

IceCube Upgrade Project Review
March 17, 2020

Recommendation:

COVID-19 Emergency Response Plan: We recommend that you provide a document that describes the risks and projected impact (on the cost, schedule, and budget) on the ICNO M&O & Upgrade/Construction activities due to the COVID-19 outbreak; this should include any respective/potential delays of the procured equipment deliveries, various productions of parts and units (DOMs, etc.), and potential losses or delays of labor and people/positions. Describe the UW & Subawardees' plans of actions to mitigate the potential risks/events. The plan should include measures that provide for personnel safety and property.

Risks and Mitigation Due to COVID-19 Outbreak

The ICNO, collaborating institutions, and subawardees, initiated an assessment of technical, cost, and schedule risks associated with the COVID-19 outbreak, including mitigation plans. In addition, organizational plans have been developed and enacted to ensure safety of personnel and protection of property.

Principal Assumption

The principal assumption for the analysis of risks is that there will be three-month total, or near total, stoppage of technical work, followed by a three-month period of gradual return to normal operations, resulting in a total of a six-month schedule impact.

Other scenarios are, of course, possible. However, there is little utility in additional analysis in the very fluid current situation. The Upgrade project will review the risks at the time of detail planning for PY3, which is scheduled to start on July 1, 2020.

Assessment of Risks and Mitigation

The risk assessment has been carried out per the Risk Management Plan (RMP). The risk severity table and risk probability table from the RMP are included below for reference.

Risk Severity

Project Objective	Very Low	Low	Moderate	High	Very High
Cost	Less than \$10k	\$10k - \$50k	\$50k - \$250k	\$250k - \$1M	> \$1M
Time	Less than 1 week	Month	3 months	6 months	Greater than 6 months
Scope	Scope decreases barely noticeable	Minor areas of scope affected	Major areas of scope affected	Scope reduction unacceptable to sponsor	Project item is effectively useless
Quality / Performance	Quality / performance degradation barely noticeable	Only very demanding applications are affected	Quality / performance reduction requires sponsor approval	Quality / performance degradation unacceptable to sponsor	Project item is effectively useless

Risk Probability

Risk Probabilities Table		Limits for Calculation	
Probability of Occurrence Descriptor	Numerical Ranges	Low	High
Very Low	< 5%	1%	5%
Low	5% - 25%	5%	25%
Moderate	25% - 50%	25%	50%
High	50% - 75%	50%	75%
Very High	> 75%	75%	95%

1. Drill Control System

Risk severity: High

Risk probability: Moderate to high

Description: Unable to procure motor drives on time. Unable to make timely progress with hands-on integration and test activities in the drill testbed; unable to add staff due to travel or hiring restrictions. Delay in development of user interfaces and control algorithms.

Impact: The control system is scheduled to be implemented and tested during 2021-2022 season in order for the drill to be ready for drilling seven holes in 2022-2023 season. This delay will result in all testing postponed to 2022-2023 season, with the possibility that main drilling may not be completed on time.

Mitigation: Motor drive procurement progress through remote communication. Work on delivery as partial delivery options or expedite. Focus on documentation and developing procedures during the working-at-home period of time. Expedite travel when resumed.

2. Crew Deployment

Risk severity: High

Risk probability: Moderate

Description: Inability to deploy full crew to the South Pole for the 2020-2021 field season.

Impact: A large majority of hot water drill repair work is scheduled for the 2020-2021 season. If we are unable to complete this work on time, it may not be ready for full system testing in the 2021-2022 season and for drilling of seven holes in the 2022-2023 season.

Mitigation: Work with ASC to expedite travel and qualification procedures. Work with smaller crew if needed at reduced capacity and scope.

3. ICM Firmware Development

Risk severity: Moderate to High

Risk probability: Moderate

Description: Working remotely is possible for a short time without access to hardware. Testing and commissioning likely delayed due to limited hardware access.

Impact: A setback will result in delay in testing of production optical modules.

Mitigation: Prioritize remote development efforts.

4. Drill Hose

Risk severity: Moderate

Risk probability: High

Description: The drill hose manufacture has been shut down. This will result in delay in production of main drill hose.

Impact: Hose delay adds strain to the logistics chain. Hose is a large shipment. There is a very strong preference to have hose at the Pole in 2021-2022, and it is absolutely needed early in the 2022-2023 season.

Mitigation: Hose was scheduled to ship end of July 2020. It is not needed in CHC until Nov or Dec 2020. The plan is to travel on vessel and be stored in McMurdo over 2021, then traverse or fly to the Pole in early 2021-2022. Backup plan could be to ship from Italy by Aug 2021, put on C17, and still get to Pole during the 2021-2022 season. This adds strain to the logistics chain.

5. Drill Cable

Risk severity: Moderate

Risk probability: Moderate

Description: Delay in procurement of main drill cable.

Impact: Drill cable likely to miss ship date (on reel) of Nov 2020.

Mitigation: Delay shipment of the main drill cable reel to fall of 2021: put on C17, and ship all the way to the Pole in the 2021-2022 season, rather than shipping by vessel and wintering in McMurdo. This will mitigate drill cable procurement lead time, cable reel refurbishment, control system integration of reel, and weathering considerations.

6. Season 2021-2022 Shipments

Risk severity: Moderate

Risk probability: Low-moderate

Description: During 2021, several systems are scheduled to be finished and shipped. They will winter-over in 2022 in order to be at the South Pole for a timely start of installation. They include main cables and optical modules for the first two holes. Delays in production will lead to all or some of the above not being ready for shipment in the 2021-2022 season.

Impact: The result will be that all equipment mentioned above must be shipped via air in order to be ready at the South Pole in early 2022-2023 season. Otherwise, full installation may be delayed.

Mitigation: Complete design reviews (remotely) as quickly as possible. Assuming production facilities will be available in fall-winter 2020 (Sweden) and spring-summer 2021 (US), this can succeed.

7. Season 2021-2022 Installations

Risk severity: Moderate-High

Risk probability: Low

Description: During 2021-2022, several systems are scheduled to be installed in preparation for 2022-2023 main installation season. They include surface cables, surface junction boxes, and related fieldwork and work in the IceCube Lab. Delays in production or shipping will lead to all or some of the above not being ready for installation on time.

Impact: The result will be that all above equipment must be installed on site in early 2022-2023 season, putting pressure on the final installation season.

Mitigation: Expedite production and delivery of above items. Plan and conduct as much field work as possible during the 2021-2022 season.

8. DOM and Cable Delivery for 2022-2023 Season

Risk severity: High

Risk probability: Low

Description: Delivery of DOMS and cables for 2022-2023 deployment is delayed.

Impact: The 2022-2023 season is the main drilling and installation season. Cables and DOMs for five strings are scheduled to be completed and shipped in order to be ready for installation. Delay in shipment may result in the project not being finished on schedule at the end of the 2022-2023 season.

Mitigation: The main cables and DOMs have sufficient float in the schedule to absorb a six-month delay. Continue on the present pace with D-Egg and mDOM activities at production sites. Continue with main cable engineering tasks during the work stoppage in order to ensure timely main cable production.

9. Calibration and Special Devices

Risk severity: Moderate

Risk probability: Low

Description: The standalone calibration and special devices are scheduled to be all ready at the South Pole for the 2022-2023 installation season.

Impact: Delay in on-time delivery may result in some of the calibration and special devices not being ready for installation. This will result in reduced calibration capability of the IceCube Upgrade project or a reduction in the R&D efforts.

Mitigation: Finalize documentation and firmware work as much as possible. Finalize design of prototype boards. Hardware design work can continue remotely for several weeks, including set up of orders for components. Mitigate effect of delays by working on design aspects that were originally planned for after the prototypes.

10. DOM Software Development

Risk severity: Moderate

Risk probability: Low

Description: Lack of access to hardware may result in delay in software development.

Impact: Any development work that requires hands-on access to hardware may be delayed until physical access is allowed, including testing new mDOM hardware and ICM firmware images.

Mitigation: Prioritize remote development efforts, such as FAT software readiness using networked mainboards.