

Basis of Estimate

1. WBS ID 1.2.2 \$95,123 Total Cost for this BOE

2. WBS Name Thermal Plant – 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 associated with the drill system’s hot water thermal plant: Preheat System, Main Heating Plants, a new Seasonal Equipment Site fuel day tank and fuel distribution system. Mainly legacy EHWD thermal plant subsystems. Excludes generator exhaust heat recovery system.

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 for PY5-PY8:

1.2.2.1	Main Heating Plants	Recon, identify/procure upgrades/replacements/spares, retrofitting and testing. Including burner rebuilds, sensor replacements, and integrated networking.
1.2.2.2	Pre-Heat System	Recon, identify/procure upgrades/replacements/spares, retrofitting and testing.
1.2.2.3	Fuel Storage and Delivery	Recon, design/specify/procure/fabricate/test new fuel storage day tank; Review and identify/procure replacements/spares, retrofit and testing. Review, specify/procure fuel delivery systems throughout EHWD

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7. Equipment, Materials, Supplies, Travel

1.2.2 only contains equipment procurements. These are capitalized as part of the larger thermal plant subsystems. There is no M&S and no travel in 1.2.2.

7.1. Equipment

The table below details all the equipment covered in this BOE.

1.2.2 CapEx ☆

WBS	Activity	12mo Subtotal PY5	12mo Subtotal PY6	12mo Subtotal PY7	12mo Subtotal PY8	Estimating Technique	Contingency
1.2.2.1.10	MHP: Procure Upgrade, Sub-Components, Spares (PY6)	\$0	\$5,000	\$0	\$0	D - Expert Opinion	C3
1.2.2.1.6	MHP: Procure MHP Upgrade, Sub-Components, Spares (PY5)	\$5,000	\$0	\$0	\$0	D - Expert Opinion	C3
1.2.2.1.8	MHP: Procure and Assemble HPU2 Integration Components	\$0	\$10,000	\$0	\$0	D - Expert Opinion	C3
1.2.2.2.4	PHS: Procure and Upgrade Control Boxes (PY6)	\$0	\$4,000	\$0	\$0	D - Expert Opinion	C3
1.2.2.2.5	PHS: Procure Upgrade, Sub-Components, Spares (PY6)	\$0	\$5,000	\$0	\$0	D - Expert Opinion	C3
1.2.2.3.10	Fuel Tower: Procure Fuel system Upgrade/Maintenance Subcomponents (PY6)	\$0	\$2,400	\$0	\$0	D - Expert Opinion	C3
1.2.2.3.11	Fuel Tower: Procure MHP Fuel Heat Exchangers Replacements (PY6)	\$0	\$10,283	\$0	\$0	C - Engineering Buildup	C3
1.2.2.3.8	Fuel Tower: Procure ARA Fueling Hose & Nozzle (PY5)	\$4,442	\$0	\$0	\$0	C - Engineering Buildup	C3
1.2.2.3.9	Fuel Tower: Procure Racor Fuel Filter Elements and Gauges Replacements (PY5)	\$1,500	\$0	\$0	\$0	D - Expert Opinion	C3

Total equipment cost is \$47,625. 31% of the total equipment cost is based on engineering buildup from quotes or catalog pricing. The remaining 69% is based on expert estimates that cannot be further refined until after the first of three remaining field seasons (FS1).

7.2. Materials & Supplies

No M&S is included in this WBS area.

7.3. Travel

No travel is included in this WBS area.

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.

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8.2. Summary of Labor Resources

The table below lists the resources and labor hours supporting the specifications and purchasing of the equipment in this BOE.

1.2.2 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
1.2.2.1.10	MHP: Procure Upgrade, Sub-Components, Spares (PY6)	EN-ME	0	24	0	0	PSL	D - Expert Opinion	C3
1.2.2.1.6	MHP: Procure MHP Upgrade, Sub-Components, Spares (PY5)	EN-ME	24	0	0	0	PSL	D - Expert Opinion	C3
1.2.2.1.7	MHP: Develop HPU2 Integrate Plan	EN	0	50	0	0	PSL	D - Expert Opinion	C4
1.2.2.1.8	MHP: Procure and Assemble HPU2 Integration Components	EN-ME	0	40	0	0	PSL	D - Expert Opinion	C3
1.2.2.1.8	MHP: Procure and Assemble HPU2 Integration Components	TE	0	40	0	0	PSL	D - Expert Opinion	C3
1.2.2.2.4	PHS: Procure and Upgrade Control Boxes (PY6)	EN-EE	0	80	0	0	PSL	D - Expert Opinion	C3
1.2.2.2.4	PHS: Procure and Upgrade Control Boxes (PY6)	TE	0	80	0	0	PSL	D - Expert Opinion	C3
1.2.2.2.5	PHS: Procure Upgrade, Sub-Components, Spares (PY6)	EN-ME	0	24	0	0	PSL	D - Expert Opinion	C3
1.2.2.3.10	Fuel Tower: Procure Fuel system Upgrade/Maintenance Subcomponents (PY6)	EN-ME	0	24	0	0	PSL	D - Expert Opinion	C3
1.2.2.3.11	Fuel Tower: Procure MHP Fuel Heat Exchangers Replacements (PY6)	EN-ME	0	16	0	0	PSL	D - Expert Opinion	C3
1.2.2.3.8	Fuel Tower: Procure ARA Fueling Hose & Nozzle (PY5)	EN-ME	8	0	0	0	PSL	D - Expert Opinion	C3
1.2.2.3.9	Fuel Tower: Procure Racor Fuel Filter Elements and Gauges Replacements (PY5)	EN-ME	16	0	0	0	PSL	D - Expert Opinion	C3
1.2.2.3.9	Fuel Tower: Procure Racor Fuel Filter Elements and Gauges Replacements (PY5)	TE	16	0	0	0	PSL	D - Expert Opinion	C3

9. References

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

[Ref-2] 2. —. *Cost Estimating Plan*.

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