identify/Procure: TOS & Tower Hardware, Repair Parts (PY7)	EN-ME	0	0	16	0	PSL	D - Expert Opinior	C3
1.2.3.1.10	Tower Ops: Identify/Procure: TOS & Tower Hardware, Repair Parts (PY7)	EN-ME	0	0	16	0	PSL	D - Expert Opinior	C3
1.2.3.1.5	Tower Ops: Crescent Emergency Repair Kit Assembly	EN-ME	0	40	0	0	PSL	D - Expert Opinior	C3
1.2.3.1.6	Tower Ops: Examine Interface between Dust Logger and Tower & Address as Needed	EN-ME	40	0	0	0	PSL	D - Expert Opinior	C4
1.2.3.1.7.2	Tower Ops: Load Cell Calibration	EN-ME	8	0	0	0	PSL	D - Expert Opinior	C2
1.2.3.1.7.3	Tower Ops: Identify/Procure: Load Cell Rigging Calibration	EN-ME	8	0	0	0	PSL	D - Expert Opinior	C2
1.2.3.1.8	Tower Ops: Identify/Procure: TOS & Tower Hardware, Repair Parts (PY5)	EN-ME	16	0	0	0	PSL	D - Expert Opinior	C3
1.2.3.1.8	Tower Ops: Identify/Procure: TOS & Tower Hardware, Repair Parts (PY5)	EN-ME	16	0	0	0	PSL	D - Expert Opinior	C3
1.2.3.1.9	Tower Ops: Identify/Procure: TOS & Tower Hardware, Repair Parts (PY6)	EN-ME	0	16	0	0	PSL	D - Expert Opinior	C3
1.2.3.1.9	Tower Ops: Identify/Procure: TOS & Tower Hardware, Repair Parts (PY6)	EN-ME	0	16	0	0	PSL	D - Expert Opinior	C3
1.2.3.2.10	Drillheads: Prepare Crates, Spares, Tools, & Docs x:	EN-ME	24	0	0	0	PSL	D - Expert Opinior	C3
1.2.3.2.10	Drillheads: Prepare Crates, Spares, Tools, & Docs x:	TE	24	0	0	0	PSL	D - Expert Opinior	C3
1.2.3.3.10	Reels & Winches: TU20 Sliprings - spec, procure, test	EN-EE	160	0	0	0	PSL	D - Expert Opinior	C3
1.2.3.3.11	Reels & Winches: Reel Components & Spares (PY6). TU20 brakes)	EN-ME	0	80	0	0	PSL	D - Expert Opinior	C3
1.2.3.3.11	Reels & Winches: Reel Components & Spares (PY6). TU20 brakes)	TE	0	40	0	0	PSL	D - Expert Opinior	C3
1.2.3.3.9	Reels & Winches: Drill Reels Sliprings - final testing and prep	EN-EE	16	0	0	0	PSL	D - Expert Opinior	C3

9. References

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

[Ref-2] 2. —. *Cost Estimating Plan.*

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Revision History

Date	Revised by	Summary of changes
2022-03-04	Barb Birrittella	Initialized document
2022-04-01	V. O'Dell	Updated tables
2022-04-08	Terry Benson	Updated tables
