U.S. DEPARTMENT OF ENERGY

PNNL-19974

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

Tethys: The Marine and Hydrokinetic Technology Environmental Impacts Knowledge Management System

Requirements Specification
Version 1.0

RS Butner
LJ Snowden-Swan
PC Ellis

October 2010

Pacific Northwest
NATIONAL LABORATORY

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UNITED STATES DEPARTMENT OF ENERGY
under Contract DE-AC05-76RL01830

Printed in the United States of America

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Tethys: The Marine Hydrokinetic Technology Environmental Impacts Knowledge Management System

Requirements Specification

Version 1.0
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Peter Ellis
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Approvals		**Date**
Project Manager	_____	_____
Group Manager (Internal Sponsor)	_____	_____
Technical Resources Manager	_____	_____

Prepared for
the U.S. Department of Energy
under Contract DE-AC05-76RL01830

Pacific Northwest National Laboratory
Richland, Washington 99352

Project Summary

Project Name	Subtask 2.1.1.1 - Development of Knowledge Management System		
Project Number	57417		
Project Manager	R.S Butner	**Phone**	372-4946
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Bldg/Room		**Mail stop**	
External Sponsor (Customer)	DOE EERE WHTP	**Phone** **FAX**	
Address			
Project Dates	xx/xx/xx ➔ xx/xx/xxxx (Start ➔ End)		
PM Plan Period	xx/xx/xx ➔ xx/xx/xxxx (Start ➔ End)		
FY Budget		**Estimated FTE**	
Estimated Procurements		**Estimated Subcontracts**	

Revision History

Release	Date	Comments
0.x	xx/xx/xxxx	

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Introduction

The marine and hydrokinetic (MHK) environmental impacts knowledge management system (KMS), dubbed Tethys after the mythical Greek goddess of the seas, is being developed for the U.S. Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy Wind and Hydropower Technologies Program (WHTP) by Pacific Northwest National Laboratory (PNNL).

Specification Purpose and Scope

This requirements specification (RS) establishes the essential capabilities required of Tethys and clarifies for WHTP and the Tethys development team the results that must be achieved by the system. Any illustrative model presented in this document is used solely to explain Tethys requirements and is NOT intended to address design or implementation issues.

Tethys Purpose and Scope

Tethys will compile information on the environmental risks from MHK devices and facilitate the creation, annotation, and exchange of information on the environmental effects of MHK technologies. Tethys will support the Environmental Risk Evaluation System (ERES), which developers, regulators, and other stakeholders can use to assess relative risks associated with MHK technologies, site characteristics, water body characteristics, and receptors (i.e., habitat, marine mammals, and fish). Development of Tethys and ERES will require focused input from stakeholders to ensure accuracy and alignment with other needs. Tethys will also support an international impacts database that will serve the member nations of the International Energy Agency's Implementing Agreement on Ocean Energy Systems (IEA-OES), Annex IV.

Existing data will be gathered from multiple sources, and data generated during the project will be added to Tethys as they become available. Sources of information will be sought from pilot and commercial MHK projects in the United States and abroad, from targeted environmental studies supported by DOE and other sources, and from data generated by PNNL and other national laboratories. Initial data will include raw quantitative data, text-based electronic documents, geographic information system (GIS) maps and layers, engineering drawings and specifications, technology descriptions, and

demographic data. In subsequent years, data from project tasks under way concurrently by PNNL and Sandia National Laboratories also will be entered into the KMS. Tethys will be the "public face" of the MHK environmental impacts effort.

A likely software solution that meets many of these criteria is the Knowledge Encapsulation Framework (KEF). The KEF was developed by PNNL under the aegis of the Technosocial Predictive Analytics Initiative (TPAI), a multiyear Laboratory Directed Research and Development project that represents a nearly $6 million investment in model integration research by PNNL. The KEF will be used as a platform for initial Tethys prototype development to permit rapid development and testing of user interface (UI) concepts.

The Product Overview section describes factors that affect Tethys and its requirements. Appendix A, Concept Examples, gives detailed examples of how Tethys is expected to be used.

Definitions, Acronyms, and Abbreviations

Some of the following definitions are taken or adapted from IEEE Std. 610.12-1990 and ANSI/IEEE Std 830-1984.

availability — the degree to which a *system* or *component* is operational and accessible when required for use. Often expressed as a probability [IEEE Std. 610.12-1990].

component — one of the parts that make up a *system*. A component may be hardware or software and may be subdivided into other units or components [IEEE Std. 610.12-1990]. Note: For this specification, the term *component* will be used in preference to the terms *module* and *unit*.

ERES — Environmental Risk Evaluation System.

extendibility — the ease with which a *system* or *component* can be modified to increase its storage or functional capacity [IEEE Std. 610.12-1990] (synonyms: extensibility; expandability).

FERC — Federal Energy Regulatory Commission.

functional requirement — a requirement that specifies a function that a *system* or system *component* must be able to perform [IEEE Std. 610.12-1990]. In this *requirements specification*, functional

requirements specify how the inputs to the software product should be transformed into outputs [ANSI/IEEE Std 830-1984].

GIS — geographic information system.

IEA-OES — The International Energy Agency's Implementing Agreement on Ocean Energy Systems.

interface requirement — a *requirement* that specifies an external item with which a *system* or system *component* must interact, or that sets forth constraints on formats, timing, or other factors caused by such an interaction [IEEE Std. 610.12-1990].

MHK – marine and hydrokinetic energy.

KEF —Knowledge Encapsulation Framework, developed by PNNL.

KMS – knowledge management system.

maintainability — the ease with which a software *system* or *component* can be modified to correct faults, improve performance or other attributes, or adapt to a changed environment [IEEE Std. 610.12-1990] (contrast with *extendibility*).

module — see *component*.

NOAA — National Oceanic and Atmospheric Administration.

performance — the degree to which a *system* or *component* accomplishes its designated functions within given constraints, such as speed, accuracy, or memory usage [IEEE Std. 610.12-1990] (contrast with *reliability*).

performance requirement — a *requirement* that imposes conditions on a *functional requirement*; for example, a requirement that specifies the speed, accuracy, or memory usage with which a given function must be performed [IEEE Std. 610.12-1990] or a static numerical requirement such as the number of simultaneous users to be supported or the number of files and records to be handled [ANSI/IEEE Std 830-1984].

PNNL — Pacific Northwest National Laboratory.

portability — the ease with which a *system* or *component* can be transferred from one hardware or software environment to another [IEEE Std. 610.12-1990] (synonym: transportability).

product — (for this document) a *system* or *component*—along with any necessary data and documentation—for which requirements are specified in a *requirements specification*.

QA — quality assurance.

reliability — the ability of a *system* or *component* to perform its required functions under stated conditions for a specified period of time [IEEE Std 610.12-1990] (contrast with *performance*).

requirement — (1) a condition or capability needed by a customer to solve a problem or achieve an objective; (2) a condition or capability that must be met or possessed by a *system* or *component* to satisfy a contract, standard, *specification*, or other formally imposed document; (3) a documented representation of a condition or capability as in (1) or (2) [adapted from IEEE Std. 610.12-1990].

requirements specification (RS) — a document of the essential *requirements* (functions, performance, design constraints, and attributes) of the software and/or hardware and their external interfaces [adapted from IEEE Std. 610.12-1990].

RS — *requirements specification*.

system — a collection of *components* related in such a way as to produce a result greater than what their parts, separately, could produce.

TPAI — Technosocial Predictive Analytics Initiative.

UI – user interface.

unit — see *component*.

usability — the ease with which a user can learn to operate, prepare inputs for, and interpret outputs of a *system* or *component* [IEEE Std. 610.12-1990].

WHTP — DOE Office of Energy Efficiency and Renewable Energy Wind and Hydropower Technologies Program.

Document Overview

The **product overview** describes the Tethys system—its users, operating environment, and general factors that affect requirements—and lays the foundation for understanding the specific requirements that follow.

The **functional requirements** describe the core functions needed by the MHK stakeholders group to automate the receipt and disposition of information within Tethys.

The **external interface requirements** include general user interface requirements and logical characteristics of interfaces between Tethys and other systems that support Tethys. Specific user interface requirements are also being developed independently of this document as part of the Phase A prototype.

Design constraints specify external requirements—particularly hardware platform choices—that bound the design solutions for Tethys.

Security requirements discuss the requirements for safeguarding data within Tethys.

Other sections include information on performance requirements, personalization requirements, and documentation requirements stipulated for Tethys.

Appendix A, Concept Examples, gives detailed examples of how the Tethys system is expected to be used.

Appendix B, Taxonomy, is a list of controlled terms that appear in this RS.

Appendix C, References and Resources, provides a list of publicly available sources cited in this RS.

Product Overview

The following overview of Tethys provides context to make it easier to understand the specific requirements presented in subsequent sections. All specific requirements are *numbered* in subsequent sections.

Product Perspective

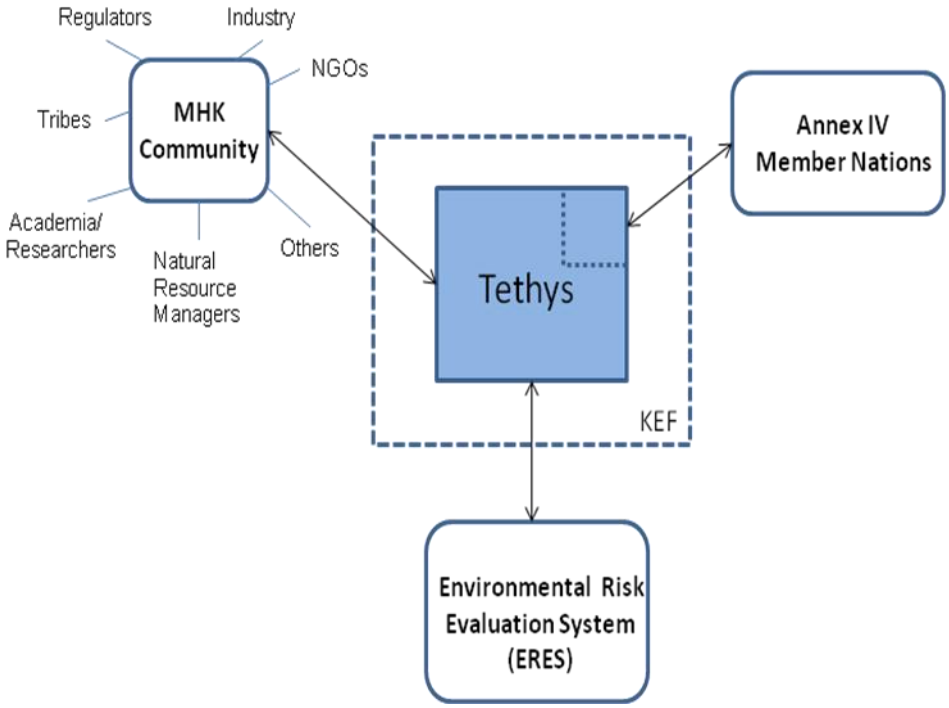

Figure 1 - Tethys System Overview

Product Functions

Tethys will facilitate the creation, annotation, and exchange of information on environmental impacts of MHK technologies. Tethys will support ERES, which developers, regulators, and other stakeholders can use to assess relative risks associated with MHK technologies, site characteristics, water body characteristics, and receptors (e.g., habitat, marine mammals, and fish). The ERES is being developed under a concurrent project task. Tethys will also support an international impacts database that will serve the member nations of the IEA-OES, Annex IV.

Existing data will be gathered from multiple sources, and data generated during the project will be added to Tethys as they become

available. Sources of information will be sought from pilot and commercial MHK projects in the United States and abroad, from targeted environmental studies supported by DOE and other sources, and from data generated by PNNL and other national laboratories. Initial data will include raw quantitative data, text-based electronic documents, GIS maps and layers, engineering drawings and specifications, technology descriptions, and demographic data. In subsequent years, data from project tasks under way concurrently by PNNL and Sandia National Laboratories also will be entered into Tethys. Tethys will be the "public face" of the MHK environmental impacts effort and will support the following requirements:

- Provide access to disparate datasets and documents, including qualitative models and findings, quantitative datasets, geographic and tabular data, and technical publications.
- Be sufficiently flexible to accommodate future uses or data types.
- Have the ability to sample and aggregate datasets into data packages.
- Support the ERES through effective software interfaces and consistent identification of data types and relationships.
- Support the performance and documentation of quality assurance on all data, and require the documentation and tagging of QA results.
- Aggregate outputs of analyses and model runs.
- Be accessible to the PNNL-led research team and to outside users with a variety of privileges.
- Be searchable in many ways.
- Contain pointers to outside datasets, especially geographic data.
- Provide portals for data inputs from outside entities.
- Provide a defined space for the IEA-OES Annex IV data and data products.

The Knowledge Encapsulation Framework, developed by PNNL under the aegis of the TPAI, will be used as a platform for initial Tethys prototype development and will inherently support many of the functionality requirements described here.

User and Environment Characteristics

The intended users of Tethys are individuals within the US and international MHK community, including researchers, academia, industry, government, regulators, nongovernmental organizations (NGOs), and other stakeholders and decision makers. These users will have diverse purposes for using Tethys, and thus the system will be designed to accommodate a variety of user types. Users will both contribute to the knowledge base and search for data. The average

user is expected to use the system weekly and is not expected to have highly sophisticated computer knowledge.

Tethys will be developed using KEF, an evidence-marshalling environment for modelers and others interested in establishing semantic linkages between distinct pieces of data. KEF allows users to store, share, and annotate datasets and other information objects (e.g., documents, images, and video) and provides the means to establish links between these objects.

Development of Tethys will take place using rapid prototyping techniques. In this development methodology, certain systems (particularly user interfaces) are developed iteratively, using rapid deployment of interface concepts and design features to allow the user community to test and evaluate them. To facilitate user feedback to these user interface concepts, a development blog will be set up that lets developers share notes about the design intent with the user community and allows the user community to provide feedback to the development team in real time as changes are made.

See Appendix A, Concept Examples, for detailed examples of how Tethys will be used.

General Constraints

Tethys must be sensitive to copyright laws and regulations when making published information available to users (e.g., literature available through paid subscription only). Although Tethys may contain proprietary data (e.g., from the Annex IV datasets), the system is not expected to contain classified materials, and system design does not accommodate export-controlled, Official Use Only, or other potential DOE document classification levels beyond documents and data cleared for access to the general public and data that is already publicly available. This constraint is discussed further in Section 3, Design Constraints.

Assumptions and Dependencies

The hardware platform used for Tethys is accessible to appropriate PNNL staff members for system initialization, maintenance, and troubleshooting.

The KEF operates most commonly in a mode that does not restrict access to documents uploaded to the system. Therefore, for this project, it is assumed that the KEF can effect permissions control over both wiki content and files physically resident on the KEF filesystem

and that the search services described herein can take advantage of these access control methods.

1. Functional Requirements

1.1 Data Access

1.1.1 Access to Disparate Datasets

Description:
Tethys shall provide access to disparate datasets and documents, including qualitative models and findings, quantitative datasets, geographic data, tabular data, and papers/electronic files in .pdf format.

For each data source, Tethys shall

- Provide context-specific interfaces for the data as enumerated in the sub-requirements to this section.
- Allow for browsing and search capabilities over all datasets.
- Allow for the semantic annotation of each data type, where possible.

1.1.1.1 Geographic Data

Description:
Tethys shall provide a means to associate documents and datasets with geographic locations or regions, and to browse the associated documents and datasets in a map format in addition to viewing the original source data for verification and validation activities. Tethys shall also provide the means to annotate this data via Tethys' standard annotation methods.

Geographic data will also require the ability to provide multiple data overlays within a single map space. See note in Section 10.2.2.1 about a potential need to replace Google Maps—currently used by the KEF—with a more robust mapping solution to support specific map visualization capabilities.

1.1.1.2 Technical Documents

Description:
Tethys shall provide a means to convert technical publications and documents published in common word processing or web-compatible formats (e.g., MS Word Documents, PDF documents, and HTML) into a wiki-based format for storage as a wiki page. It shall store the wiki-converted data in the wiki and allow users to view the original source

document alongside the wiki version of the text to verify that the two documents appropriately match.

PDFs will be unavailable for direct annotation; however, the wiki text version of the document shall support annotation via Tethys' annotation system.

1.1.2 Flexibility for Future Uses

Description:
Tethys shall be sufficiently flexible to accommodate new uses or data types. Code shall be written in a manner that allows Tethys maintainers to appropriately expand on and construct new functionality based on new data sources or new requirements for existing data sources.

1.1.3 Access to Outside Data Sets

Description:
Tethys shall permit the creation of pointers to outside information resources, referenced by URL/URI. A wiki page for this resource will be created in Tethys and will support the usual annotation and semantic property capabilities. Links to these datasets shall be maintained by Tethys staff, though links can be submitted via other sources (this is not currently fully accounted for in this specification, but is partly covered by requirement 1.1.4).

1.1.4 Users Adding Data

Description:
Users will be given access to the system to add data as desired from various sources. As part of this requirement, limitations on what users may add need to be determined, and, if needed, appropriate access groups for adding data need to be defined.

1.2 Data Processing/Manipulation

1.2.1 Data Packaging

Description:
Tethys shall have the ability to sample and aggregate datasets (e.g., outputs of analyses and model runs) into data packages. We define "data packages" here as having the capability to cluster or group documents related to a particular model, task, or research interest using the KEF's semantic capabilities. These "data packages" can be either specific to a user (and thus private) or publicly accessible.

1.2.1.1 All Wiki Documents May Be Packaged

Description:
All documents stored in Tethys, whether datasets, geographic data, or actual documents, shall be eligible for treatment as a member of a data package. Only wiki versions of these documents may be packaged; however, original versions shall be accommodated by being appropriately attached or linked to the wiki text version of the original.

1.2.1.2 All Wiki Documents May Be Members of Multiple Data Packages

Description:
A single document must be allowed to be part of multiple data packages.

1.2.1.3 Interface Must Be Provided

Description:
A suitable interface must be provided that both indicates which data packages a given document is a member of and indicates to the user an easy method of constructing either a private or a public data package.

1.2.1.4 Must Integrate With Model Results

Description:
The data packaging mechanism must integrate with models to allow the supporting data used in the modeling runs to be attached to the results.

1.2.2 Multiple Search Avenues

Description:
Tethys shall allow the user to search in several ways, including but not limited to

- full-text searches against the entire Tethys document collection
- limited searching against defined subsets of the ERES and Annex IV standards, as well as semantic properties used by other document formats stored in Tethys
- human-curated keyword searches, as needed.

The Tethys design team shall regularly assess the need for additional search functionality based on user needs and the volume of available data.

1.2.3 Models Run Externally

Description:
Initially, Tethys shall only be responsible for enabling the marshalling of evidence for model runs while also documenting and providing accountability measures for each model run. Tethys shall also be expected to store results of a given model run, but initially these models shall be run external to Tethys.

At a later date, the Tethys design team shall explore the appropriate integration of model runs into Tethys as demand and staff availability allow. If this is considered, the Tethys design team shall take into account associated issues at design time, including at minimum

- user interface requirements and constraints
- access requirements and constraints.

1.2.4 Annotation Layer Must Be Separated from Display Layer

Description:
Data gathered from external data sources must support some level of annotation within.

1.3 Portals for User-Provided Data

Description:
Tethys shall provide a method by which it may be linked to outside data sources that serve as authoritative data sources on MHK technologies. This will include data from the IEA-OES Annex IV databases. In addition, if data from a given portal is pulled into Tethys for storage and reference, Tethys shall appropriately note that the data was originally from an external source and make relevant information about that source available, including but not limited to

- original author of the data
- date the data was created
- date the data was entered into the system (if needed)
- link back to the original data set (if available).

1.4 Support to ERES

Description:
Tethys will support the ERES through effective software interfaces and consistent identification of data types and relationships.

Although there are no data standards for ERES as of this writing, Tethys shall adhere to any data standards established by the ERES in supporting the ability to store, manipulate, and view ERES data.

For usability requirements, refer to Section 5.1.3.

1.4.1 Consistently Identifying Data Types and Relationships

Description:
Given the same input, Tethys should consistently identify the data types and relationships such that two distinct imports of the same data effectively match. In addition, when importing multiple sources of data that match ERES data standards and requirements, all elements in these datasets shall be understood to have the same basic meaning as any other dataset containing ERES data.

1.4.2 ERES Data Structures Within Tethys

Description:
Tethys shall store relevant input and output files generated by ERES. These input and output files shall mirror the organizational structure used by other KEF projects, namely

- ERES
    - ERES Input Data
    - ERES Case Study Outputs
        - Run 1
        - Run 2
            - Scenarios

ERES input data values are available for annotation and viewing but cannot be changed. The input information may be commented on, and information may be added. The copy maintained within the Tethys wiki shall be imported from the original ERES data file for this purpose (and the original ERES data file shall never be changed).

1.5 Support to Annex IV

Description:
Tethys will provide a defined space for interested parties to query the IEA Annex IV data and data products.

Although there are no data standards for Annex IV as of this writing, Tethys shall adhere to any data standards established for Annex IV in supporting the ability to store, manipulate, and view Annex IV data.

For usability requirements, refer to Section 5.1.3.

1.6 Quality Assurance

Description:
Tethys will support the performance and documentation of quality assurance on all data and require the documentation and tagging of QA results. Further, Tethys shall require quality assurance measures and documentation for its backend code to ensure code quality and stability.

1.6.1 All Data QA Measures Shall Be Publicly Auditable

Description:
Data provided within Tethys shall make transparent any QA information available for that specific dataset. Users should be able to use this QA information as part of an overall assessment of the quality of data available within Tethys, as well as the quality of the data available for their own needs.

1.6.2 All Code QA Measures Shall Be Auditable Within PNNL

Description:
Any staff member working on Tethys shall be able to audit any design documentation, code, code documentation, testing results, or associated material to ensure sufficient code quality and stability of Tethys as a project. Tethys designers shall take continual steps to improve and otherwise enhance QA quality to assist in the active development of Tethys as a publicly accessible tool.

1.6.3 Development Blog

Description:
The Tethys design team shall maintain a blog to inform Tethys users of the team's design intent and to allow users to provide appropriate feedback. The blog shall be clearly linked from the main Tethys interface, and any Tethys user shall be allowed to post comments (only Tethys designers will be allowed to add new posts).

1.6.4 User Support Forum

Description:
The Tethys design team shall maintain a discussion forum to assist in the discussion of the system's design; this will be distinct from the blog posts and will provide a method of collecting feedback that might not otherwise be gathered due to the scope of each development blog

post. The forum shall be clearly linked from the main Tethys interface, and any Tethys user shall be allowed to post comments.

1.6.5 Rapid Prototyping Techniques

Description:
As part of the quality assurance process, developers shall use rapid prototyping techniques combined with feedback from Tethys stakeholders to develop and maintain the system. Developers are expected to release iteratively, starting with a minimum subset of the desired functionality and building on known functional and stable code.

2. External Interface Requirements

2.1 Behavioral Requirements/Business Rules

2.1.1 Data Interface Requirements

Description:
The KEF KMS framework shall represent data in conformance with the officially accepted standards for the respective data formats. The KEF KMS framework shall also accept data structured according to the officially accepted standards for each respective data format. See also Section 3.1.1.

2.2 User Interface Requirements

2.2.1 Ability to Import Data

Description:
Tethys should allow users to import data in the ERES, Annex IV, and other required datasets as a fluid portion of the Tethys interface. This interface should utilize the same user interface used to browse and query the data via Tethys.

As noted elsewhere in this RS, each data import shall comply with the data standards established for each data format. Should standards not exist for a data format, data imports shall represent a "best faith" attempt to add data to Tethys, with user and stakeholder input whenever possible. The Tethys design team shall establish specific allowed and disallowed file types for data that may be added to the system as part of an effort to ensure data quality.

2.2.2 Data Querying Ability

Description:
Tethys shall allow the user to query data in order to manipulate and better understand the data made available through the system. The Tethys UI shall support this by providing several different interfaces for data querying, including, at minimum, querying against metadata properties defined within the data.

2.2.3 Data Browsing Ability

Description:
The Tethys UI shall support the user's ability to browse through data made available via Tethys. It shall provide complete access to the models and assumptions made to provide the data and shall provide the users with a method of understanding and presenting the meaning of the data. In addition, the UI shall provide multiple methods of accessing this information to support the variety of data interpretation and access styles of the target audience.

Tethys shall allow for visualizing the data's relationship with its region. Because each data unit relates to a specific geographic area, the UI must support the ability to browse information, given a defined geographic scope.

2.2.3.1 Minimum Browsing Data Available

Description:
When displaying data, Tethys shall provide the following metadata to users, regardless of data type:

- an indicator of the type of data being shown
- an indicator of the quality of the data being shown (which will be determined via screening by knowledgeable subject matter experts or a suitably knowledgeable Tethys staff member)
- an indicator of the age of the data.

Source:
See Appendix A, examples A.3 and A.4.

2.2.4 Data Accessibility

Description:
Tethys users will be able to access data efficiently through several different data access paths. In all cases, the users shall be able to access the data requested or required with a minimum of overhead, which we define as an average of within four clicks from the main Tethys screen.

2.2.5 Functionality Will Be Geared Toward Appropriate Audience

Description:
When designing the functionality for Tethys, the design team shall take into account the various personas described in Appendix A, Concept Examples. Each function shall be evaluated against several

potential audiences to ensure that the interface is designed for use by the greatest number of interested parties.

Where designs are necessarily specific to a given user group, this will be appropriately noted in both the interface and the associated design documents.

2.2.6 Users Shall Be Provided Collaboration Space

Description:
Users shall be provided with a forum space to enhance the collaborative abilities of Tethys. This forum space will be contained within the same software used by the developers for user communication as described in Section 1.6.4. The forum space shall be visibly linked from all Tethys pages.

2.2.7 EndNote Exports

Description:
Tethys shall provide the capability to export a reference list in EndNote-compatible format for use by researchers that need to maintain a citation database.

2.3 User Personalization Requirements

Description:
This subsection covers requirements for user personalization features within Tethys.

2.3.1 Tethys Shall Be User-Aware

Description:
Tethys must be able to independently identify users to provide the user personalization requirements outlined below and any future user personalization requirements deemed necessary by the Tethys design team.

2.3.2 Tethys Shall Store User Data in a Persistent Manner

Description:
Tethys must be able to store user-specific preferences such that these preferences persist regardless of the computer or environment used to access Tethys. This data must be tracked on the server side.

2.3.3 Users Shall Be Provided with Data Packaging Ability

Description:
Refer to Section 1.2.1 for details.

2.3.4 User Shall Be Provided with "Shopping Cart" for Downloads

Description:
Users will be provided with a "shopping cart" mechanism which they can use to select content from Tethys to download and review for later reference or for use in other environments. After filling the cart, the user will be able to either save those documents for later review or download them in a compressed format.

2.4 Hardware Interface Requirements

Description:
The KEF KMS framework is considered hardware-agnostic insofar as the hardware can comply with the underlying software interface requirements as necessary.

Tethys shall run on the following recommended minimum hardware specifications:

- 2.5-GHz processor, preferably with multiple cores
- 8-GB RAM
- 300-GB disk space.

Note that these requirements reflect an optimum configuration and that testing has shown that hardware significantly affects the responsiveness and overall usability of KEF-related projects, including Tethys. If the site is moved to new hardware, disk space minimum requirements shall be determined in part by the total amount of disk space used by Tethys.

Currently, PNNL manages the hardware that hosts Tethys. Should this change, the Tethys design team strongly recommends considering a match to that hardware that exceeds the minimum specifications above.

2.4.1 Network Access

Description:

The machine running Tethys shall have appropriate network access to ensure that all users that require access to the system can access it.

2.5 Software Interface Requirements

Description:
The KEF KMS framework is built on a traditional Linux/Apache/MySQL/PHP (LAMP) software stack with additional Java components that allow the framework to find material related to specifically tagged documents within the KMS.

- PHP requires at least version 5.2.11, but the KEF framework does not currently support any version in the 5.3 branch.
- MySQL 5 is required.
- Apache 2.2.13 is required, at minimum.
- Java 1.6.0_17 is required for the automated discovery mechanism and pipeline mechanism.

2.5.1 Summarizer Component

Description:
KEF uses a summarizer component specific to Apple's OS X operating system to assist with generating summaries of documents contained within KEF wikis, including Tethys. If Tethys is relocated to another operating system that matches the software interface requirements described herein, another alternative summarizer would need to be located for use with the system.

3. Design Constraints

3.1 Standards Compliance

3.1.1 Data Import/Export Standards

Description:
Tethys shall support importing and exporting data that is formatted according to either the ERES or Annex IV data standards. Other data standards and the Tethys' ability to import/export according to those data standards will be assessed and implemented as needed.

3.1.1.1 Data Import Standards

Description:
When made available, Tethys shall adhere to any standards dictated by the ERES or Annex IV when importing data from these data sources. For any other data that adheres to a particular standard, Tethys shall adhere to that standard when importing relevant data.

3.1.1.2 Data Export Standard

Description:
Tethys shall use RDF or Dublin Core for data exports whenever possible. The Tethys design team is expected to determine which of the two standards is more appropriate for supporting the project.

3.1.2 Internal Metadata Standards

Description:
Tethys shall use a consistent and documented standard of representing data and relationships between data elements internally. Due to the nature of Tethys and its use of wiki-based semantic data, the internal standard shall be the definition and querying standards set forth by the Semantic MediaWiki extension to MediaWiki.

3.2 Other Limitations

3.2.1 PHP Compatibility Limitations

Description:
The KEF framework currently does not operate on PHP 5.3 and above due to component compatibility issues. Software running the KEF KMS framework is required to run on the 5.2 branch of PHP to maintain compatibility.

4. Performance Requirements

4.1 Data Access Speed

Description:
Individual pages within Tethys shall load initially within 10 seconds, with an optimum page loading target of fewer than 2 seconds. For pages that require additional processing past the initial page load, the framework must indicate to the user that an action is still underway.

4.2 Accuracy of Data Displayed

Description:
When provided a set of inputs, Tethys shall take all measures possible to ensure that those inputs are correctly and accurately displayed to the user. Tethys is not required to validate or otherwise ensure the veracity of a given dataset; however, Tethys is required to ensure that the data is correctly and accurately displayed to users who request that data.

5. Usability Requirements

5.1 Ease of Data Entry and Manipulation

Description:
Users of the KMS will be able to manipulate and understand metadata associated with a particular data model without advanced knowledge of how the metadata is structured or specified.

5.1.1 Provide a Usable Semantic Exploration Frontend

Description:
The KMS shall provide graphical frontends to assist with metadata property exploration and annotation. Users will be able to explore the data without necessarily being made aware of the associated metadata format.

5.1.2 Provide a Usable Browsing Frontend Specific to Data Types

Description:
As covered in sSections 1.1.1.1 and 1.1.1.2, the system shall provide proper browsing frontends for each distinct type of data that may be input to the system. The system must also support the expansion of these frontends to include more advanced user interactions or the addition of new data types that require distinct data presentation.

5.1.3 Support for ERES-Specific or Annex IV-Specific Needs

Description:
Should specific usability needs arise to support access to ERES or Annex IV data, the Tethys design team shall take these needs into account when designing any specialized interfaces for these two data sources.

6. Reliability Requirements

6.1 Highly Reliable Core Functionality

Description:
The KEF KMS is built atop MediaWiki, a wiki engine that supports multiple forms of caching, load-balancing, and database replication—among other methods—to ensure high reliability. The wiki software underlying the KEF KMS shall maintain this reliability level by using various methods of increasing availability and response times as required for Tethys.

Source:
Wikipedia (2010a).

6.2 Uptime

Description:
Although Tethys itself is not considered mission-critical, the client still expects at minimum a 90% uptime. Should errors or problems cause downtime, the system shall be required to fail gracefully and notify users of these issues.

Because uptime measurements are subjective, we consider a 90% uptime rating to include machine uptime, network availability, and applicable performance issues that cause slow response times (which effectively render the service unusable even with a consistent machine or network uptime).

Per Wikipedia, a 90% uptime rate implies 36.5 days of downtime per year.

Source:
Wikipedia (2010b).

6.3 Backups

Description:
Tethys shall be appropriately backed up to ensure that the database driving the knowledgebase and the uploaded physical files associated with the knowledgebase are available for disaster recovery operations.

7. Security Requirements

7.1 Logins Required to Edit

Description:
The KMS shall ensure that users must create an account and log in before they can modify data. Access to browse data, however, shall be unrestricted except as described in Section 7.2.

7.2 Access Controls for User Actions

Description:
In addition to the minimum requirement that users must log in to edit data, the KMS shall support the ability to control user access to the individual portions of the KMS via a group-based permissions structure, with most groups defined during the construction phase of the process and additional groups defined as needed.

Further restrictions on user actions shall be determined as the project proceeds.

7.2.1 PNNL Staff Must Control Access

Description:
PNNL staff supporting the project must be able to control access across the KMS. At minimum, Tethys shall provide an access group for the Tethys design team and administrators, which shall have complete access to all system content and functionality.

7.2.2 Document-Level Permissions Controls Required

Description:
Tethys shall provide document-level permissions controls where needed and required by the nature of the data included in the wiki. In addition, Tethys must provide the ability to limit access to certain user actions or to groups of users (as opposed to individuals). Access controls shall also be available for groups of documents (as defined by MediaWiki categories).

Tethys must also provide the capability to prohibit public viewing of a set of documents or of a specific document, both with and without provided logins.

7.2.3 External Access Must Be Provided

Description:
Access must be provided to stakeholders external to PNNL for Tethys to be considered effective. Tethys must provide the ability to assign a variety of privileges to these external users.

7.3 Access to Underlying Software and Hardware

Description:
Access to the underlying software and hardware supporting Tethys shall only be available to PNNL staff with a direct need to support the project. Access shall be denied to non-PNNL staff and PNNL staff without a sufficient need. Access shall be granted at the discretion of the project manager or Tethys administrators as needed.

8. Availability Requirements

8.1 Availability of Supporting Resources

Description:
Tethys' availability relies on all of the associated components within the KMS operating in a consistent and stable state, including the network connection, web server software (and its associated extensions), database software, and the KMS software itself.

As stated in section 6, Tethys itself is not considered mission-critical, but a minimal guarantee for uptime and appropriate data backup measures must be taken to provide the highest availability level for these resources.

8.2 Uptime

Description:
Requirement 6.2 is duplicated here by reference.

9. Portability Requirements

9.1 Tethys Portability

Description:
Tethys must be able to be relocated to new hardware as needed insofar as the new hardware complies with the hardware and software requirements (Sections 2.3 and 2.4, respectively). However, Tethys will initially be located on hardware supported by PNNL, so no immediate portability need exists.

Should there be a need to move Tethys to new hardware, refer to Section 2.4.1.

9.2 Model and Model Data Portability

Description:
To allow for the ultimate portability of model data and the use of Tethys as an evidence-marshalling environment, Tethys must allow retrieval of original source information about particular models, including the data for a given model or a given model run.

9.2.1 Import Processing

Description:
Models imported into Tethys must be able to be processed for the model data to appear within Tethys. Tethys will allow imports of model data using the official standard for specifying a given model format. Data that ignores or otherwise violates the standard shall not be imported to ensure the quality of available Tethys data.

For any data import processing, Tethys developers must provide appropriate code to facilitate the import of a given data type which adheres to any applicable data standards.

9.2.2 Export Processing

Description:
Although Tethys is not intended to be the method by which models are run, the system must recognize that users need to retrieve models and associated data from the system in a format that is usable for continued modeling. This may mean simply providing a link to the original model data that was imported into Tethys, or, at a later date, may also mean dynamically generating models within the system itself.

9.3 Document Portability

Description:
Tethys shall allow users to download, where appropriate, the original source documents stored within the system, which includes any imported quantitative or qualitative data, papers, files in .pdf format, or other documents.

9.3.1 Wiki-Based Documents Shall Link to Original Source

Description:
Any wiki-based document within Tethys shall contain a link back to the original source file.

10. Supportability Requirements

10.1 Maintainability Requirements

10.1.1 Tethys Shall Separate User and Data Layers

Description:
Tethys developers shall ensure that code layers for user interaction and data interaction are sufficiently abstracted such that they are independently maintainable.

10.1.2 Code Shall Adhere to QA Standards

Description:
All Tethys code shall adhere to the QA standards outlined in Section 1.6.

10.2 Extendibility Requirements

10.2.1 Model Expandability

Description:
The KMS must support the ability to add additional types of models in the future, in addition to supporting the extension and modification of existing models to adapt to user needs and requirements. The KMS shall allow for these model extensions while maintaining backwards compatibility with previous model versions as needed.

10.2.2 KMS Functionality

Description:
The KMS supports the ability to add functionality via the use of extensions to the framework. The KMS will allow maintainers to add functionality as needed.

10.2.2.1 Map Functionality

Description:
The KMS may be required to consider alternatives to the current implementation of Google Maps as a viewer of geographic data if Google Maps cannot provide sufficient levels of detail, given the GIS data provided for Tethys. Other options shall be evaluated if the need arises to replace Google Maps as the preferred map engine.

Appendices

Appendix	Information
Concept Examples	This is a description of how end-users might use the product in one or more realistic situations.
Taxonomy	A listing of properties that shall be used by Tethys.
References and Resources	A list of the documents referenced in the RS and where to find them.

A. Concept Examples

A.1 Federal Resource Manager – NOAA National Marine Fisheries Service Staff

Jane is a biologist with the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service and is investigating whether there are concerns with a proposed wave energy project off the northern coast of Washington state. A wave energy company has submitted a preliminary permit application to the Federal Energy Regulatory Commission (FERC), and Jane is working with the applicant to gather baseline information in order to provide a thorough review of the study plan and biological assessment presented in the application. Her responsibilities involve not only review of FERC applications, but non-FERC projects (e.g., projects pursued by the government) as well.

The question that Jane is trying to answer for every project proposal is: "How sensitive do we view this area?" Initially, she is looking for information that indicates the presence of sensitive fish species and/or habitats in the proposed project area. Jane's primary concerns are potential risks to the local fish population posed by the presence of a wave energy device and associated transmission cables (e.g., effect on kelp beds). The applicant has provided some initial information; however, Jane must check the validity of this information and find supplementary information in order to complete a thorough analysis.

The NOAA biologist is interested in producing queries where she selects the following:

- geographical region
- species of interest
- stressor of interest.

Jane would like Tethys to provide

- technical details of the technology proposed
- a map with multiple overlays showing (at a minimum)
    - site boundaries and location of cables
    - current uses of the project area
    - essential fish habitat and bathymetry at the site
    - species populations at the site

    - where in that geographical area studies have been performed.
- a list of environmental impact studies and project sites that may be related to the application
- an online forum for communicating/consulting with colleagues in the field who may have experience with similar sites.

Jane's role in the permit process focuses largely on providing due diligence across a wide range of technical issues, but typically she does not have the opportunity to focus exclusively on a single site or project. As a result, the knowledge management system needs to be able to support the rapid retrieval of both site-specific and general environmental impact information.

A.2 State Regulator/Permit Writer

Joe is a permit writer for the Washington State Department of Ecology. He would like to use Tethys in conjunction with the Environmental Risk Evaluation System (ERES; see Product Overview section of this RS) to determine the potential environmental stressors and primary risks associated with a tidal energy device being proposed for a pilot-scale facility off the west coast of Washington state.

Specifically, he must review applications to FERC for installation of MHK energy devices to ensure that the proposed projects comply with the Clean Water Act (Section 401, water quality) and the Coastal Zone Management Act (potential effects on coastal resources). As part of his job, he is in constant consultation with the State Department of Fish and Wildlife. The Department of Ecology is working on applying and retrofitting its standard process for in-water projects (e.g., traditional hydropower) to MHK device permits.

Because every proposed site for permitting is essentially unique, Joe must learn everything he can about the conditions of the site (e.g., site characteristics, resources in the area, and potential impacts of the technology on the site environment). For example, the benthic habitat and near-shore environment (eel grass and macro algae) in the proposed project area are one area of concern. Joe is responsible for using ERES (along with other tools and public involvement processes) to rank these impacts alongside other potential impacts.

An important consideration in Joe's work is that the public nature of the permitting process requires full transparency and traceability in his decision making; every assumption or data point used to develop the risk identification and prioritization must be available for public

scrutiny and evaluation. Tethys thus is expected to play an important part in providing that traceability and transparency. This will be provided by allowing model results to be associated with all of the supporting data used in the modeling runs (scenarios) as well as providing a mechanism for annotation of the results of these scenarios by multiple users.

Because Joe does not have the time to look at the raw data, he would be looking for summarization/compilations of data created by the Tethys system. For example, a map with overlays of potential sites for MHK technology, protected resources, and other attributes would be very useful to him. Existing MHK applications that are similar to the proposed site would also be very helpful.

Joe would also like a "shopping cart" that would allow him to choose the information resources on Tethys and save them for later (e.g., as bookmarks) or download them as a single compressed folder to his system. In addition, increased access to proprietary information for use in his reviews would help immensely.

Joe's role in the permitting process requires a great deal of interaction with the ERES risk modeling tool. Because the results of this modeling will help to shape the regulatory response to proposed projects, it is important that Tethys provide him with the ability to manage the risk modeling framework efficiently and effectively.

A.3 Tribal Scientist

Bob is a coastal geographer for the Swinomish Indian Tribe and needs information on one of the proposed in-stream tidal energy projects that the Snohomish County Public Utility District may develop in Puget Sound, Washington. The Swinomish Reservation is located on the northeastern shore of Puget Sound, near La Conner and Anacortes, Washington. Bob's responsibility is to protect treaty resources and rights and to determine whether the project will

- Interfere with or limit the tribe's access to traditional fishing grounds (i.e., "usual and customary").
- Negatively impact the fish species they hunt through direct impacts such as strike, electromagnetic fields, or acoustics, or through indirect effects such as changes in the tidal/shore characteristics.
- Otherwise negatively impact their fishing activities, such as by tangling or damaging tribal fishing lines and other equipment.
- Result in the placement of power lines and other supporting infrastructure on tribal lands.

Specifically, the tribal member would like to use Tethys to produce

- a map showing proposed site(s) for MHK devices (e.g., FERC map) with overlay of traditional fishing grounds
- a summary or simplified version of environmental research reports applicable to the area/species (possibly shown on map)
- restoration data, including historical records showing the natural conditions of the site.

Ideally, Bob would like to find supporting information that qualifies for Washington state's definition of best available science. The most important information would include not only current baseline biological and ecological information but also historical baseline data that reflect conditions prior to the establishment of treaty rights.

Bob's primary role is to advocate and monitor the "H" integration process, where improving harvest, hatchery, and habitat management simultaneously is used for successful recovery of viable fish (e.g., salmon) populations.

A.4 Public User (NGO)

Kristina works for Ocean Advocates, a grass-roots, non-profit organization concerned with ocean and coastal protection. Kristina is the lead responsible for providing information to and getting feedback from the organization's constituency on a proposed wave energy project off the California coast. She has been participating in an informal working group that includes several renewable energy industry groups and environmental groups with a stake in the development of wave energy.

Specifically, Kristina needs information on the potential impacts of the proposed wave energy project on wave height, sediment transport (beach profile), water quality, and electromagnetic effects on marine life. She is most interested in results of actual monitoring/collection of data on projects in the water. She has been working with the local wave energy project and will be receiving results from monitoring studies to help determine whether the project should proceed as planned, and if so, any mitigation strategies that will be necessary. Kristina would like to use Tethys to find

- marine spatial planning data at the project level (near shore, about 1 mile out from the shore)

- supporting information that would help her decipher the results of the monitoring studies
- a "translation" and putting into context (i.e., extrapolating to/from other projects) of the science of environmental effects of these projects for a lay audience (e.g., their constituency).

Kristina would also like Tethys to indicate data type and/or quality for each piece of information that she accesses on the Tethys system.

A.5 MHK Industry User

John is an engineer for XYZ Tidal Energy, a company interested in developing a tidal energy project off the coast of Maine. Initially, John needs to identify the best sites in the area for a tidal project, given factors such as current strength, bathymetry, seabed slope and composition, and proximity to population centers. John also needs to develop an overall understanding of the regulatory process involved, including the agencies that have a role in the FERC permitting process and the associated time commitment/allotment necessary for each stage of the process. Overall, John needs to learn as much as possible from the experiences of companies that have already entered or completed the process of acquiring a FERC license.

To support these needs, Tethys will provide

- a map showing the likely sites for tidal development in Maine waters, with an overlay of existing uses of these sites
- a regulatory timeline for existing projects showing key events and issued documents for projects already in the permitting process.

B. Taxonomy

The main page of Tethys will provide a search function that consists of approximately six drop-down menu categories along the lines of the following:

- Technology
  - Current-Based
    - Horizontal axis turbines
    - Ducted horizontal axis turbines
    - Vertical axis turbines
    - Oscillating hydrofoils
  - Wave-Based
    - Point absorbers
    - Attenuators
    - Oscillating wave surge converters
    - Oscillating water column
    - Overtopping devices
    - Submerged pressure differential devices
- Region
  - Tropical
  - Temperate
  - Subarctic
- Water Body Type
  - Estuarine
  - Coastal
    - Nearshore
    - Shoreline
  - Open Ocean
  - Riverine
- Site Characteristics
- Receptors
  - Ecological (inhabiting/migrating species, indirectly affected species)
    - Water quality and ecosystem
    - Reptiles
    - Aquatic and marine mammals
    - Fish
    - Aquatic and marine invertebrates
    - Birds
    - Benthic habitats
  - Non-ecological (alternative uses, visual/aesthetic/cultural impacts)
    - Navigation

        - Infrastructure
        - Coastal erosion
        - Recreation
- Stressors
    - Physical presence (obstructions, attraction)
    - Dynamic effects (strike)
    - Energy removal
    - Chemical
    - Acoustic
    - EMF
- Scale of Operation
    - Experimental (in-field)
    - Pilot
    - Full-sized, individual unit
    - Full array (farm)
- Data Source/Quality
    - Journal article (peer-reviewed)
    - Social media (e.g., blog)
    - etc.

C. References and Resources

ANSI/IEEE Std. 830-1984. *IEEE Guide to Software Requirements Specifications*. The Institute of Electrical and Electronics Engineers, New York.

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