

# Basis of Estimate

**1. WBS ID** 1.2.9 \$273,576 total cost for this WBS

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**2. WBS Name** Installation Off-ice

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**3. Estimated by** Delia Tosi (University of Wisconsin)

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## 4. WBS Dictionary Description

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Development of tools, equipment and procedures to ensure smooth and safe handling and testing of sensors at the South Pole and installation of 7 strings.

## 5. Assumptions and Related Documents

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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

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The scope of this BOE covers the following L4 areas:

1.2.9.1	Sensor Handling & Testing: Process & Equipment	Define and develop the handling process for sensors and special devices at the South Pole, including execution of the South Pole Acceptance Testing. Coordinate with ASC to secure use of suitable equipment available at the South Pole.
1.2.9.2	Rigging for String Installation	Determine & procure rigging hardware to be used during installation to connect safely the sensors to the main down hole cable.
1.2.9.3	Installation Monitor Equipment: Depth Monitor and Handheld Testers	Development of tools to be used during and after installation to monitor the depth of the string and connectivity to the sensors through hand-held devices.

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1.2.9.4	Logging & Calibration Support	Support bore hole logging. Implementation of electronic logbook for geometry record.
1.2.9.5	Develop Installation Training Package	Develop training and training tools for installation personnel

## 7. Equipment, Materials, Supplies, Travel

### 7.1. Equipment

Procurement of: materials for sensor handling facility, pressure sensors, installation rigging. Assumption that logging winch can be borrowed from IDP. Assumption that sensor sleds can be assembled on ice at no cost to project with materials already present in the USAP. Assumption that a testing tent for usage in FS2 and FS3 can be located and borrowed from USAP.

WBS	Activity	Subtype	12mo Subtotal PY5	12mo Subtotal PY6	12mo Subtotal PY8	12mo Subtotal PY7	Estimating Technique	Contingency
1.2.9.1.3.2	Off-ice Install: Procure Sensor Handling Equipment	CapEx	\$8,453	\$0	\$0	\$0	C - Engineering Buildup	C3
1.2.9.1.3.3	Off-ice Install: Procure ESD Sensor Handling Equipment	CapEx	\$5,549	\$0	\$0	\$0	D - Expert Opinion	C4
1.2.9.2.8	Off-ice Install: Procure Installation Hardware	CapEx	\$108,000	\$0	\$0	\$0	C - Engineering Buildup	C3
1.2.9.2.9	Off-ice Install: Procure Installation Weights	CapEx	\$9,900	\$0	\$0	\$0	D - Expert Opinion	C4
1.2.9.3.2.1	Off-ice Install: IME ICL Quad Connectivity Tester Design, Prototype & Production (2023-24)	CapEx	\$0	\$4,800	\$0	\$0	D - Expert Opinion	C4
1.2.9.3.3.2	Off-ice Install: IME Depth Readout Development and System Integration (2022-23)	CapEx	\$3,400	\$0	\$0	\$0	D - Expert Opinion	C4
1.2.9.3.3.7	Off-ice Install: Procure Pressure Sensors	CapEx	\$0	\$104,796	\$0	\$0	C - Engineering Buildup	C2
1.2.9.4.2.3	Off-ice Install: Procure Tablets for Logbook	CapEx	\$0	\$5,967	\$0	\$0	D - Expert Opinion	C4
1.2.9.4.2.5	Off-ice Install: Procure Laser Rangefinders & various Installation Supplies	CapEx	\$0	\$5,355	\$0	\$0	E - Extrapolation from Actuals	C3

### 7.2. Materials & Supplies

No M&S included in 1.2.9. Shipping supplies for items built in 1.2.9 are included in 1.2.1.

### 7.3. Travel

Travel is generally covered by 1.2.1. Specific travel in 1.2.9 is related to deliverables, such as the final test of the IME Depth Readout and the IME QCT test that require a full-length quad, only available at MSU. Budget for domestic trips is estimated as in the Project's "Key Assumptions" document" (1).

WBS	Activity	12mo Subtotal PY5	12mo Subtotal PY6	12mo Subtotal PY7	12mo Subtotal PY8	Estimating Technique	Contingency
1.2.9.3.2.1	Off-ice Install: IME ICL Quad Connectivity Tester Design, Prototype & Production (2023-24)	\$0	\$1,800	\$0	\$0	E - Extrapolation from Actuals	C1
1.2.9.3.3.2	Off-ice Install: IME Depth Readout Development and System Integration (2022-23)	\$1,800	\$0	\$0	\$0	E - Extrapolation from Actuals	C1

## 8. Labor

### 8.1. Labor Estimate

Labor for 1.2.9 is covered by LOE effort in 1.2.1. Only specific task-oriented engineering is covered in 1.2.9. Labor hours are estimated by Subject Matter Experts based on experience in Gen1 on similar work.

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## 8.2. Summary of Labor Resources

WBS	Activity	Resource ID	LPY5	LPY6	LPY7	LPY8	Estimating Technique	Contingency
1.2.9.3.3.2	Off-ice Install: IME Depth Readout Development and System Integration (2022-23)	EN-EE	60	0	0	0	D - Expert Opinion	C3
1.2.9.3.3.3	Off-ice Install: IME Depth Readout System Final Integration (2023-24)	EN-EE	0	40	0	0	D - Expert Opinion	C3

## 9. References

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- [Ref-1] 1. **IceCube Upgrade Project. Key Assumptions for the IceCube Upgrade Project.**
- [Ref-2] 2. —. *Cost Estimating Plan.*

## Revision History

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Date	Revised by	Summary of changes
2022-02-25	Delia Tosi	