

# Basis of Estimate

1. **WBS ID** 1.4.2 \$ \$154,107 total for this WBS

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2. **WBS Name** Surface Cables

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3. **Estimated by** Tyce DeYoung (Michigan State University)

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## 4. WBS Dictionary Description

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This element includes design, procurement, and quality assurance of the physical cables running along the surface from the IceCube Laboratory (ICL) building to the Upgrade strings. It also includes labor and materials associated with modifications to the ICL required by the Upgrade project which are not provided by ASC, and transportation of equipment to Port Hueneme.

## 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 L3 areas:

1.4.2.1	Surface Cable Assemblies	The labor, materials, and capital equipment required to design, spec, purchase and assure quality of the cable assemblies carrying power, communications, and timing information from the ICL to the terminations of the MCAs in the surface junction boxes.
1.4.2.2	Surface Junction Boxes	Labor, material, and equipment required to design and construct or purchase the junction boxes housing the connections between the MCAs and SCAs.

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1.4.2.3	ICL Upgrade	The labor to support definition of requirements for SCA entry into the ICL and infrastructure support of CPT surface electronics within the ICL. Includes surface cable entry, power usage, and heat load; any modifications of the ICL are implemented by ASC.
1.4.2.4	On-ice support for surface cable installation	

## 7. Materials, Supplies, Equipment, Travel

### 7.1. Procurement of Materials, Supplies, Equipment

Materials, supplies and equipment in this area are related to design, prototyping and testing of the surface cable assemblies (SCAs), surface junction boxes (SJBs), and patch panels and patch cables to be installed in the ICL, and connectorization and testing of the SCAs at MSU.

Cost of \$2,000 per SJB (times seven boxes) is based on engineering estimate.

Cost of \$1,000 for ICL patch panels is SME estimate. Costs of \$175 per patch cable times 174 cables (154 for ICL and 20 for NTS) plus 15 spares are based on cable and connector quotes updated 2022. Milspec connectors were previously purchased in 2021 and are not included in the cost estimate. Cost of shipping to PTH is based on SME estimate.

Costs of physical qualification (PQ) medical exam and rental of extreme cold weather (ECW) gear for SMEs deploying to South Pole in support of installation activities is based on guidance from the project office.

An allowance for miscellaneous supplies of \$500/year for the duration of the effort in each L4 area is based on SME experience.

### 7.2. Summary of Materials, Supplies, and Equipment Resources

WBS	Activity	Subtype	12mo Subtotal PY5	12mo Subtotal PY6	12mo Subtotal PY7	12mo Subtotal PY8	Estimating Technique	Contingency
1.4.2.2.4	SJBs	CapEx	\$14,000	\$0	\$0	\$0	D - Expert Opinion	C4

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WBS	Activity	Subtype	12mo Subtotal PY5	12mo Subtotal PY6	12mo Subtotal PY7	12mo Subtotal PY8	Estimating Technique	Contingency
1.4.2.2.6	Shipping costs to PTH	M & S	\$1,500	\$0	\$0	\$0	D - Expert Opinion	C4
1.4.2.2.8	Surface Junction Box miscellaneous supplies	M & S	\$125	\$0	\$0	\$0	F - Parametric	C1
1.4.2.3.2.5	Shipping costs	M & S	\$1,000	\$0	\$0	\$0	D - Expert Opinion	C4
1.4.2.3.3.4	Patch cables (169)	M & S	\$29,575	\$0	\$0	\$0	C - Engineering Buildup	C2
1.4.2.3.3.7	Patch cable shipping costs	M & S	\$0	\$1,200	\$0	\$0	D - Expert Opinion	C4
1.4.2.3.4	ICL Upgrade Support miscellaneous supplies	M & S	\$500	\$500	\$500	\$250	F - Parametric	C1
1.4.2.4.4	Cable SME FS2 PQ costs (Headcount 2)	M & S	\$0	\$1,400	\$0	\$0	C - Engineering Buildup	C2
1.4.2.4.4	Cable SME FS2 ECW costs (Headcount 2)	M & S	\$0	\$500	\$0	\$0	C - Engineering Buildup	C2

## 7.3. Travel

WBS	Activity	12mo Subtotal PY5	12mo Subtotal PY6	12mo Subtotal PY7	12mo Subtotal PY8	Estimating Technique	Contingency
1.4.2.4.4	Cable SME FS2 Deployment travel (Headcount 2)	\$0	\$0	\$3,600	\$0	E - Extrapolation from Actuals	C1

Travel is budgeted for two surface cable SMEs to travel to South Pole in FS2 to assist with installation of the surface cables and surface junction boxes. Costs for PQ and ECW equipment are included under M&S.

## 8. Labor

### 8.1. Labor Estimate

Labor costs for WBS 1.4.2 include design, connectorization, and final acceptance testing of the surface cable assemblies (SCAs), design and procurement of the surface junction boxes (SJBs), coordination with ASC of modifications to ICL required for SCA installation, production of patch panels and cables for the SCAs inside ICL, and on-ice support for surface cable installation.

Labor estimates for procurement of the SJBs are based on SME estimate. The bulk of the effort is scheduled for PY4 with 8 hours in PY5. Labor of 24 hours per SME involved in SJB production for pre-ship review is based on experience with past project reviews. Labor estimate of 3 days for packaging and shipping SJBs is based on experience with shipping other project items.

Labor estimate for design and fabrication of patch panels is based on SME estimate. Labor for final design of patch cables is SME estimate. Labor for production of patch cables is SME estimate based on time required for fabrication of test leads and connectorization of SCAs. Labor for final design review and pre-ship review are based on experience with past project reviews.

Labor estimate for on-ice SME support for installation is based on SME evaluation of required tasks in ICL.

# Basis of Estimate

## 8.2. Summary of Labor Resources

WBS	Activity	Resource ID	LPY5	LPY6	LPY7	LPY8	Estimating Technique	Contingency
1.4.2.2.4	Fabrication	EN-ME	8	0	0	0	D - Expert Opinion	C4
1.4.2.2.6	Pre-ship review	TE	24	0	0	0	A - Analogy	C2
1.4.2.2.6	Pre-ship review	EN-ME	24	0	0	0	A - Analogy	C2
1.4.2.2.6	Pre-ship review	SS	24	0	0	0	A - Analogy	C2
1.4.2.2.6	Shipping to PTH	EN-ME	24	0	0	0	D - Expert Opinion	C3
1.4.2.3.2.3	Fabrication	SS	20	0	0	0	D - Expert Opinion	C4
1.4.2.3.2.4	Pre-ship review	SS	8	0	0	0	A - Analogy	C2
1.4.2.3.2.5	Shipping to PTH (NB: small)	SS	16	0	0	0	D - Expert Opinion	C3
1.4.2.3.3.1	Final design	SS	24	0	0	0	D - Expert Opinion	C4
1.4.2.3.3.3	Final design review	SS	56	0	0	0	E - Extrapolation from Actuals	C2
1.4.2.3.3.4	Procurement	SS	16	0	0	0	D - Expert Opinion	C3
1.4.2.3.3.4	Procurement	TE	40	0	0	0	A - Analogy	C1
1.4.2.3.3.5	Production	TE	150	30	0	0	D - Expert Opinion	C3
1.4.2.3.3.6	Pre-ship review	SS	0	24	0	0	A - Analogy	C2
1.4.2.3.3.7	Shipping to PTH	TE	0	32	0	0	D - Expert Opinion	C3
1.4.2.4.5	Cable SME support for FS2 activities (slot 1)	EN-ME	0	0	115	0	C - Engineering Buildup	C1
1.4.2.4.6	Cable SME support for FS2 activities (slot 2)	EN-EE	0	0	150	0	C - Engineering Buildup	C1

## 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
2022-02-28	Tyce DeYoung	First version created
2022-03-09	Tyce DeYoung	Added tables from Smartsheets. Added total PY5-8 cost.
2022-04-10	Tyce DeYoung	Removed references to PY4 activities. Added information regarding on-ice installation activities.

# Basis of Estimate



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45272 BK001 Alpha Wire | Cables, Wires | DigiKey

<https://www.digikey.com/en/products/detail/alpha-wire/45272-BK001...>



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Image shown is a representation only. Exact specifications should be obtained from the product data sheet.

## 45272 BK001

### Digi-Key Part Number

45272BK001-1000-ND

### Manufacturer

Alpha Wire

### Manufacturer Product Number

45272 BK001

### Supplier

[Alpha Wire](#)

### Description

CABLE 2 PAIR 24AWG BLACK 1000'

# Basis of Estimate



701 Brooks Ave South,  
PO Box 677  
Thief River Falls, MN 56701-0677  
USA

[www.digikey.com](http://www.digikey.com)  
Orders 1-800-344-4539  
Fax 218-681-3380  
E-mail [quotes@digikey.com](mailto:quotes@digikey.com)  
E-mail [orders@digikey.com](mailto:orders@digikey.com)

Quote # 14084664  
USD \$

Customer: BRIAN FERGUSON  
MICHIGAN STATE UNIVERSITY  
DEPARTMENT OF PHYSICS & ASTRONOMY  
567 WILSON ROAD, ROOM 3218  
EAST LANSING MI 48824-0000

Customer Reference:  
Customer: 12888413  
Quote Date: 23-Apr-2021  
Document Date: 23-Apr-2021  
Refer to quote number when placing orders.

Line Item	Item Number / Description	Quantity	Minimum Release	Package Quantity	Unit Price USD \$	Extended Price USD \$
1	<b>PART:</b> AMS3114F14-12S-ND <b>DESC:</b> CONN RCPT FEMALE 12P GOLD SLD CUP <b>CUST:</b> Not Provided <b>ROHS NONC</b> <b>MFG:</b> Amphenol Industrial Operations / MS3114F14-12S <b>COO:</b> UNITED STATES <b>ECCN:</b> EAR99 <b>HTS:</b> 8536.69.4020 <b>Pricing Valid Through:</b> 23-May-2021 <b>Pack Type:</b> BAG <b>Current Stock Status:</b> 0 AVAIL/BAL EST WKS 16 ARO <b>Standard MFG Lead Time:</b> EST WKS 16 <b>Mercury:</b> Cert on File. For more information contact <a href="mailto:Environmental@DigiKey.com">Environmental@DigiKey.com</a> <b>NOTE:</b> NOTE: NON CANCELLABLE NON RETURNABLE. **PART MUST BE DROP SHIPPED FROM THE MFG IF ORDERED. DELIVERY VERIFIED AT TIME OF ORDER**	187	100	1	56.44350	10554.93
2	<b>PART:</b> AMS3114F14-12P-ND <b>DESC:</b> CONN RCPT MALE 12P GOLD SLD CUP <b>CUST:</b> Not Provided <b>ROHS NONC</b> <b>MFG:</b> Amphenol Industrial Operations / MS3114F14-12P <b>COO:</b> UNITED STATES <b>ECCN:</b> EAR99 <b>HTS:</b> 8536.69.4020 <b>Pricing Valid Through:</b> 23-May-2021 <b>Pack Type:</b> BAG <b>Current Stock Status:</b> 0 AVAIL/BAL EST WKS 16 ARO <b>Standard MFG Lead Time:</b> EST WKS 16 <b>Mercury:</b> Cert on File. For more information contact <a href="mailto:Environmental@DigiKey.com">Environmental@DigiKey.com</a> <b>NOTE:</b> NOTE: NON CANCELLABLE NON RETURNABLE. **PART MUST BE DROP SHIPPED FROM THE MFG IF ORDERED. DELIVERY VERIFIED AT TIME OF ORDER**	187	100	1	50.28720	9403.71
3	<b>PART:</b> AMS3114F14-5S-ND <b>DESC:</b> CONN RCPT FEMALE 5P GOLD SLD CUP <b>CUST:</b> Not Provided <b>ROHS NONC</b> <b>MFG:</b> Amphenol Industrial Operations / MS3114F14-5S <b>COO:</b> UNITED STATES <b>ECCN:</b> EAR99 <b>HTS:</b> 8536.69.4020 <b>Pricing Valid Through:</b> 23-May-2021 <b>Pack Type:</b> BAG <b>Current Stock Status:</b> 0 AVAIL/BAL EST WKS 16 ARO <b>Standard MFG Lead Time:</b> EST WKS 16 <b>Mercury:</b> Cert on File. For more information contact <a href="mailto:Environmental@DigiKey.com">Environmental@DigiKey.com</a> <b>NOTE:</b> NOTE: NON CANCELLABLE NON RETURNABLE. **PART MUST BE DROP SHIPPED FROM THE MFG IF ORDERED. DELIVERY VERIFIED AT TIME OF ORDER**	15	10	1	63.41900	951.29



Abbreviations: VA = Value Add DISC = Discontinued CONV = Conversion NSTK = Non-stock ARO = After Receipt of Order DEL = Delivery  
EST WKS = Estimated Weeks  
Pricing does not include freight.