

Summary of BOE Supporting Docs

1.2 Relocation Schedule P16-P18

WBS	Name	Start Time	End Time
1.2	1.2.1.1	09/19/18 00:00 AM	10/02/18 03:00 PM
1.2	1.2.1.2	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.3	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.4	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.5	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.6	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.7	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.8	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.9	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.10	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.11	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.12	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.13	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.14	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.15	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.16	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.17	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.18	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.19	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.20	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.21	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.22	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.23	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.24	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.25	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.26	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.27	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.28	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.29	09/19/18 00:00 AM	09/26/18 03:00 PM
1.2	1.2.1.30	09/19/18 00:00 AM	09/26/18 03:00 PM

Smartsheets

1.2.4 CapEx

Activity	Subtype	12mo Subtotal P15	12mo Subtotal P16	12mo Subtotal P17	Estimating Technique	Contingency
Control Panels, PLC Motor Controllers and Breakers (Incl. Control)	CapEx	\$16,000	\$0	\$0	D - Expert Opinion	C2
Network Controllers, CS HW Production Ignition Servers (Incl. DCC, TOS1, TOS2)	CapEx	\$16,000	\$0	\$0	D - Expert Opinion	C2
Network Controllers, CS HW Production Database Server (Incl. DCC)	CapEx	\$16,000	\$0	\$0	D - Expert Opinion	C2
Network Controllers, CS HW Production Peripherals (Incl. DCC, TOS1, TOS2)	CapEx	\$2,720	\$0	\$0	D - Expert Opinion	C3
Network Controllers, CS HW DCC Core Switch & Security Appliance	CapEx	\$4,000	\$0	\$0	D - Expert Opinion	C3
Network Controllers, CS HW Production Main PLC - PLC (Incl. DCC, TOS1, TOS2)	CapEx	\$30,000	\$0	\$0	D - Expert Opinion	C3
Network Controllers, CS HW P15 Resupply	CapEx	\$0	\$4,000	\$0	D - Expert Opinion	C4
Network Controllers, CS HW P17 Resupply	CapEx	\$0	\$0	\$4,000	D - Expert Opinion	C4

1.2 Relocation Cost Workbook P16-P18

WBS	Activity	Resource ID	LPV5	LPV6	LPV7	LPV8	Estimating Technique	Contingency
1.2.4.2.11.1	Network Controllers, CS HW Production Ignition Servers (Incl. DCC, TOS1, TOS2)	EN-EE	10	0	0	0	C - Engineering B	C2
1.2.4.2.11.2	Network Controllers, CS HW Production Database Server (Incl. DCC)	EN-EE	10	0	0	0	C - Engineering B	C2
1.2.4.2.11.3	Network Controllers, CS HW Production Peripherals (Incl. DCC, TOS1, TOS2)	EN-EE	16	0	0	0	C - Engineering B	C2
1.2.4.2.11.4	Network Controllers, CS HW DCC Core Switch & Security Appliance	EN-EE	8	0	0	0	C - Engineering B	C2
1.2.4.2.11.5	Network Controllers, CS HW Production Main PLC - PLC (Incl. DCC, TOS1, TOS2)	EN-EE	36	0	0	0	C - Engineering B	C2
1.2.4.2.11.7	Network Controllers, CS HW P15 Resupply	EN-EE	0	144	0	0	C - Engineering B	C2
1.2.4.2.11.8	Network Controllers, CS HW P17 Resupply	EN-EE	0	0	144	0	C - Engineering B	C2

1.2.4 Labor Hours

WBS	Activity	Resource ID	LPV5	LPV6	LPV7	LPV8	Estimating Technique	Contingency
1.2.4.2.11.1	Network Controllers, CS HW Production Ignition Servers (Incl. DCC, TOS1, TOS2)	EN-EE	10	0	0	0	C - Engineering B	C2
1.2.4.2.11.2	Network Controllers, CS HW Production Database Server (Incl. DCC)	EN-EE	10	0	0	0	C - Engineering B	C2
1.2.4.2.11.3	Network Controllers, CS HW Production Peripherals (Incl. DCC, TOS1, TOS2)	EN-EE	16	0	0	0	C - Engineering B	C2
1.2.4.2.11.4	Network Controllers, CS HW DCC Core Switch & Security Appliance	EN-EE	8	0	0	0	C - Engineering B	C2
1.2.4.2.11.5	Network Controllers, CS HW Production Main PLC - PLC (Incl. DCC, TOS1, TOS2)	EN-EE	36	0	0	0	C - Engineering B	C2
1.2.4.2.11.7	Network Controllers, CS HW P15 Resupply	EN-EE	0	144	0	0	C - Engineering B	C2
1.2.4.2.11.8	Network Controllers, CS HW P17 Resupply	EN-EE	0	0	144	0	C - Engineering B	C2



Summary of BOE Supporting Docs

1.2.4 CapEx

1.2.4 Labor Hours

Smartsheets

BOE
Describes L3 element
Breaks down to L4 detail

Basis of Estimate

1. WBS ID 1.2.4 Total cost for this WBS: \$1,118,571

2. WBS Name Computing and Control System - Off-ice

3. Estimated by Andrew Landrie, Paul Wisniewski, & Terry Benson (University of Wisconsin)

4. WBS Dictionary Description
Includes development and verification of new drill control system software and hardware, network, sensors, e-stop, network and e-stop cabling and connectors, motor drives, and the Drill Control Center.

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 "Key Assumptions document (1). The techniques are: A=Analogy, C=actuals, F=Parametric, L=Learned from Experience, E=Extrapolation from

- The cost estimate technique classifies the estimate as a parametric estimate (F) based on the Government Accountability Office (GAO) best practices. These are the techniques are: A=Analogy, C=actuals, F=Parametric, L=Learned from Experience, E=Extrapolation from
- Contingency codes are assigned to 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:

1.2.4.1	Architecture	Evaluate EHWD system and define IceCube Upgrade Drill requirements, system design.
1.2.4.2	Control System Hardware	Motor controllers and readouts, sensors, network controllers, indoor cables (sensor and network).
1.2.4.3	Control System Software	Motor controllers and readouts, data acquisition, system operator functions.
1.2.4.4	Motor Drives	Define functional and electrical requirements, specify and procure drives, programming and testing.

Last revision: 14 March 2022

BOE

Many areas can stop here. More complicated areas, like 1.2, need more.



Summary of BOE Supporting Docs

Relocation Schedule P16-P18

Smartsheets

Relocation Cost Workbook P16-P18

1.2.4 CapEx

1.2.4 Labor Hours

Basis of Estimate

- WBS ID: 1.2.4 Total cost for this WBS: \$1,118,571
- WBS Name: Computing and Control System - Off-ice
- Estimated by: Andrew Landrie, Paul Wisniewski, & Terry Benson (University of Wisconsin)
- WBS Dictionary Description: Includes development and verification of new drill control system software and hardware, network, sensors, e-stop, network and e-stop cabling and connectors, motor drives, and the Drill Control Center.
- 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 "Key Assumptions" document (2).
 - The cost estimate technique classified by the Government Accountability Office (GAO) best practices. These are: A=Analog; C=Actuals; F=Parametric; L=Learned from Experience; E=Extrapolation from Past Experience.
 - Contingency codes are assigned to 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).
- Scope: The scope of this BOE covers the following L4 areas:

1.2.4.1	Architecture	Evaluate EHWD & Drill requirements
1.2.4.2	Control System Hardware	Motor controllers, indoor controllers, indoor system operator fu
1.2.4.3	Control System Software	Motor controllers system operator fu
1.2.4.4	Motor Drives	Define functional and procure drives

Last revision: 14 March 2022

BOE
Describes L3 element
Breaks down to L4 detail

Estimate Worksheet
Tailored as needed
Describes an L4 element in more detail, to L5 or L6

Excel: CS_DCR_3March2022 - Saved

Description	Material Cost	Engr Hours	Labor Basis of Estimate	Component	Qty	Unit Cost	Net Cost	Basis of Estimate
action Ignition Servers (1x DCC, TOS1, TOS2)	\$ 10						\$ 10	1.2.4.2.1.1 US_GURITE_3000107970278
action (Base Server (1x DCC)	\$ 10						\$ 10	1.2.4.2.1.1 US_GURITE_3000107970278
action Peripherals (1x DCC, TOS1, TOS2)	\$ 279.22						\$ 279.22	1.2.4.2.1.1 Dell Computer - Quate - 300
action DCC Core Switch & Security Appliance	\$ 444.60						\$ 444.60	1.2.4.2.1.1 Dell Computer - Quate - 300
action Main PLC - PLC (1x DCC, TOS1, TOS2)	\$ 3						\$ 3	1.2.4.2.1.1 3 & 1/2 IPS TOS PLC Chassis 01
supply	\$ 423.05						\$ 423.05	1.2.4.2.1.1.4 CoreSwitch-Quato.pdf
supply	\$ 4						\$ 4	1.2.4.2.1.1.4 Product Detail Print - Insight
Total	\$ 66,720.00	368						

Estimate Worksheet

For labor and materials that are estimated based on engr judgment or past experience, stop here



Summary of BOE Supporting Docs

1.2.4 CapEx

WBS	Activity	Start	End	Duration
1.2.4.1	Control System Hardware	09/19/18	09/19/18	1d
1.2.4.2	Control System Software	09/19/18	09/19/18	1d
1.2.4.3	Motor Drives	09/19/18	09/19/18	1d

Smartsheets

1.2.4 Labor Hours

WBS	Activity	Resource	LPV5	LPV6	LPV7
1.2.4.2.1.1	Network Controllers: CS HW Production Ignition Servers	EH-EE	10	0	0
1.2.4.2.1.2	Network Controllers: CS HW Production Database Server	EH-EE	10	0	0
1.2.4.2.1.3	Network Controllers: CS HW Production Peripherals	EH-EE	10	0	0
1.2.4.2.1.4	Network Controllers: CS HW DCC Core Switch & Security Appliance	EH-EE	8	0	0
1.2.4.2.1.5	Network Controllers: CS HW Production Main PLC	EH-EE	30	0	0
1.2.4.2.1.7	Network Controllers: CS HW P18 Resupply	EH-EE	0	144	0
1.2.4.2.1.8	Network Controllers: CS HW P17 Resupply	EH-EE	0	0	0

BOE
Describes L3 element
Breaks down to L4 detail

Estimate Worksheet

L4	Description	Material Cost	Engr Hours	Labor Basis of Estimate	Component	Qty	Unit Cost	Net Cost	Basis of Estimate
1.2.4.2.1.1	Network Controllers: CS HW Production Ignition Servers	\$ 10,000.00	368	Engr judgement	Ignition Servers	10	\$ 1,000.00	\$ 10,000.00	1.2.4.2.1.1 US-GUR
1.2.4.2.1.2	Network Controllers: CS HW Production Database Server	\$ 10,000.00	368	Engr judgement	Database Server	10	\$ 1,000.00	\$ 10,000.00	1.2.4.2.1.1 US-GUR
1.2.4.2.1.3	Network Controllers: CS HW Production Peripherals	\$ 10,000.00	368	Engr judgement	Peripherals	10	\$ 1,000.00	\$ 10,000.00	1.2.4.2.1.1 US-GUR
1.2.4.2.1.4	Network Controllers: CS HW DCC Core Switch & Security Appliance	\$ 10,000.00	368	Engr judgement	Core Switch & Security Appliance	10	\$ 1,000.00	\$ 10,000.00	1.2.4.2.1.1 US-GUR
1.2.4.2.1.5	Network Controllers: CS HW Production Main PLC	\$ 10,000.00	368	Engr judgement	Main PLC	10	\$ 1,000.00	\$ 10,000.00	1.2.4.2.1.1 US-GUR
1.2.4.2.1.7	Network Controllers: CS HW P18 Resupply	\$ 10,000.00	368	Engr judgement	P18 Resupply	10	\$ 1,000.00	\$ 10,000.00	1.2.4.2.1.1 US-GUR
1.2.4.2.1.8	Network Controllers: CS HW P17 Resupply	\$ 10,000.00	368	Engr judgement	P17 Resupply	10	\$ 1,000.00	\$ 10,000.00	1.2.4.2.1.1 US-GUR
Total		\$ 66,700.00	368					\$ 66,700.00	

Estimate Worksheet
Tailored as needed
Describes an L4 element in more detail, to L5 or L6

Basis of Estimate

1. WBS ID: 1.2.4
Total cost for this WBS: \$1,118,571

2. WBS Name: Computing and Control System - Off-ice

3. Estimated by: Andrew Landrie, Paul Wisniewski, & Terry Benson (University of Wisconsin)

4. WBS Dictionary Description: Includes development and verification of new drill control system software and hardware, network, sensors, e-stop, network and e-stop cabling and connectors, motor drives, and the Drill Control Center.

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 (see "Key Assumptions" document (1)). The cost estimate technique classified as Government Accountability Office (GAO) best practices. These are: A=Analog; C=Contingency; E=Extrapolation from actuals; F=Parametric; L=Learn from Experience; P=Professional Judgment.

6. Scope: The scope of this BOE covers the following L4 areas:

L4	Description	Material Cost	Engr Hours	Labor Basis of Estimate	Component	Qty	Unit Cost	Net Cost	Basis of Estimate
1.2.4.1	Architecture			Evaluate EHW4 & Drill requirements					
1.2.4.2	Control System Hardware			Motor controllers, indoor controllers, indoor system operator fu					
1.2.4.3	Control System Software			Motor controllers system operator fu					
1.2.4.4	Motor Drives			Define functional and procure drives					

BOE

1. WBS ID: 1.2.4
Total cost for this WBS: \$1,118,571

2. WBS Name: Computing and Control System - Off-ice

3. Estimated by: Andrew Landrie, Paul Wisniewski, & Terry Benson (University of Wisconsin)

4. WBS Dictionary Description: Includes development and verification of new drill control system software and hardware, network, sensors, e-stop, network and e-stop cabling and connectors, motor drives, and the Drill Control Center.

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L4	Description	Material Cost	Engr Hours	Labor Basis of Estimate	Component	Qty	Unit Cost	Net Cost	Basis of Estimate
1.2.4.1	Architecture			Evaluate EHW4 & Drill requirements					
1.2.4.2	Control System Hardware			Motor controllers, indoor controllers, indoor system operator fu					
1.2.4.3	Control System Software			Motor controllers system operator fu					
1.2.4.4	Motor Drives			Define functional and procure drives					

Estimate Worksheet

L4	Description	Material Cost	Engr Hours	Labor Basis of Estimate	Component	Qty	Unit Cost	Net Cost	Basis of Estimate
1.2.4.2.1.1	Network Controllers: CS HW Production Ignition Servers	\$ 10,000.00	368	Engr judgement	Ignition Servers	10	\$ 1,000.00	\$ 10,000.00	1.2.4.2.1.1 US-GUR
1.2.4.2.1.2	Network Controllers: CS HW Production Database Server	\$ 10,000.00	368	Engr judgement	Database Server	10	\$ 1,000.00	\$ 10,000.00	1.2.4.2.1.1 US-GUR
1.2.4.2.1.3	Network Controllers: CS HW Production Peripherals	\$ 10,000.00	368	Engr judgement	Peripherals	10	\$ 1,000.00	\$ 10,000.00	1.2.4.2.1.1 US-GUR
1.2.4.2.1.4	Network Controllers: CS HW DCC Core Switch & Security Appliance	\$ 10,000.00	368	Engr judgement	Core Switch & Security Appliance	10	\$ 1,000.00	\$ 10,000.00	1.2.4.2.1.1 US-GUR
1.2.4.2.1.5	Network Controllers: CS HW Production Main PLC	\$ 10,000.00	368	Engr judgement	Main PLC	10	\$ 1,000.00	\$ 10,000.00	1.2.4.2.1.1 US-GUR
1.2.4.2.1.7	Network Controllers: CS HW P18 Resupply	\$ 10,000.00	368	Engr judgement	P18 Resupply	10	\$ 1,000.00	\$ 10,000.00	1.2.4.2.1.1 US-GUR
1.2.4.2.1.8	Network Controllers: CS HW P17 Resupply	\$ 10,000.00	368	Engr judgement	P17 Resupply	10	\$ 1,000.00	\$ 10,000.00	1.2.4.2.1.1 US-GUR
Total		\$ 66,700.00	368					\$ 66,700.00	

Estimate Worksheet
Tailored as needed
Describes an L4 element in more detail, to L5 or L6

Quote

Quote No. 30001979278.1
Total \$1,167.81
Customer # 161027705
Quote on File by Jan 16, 2021
Expires on Dec 17, 2021

Product: Precision 2930 Rack
Unit Price: \$1,167.81
Quantity: 1
Subtotal: \$1,167.81

Shipping: \$0.00
Environmental Fee: \$0.00
Non-Taxable Amount: \$1,167.81
Taxable Amount: \$0.00
Estimated Tax: \$0.00
Total: \$1,167.81

Estimate Worksheet

L4	Description	Material Cost	Engr Hours	Labor Basis of Estimate	Component	Qty	Unit Cost	Net Cost	Basis of Estimate
1.2.4.2.1.1	Network Controllers: CS HW Production Ignition Servers	\$ 10,000.00	368	Engr judgement	Ignition Servers	10	\$ 1,000.00	\$ 10,000.00	1.2.4.2.1.1 US-GUR
1.2.4.2.1.2	Network Controllers: CS HW Production Database Server	\$ 10,000.00	368	Engr judgement	Database Server	10	\$ 1,000.00	\$ 10,000.00	1.2.4.2.1.1 US-GUR
1.2.4.2.1.3	Network Controllers: CS HW Production Peripherals	\$ 10,000.00	368	Engr judgement	Peripherals	10	\$ 1,000.00	\$ 10,000.00	1.2.4.2.1.1 US-GUR
1.2.4.2.1.4	Network Controllers: CS HW DCC Core Switch & Security Appliance	\$ 10,000.00	368	Engr judgement	Core Switch & Security Appliance	10	\$ 1,000.00	\$ 10,000.00	1.2.4.2.1.1 US-GUR
1.2.4.2.1.5	Network Controllers: CS HW Production Main PLC	\$ 10,000.00	368	Engr judgement	Main PLC	10	\$ 1,000.00	\$ 10,000.00	1.2.4.2.1.1 US-GUR
1.2.4.2.1.7	Network Controllers: CS HW P18 Resupply	\$ 10,000.00	368	Engr judgement	P18 Resupply	10	\$ 1,000.00	\$ 10,000.00	1.2.4.2.1.1 US-GUR
1.2.4.2.1.8	Network Controllers: CS HW P17 Resupply	\$ 10,000.00	368	Engr judgement	P17 Resupply	10	\$ 1,000.00	\$ 10,000.00	1.2.4.2.1.1 US-GUR
Total		\$ 66,700.00	368					\$ 66,700.00	

Quote

Quote No. 30001979278.1
Total \$1,167.81
Customer # 161027705
Quote on File by Jan 16, 2021
Expires on Dec 17, 2021

Product: Precision 2930 Rack
Unit Price: \$1,167.81
Quantity: 1
Subtotal: \$1,167.81

Shipping: \$0.00
Environmental Fee: \$0.00
Non-Taxable Amount: \$1,167.81
Taxable Amount: \$0.00
Estimated Tax: \$0.00
Total: \$1,167.81



1.2 BOE & Supporting Docs Roadmap (Docushare ver.)

WBS	Name	BOE	Estimate Worksheet	Vendor Quotes
	Docushare Collection:	16499	16520	16522
1.2.1	Management and Systems Engineering	1.2.1 BOE	n/a – All backup information within BOE	All in same collection
1.2.2	Thermal Plant	1.2.2 BOE	1.2.2 Est. Worksheet	
1.2.3	Tower Operations Site	1.2.3 BOE	1.2.3 Est. Worksheet	
1.2.4	Control System	1.2.4 BOE	1.2.4 Est. Worksheet	
1.2.5	Power Generation and Distribution	1.2.5 BOE	1.2.5 Est. Worksheet	
1.2.6	Water Handling Systems	1.2.6 BOE	1.2.6 Est. Worksheet	
1.2.7	Support Equipment	1.2.7 BOE	1.2.7 Est. Worksheet	
1.2.8	Drill Field Seasons	1.2.8 BOE	n/a – All backup information within BOE	
1.2.9	Installation – Off Ice	1.2.9 BOE	1.2.9 Est. Worksheet	
1.2.10	Installation – On Ice	1.2.10 BOE	n/a – All backup information within BOE	

See COLUMN "S" in Estimate Worksheets for rationale, basis, and links to vendor quotes