

# Basis of Estimate

**1. WBS ID** 1.2.6 **\$57,615 total cost for this WBS**

**2. WBS Name** Water Handling Systems - 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 water storage, transfer, and makeup: Water tanks, High Pressure Pump system, and new water filtration and degassing system, all pumps including downhole return pump, all interconnect hoses and plumbing, and the ARA Hot Water Drill (to replace the Rodriquez Well 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

1.2.6 is comprised of the following L4 elements. The scope of this BOE covers all but 1.2.6.3 and 1.2.6.6 for PY5-8. 1.2.6.3 and 1.2.6.6, as captured in this L3, will be completed in PY4.

|         |                                      |   |
|---------|--------------------------------------|---|
| 1.2.6.1 | Water Tanks                          | Recon, identify/procure upgrades/replacements/spares, retrofit and testing.                                       |
| 1.2.6.2 | Pumps                                | Recon, identify/procure upgrades/replacements/spares, retrofit/recondition/testing.                               |
| 1.2.6.3 | Filtration and Condensate Management | Define requirements, design and specify, procurement, fabrication and assembly, integration/verification/testing. |
| 1.2.6.4 | Interconnects - External             | Recon, identify/procure replacements/spares, includes MDS interconnects and surface hose.                         |

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|         |                               |  |
|---------|-------------------------------|--|
| 1.2.6.5 | MDS Internal Hoses            | Evaluate, procure, and replace, as needed, MDS internal water and fuel hoses                   |
| 1.2.6.6 | ARA Hot Water Drill Subsystem | Recon, identify/procure replacements/spares, subsystem testing, integration and commissioning. |

## 7. Equipment, Materials, Supplies, Travel

1.2.6 only contains equipment procurements, which are capitalized as part of the larger water handling subsystems. There is no M&S and no travel in 1.2.6.

### 7.1. Equipment

1.2.6 Water Handling equipment procurements are listed below.

1.2.6 CapEx ☆

| WBS       | Activity  | 12mo Subtotal PY5 | 12mo Subtotal PY6 | 12mo Subtotal PY7 | 12mo Subtotal PY8 | Institution | Estimating Technique | Contingency |
|-----------|---|-------------------|-------------------|-------------------|-------------------|-------------|----------------------|-------------|
| 1.2.6.1.3 | Water Tanks: Procure Repair Parts, Replacements (PY6)       | \$0               | \$5,000           | \$0               | \$0               | PSL         | D - Expert Opinion   | C4          |
| 1.2.6.2.5 | Pumps: Procure Repair/Replacement Components (PY5)          | \$6,600           | \$0               | \$0               | \$0               | PSL         | D - Expert Opinion   | C4          |
| 1.2.6.2.6 | Pumps: Procure Repair/Replacement Components (PY6)          | \$0               | \$5,000           | \$0               | \$0               | PSL         | D - Expert Opinion   | C4          |
| 1.2.6.4.9 | Interconnect: Procure External Interconnect materials (PY6) | \$0               | \$10,551          | \$0               | \$0               | PSL         | C - Engineering B    | C4          |
| 1.2.6.5.3 | MDS: Procure Replacements Internal Hoses and Spares         | \$0               | \$11,365          | \$0               | \$0               | PSL         | D - Expert Opinion   | C4          |

Total equipment cost is \$38,516. 27% of the total equipment cost is estimated from engineering buildup, however all the remaining costs in 1.2.6 are assigned a conceptual (C4) contingency code because they cannot be better estimated until further assessment during the next on-ice field season.

### 7.2. Materials & Supplies

There is no M&S.

### 7.3. Travel

There is no travel in this WBS area.

## 8. Labor

### 8.1. Labor Estimate

Labor is mainly the effort needed to identify annual resupply procurements, process those, and assemble and pack for shipment. There is some assembly effort in 1.2.6.1 and 1.2.6.4.

All labor estimates are based on expert opinion.

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## 8.2. Summary of Labor Resources

### 1.2.6 Labor Hours ☆

| WBS       | Activity  | Resource ID | LPY5 | LPY6 | LPY7 | LPY8 | Institution | Estimating Technique | Contingency |
|-----------|---|-------------|------|------|------|------|-------------|----------------------|-------------|
| 1.2.6.1.3 | Water Tanks: Procure Repair Parts, Replacements (PY6)       | EN-ME       | 0    | 24   | 0    | 0    | PSL         | D - Expert Opinion   | C4          |
| 1.2.6.2.5 | Pumps: Procure Repair/Replacement Components (PY5)          | EN-ME       | 40   | 0    | 0    | 0    | PSL         | D - Expert Opinion   | C4          |
| 1.2.6.2.6 | Pumps: Procure Repair/Replacement Components (PY6)          | EN-ME       | 0    | 24   | 0    | 0    | PSL         | D - Expert Opinion   | C4          |
| 1.2.6.4.9 | Interconnect: Procure External Interconnect materials (PY6) | EN-ME       | 0    | 40   | 0    | 0    | PSL         | D - Expert Opinion   | C4          |
| 1.2.6.5.1 | MDS: Evaluate Water Hoses (1-1/2", 3/4", and 1/2" Hose)     | EN-ME       | 0    | 8    | 0    | 0    | PSL         | D - Expert Opinion   | C4          |
| 1.2.6.5.2 | MDS: Evaluate Fuel Hoses                                    | EN-ME       | 0    | 8    | 0    | 0    | PSL         | D - Expert Opinion   | C4          |
| 1.2.6.5.3 | MDS: Procure Replacements Internal Hoses and Spares         | EN-ME       | 0    | 16   | 0    | 0    | PSL         | D - Expert Opinion   | C4          |

## 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.      |
| 2022-04-09 | Terry Benson     | Updated tables       |