Configuration Management Plan
2019-007.2

	Approval	Date
Project Manager	Farshid Feyzi	02/19/20
Technical Coordinator	Mike DuVernois	02/07/20
Project Engineer	Perry Sandstrom	02/12/20
Q&S Manager	Mike Zernick	02/19/20

Change Log

Revision	Description : Author	Date
0	Original document: M. Zernick	03/07/19
1	Clean-up, addition of cooperative agreement definitions for budget and schedule impact: M. Zernick	07/01/19
2	Updated hardware control/CR process passages, general edits: MAZ/FF/MDuV/JD	02/19/20

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IceCube Upgrade Configuration Management Plan

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1.0 Purpose

The purpose of the Upgrade Configuration Management Plan is to assure that IceCube Upgrade documentation is controlled, complete, correct, and available for IceCube Upgrade personnel, collaborators, reviewers, and users.

2.0 Scope

2.1 This plan describes the document release and revision control procedures used by the IceCube Upgrade to meet the requirements of the quality management system and the personnel responsibilities to implement the procedures.

2.2 It applies to all collaboration members involved in the IceCube Upgrade project worldwide.

2.3 In situations where information in this document conflicts with another document, the project manager, project engineer, and quality and safety (Q&S) manager shall resolve the conflict.

3.0 References

3.1 This document is created under authorization of the IceCube Upgrade Project Execution Plan (PEP) and is subordinate to the IceCube Upgrade Quality Plan.

3.2 2020-001, IceCube Upgrade Project Execution Plan (PEP) 9000-0003, IceCube Upgrade Quality Plan.

3.3 2019-006, IceCube Upgrade document control procedure 2019-001, Upgrade WBS dictionary database definitions.

4.0 Definitions

4.1 **SharePoint** - the repository for IceCube Upgrade project documentation.

4.2 **Approval** - the process through which a document is reviewed and determined to be suitable for use by knowledgeable staff and management.

4.3 **Author** - the person that creates the document; typically used for text documents; interchangeable with originator.

4.4 **Controlled document** - any process or project document that is formally approved, maintained, distributed, and revised via a document control system.

4.5 **Document** - any electronic- or paper-based representation used to communicate information. For the purposes of the IceCube Upgrade project, documents may appear as product proposals, requirements, specifications, plans, analyses, design reviews, traceability matrices, parts lists, drawings, schematics, processes, procedures, training materials, manuals, e-mail, assembly and test records, acceptance forms, budgets, and schedules. The word “drawing” can be used as a synonym for document.

4.6 **Document control system** - the system used to create, approve, maintain, revise, distribute, and archive documents at a given facility.

4.7 **Document management system** - the system used to oversee the maintenance of project documents throughout the collaboration.

4.8 **Change Request (CR)** - the process by which document and design changes are revised, controlled, and released (documents may be made obsolete or deprecated through this process also).

4.9 **Originator** - the person that creates the document; typically used for graphic documents; interchangeable with author.

4.10 **UW** - University of Wisconsin–Madison

5.0 Responsibilities

5.1 The configuration manager (CM) is the Q&S manager. The Q&S manager will assure changes are completed correctly and supervise the uploading of the new revisions and archiving of obsolete documents. The Q&S manager reports to the project manager.

5.2 Originators of IceCube Upgrade quality documents/items are required to follow the documentation process as described in the next section.

5.3 Persons approving IceCube Upgrade documents are required to follow the documentation process as described in the next section.

6.0 Process

The configuration management process for IceCube Upgrade shall include the following components:

6.1 Document Control

6.1.1 Requirements

The fundamental requirements for document control are as follows:

6.1.1.1 All information needed to design, manufacture, test, install, and use systems and components developed for IceCube Upgrade are defined in

appropriate drawings and documentation. This includes information required to coordinate work, allocate resources, and monitor progress.

6.1.1.2 The current documentation reflects the current configuration.

6.1.1.3 Previous configurations are documented and archived.

6.1.1.4 A flexible procedure exists for preliminary drafts and/or items not requiring a formal release and control system while maintaining the necessary minimum elements.

6.1.1.5 Appropriate personnel must approve documentation before release.

6.1.1.6 In general, documentation must be released before hardware is procured and built or before software is released or delivered. Exceptions can be made for good reasons, such as early procurement of long-lead items or fast track rapid prototyping schedules, but in such cases there must be timely follow up to assure documentation is completed as soon as possible.

6.1.1.7 After release, changes are accomplished through a formal change procedure to assure that appropriate personnel have reviewed the proposed changes and that the impact on other system components and documents is taken into consideration and implemented.

6.1.1.8 The revision status of all IceCube Upgrade documents must be clear and readily verifiable.

6.1.1.9 Because of their nature, some documents generated for the project do not need to be controlled through a document control system, but do need to be archived. These documents include meeting minutes, design review reports, and e-mail messages.

6.1.1.10 The current, released, and authoritative version of each document resides in the appropriate SharePoint library.

6.1.2 Document Content

6.1.2.1 PEP supporting documents (i.e., processes, procedures, forms, specifications, test plans, etc.) shall contain the following information:

- **Purpose** - the reason the document was written.
- **Scope** - what portion of the project and project staffing the document applies to.
- **References** - other documents referred to in the document.
- **Definitions** - listing of applicable acronyms and terminology definitions.
- **Responsibilities** - who (by title or function) is accountable for activities described in the document.
- **Process/procedure/plan** - details of the activities the document describes.
- **Records** - the documentation (paper or electronic) that needs to be maintained to assure compliance with requirements.

6.1.2.2 Each page of the document shall include (at a minimum):

- Document identification - document name and/or number.
- Page number

6.1.2.3 All documents shall indicate the total number of pages in the document.

6.1.2.4 All documents shall contain a revision history that describes the changes made to the document after its initial approval and the reason why the changes were made.

6.1.2.5 The approval signatures shall be maintained as part of the document.

6.1.2.6 Documents created for the Design Baseline Library bear the contents as demonstrated in the instructions and examples in the Design Baseline Library in Sharepoint.

6.1.3 Document Management Procedures

The project document control system is maintained at the IceCube Upgrade project office and is implemented as described in this section. It shall contain all concept and authorizing documents for the project (see 6.1.5). ***Requirements for document control systems at other facilities are defined in 6.1.6.***

6.1.3.1 **Document (drawing) list** - The project document list is depicted in the respective SharePoint library. The required fields included in each record are:

6.1.3.1.1 **Document number** – PEP support document numbers are assigned sequentially and are of the form:

YYYY-00X.V
YYYY = Year; X = sequential number; V = version

Design Baseline Library assigns document numbers to its documentation as per the instructions for each document as contained in the Design baseline Library.

6.1.3.1.2 **Originator** - The initials of the author of the document identify the originator. When the document has been generated outside of UW, the institution name may be substituted for the author's initials.

6.1.3.1.3 **Originator date** - This is the date of the current preliminary (before release) version. It should be updated each time the document is changed. At the time of release, this date remains the date the document was last updated prior to release.

6.1.3.1.4 **Release date** - This is the date of the original release of the document defined as the date of the last signature, normally quality assurance (QA), in the formal approval process. Other signatures normally required in addition to QA are the originator, engineering, and project management. QA signs last because one of the items verified by QA is the presence of all required signatures. The release date is not subsequently changed. Preliminary documents have no release date

and the field is blank.

6.1.3.1.5 **Revision date** - For revisions (all changes after original release), the revision date is the date the revision was approved and signed off. Note that preliminary documents do not have revision dates. The latest version of a preliminary document is defined by the originator date. The revision date is the date that the QA sign-off has occurred on a CR.

6.1.3.1.6 **Document format** - Templates for various documents exist in their respective SharePoint libraries.

6.1.3.1.7 **Document flow** - The author shall forward electronic files of the documents to the project technical coordinator.

6.1.4 Approval and Release

6.1.4.1 When the document has been reviewed and signed by the required personnel or passes through the requisite Design Review, it is released and is subject to formal distribution and revision control. Documents shall be reviewed and approved by appropriate personnel prior to release. The signing of a document by an approver indicates that that person agrees the document is suitable for its intended use and ready for release.

6.1.5 Distribution

6.1.5.1 The Q&S manager will upload approved documents into the appropriate SharePoint library. Note: The version suffix must be removed from the document number prior to uploading it. Otherwise, SharePoint will upload it as a new document rather than a revised one. The current version document number must be maintained.

6.1.6 Document Control Systems

The IceCube Upgrade project has numerous collaborators (partners) that are/will be involved in the design, development, and manufacturing of the project. The document control systems at partner facilities may vary

significantly in scope and capability.

6.1.6.1 The partner document control systems shall be used for approving, maintaining, and revising IceCube Upgrade documents if they meet the requirements noted in sections 6.1.1, 6.1.2, 6.1.4, 6.1.5, and 6.4.

6.1.6.2 Partner document control systems must have a current drawing or document list that contains the document title, document number, current revision, and name of author.

6.1.6.3 Facilities may use the project document control system if they do not have a document control system that meets these requirements.

6.1.6.4 It is the responsibility of all UW suppliers to notify the UW Q&S manager and the cognizant UW engineer or subsystem manager of all documentation changes.

6.2 Hardware Control

The control and location of the hardware documentation lies within the design baseline and as-built libraries in SharePoint. The baseline content is stored in a documentation database in SharePoint that allows for collaboration-wide contributions, editing, and reviewing. There exists a full available history of edits. A document control system transitions the uncontrolled documents held in common by the collaboration into controlled and approved documents. The Q&S manager manages the transition from uncontrolled to controlled documentation with approvals from tech board discussions and internal engineering reviews.

This configuration management system originated in the first year of the project and contains the systems and subsystems of WBS 1.3, 1.4, 1.5, and 1.6. The drill documentation is handled separately as the requirement of broad, international editing of the documents is not required for the drill. The respective L3 (or lower) managers own these documents until the documents are controlled via successful review.

6.2.1 Control of Hardware Documentation

Documentation generated for the purposes of defining the design, manufacture, installation, and service of IceCube Upgrade

hardware shall be created, approved, and changed per the processes noted in sections 6.1 and 6.4 of this document.

6.2.1.1 Hardware documentation may include:

- Requirements
- Specifications
- Assembly procedures
- Assembly drawings
- Bill of materials (BOMs)
- Test procedures
- Routing sheets, travelers, test result forms
- Installation/commissioning procedures and forms

These drawings are organized with a hierarchical configuration management document (CMD) index file, an interface design document (IDD), an engineering requirements document (ERD), and design notes (DSN) as described in the design baseline library in SharePoint.

System engineering is handled through multiple, defined document types for each baseline configuration item. Configuration items are stored hierarchically from the “IceCube Upgrade” level down to low-level hardware and software items such as cable assemblies, electronics boards, and glass pressure housings. Each configuration item has the following documents:

- Configuration management document (CMD) - links the hierarchy of configuration items and BOMs for bottom level configuration items.
- Engineering requirements document (ERD) - details the engineering requirements, and often how a requirement hooks to science requirements, how a requirement is verified, and how a requirement is set.
- The engineering requirements come from the higher-level science requirements via the PEP science-engineering requirements flow-down matrix. They blend with the hardware experiences learned from the Gen1 IceCube construction. This is especially important for the extreme environment of the deep, cold glacial ice of South Pole.
- Interface definition document (IDD) - covers the interfaces (electrical, mechanical, optical, etc.) between a given configuration item and any other

configuration items affected.

- Design status document (DSN) - within a presentation format, contains the status of the design, photos of parts, and links to manufacturers and software repositories as needed, and it generally forms an evolving repository of documentation of the design process of the individual configuration item.

6.2.2 Assembly Drawings

6.2.2.1 Assembly drawings shall be developed for each assembly or subassembly that needs to be manufactured for the IceCube Upgrade.

6.2.2.2 **Version** - Assembly drawings shall clearly state the version of the assembly or subassembly they represent.

6.2.3 Assembly Procedures

6.2.3.1 Assembly Procedures, as applicable, shall clearly state what version(s) of the assembly with which they shall be used.

6.2.4 Bill of Materials (BOM)

6.2.4.1 Each assembly drawing shall be accompanied with a BOM that describes all of the materials and components that are required to build an assembly or subassembly, including quantity, part/model # (as appropriate), and part version (as appropriate).

6.2.4.2 The BOM may be a standalone document or included as part of the assembly drawing. (DOMPRODTEST)

6.2.5 Hardware Configuration Database

6.2.5.1 Engineering shall establish a database that maintains the "as built" configuration of IceCube Upgrade devices (for hardware, software, and firmware). (DOMPRODTEST)

6.2.5.2 The database shall contain the following information:

6.2.5.2.1 Part #, serial #, and revision of the final assembly.

6.2.5.2.2 Part #, serial #, and revision of all subassemblies integrated into an assembly.

6.2.5.2.3 Part # and serial # of major components integrated into an assembly.

6.2.5.2.4 Firmware installed.

6.2.5.2.5 Date of manufacture.

6.2.6 Installation

6.2.6.1 Records shall be maintained in the project office of the order and location in which devices are installed into the IceCube Upgrade array.

6.2.6.2 This includes:

- Digital optical modules
- Cables - down hole and surface
- Down hole accessories - hole loggers, calibration devices, etc.
- Computers and major data acquisition accessories (i.e., DORcards)

6.3 Software Control

The IceCube Upgrade software is controlled in accordance with the M&O Plan, including use at GitHub.

6.3.1 Testing is emphasized in the development stage. There are unit tests for individual components for functionality. Integration and system testing occur at the (South Pole Test Station) SPTS.

6.3.2 Releases are named, numbered, and tagged in version control system.

6.3.3 All major changes (DAQ, DOM mainboard software) reviewed at collaboration-wide teleconference before rollout.

6.3.4 8- to 24-hour test runs of release candidates at pole – data quality vetted by operations group

6.4 Change Control

6.4.1 Preliminary documents - Preliminary documents may be changed by the originator and distributed as needed. The originator must advise the CM of the date when the revision occurs.

6.4.2 Released documents - Released documents may be changed only via a CR or similar partner change system. Supporting

documents may be revised through a partner's change control system.

6.4.3 Project change request process - The originator (owner) of the change or a member of the change control board shall complete the CR form. The person completing the form gets a CR number from the CR Log, notes the changes to the document, and fills out the CR form. Note: The project manager in conjunction with the Q&S manager manages the project change request process.

6.4.3.1 Each IceCube Upgrade CR receives a CR number of the format xxx, where xxx is the next sequential number in the SharePoint CR folder for the IceCube Upgrade.

6.4.3.2 The CR process shall be flexible enough to accommodate technical and project (programmatic) changes, where project changes include cost (budget), schedule, and science objectives.

6.4.3.2.1 Project changes shall be reviewed and approved as described in the PEP and detailed throughout this section.

6.4.3.3 If the change can be described simply in words, it may be done via the CR form by itself. For more complex changes, a redlined copy of the changed document(s) or other supporting documents (i.e., budget spreadsheets) can be attached to the CR. It is also acceptable to use electronic revision tracking.

6.4.3.4 The CR master log shows the CR number, originator, date the CR number was issued, and the document(s) being changed.

6.4.3.5 The CR is then circulated through a SharePoint workflow for approval to the same functions approving the original document.

6.4.3.6 See **Change Class Table** below:

Change Class Table			
Class of Change	**Class 1**	**Class 2**	**Class 3**
Types of Change	• **Project purpose or goals** • **Total Project cost (>/= $150K)** • **NSF milestone**	• **Project Technical Baseline** • **Performance Requirements** • **WBS Level 2 cost** • **Project Office milestone** • **Interfaces** • **Safety** • **Quality** • **Contingency Funds** • **Reliability**	• **WBS Structure below Level 3** • **Does not affect form, fit or function** • **WBS Level 3 cost** • **Subsystem milestones** • **Does not cross interfaces or WBS elements**
NSF Approval?	**YES**	**NO**	**NO**
Approval Signatures	**Project Manager** **L2** **Originator** **QA**	**Project Manager** **L2** **Project Engineer** **Originator** **QA**	**L2** **Technical Lead/Engineer** **Originator** **QA**
CCB Approval?	**YES**	**YES**	**NO**
Tech Board Approval?	**YES**	**YES**	**YES**

6.4.3.7 Class 2 changes may result in collateral baseline changes. In this case, it is recommended that two CRs be submitted, one for the Class 2 change and one for the corresponding Class 1 change.

6.4.3.8 Quality system changes will be addressed as technical changes.

6.4.3.9 Once approved, the changes are incorporated into the document(s) and the revised document(s) proceed through the SharePoint workflow for sign-off.

6.4.3.10 After all tasks related to a given CR have been completed, QA conducts a final review of the CR to ensure that the information contained in the CR and adjunct documents is complete and accurate. QA then signs and closes the CR.

6.4.3.11 After approval, the completed CR is filed, and the log is updated with the date the CR was approved and closed.

6.4.3.12 A database of all CRs will be maintained and will be made available for access on the network through SharePoint.

6.4.3.13 One CR can be used to change more than one document. The CR should describe a change that affects multiple documents.

6.4.3.14 All new changes to the enhanced hot water drill (EHWD) will be made through the IceCube Upgrade project office system. Technical changes to the (EHWD) may be completed through the PSL change process (PSL manages the construction and testing of the EHWD for the Upgrade project).

6.4.4 Project change control board - A project change control board (CCB) shall be convened to review project, design, and documentation (Class 1 and Class 2) changes for the project.

6.4.4.1 Responsibilities - The responsibilities of the CCB shall be to review proposed changes to project content (schedule, budget, scope), project/device design, or project documentation to determine:

6.4.4.1.1 Whether the change should be implemented.

6.4.4.1.2 Where the change is to be implemented.

6.4.4.1.3 Other devices or documents that are affected.

6.4.4.1.4 Dispensation of materials, subassemblies, etc., in process (scrap, rework, use as-is).

6.4.4.1.5 Timing of implementation, including change cut-in (i.e., phased cut-in, use all old units first, etc.).

6.4.4.1.6 Effect on project quality and safety.

6.4.4.1.7 Verification to qualify change (what verification is needed and whether the documentation is adequate).

6.4.4.1.8 Effect on cost, funding source, schedule, and scientific objectives.

6.4.4.2 Changes to be reviewed - All changes except Class 3 changes shall be reviewed by the IceCube Upgrade project CCB with respect to the criteria noted in 6.4.4.1.

6.4.4.2.1 At a minimum, Class 3 changes shall be submitted to the technical coordinator for concurrence on the classification.

6.4.4.3 Chairperson - The project manager or designee, who has responsibility for the change control process, shall chair the CCB.

6.4.4.3.1 The project manager will determine the classification of changes.

6.4.4.3.2 The project manager shall convene meetings of the CCB and invite additional members as appropriate.

6.4.4.4 Timing of meetings - The CCB shall convene at least weekly, but may be convened more frequently at the chairperson’s discretion. The CCB chairperson has discretion to cancel or postpone a meeting.

6.4.4.5 Members - The membership of the CCB is as defined in the IceCube Upgrade Project Execution Plan (PEP).

6.4.4.5.1 The final decision for baseline changes shall reside with project management.

6.4.4.6 Participants - Other project staff or non-collaboration members may attend meetings of the CCB (in addition to the CCB members).

6.4.4.7 Quorum - An official CCB meeting shall have at least six members present.

6.4.4.7.1 Attendance may be through physical attendance or by phone, computer, or other electronic means.

6.4.4.8 Approval and implementation - All Class 1 and 2 changes shall be reviewed by the CCB prior to final QA sign-off.

6.4.4.8.1 Changes shall not be implemented before the CR is signed.

6.4.4.9 Class 1 change proposals - Changes that represent a significant change to the schedule, budget, or scientific objectives shall be escalated to the project manager and the National Science Foundation for review and approval per the PEP.

6.4.4.10 Records of meetings - Minutes of CCB meetings shall be maintained and include (at a minimum):

- Attendees
- CRs reviewed
- Actions
- CR outcome (need more information, closed, sent to NSF for approval, etc.)

7.0 Records

7.1 **Document (drawing) list** - The project will maintain a document (drawing) list as described above (see 6.1.3.1). When specified, a paper copy of the list will be maintained in the IceCube Upgrade project office (or other suitable location).

7.2 **Electronic document files** - Electronic files of current and superseded documents will be stored in the SharePoint archiving system.

7.3 **Original paper documents** - The original paper copies with signatures for process and top level documents are maintained in the IceCube Upgrade project office at UW–Madison, as applicable. The signed originals of supporting documents are maintained in the document control system of the facility having oversight for that document.

7.4 **Paper copies** - Paper copies of released and revised documents are not necessarily controlled or current. The online version of a document is current.

7.5 **Change requests** - Signed copies of the CR forms, including the redlines/changes, supporting documents, and a copy of the final revised document, are maintained in the change control library in SharePoint.

7.6 **Master CR log** - This log is maintained in the change control library in SharePoint.

7.7 **Change control board meeting minutes**

Title	Assigned To	Status	% Complete	Outcome	Created
IceCube Upgrade CMP 2019-007.2	MICHAEL A DUVERNOIS	Completed	100.00%	Signed	2/7/2020 10:44
IceCube Upgrade CMP 2019-007.2	PERRY W SANDSTROM	Completed	100.00%	Signed	2/12/2020 10:44
IceCube Upgrade CMP 2019-007.2	FARSHID FEYZI	Completed	100.00%	Signed	2/19/2020 13:35
IceCube Upgrade CMP 2019-007.2	Mike Zernick	Completed	100.00%	Signed	2/19/2020 13:45