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Principal Investigator's Name: Kael Hanson
Department: Physics / WIPAC
Organization: University of Wisconsin-Madison

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COOPERATIVE AGREEMENT (CA)

AWARD: PLR-1600823	**EFFECTIVE DATE:**	April 1, 2016
	EXPIRATION DATE:	March 31, 2021

PROJECTED TOTAL AWARD FUNDING:

(Subject to availability of funds) $35,000,000

CUMULATIVE AMOUNT:

$3,500,000

SOLICITATION:

(Incorporated by reference, as amended)

NSF 15-587

Management and Operation of the IceCube Neutrino Observatory (ICNO)

CFDA NUMBER: 47.050

OTHER AWARDS UNDER THIS PROGRAM:

Show List of Awards

AWARDEE: University of Wisconsin-Madison

PROJECT TITLE: Management and Operations of the IceCube Neutrino Observatory 2016-2021

PROJECT ABSTRACT: https://www.fastlane.nsf.gov/servlet/showaward?award=1600823

Principal Investigator (s)	Proposal No.	Institution (s)
Francis Halzen	PLR-1600823	University of Wisconsin-Madison
Albrecht Karle		University of Wisconsin-Madison
Kael D. Hanson		University of Wisconsin-Madison

NSF Contact Information:

Financial/Administrative questions: e-mail your NSF Grants and Agreements Official, Kristin B. Spencer, at kspencer@nsf.gov or call the Division at 703-292-4585.

Programmatic questions: e-mail your NSF Program Officer, Vladimir O. Papitashvili, at vpapita@nsf.gov or call the Program Division at 703-292-7425.

This CA is entered into between the United States of America, represented by the National Science Foundation (NSF), and the above named Awardee pursuant to the authority of the National Science Foundation Act of 1950, as amended (42 USC 1861-1875). This CA is provided electronically to the Awardee. The Awardee is responsible for full compliance with all Programmatic and Financial/Administrative Terms and Conditions as initially stated or as updated over the life of this CA. The Awardee's request to draw down funds under this CA will represent acceptance by the Awardee of all Terms and Conditions of the CA. The Authorized Organizational Representative (AOR) will be electronically notified of any changes to these Terms and Conditions and is encouraged to immediately review these changes and contact the Grants and Agreements Official or Program Officer within thirty days with any questions.

Financial/Administrative Terms and Conditions (FATC):

General FATC:
http://www.nsf.gov/publications/pub_summ.jsp?ods_key=NSF99999FATC004

Award Specific FATC:

Part 1. Award Specific Financial and Administrative Terms and Conditions (FATC)

1.1. Award Interpretation
a. Other Terms and Conditions Incorporated by Reference. In addition to the General FATC referenced above, the following terms and conditions are incorporated by reference in this award:

Cooperative Agreement Supplemental Financial/Administrative Terms and Conditions for Managers of Large Facilities (FATC-LF): http://www.nsf.gov/pubs/policydocs/cafatc/cafatc_lf116.pdf

b. Deviations from the FATC and FATC-LF: To meet the specific needs and requirements of this CA, deviations are provided in full text herein and by any subsequent amendments.

c. Cognizant Agreements Officer. The NSF Grants and Agreements Official responsible for award and administration of this CA may be either a Grants and Agreements Officer or a Contracting Officer. For purposes of this award, this official is referred to throughout as the Contracting/Agreements Officer.

d. Cognizant Program Officers. This award is cosponsored by NSF's Polar Programs Division and Physics Division. The NSF Program Officers are Vladimir O. Papitashvili, Polar Programs Division, vpapita@nsf.gov, 703-292-7425, and James Whitmore, Physics Division, jwhitmor@nsf.gov, 703-292-8908.

1.2. Term of Agreement. The term of this agreement ends on March 31, 2021 unless otherwise amended. The term may be extended another 60 months upon NSF's assessment of satisfactory performance.

1.3. Funding
a. Anticipated Total NSF Funding. Consistent with NSF budgets and research priorities, and contingent on the availability of funds and on the conduct of this award, NSF intends to provide a total of $35,000,000 over the term of 5 (five) program years, split equally between the GEO/PLR and MPS/PHY divisions.

b. Initial Provision of Funds. Partial incremental funding for Program Year One in the amount of $3,500,000 is provided at the time of award to support IceCube Neutrino Observatory Management & Operations (ICNO/M&O) activities in accordance with the revised budget dated March 3, 2016.

c. Funding Schedule. Provided the conditions described in 1.3.a. are met, NSF intends to issue funds in accordance with the following schedule:

Year 1, 04/01/2016-03/31/2017: $7,000,000
Year 2, 04/01/2017-03/31/2018: $7,000,000
Year 3, 04/01/2018-03/31/2019: $7,000,000
Year 4, 04/01/2019-03/31/2020: $7,000,000
Year 5, 04/01/2020-03/31/2021: $7,000,000

d. Carryover of Uncommitted Funds. The Awardee may carry over uncommitted funds in an amount not to exceed fifteen percent (15%) of the program year funding unless otherwise approved in writing by the NSF Program Officers. The Awardee shall include a forecast of program year uncommitted funds in the annual progress report. Uncommitted Carryover is defined as the amount of funding available at the end of each program year that has not been expensed or committed (encumbered), which is then carried over via program year-end budget processing for use in the next program year. Uncommitted funding in excess of 15% percent will be deducted from the following program year budget, unless otherwise approved in writing by the NSF Program Officers.

e. Senior Personnel Salary Compensation. In accordance with NSF's Senior Personnel Salary and Wages Policy, the Awardee is authorized to charge salary compensation in excess of two months' regular salary for those senior personnel specifically identified in the approved proposal: the Principal Investigator; Director of IceCube Operations; and Associate Director for Science and Instrumentation.

1.4. Common Fund. The Awardee shall establish and maintain a Common Fund through a University of Wisconsin dedicated account(s) that will be monitored by NSF. The Common Fund is provided through contributions of each participating institution or funding agency based on the number of PhD-level researchers from that institution or related funding agency. The current Common Fund contribution per PhD researcher is $13,650 in cash or in-kind as determined by the Awardee. This amount will be reviewed annually to ensure that the overall funding is sufficient to cover Common Fund activities. These activities include UW data center operations, South Pole System (SPS) and South Pole Test System (SPTS) maintenance at UW, DAQ maintenance, data warehouse operations, procurement of computer hardware, storage media and archival services, support of winter over personnel, and essential hardware.

1.5. Monitoring of NSF Funds. The Awardee is responsible for overall supervision, financial oversight and reporting for the NSF-funded portion of IceCube M&O support. The Awardee will provide a tracking and accounting system for monitoring cost of equipment and labor and for system performance. The Awardee will account for all NSF-funded M&O costs incurred under this award separately from any other funding received.

1.6. Equipment
a. NSF Reversionary Rights. Add the following to the FATC Article entitled "Equipment," paragraph c.8, Right to Transfer Title (internally numbered):

"(c) NSF's reversionary rights under this article also apply to equipment purchased with NSF Funds provided to the Common Fund. Equipment purchased under this award through use of NSF funds contributed to the Common Fund shall be accounted for separately from equipment purchased through use of Common Funds contributed by other organizations. The Awardee will ensure that acquisition and any subsequent modification of such equipment through use of NSF funds is not compromised by other encumbrances."

b. Transfer of Equipment from Previous Award. All equipment for which the Awardee had accountability under NSF Cooperative Agreement No. 0937462 is hereby transferred to this CA. The inventory schedule provided by the Awardee and dated February 11, 2016 shall be made part of this Agreement. Title to all equipment shall be vested in the Awardee in accordance with the FATC Article entitled "Equipment."

c. Notwithstanding paragraph b., NSF retains an interest in equipment having an acquisition cost of $5,000 or more that is transferred from Award No. 0937462 to this CA, as well as new equipment purchased under this CA with NSF funds, and hereby reserves the right to transfer the title to the Federal Government or a third party named by the Federal Government at any time during the award period.

1.7. Significant Program Change
a. Subaward Reporting. Add the following to the FATC Article entitled "Significant Project Changes," paragraph a.3:
"Only significant subawardee and subcontractor activities shall be included in the annual reports and final report. For purposes of this CA, significant subawardee and subcontractor activities are those valued at more than $250,000."

b. Limitation on Reallocation of Funds. Written approval is required from the NSF Program Officers for reallocation of funds in excess of $250,000 from the annually approved ICNO/M&O Plan when such reallocation will occur across Control Accounts in the M&O WBS. The Awardee will document reallocation of funds through the IceCube M&O change control process.

1.8. Subaward/Subcontract Requirements
a. Prior Approval. In accordance with the FATC-LF Article entitled "Subawards, Subcontracts, or other Contractual Arrangements," the Awardee shall seek prior approval of requests to enter into such arrangements. The parties agree that, in order for NSF to exercise its responsibility for oversight and monitoring of this award, support for which represents a sizeable investment for the Government, the procedures set forth below shall be followed to ensure that research and related programmatic activities, award-specific services and major equipment are obtained in an effective manner and in compliance with the provisions of applicable Federal statutes and executive orders.

b. Applicability. The Awardee shall obtain the written approval of the Contracting/Agreements Officer prior to placing any new subaward/subcontract exceeding $250,000 in direct costs that was not part of the approved budget, including award-specific services and major equipment. This requirement also applies to modifications exceeding $250,000 in direct costs to existing subawards/subcontracts. As used in this agreement, the term "subaward/subcontract" includes contracts, cooperative agreements, purchase orders, orders issued under blanket purchase agreements or similar instruments, awards made to subrecipients regardless of form, and modifications to all the aforementioned. The following are excluded from this requirement:

1) Memoranda of Understanding. The term subaward/subcontract does not apply to Memoranda of Understanding with collaboration member institutions and individuals who will provide funding or in-kind support to the project. For such agreements, the Awardee will act in accordance with Sections 2.3g, 2.6, and where referred to elsewhere in the Program-Specific Terms and Conditions, below. However, should the Awardee desire to enter into an agreement in which the Awardee will provide NSF funding to a collaboration member institution or individual, the Awardee will submit work plans, detailed budgets, and budget justifications to the NSF Program Officers for review and approval prior to executing that agreement.

2) Actions below Threshold. While prior approval is not required for assistance awards or procurements that have total value of less than $250,000, all other policies and regulations will apply and are the responsibility of the Awardee. The Awardee shall not artificially segregate its assistance awards and/or procurements to lesser dollar amounts for the purpose of circumventing the Prior Approval requirement.

3) Procurements for COTS, Materials and Supplies, and General Services. Planned, fully competed procurements for Commercial Off the Shelf Items (COTS) that are awarded on a lowest price, technically acceptable basis; acquisition of raw materials needed for construction; supply orders consisting of items under $5,000 each, even when the total order may exceed the threshold; and general services (other than award-specific services) are excluded from this requirement.

4) Lower-tier Procurements and Assistance Awards. The Awardee will ensure that the Prior Approval requirement flows down to the subawards/subcontracts under this agreement for which the value exceeds $250,000.

c. Procedure
1) For subawards, the Awardee will submit a clear description of work to be performed, basis for selection, any key personnel and their qualifications, budget and budget justification. The Awardee shall include the basis for its determination of the reasonableness of the proposed budget and a determination of responsibility of the recipient. The request will include any special terms, unusual conditions and any changes to the Awardee's internal controls that would be necessary to administer the subaward.

2) For procurements, the request shall include a clear description of the need and the work to be performed, type of subcontract, basis for selection, determination of responsibility, and degree of competition obtained. Where the award will be made without competition, the memorandum shall include a detailed justification. The Awardee will describe the cost or price analysis performed, and support its determination of price reasonableness. Where the total price differs significantly from the Awardee's total price objective, the memorandum shall explain this difference. The Awardee will state the source of funding and verify that the funds are available for the purpose.

3) Upon satisfactory review, the NSF Contracting/Agreements Officer will provide written approval to the Awardee. Approval of the Contracting/Agreements Officer shall not be construed to constitute a determination of the allowability of any cost under this agreement, unless such approval specifically provides that it constitutes a determination of the allowability of such cost.

d. Award and Administration
1) The Awardee shall make all consultant agreements, subawards, subcontracts and other commitments in its own name and shall not bind or purport to bind the Government or NSF; agrees to administer/monitor all subawards/subcontracts it enters into and supports with NSF funds in accordance with the applicable federal cost principles and the applicable federal administrative requirements; remains responsible for maintaining the necessary documentation on all subawards/subcontracts and making it available to NSF upon request; and shall include significant subaward/subcontract activities in the annual and final reports, as well as in the final project outcomes report.

2) Incorporation of Applicable Terms and Conditions. All subaward/contractual arrangements shall contain appropriate provisions consistent with the applicable FATC and any applicable special conditions included in this Agreement. The Awardee shall establish appropriate approval thresholds and monitoring procedures to ensure compliance with all applicable flowdown requirements.

e. Prompt Notification of Claims. The Awardee shall give the Contracting/Agreements Officer immediate notice in writing of any legal action or suit filed and prompt notice of any claim made against the Awardee by any subawardee or contractor which in the opinion of the Awardee may result in litigation, related in any way to this agreement, with respect to which the Awardee may be entitled to reimbursement from the Government.

1.9. Reporting Classifiable Information. The FATC article entitled "Reporting Classifiable Information" is hereby modified to add the following:
"The Awardee agrees that no NSF buildings, facilities or equipment used in whole or in part for NSF-supported research, will be used for any classified research projects. The Awardee will provide the NSF Program Officers and the Contracting/Agreements Officer with a current copy of its Classified Research Policy and Procedures as well as any future amendments to that policy that may be made during the term of this CA."

1.10. Information Security. In accordance with the FATC-LF article entitled "Information Security," within sixty days of the effective date of this award, the Awardee shall provide to the NSF Program Officers a written, updated summary of the Awardee's current IT security program to protect research and education activities in support of the award. All other text of FATC-LF Article entitled "Information Security" remains unchanged.

Programmatic Terms and Conditions (PTC):

General PTC:
http://www.nsf.gov/publications/pub_summ.jsp?ods_key=NSF15587TPTC000

Award Specific PTC:

Part 2. Award Specific Programmatic Terms and Conditions (PTC)

2.1. Program Description. The ICNO is the world's first high-energy neutrino detector, located deep within the ice cap under the U.S. Amundsen-Scott South Pole Station in Antarctica. The neutrinos are detected through their interactions in or near the cubic kilometer IceCube array of 5160 optical sensors that constitute this detector. These interactions produce high-energy muons (charged particles) that pass through the detector providing a way to determine the arrival direction and energy of the primary neutrino. With the discovery in 2013 of the first neutrinos from beyond our Solar System, the ICNO demonstrated that it has opened a new window on the Universe, providing unique data on the engines that power active galactic nuclei, the origin of high-energy cosmic rays, the nature of gamma-ray bursts, the activities surrounding supermassive black holes, and other violent and energetic astrophysical processes. The purpose of this award is to provide funding for the continuing exploitation of the Observatory for new discoveries and exciting science.

2.2. Mission. The mission of ICNO/M&O is to operate and maintain the IceCube high-energy neutrino detector located at the South Pole, and to coordinate research effort with IceCube researchers worldwide towards the goal of exploiting ICNO fully for science and education.

2.3. Specific Duties of the Awardee. The Awardee will plan, staff, execute, and manage the maintenance and operations of the IceCube Neutrino Observatory. The Awardee will operate and maintain ICNO in accordance with the operational requirements, policies and procedures set forth in the ICNO Management & Operations Plan (M&O Plan). Specific activities will be described and submitted for approval via this Plan. Specifically, the Awardee will:

a. Operate and maintain the ICNO infrastructure, manage the Observatory technical and scientific staffs (including subawardees), as well as all activities carried out by the IceCube Collaboration and partners according to current best practices and in full compliance with all relevant laws and regulations, including National Security requirements.

b. Provide upgrades, enhancements and new services as required and within available resources to ensure community access to state-of-the art facilities and support.

c. Recruit, develop and retain qualified scientific, education, engineering and administrative staff. Review management staff, policies and procedures as needed.

d. Coordinate and provide technical support for NSF-funded awards to other organizations requiring access to IceCube data in accordance with the requirements defined in the annual M&O Plan.

e. Assist NSF in developing and implementing strategic partnerships with U.S. universities, federal, non-federal, and international organizations that will enhance the scientific capabilities and support available to the entire polar scientific community in accordance with the requirements defined in the annual M&O Plan.

f. Consult with advisory committees and the Collaboration to help ensure that IceCube facilities and services are responsive to the Collaboration's needs.

g. Adhere to a written policy for acceptance of any complementary programs supported by sponsors other than NSF. The Awardee shall submit the policy within 60 days from the beginning of this award for NSF approval. The policy shall include written notification to the NSF Program Officers prior to entering into any formal arrangements with other partners, including foreign governments, corporations, non-profit organizations, universities or other organizations.

h. Develop and use appropriate methods to determine the effectiveness of management performance for ICNO. Develop and use appropriate methods to monitor and improve the Awardee's interactions with ICNO primary stakeholders.

2.4. Quality Objectives. In performing the Awardee's specific duties in support of the ICNO mission, the Awardee will be required to plan for and demonstrate continuing progress in the following areas:

a. Ensuring that the ICNO/M&O activities meet the established operational requirements.

b. Responding to the community of ICNO users by addressing questions and communicating future plans for ICNO.

c. Using effective performance measures or performance metrics.

d. Continuing to improve the representation of women and underrepresented minorities in the ICNO workforce.

e. Enhancing the capabilities of its technical, financial and management systems to support ICNO maintenance and operations.

2.5. Project Governance
a. Overall Organization. The IceCube Neutrino Observatory is a collaborative effort between the University of Wisconsin (hereafter, the Awardee) and an international IceCube Collaboration (the Collaboration). The National Science Foundation (NSF) provides funding for U.S. activities and overall program oversight.

b. ICNO Operations Organization. The Awardee's ICNO Operations Organization is responsible for reliable overall management, operation of the IceCube detector, data management, and the full exploitation of the IceCube scientific program. The ICNO Operations Organization is located within UW's Wisconsin IceCube Particle Astrophysics Center (WIPAC). The WIPAC is the primary interface to the university administrative and support systems and includes people whose salaries are paid by the university, including accounting, purchasing, human resources, and other general administrative support. The Operations Organization has five primary elements: Program Management, Detector Maintenance & Operations, Computing & Data Management, Triggering & Filtering and Data Quality, and Reconstruction & Simulation Tools.

1) Program Management. Activities will include Management and Administration, Engineering, Science and R&D Support, USAP Logistics, Safety, Software Coordination, Coordination of Education and Outreach, Distributed Computing infrastructure, and other services typically provided by a scientific host laboratory.

2) Detector Maintenance & Operations. The Awardee's proposed objectives shall demonstrate high data quality, meet necessary data throughput rates, provide a secure archive and appropriate technical documentation, follow accurate maintenance and upgrade procedures, maintain a problem reporting system, follow a cost-effective upgrade strategy, maintain a software library and revision history, and demonstrate overall system sustainability. Areas included under this element are: Run Coordination, Data Acquisition (DAQ), Online Filters (P&F), South Pole System (SPS) and South Pole Test System (SPTS), Experiment Control (IceCube Live), Monitoring, Calibration, Surface Detector Operations and Supernova Operations.

3) Computing & Data Management. Activities will include: filtering data at South Pole for satellite transmission and incorporating data into the Data Warehouse; maintenance of Data Warehouse and UW Data Center and support the Distributed Computing infrastructure; maintenance of data archiving system, networking and security infrastructure, core online/offline software code repository and build system; maintenance of the simulation production software and coordination for the production data stream and simulation stream, and maintenance of the data processing software and verification software framework.

4) Triggering & Filtering. Activities will include coordination of the Trigger, Filter and Transmission (TFT) board and develop and verify Physics Filters and code for pole filtering. The TFT board evaluates proposals and executes plans to ensure that the IceCube detector operates in a configuration that meets the physics needs of the Collaboration while ensuring that the limited resources available from the South Pole System are utilized. The Physics Filters that select events for immediate transmission to the Northern Hemisphere must be evaluated for further analysis to ensure that they meet the evolving physics needs of the Collaboration and that the most effective reconstruction and filtering tools are in use online.

5) Data Quality, Reconstruction & Simulation Tools. Activities will include managing Simulation Software tools and maintaining detector simulation software (IceSim), maintaining and verifying simulation of Event Generation, Photon Propagation, and Geometry Calibration; developing core common Reconstruction Tools in order to process raw waveform data to ultimately reconstruct muon tracks, shower events, direction, energy, and background probability of in-ice events, as well as to reconstruct cosmic-ray air showers; developing and maintaining high level Analysis Tools to maximize the efficiency of turning reconstructed data into physics results; performing Data Quality checks to support final selection of science-ready data and coordinating, developing and monitoring common reconstruction for Offline Data Processing.

c. UW-Organized Advisory Groups
1) Software & Computing Advisory Panel. The UW-organized ICNO Software & Computing Advisory Panel (SCAP) is composed of experts in the fields of software development and scientific computing. The SCAP advises the Awardee's PI and Co-PIs and the Collaboration on the following topics: on-line computing; on-line and off-line data processing and filtering; off-line computing facilities; and, simulations and analysis support. The Panel provides a written report to the Awardee following each meeting.

2) Science Advisory Committee. The UW-organized Science Advisory Committee (SAC) provides advice to the Awardee's PI and Co-PIs and to the Collaboration on the IceCube scientific program, and evaluates the effectiveness of support provided by the operations organization and the contributions of the IceCube collaborating institutions. The Committee provides a written report to the Awardee following each meeting.

d. Major Subawards. As proposed by the Awardee and approved by NSF, major subawards at the time of this award are as follows:

1) The Lawrence Berkeley National Laboratory (LBNL): Data acquisition maintenance; computing infrastructure.
2) Pennsylvania State University: Data Acquisition firmware support; simulation production.
4) University of Delaware, Bartol Institute: IceTop calibration, monitoring and maintenance; on-ice field work.
5) University of Maryland, College Park: Overall IceCube software coordination; IceTray software framework; simulation software; maintenance and testing of PnF software and online filters.
6) University of Wisconsin, River Falls, as a shared grant: IceCube Education and Outreach.
7) University of Alabama at Tuscaloosa: Detector re-calibration, reconstruction and analysis tools.
8) Michigan State University: Simulation software, simulation production.

e. Key External Organizations
1) The IceCube Collaboration. The IceCube Collaboration currently consists of 47 institutions in 12 countries and approximately 300 students, postdocs, faculty and other researchers. The ICNO/M&O is a collaborative effort involving UW and the rest of the IceCube Collaboration for operation and management of the centralized core activities at the South Pole Station and UW, and distributed M&O activities at the other collaborating institutions. These activities are supported by NSF under this award and by a Common Fund, consisting of funding as well as in-kind contributions, provided by the IceCube Collaboration. Every IceCube institution will contribute to M&O, to service activities associated with normal experiment run monitoring, calibration, and data validation, and to analysis activities. Institutions outside the U.S. are supported by their respective national funding agencies.

2) The International Oversight and Finance Group (IOFG): The IOFG is a committee created in 2004 to inform NSF and other partner agencies about the issues related to management of the IceCube Project (including construction phase, M&O and research phases, and sunset phase) or issues that may affect the future of the IceCube Project. The IOFG is currently comprised of representatives of the funding agencies from Belgium, Germany, Sweden, and the United States that participated in construction of the IceCube Neutrino Observatory and works by consensus according to guidelines agreed internally by the group. The IOFG is chaired by the cognizant NSF Program Officers.

2.6. Planning Requirements
a. ICNO Management & Operations Plan (M&O Plan). Within 60 days of receipt of this award, the Awardee will submit the M&O Plan to NSF. The M&O Plan should be structured along the same lines as the Operations Organization described by 2.5.b and address at a minimum each of the Quality Objectives described by 2.4 above. The M&O Plan will describe the management, roles and responsibilities, lines of authority and communications, critical or significant project activities, and performance objectives and milestones. The M&O Plan will clearly identify the budget allocation of the various funding sources, including the direct NSF funding provided through this award, the Common Fund, and any other sources. The Awardee will work with the Collaboration to define the activities and costs for which the Common Fund will be expended. The M&O Plan will be updated annually and submitted for NSF approval together with the annual progress report within 90 days prior to the annual expiration date. The Awardee will send the approved M&O Plan to each of the non-U.S. IOFG members.

b. Memorandum of Understanding (MOU). Within 60 days of this award, the Awardee will provide an update on the existing (and new if necessary) MOUs with all U.S. and foreign institutions in the Collaboration that will perform M&O and related service activities and submit the signed MOUs to NSF. The MOU includes commitments to all M&O tasks to be carried out by the overall collaboration, including those supported by the Common Fund, and through in-kind support, and

by funding provided through this agreement. The MOU will also include the commitments to service activities by each collaborating institution. The Awardee will provide the MOUs to the IOFG for review and to take cognizance of the commitments made by the overall collaboration, and in particular, commitments by the institutions to which their funding agencies provide support. The MOUs and addenda shall be updated and re-submitted as changes occur, typically on an annual basis.

c. Integration and Coordination. The Awardee is responsible for integrating the contributions to M&O by all participating organizations. Activities in support of this key responsibility shall be included in all required plans and reports. The Awardee will operate or coordinate centralized Core Activities, including operations of core computing systems, networking at Wisconsin and South Pole, data warehouse, data acquisition system maintenance, online filtering and maintenance of test facilities, instrumentation research and development, science and technical support, general management and administration, and education and outreach. Core Activities are supported by NSF under this award and by the Common Fund, consisting of funding as well as in-kind contributions. The Awardee will also coordinate the distribution of Service Activities such as routine monitoring, calibration and event simulation tasks that are to be performed by members of the Collaboration as part of their own base grant support.

2.7. Reporting Requirements
a. Electronic Submissions. The Awardee will provide ad hoc and regular reports as designated by the NSF cognizant Program Officials with content, format, and submission time line established by the NSF cognizant Program Officials. The Awardee will submit all required reports via Research.gov using the appropriate reporting category; for any type of report not specifically mentioned in Research.gov, the Awardee will use the Interim Report function in FastLane to submit reports.

b. Annual Report. The Awardee will submit annual reports through Research.gov within 90 days prior to the project's annual expiration date. The report will describe progress made based on milestones and objectives in the approved annual M&O Plan. Significant differences between planned and actual accomplishments will be discussed. The report will consist of a summary of work accomplished during the reporting period, including major technical accomplishments and an assessment of current or anticipated problem areas and corrective actions, and progress in the area of project governance. Approval of the Program Officers is required prior to receipt of scheduled incremental funding.

c. Interim Reports. This agreement requires one 6-month interim report of the status of all M&O activities under this award. The Awardee will submit to the NSF Program Officers a brief summary, including a section on the overall status and performance of the data handling and detector systems. It will also include highlights and accomplishments, specific comments on detector performance such as uptime and scheduled maintenance, commissioning status, failures, software releases and test results, major procurements planned or placed, an assessment of the overall labor effort, and any other performance data that is needed to characterize the overall data system performance. The report is due by the end of the sixth month of the current term. However, NSF reserves the right to require more frequent reporting if necessary.

d. The Final Report, which will include all 60 months of this award term, will be required within 120 days after the project's expiration date.

2.8. Awardee Support of Ongoing Management and Oversight
a. Annual Reviews. NSF will conduct reviews of the ICNO/M&O activities through annual site visits of cognizant Program Officers that will address management issues, cost and performance objectives, and scientific and technical performance and issues. An external panel review covering, at a minimum, project management, cost and performance objectives, and scientific and technical performance will be organized after the second and fourth project years to inform NSF's decision on potential pathways for the support of ICNO/M&O activities beyond 2021. NSF expects to invite IOFG members to participate in this review.

b. Point of Contact. The Project Directors for the Awardee will serve as the point of contact for the NSF cognizant Program Officials, including providing notification of any critical project management issues such as changes in key personnel, cost, schedule, and management structure or procedures prior to implementing such changes.

c. Commitment and Cooperation. The Awardee will ensure full commitment and cooperation among the governing structure components and all program staff during all ongoing NSF program management and oversight activities. The Awardee will ensure availability of key institutional partners during any desk or on-site review as well as timely access to all program documentation.

d. GPRA Reporting Metrics. The Awardee will work with the NSF Cognizant Program Officials to define appropriate GPRA performance metrics for ICNO M&O.

2.9. NSF Required Clauses for Work Performed in Antarctica and Data Policy
a. Work performed in Antarctica. This award is subject to the Antarctic Conservation Act (ACA), 16 U.S.C. 2401. Unless authorized by regulation or permit, violation of the ACA may result in civil or criminal fines up to $10,000, imprisonment for up to one year, and, where appropriate, administrative sanctions up to and including debarment.

b. Data Policy. The Director of the Division of Polar Programs (PLR) has established Guidelines and Award Conditions for PLR Scientific Data. The full document is available via the PLR web page (http://www.nsf.gov/div/index.jsp?div=plr), or, directly, at http://www.nsf.gov/geo/geo-data-policies/plr/plr-data-mgt-policy-jan21-2016.pdf. In concert with the award package approved by the National Science Board, the Awardee developed a plan for data management, dissemination, and sharing IceCube research results and data that is consistent with the NSB and IOFG guidance and with the overall

NSF data policy. This plan is included in the IceCube Collaboration Governance Document as Appendix E (rev. 8.4, November 2015) and available from the project's website (http://icecube.wisc.edu/collaboration/governance).

2.10. Key Personnel
a. Prior Approval. The individuals specified below are considered essential to the work being performed hereunder. Prior written approval of the cognizant NSF Program Officers and the NSF Contracting/Agreements Officer is required for any changes in key personnel.

Principal Investigator
Director of IceCube Operations
Associate Director for Science and Instrumentation

b. Other Critical Personnel. The cognizant NSF Program Officers shall be notified in advance of any changes to the proposed upper level management structure, overall management structure and the IceCube Collaboration Spokesperson.