Scope of Review Work, Targeted Questions on Overall Review

1. Has the project has substantially and meaningfully addressed the re-baseline review recommendations that are pertinent to the project management (PM) elements in this review?

Response: This review was premature as recommendations from the June *Re-baseline Report* are still in the process of being addressed. The project team was able to demonstrate that they have a plan in place to address the identified gaps with their project management capabilities, but the work products necessary to close these gaps are not expected to be complete until October 1. While the actions being taken by the project team appear adequate, it is difficult to provide a definitive assessment until these gaps have been fully addressed. Further discussion on incomplete responses and the plan to close the gaps is included in detailed sections below.

The project has addressed and closed out the items regarding updating the formal documentation, the logistics documents, and the risk register. Taking pro-active mitigation steps to purchase fuel containers for transport and storage to reduce the risk of inadequate fuel during the drilling season is laudable. While the details in the risk register have greatly improved, the formal documentation (RMP, Key Assumptions, Risk Analysis, Scope Management Plan, PEP) is still not clear and comprehensive. For example: the PEP section on contingency management only mentions cost contingency, not the highly relevant schedule contingency; the scope plan only includes cost and schedule options for on-ice scope while reductions in the number and complexity of in-kind instruments during fabrication could be done to reduce on-ice resource and schedule demands. Shortcomings of specific documents are further discussed within this document.

2. Do any significant gaps remain with their project management (PM) capabilities? If yes, how might these impact to the project's ability to complete the planned scope within budget and schedule?

Response: The project management office appears to be weak in leadership and in the ability to create a formal, integrated, and documented picture of the key aspects of the project. The decision to stay with a clumsy and inadequate scheduling tool shows lack of leadership and an inability to make difficult decisions. Poor documentation and integrated project parameters are a symptom of poor understanding of or lack of attention to basic project management practices. While the technical leads appear to have in depth experience and expertise (the same team who executed initial Ice Cube), the project management team has substantially turned over.

Missing critical information like the total amount of schedule contingency, particularly for this time constrained project, shows a lack of ownership and/or time spent on integrating and understanding the top level, key aspects of this project. This is a separate issue from the lack of project controls staff. The addition of Project Director Vivian O'Dell to the management team has clearly provided a positive impact but does not completely compensate for this gap in leadership.

Lack of leadership and understanding of the role of project management hinders the project's ability to communicate with key stakeholders and team leads, assess status against the plan, identify issues and threats, and make decisions in a timely manner. This erodes confidence in the project's ability to meet targets with respect to scope, schedule, and cost.

3. Is there any evidence of recurring challenges with their PM capabilities, similar to those identified in the re- baseline review, e.g., staffing, PM capacities and support tools? Where applicable provide specific examples and advise on the priorities and recommended steps to achieve resolution.

Response: The project is not at final design readiness. Adequate tools for capturing the project plans, analyzing risk and contingency, and tracking progress are not yet in place, although the project has a plan to get the tools in place and working by October 1. Top level project documents lack a significant amount of key integrated information that should be based on lower project level details captured in multiple files and documents. The technical work, the WBS, schedule tasks, and the BOEs are detailed and mature, but project documentation, tools, and processes are not. Many of the major documents still lack clarity and comprehensiveness after being addressed by the project team in response to panel recommendations and comments.

Summarized and integrated project information is an essential project management and communications tool. An examination of lower level project planning shows that the project planning at the technical lead level is sound. What is lacking is the integration and summarization of plans in a way that reveals overall status, trends, and issues that the Project Manager can use to direct the work and resources. An example is the management of project schedule contingency. While the logistics manager may know about the float in the logistics schedule and the on-ice drill manager may keep track of the float in the on-ice schedule, it is the Project Manager who combines the information into a coherent picture of total float/contingency for the project, analyzes the remaining float against progress, and decides if the project should take any actions to use or increase the overall contingency amount to keep the project healthy. The PM needs to be able to integrate lower information from the lower levels to effectively plan and execute the project objectives and demonstrate understanding and control of critical project issues. The fact that the kind of integrated data needed to manage the project can be created when requested (as shown during reviews) indicates that the project is mature in content and details. The fact that this information is not already on hand and in use by project management indicates a weakness of the project management.

Scope of Review Work

• ***Verify that the Project has adequately addressed all of the panel recommendations outlined in the IceCube Upgrade Project Review of Re-baselining External Panel Report June 14, 2022 (herein referred to as Re-baseline Report).***

Response: This review was premature as recommendations from the June *Re-baseline Report* are still in the process of being addressed. The project team was able to demonstrate that they have a plan in place to address the identified gaps with their project management capabilities, but the work products necessary to close these gaps are not expected to be complete until October 1. While the actions being taken by the project team appear adequate, it is difficult to provide a definitive assessment until these gaps have been fully addressed.

The project team's plan and progress to date is good. The project team still needs to show that the project has the appropriate tools in place and is generating information to manage and communicate the project effectively. They need to show NSF that they know the project's critical path, not just tell them that they know it. They need to prove that they have a better grasp of critical path method informed schedule and cost contingency requirements.

The project has addressed and closed out the items regarding updating the formal documentation, the logistics documents, and the risk register **(PR_Rec6 & RP_Rec7)**. Taking pro-active mitigation steps to purchase fuel containers for transport and storage to reduce the risk of inadequate fuel during the drilling season is laudable. While the details in the risk register have greatly improved, the formal documentation (RMP, Key Assumptions, Risk Analysis, Scope Management Plan, PEP) is still not clear and comprehensive. For example: the PEP section on contingency management only discusses cost contingency, not the highly relevant schedule contingency; the scope plan only includes cost and schedule options for on-ice scope while reductions in the number and complexity of in-kind instruments during fabrication could be done to reduce on-ice resource and schedule demands.

The list of recommendations for the *Re-baseline Report* that were still being addressed by the project team at the time of this review are as follows:

RP_Rec2- Hire Project Controls effort to support key Project Office functions

RP_Rec3- Improve Project Office processes to better integrate schedule, cost, and resource information

RP_Rec4- Use EVMS reports and practices with the project team to help manage the Project

RP_Rec5- Establish appropriate logic links for all activities in the schedule

RP_Rec8- Establish a recognized methodology for performing schedule risk analysis and use it to assess risk-adjusted float and schedule contingency needs

RP_Rec9- Write up Standard Operating Procedures (SOPs), Training Plans (TP), and Field Work Plans (WP) and ensure that Project personnel are familiar with them prior to field deployment

An integrated master schedule (IMS) that supports and follows GAO/NSF best practices **(RP_Rec5)** is critical and will help close many of the identified gaps. The IMS maintained in SmartSheets provided for review was improved by following the recommendations, but was still missing the necessary logical ties to provide visibility to critical and near critical activities. This is a limitation of the tool, not a refusal to respond. The project team is in the process of converting the SmartSheets schedule to Primavera P6 (P6), a much more powerful tool that can support the control and management of the project plan. The review team was able to meet with one of two contractors supporting the project team in this effort and was satisfied that their approach will produce a schedule aligned with GAO/NSF best practices.

The SmartSheets schedule was frozen as of 8/5/2022 and missing logic and additional updates are now being entered directly into the P6 IMS. The project team expects the IMS to be fully converted into P6 by the end of August.

The project team also expects to decide on a contractor to engage to support project controls for the remainder of the project by the end of August. The project team has formulated the draft scope of work and is reviewing the evaluation criteria. It is expected that multiple SMEs will support this work and 1 FTE/year total is estimated for this effort in the cost baseline provided to the review team **(RP_Rec2)**.

The project team expects to baseline the IMS in P6 in September and the first month of tracking with the new tools will be October **(RP_Rec3)**. By this time, the project team expects to support reporting that can (1) identify critical and near critical activities, (2) be used to perform EVM reporting **(RP_Rec4)**, and (3) be used to perform schedule risk analysis and to assess risk-adjusted float and schedule contingency needs **(RP_Rec8)**.

A write up of Standard Operating Procedures (SOPs), Training Plans (TP), and Field Work Plans (WP) and associated training **(RP_Rec9)** is still in progress. The project has indicated that updated status and long-term plans would be in place by September. The review team would expect these documents will include, at a minimum, detailed plans matching the baseline IMS for each field season with the expectation that these would be revised as the project progresses and as needed. The Field Work Plans should include the baseline scope of work and also detail how descoping options should be managed.

Recommendation: Conduct a final version of this *Risk/Schedule/Contingency Review* after recommendations from the June *Re-baseline Report* and this report are resolved.

• Analyze the Smartsheet schedule and schedule risk analysis to verify that steps have been taken by ICNO-U project respond to the panel's recommendations, and the changes are clear, comprehensive and sufficiently documented in the related files, e.g., key assumptions document (KAD), project execution plan (PEP), cost estimating plan (CEP), Risk Register, Risk Management Plan (RMP), Smartsheet schedule, and that there is sufficient evidence of adherence to the GAO's scheduling best practices and guidance in the NSF Research Infrastructure Guide (RIG).

Response: It is premature to report on the SmartSheets schedule status since the project froze it at the beginning of August to transfer to P6. The project implemented many of the schedule improvement recommendations from the review, but the application still suffers from the undesirable limitations noted in the report. The need for separate spread sheets for schedule, resources, and logistics and a lack of integration between these places a heavy burden on the project team to manually keep these documents in sync as the project progresses. It also raises the possibility of not recognizing schedule delays in time to exercise mitigations to recover schedule. Since the transfer process is ongoing, we can only comment on the project's process and intentions for creating an acceptable and useful schedule in P6. The project has two initial contractors who are uploading the schedule from smart sheets and correcting the shortcomings – fixing logic and taking advantage of the advanced capabilities of P6, such as critical path and float analysis. They will also upgrade to Acumen risk analysis as an improvement over the limited and questionable risk analysis using the simplified critical path and @Risk. The transfer is planned to finish by October 1, with a resource loaded schedule containing appropriate logic, a schedule health analysis, critical path and float analysis, a time phased cost book, and a ready to implement EVM process. The project's intention is to select one P6 product and then decide on a contractor to engage as project controls support for maintaining the schedule and cost book and providing risk analysis, progress tracking, and EVM reporting. Reviewers spoke with DASH360 representatives to go over the initial scope of work, the interactions with project leads, and the expected final products from the transfer to P6.

The review team believes that the project team is taking the correct steps to resolve the identified gaps and put in place schedule and risk analysis tools better suited to the exigencies of this project. The interviewed contractor has extensive experience with NSF project requirements and a sterling reputation for meeting those requirements. The approach has a high probability of successfully meeting the goals of a logically sound, resource and cost loaded IMS that can support EVM and Monte Carlo risk analysis by October 1.

- **Analyze the Smartsheet schedule and schedule risk analysis….**

    - **Has the rationale for any departures from GAO Scheduling Best Practices Guide (Scheduling Guide) been documented?**

    - **Is the critical path, or longest path (in the presence of date constraints), calculated by the scheduling software valid?**

    - **Does the Project's schedule meet the applicable criteria outlined in GAO's Scheduling Guide? If not, and considering the key questions in the GAO Guide, are any of the likely effects of not meeting criteria applicable?**

Response: Not applicable, cannot be adequately reviewed until the transfer from SmartSheets to P6 is complete.

• Analysis of the cost risks and analysis results to verify that steps taken by ICNO-U project respond to the panel's recommendations, and the changes in the related files are clear, comprehensive and sufficiently documented.

• These should also include the risk and cost impacts due to recent changes, including but not limited to proposed transport of fuel via tanks, scope and transition strategy from Smartsheet to Primavera P6 enterprise software, use of contracted support for software implementation and Project Controls support.

> **• Is there convincing substantiation for the risk probability and impact for the risks listed?**
>
> **• Do you feel there are any correlated risks whose combined likelihood of occurrence and collective impact would necessitate a greater budget contingency than that estimated by the project?**

Response: This panel reviewed the identified cost risks in the Risk Register and the process for generating budget contingency. It did not closely examine the bases of estimate of the risk impacts for cost reasonableness. The cost risks were appropriately updated in response to the panel recommendations. Changes resulted in clear, comprehensive, and sufficient documentation for the listed risks, with impacts listed quantitatively rather than qualitatively. The risks for fuel transportation via tanks were revised to reflect the reduced risk for delayed transport. The improvements to the related documents (RMP, Risk Register, BOEs, Risk Assessment, and Scope Plans) have mostly been completed and are responsive to the review recommendations. There is good substantiation for the risk probability and impact for both estimate uncertainties and discrete risks. The described risk calculation processes adhere to good practices and reasonableness and the description is much improved. The method of combining contingency derived from estimated uncertainties and from a Monte Carlo is standard. The cost risk analysis in the *Risk Schedule and Budget Assessment*, however, is light on the analysis and meaning of the data, leaving the reader to derive their own understanding of the significance of plots, charts, and data. A good example is the tornado plot from the cost risk Mone Carlo, which has no explanations to accompany the plot.

Recommendation: Provide additional analysis and significance of the cost and schedule risk analysis results in the *Risk Schedule and Budget Assessment.*

Response: The costs for the initial P6/Acumen software implementation and the ongoing project controls support contracts are now included in the budget. Each of these items currently uses reasonable placeholder budget amounts with potential cost increases covered by a risk in the register. Final costs are pending vendor quotes based on the definition of work (SOW) for ongoing project controls support. The actual budget amount will depend upon the level of support supplied and the choice of contractor. There is likely to be a cost increase for contractors If the project follows recommendations in this report to find PM support and coaching, in addition to the planned routine project controls efforts, to help fill the gap in project management

capabilities in the ICNO-U project office. A contractor like DASH360, the one currently engaged in the transfer of the schedule from SmartSheets to P6, that has experienced personnel with a range of skills from project controls to project management, may be a good choice for combined PM support and project controls. Using a single contractor could significantly speed up the time required to find qualified management support.

The planned implementation of improved project scheduling and risk analysis tools (P6/Acumen) currently in progress will further refine and improve the results of the probabilistic risk analysis and lend greater credence to the results. While the improved tools may change the total cost risk estimate somewhat, the reviewers do not anticipate a large increase above the current estimate from a new cost risk Monte Carlo, since the processes are similar.

Recommendation: When writing SOWs for an ongoing project controls support contract, consider needs for project management support and coaching and ensure that the selected contractor has the capacity and expertise to provide more than routine project controls support.

Response: Correlated risks could combine in a way to require higher budget contingency than currently estimated. The most likely correlation to have an impact is that between cost and schedule, thus it is considered good practice to use combined cost and schedule risk analysis. The project intends to use combined analysis in the new Monte Carlo risk simulations in addition to separate analyses. A strong correlation could result in increased budget and/or schedule contingency needs. There are other potential correlations that could also come into play, such as those between global inflation, increased salaries in a tight job market for replacement or augmented staff, as well as salary raises and bonuses to retain current staff. Risk PM-02 covers increased salaries for Key staff replacement, but job market salary increases would also apply to the many risks that involve replacement, augmentation, or retention of staff. If that risk occurs, salaries other than those for key positions could also be affected. Including correlated risks in a Monte Carlo analysis requires advanced project management controls knowledge and additional work to insert correlations. Impacts of correlations are likely to be minor compared to the larger risk impacts in the schedule, and the knowledge gained is often not worth the effort expended. It should be noted that this amount of rigor is more than what is required in the NSF RIG.

Recommendation: The project team should pursue a correlated cost and schedule Monte Carlo simulation analysis, but it should carefully weigh effort versus benefit of pursuing other correlated risks.

• Analysis of the revised contingencies for budget, schedule and scope to verify that the revisions and results outlined in the related files (noted in slide eight (8) the second bullet) respond to the panel's concerns, recommendations, and align with expectations set forth in the NSF RIG, section 6.2 and GAO best practices as applicable.

• Is there convincing substantiation for the risk probability and impact for the schedule contingency particularly in project year 3 where there is a lot going on, there is a high population on-ice, little flexibility of NSF AIL to accommodate any additional surge capacity that might be needed.

• Does the Field Season 3 plan have a high likelihood of success, without depending on heroic efforts

Response: The project revised the contingencies for budget, schedule, and scope per the review panel recommendations, with some shortcomings listed below. In general, the substantiation for quantified probability and impact is convincing for events leading up to and including FS3. The project team responded to the panel recommendation to perform a 'toy' Monte Carlo schedule risk and contingency analysis, but it is unlikely to be accurate and does not meet GAO standards. It leaves open the question that the project may have underestimated the potential for not meeting the project end date without exercising some if not all descopes and/or taking heroic measures in order to complete work by the season end date. Although this is a mid-scale project in which the formality of project controls could be expected to be reduced, the constrained nature of the schedule and logistics requires clear and comprehensive schedule management and analysis tools. An accurate Monte Carlo risk analysis cannot be accomplished until the transfer to P6/Acumen is complete. Therefore, it is premature to evaluate the results of the 'toy' Monte Carlo schedule risk and contingency analysis at this time.

The schedule risk analysis uses typical data from the risk register (probability and PERT- low, likely, and high impacts) as inputs to an @Risk Monte Carlo simulation to estimate the risk adjusted project finish dates. The results in this case, however, are not reliable due to the weaknesses and limitations of the current schedule tools and to some inaccuracies in the risk register inputs. Many of these problems were already described in June *Re-baseline Report*. The use of a simplified critical path, with few activities and constrained dates, does not yield a robust and believable risk adjusted project end date. Another notable weakness is that estimate uncertainties were not included in the schedule contingency calculation, as was done in the cost contingency calculation. The project controls contractors currently creating the P6 schedule and implementing Acumen risk analysis are skilled in the practice of running risk analysis for separate cost and schedule simulations as well as for combined simulations. When this is in place the probability for an accurate schedule contingency analysis is high.

Response: For Field Season 3 to have a high probability of success, the risk adjusted end date from the Monte Carlo analysis for completing all project installation and winterizing tasks must fall within the end of the on-ice season date. NSF RIG requires a confidence level of 70%-90%

confidence level for the adjusted end date. For illustrative purposes only, the results of the "toy" Monte Carlo will be discussed. The current estimate of float in the SmartSheets schedule between the last project tasks and the season end is about 10 days. The 'toy' Monte Carlo yields a risk adjusted end date with 80% confidence level that falls within the season end date with a few days of schedule float left over as schedule contingency. (As stated previously, this information is not particularly reliable due to the shortcomings of the SmartSheets schedule and risk analysis.) Exercising all descope options is estimated to provide about 20.5 days of schedule contingency in addition to the schedule float. Because the current "toy" Monte Carlo method probably underestimates the impact of risks on the adjusted end date, the likely outcome of the new Monte Carlo will be an adjusted end date that equals or exceeds the season end date. In that case, the project will need to make a proposal to exercise some descope options and create a new baseline with reduced scope. NSF will need to review and approve any such proposal. How many options to exercise will depend upon the extent of the schedule impact and whether it is desirable to restore the original baseline schedule float.

The project risk and contingency management plans and processed have gaps and less than desirable practices that should be corrected to achieve a more accurate understanding of risks and the future Monte Carlo forecasts of impacts. The list of shortcomings that need to be corrected before running the new Monte Carlo are the following:

- Incorrectly estimated schedule impact inputs from the Risk Register lead to inaccurate estimates of schedule end dates/contingency requirements from Monte Carlo simulations. In some cases, the schedule impact in the Risk Register is underestimated when unimplemented reactive risk mitigations are included in the impact estimates. The risk impact should be calculated *only* on mitigations which are currently incorporated into the baseline. Example: the EXT1 "Fuel delivery delayed" risk incorrectly assumes zero schedule impact because the project can exercise descoping options and drop the cold reaming of holes.
- There appear to be missing risks with schedule impacts. One is the need for a fourth field season, which would occur after all descope options are exhausted. This risk is mentioned in the Risk Analysis Document but could not be found in the Risk Register. Another missing risk involves problems that may be encountered during the new drilling processes for hole reaming and deeper holes.
- Several gaps in project risk and scope analyses documentation indicate a lack of understanding and integration at the project management level. The technical leads exhibit a depth of knowledge and experience that shows good estimation of durations and logistics sequencing. The list of risks, impacts, mitigations, and risk responses are comprehensive, with few exceptions. But there is inconsistent methodology in the use of the risk ranking. The risk impacts and risk analysis discussions are confused and contradictory. The *Risk Schedule and Budget Assessment* appears to be a copy of the previous Ice Cube project document that contains out of date and inaccurate information.

Example: The statement that all contingency is held at the end of the project is untrue. There appears to be float, i.e., contingency, inherent in the shipping schedule as well as at the end of each field season, but the amounts of float are not easily visible or tracked in the schedule.

- The Scope Management Plan is incomplete. It lists potential descope options for dropping up to 2 strings, dropping reaming for some or all holes, or shortening some of the longer strings. There is a discussion of compressing or limiting the activities at the end of FS3 for storing and retrograding equipment in the risk analysis, but this is missing in the descope options. The *Risk Schedule and Budget Assessment* does not state the total amount of schedule contingency available to the project, either inherent in the schedule or through exercising descope options. The is a critical piece of information of a very crucial datum for a tightly schedule constrained project like ICNO-U. An attempt by reviewers to determine the total amount of contingency from the documents and the schedule was not successful due to lack of clarity or missing information. The schedule appears to have 10 days of float at the end of FS3. The descope options were given different units (weeks, days, or hours), which could not easily be turned into workdays since information on the number of on-ice shifts was not readily apparent in the BOEs or Key Assumptions. When asked, the project provided a table adding up to 20.5 workdays for descopes. Reviewers could not determine if the inherent float plus the descope contingency are adequate to ensure successful project completion in 3 field seasons, given the problems in the risk analysis.
- There appears to be a high probability that some descopes and loss of science will be necessary to avoid a fourth season on ice.
- A minor detail is that the risk ranking algorithm is based on the probability adjusted impacts, thus low probability/high consequence risks do not show up as major risks. Probability adjusted risk impacts are typically used in calculating aggregate risk impacts and are less useful for ranking and management purposes. Although the project periodically reviews all risks, changing to risk impact for ranking could raise consciousness and increase vigilance of high consequence threats.

Recommendation: Include descope decision dates in the schedule.

Recommendation: Update the *Risk Schedule and Budget Assessment* and the *Scope Management Plan for the IceCube Upgrade Project* to clearly identify and discuss total schedule contingency from both inherent float and descope contingency.

Recommendation: Include all known decsope options, including a reduction in the tasks and time for winterizing and retrograding equipment at the end of the FS3 season, in the scope management plan. Consider adding potential off-ice descope options that could improve on-ice schedule performance in addition to the reductions of scope during installation.

Recommendation: Incorporate visible inherent contingency into the P6 schedule before major constraint dates and/or between phases. Consider inserting physical "*schedule visibility tasks (SVT)"* between baseline completion and constrained end dates. These can then be adjusted down in duration as the schedule slips. Examples: Float or contingency activities between (1) "ready to ship" and "required on site" for equipment and materials; and (2) "Pole storage and Retrograde complete" and "End of FS3 polar activities". The NSF RIG describes uses of this type of SVT:

"*A project may want to use schedule buffers to manage or monitor interim milestones or external deliverables to the project such as subcontract work. These types of schedule buffers should be identified as schedule margin with SVTs in lieu of lags. If a schedule margin (buffer) activity is used in the baseline schedule, its duration should be zeroed out prior to running a schedule risk analysis." … "In addition to the project end date, the total float or schedule margin for major deliverables should be reviewed and evaluated."*

• Analysis of the capacity of the project management support, and the effectiveness of the planned strategy to strengthen weaknesses outlined in the June *Re-baseline Report*, including but not limited to the introduction and timeliness of the new tools, e.g., Primavera P6 and contractor support for project controls. The documented plans with cost and schedule estimates should also be reviewed for completeness, clarity and likelihood of effectiveness.

• Identification of other "newly identified" issues related to schedule, risk, contingency or project management that are significantly out of alignment with NSF expectations as outlined in the NSF RIG.

Response: The project management office appears to be weak in leadership and in the ability to create a formal, integrated, and documented picture of the key aspects of the project. The decision to stay with a clumsy and inadequate scheduling tool shows lack of leadership and an inability to make difficult decisions. While the technical leads appear to have in depth experience and expertise (the same team who executed initial Ice Cube), the project management team has substantially turned over. Lack of leadership and understanding of the role of project management hinders the project's ability to communicate with key stakeholders and team leads, assess status against the plan, identify issues and threats, and make decisions in a timely manner. This erodes confidence in the project's ability to meet targets with respect to scope, schedule, and cost.

The project staffing plan includes full time Project Manager, F. Feyzi. There is evidence that the Project Manager is not working full time on project management issues. A review of the change logs for the major project documents lists V. O'Dell as the author of most changes since December 2021. The Project Manager, F. Feyzi, is not listed and seems to have little to do with preparing documents for the April Re-baseline Review, or with supplying responses to the review recommendations. He was not prominent during the kick-off meeting or for the Q&A session for this review. Missing critical information like the total amount of schedule contingency for this time constrained project and key decisions such as deciding to include reduction of the winterizing and retrograde tasks in the baseline to generate additional schedule float demonstrates a lack of ownership and/or time spent on integrating and understanding the top level, key aspects of this project. This is a separate issue from the lack of project controls staff. The addition of Project Director Vivian O'Dell to the management team has clearly provided a positive impact but does not completely compensate for this gap in project management. O'Dell's is part time but is performing many of the duties which would normally be assigned to a Project Manager. This is not tenable in the long run given her role as the Director for both the Ice Cube Upgrade and future projects.

The staffing plan for project administration shows that the Project Manager does not have paid hours for 2.5 months in the middle of each drilling season and that his time is significantly reduced starting in October 2023. The Project Director's time is also reduced as the work progresses. The rationale for these reductions in staff provided by the project are not convincing nor are they backed by substantiating evidence.

Recommendation: Take steps to address weaknesses in the project management office.

- Rebalance the roles of the Project Manager, Project Director, and the contracted project controls support to cover gaps and to match the staffing plan allocations.
- Ensure that the Project Manager role is an active one that reflects ownership of the responsibilities.
- Consider coaching to ensure that all members of the project management team are knowledgeable of all aspects of good project management and capable of performing their roles per NSF expectations.
- Assign adequate effort to cover project management functions throughout the project lifetime. Provide stronger, evidence-backed justification of any reduction in project management over time.

Response: The project is not at final design readiness. Top level project documents lack a significant amount of key integrated information that should be based on lower project level details captured in multiple files and documents. The technical work, the WBS, schedule tasks, and the BOEs are detailed and mature, but project documentation, tools, and processes are not. Many of the major documents still lack clarity and comprehensiveness after being addressed by the project team in response to panel recommendations and comments.

Examples include integrated staffing spreadsheets (FTEs per year/quarter per job category) at project and WBS II Levels. Standard aids used to demonstrate project planning maturity such as schedule milestones charts, high level or schedule cartoons, timed-phased procurement plans, etc. are also missing. Most of these items are explained in the RIG and are often requirements for 'final design' readiness.

Detailed BOE information should be captured and summarized in the high-level project documents. Example: The 9 hour-day, 6 day-week for on-ice activities is only found in the BOEs and the number of shifts per day is mostly undiscoverable. This type of information is usually found in the Key Assumptions Document. Lack of such integrated information means that reviewers spend an inordinate amount of time searching for data in multiple documents and creating their own tables and charts pulled from lower-level details to find answers to charge questions. Such poor use of reviewers' time is frustrating to the reviewer and may result in less thorough reviews. For many reviewers, the norm is to start with high level information, select areas of concern or targets for deeper dives, and then to proceed to detailed lower-level information. Vivian O'Dell and her team were able to produce summarized and integrated documents when requested. It seems that the data is there, but these are all examples of information that should be included in regular reports and key project artifacts.

Summarized and integrated project information is an essential communications and project management tool. The PM needs to be able to align project team members to effectively plan

and execute the project objectives and demonstrate understanding and control of critical project issues.

Recommendation: Take steps to resolve recurring difficulties with producing formal project documents that meet standards.

- Bring in outside experts to work closely with and to coach staff on bringing documents to the desired level of maturity and completeness. Use outside experts to review formal project documents for clarity and comprehensiveness. Consider using contractors and/or consultants to accomplish this. This effort could potentially be combined with the project controls support contract.
- Ensure adequate and qualified effort is assigned to this task.

Recommendation: The project should incorporate missing summary and integrated project-level information such as graphics and analyses that can effectively communicate project scope, status, processes, and key features. The RIG and Gen 1 Ice Cube documents should be consulted for guidance and examples.

Response: The review team did not find any other “newly identified” issues related to schedule, risk, contingency or project management that are significantly out of alignment with NSF expectations as outlined in the NSF RIG.