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Project-Specific Design Methodology

Technology Evaluation and Optimization

Design Standards Development

Technology Innovations

Type/Project Certification Process

Long-Term Performance Monitoring

MHK Data Repository and Content Model

Metocean Design Basis

Ecosystem and Wildlife Impacts

MHK Data Repository and Instrumentation Database

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MHK Data Repository and Instrumentation Database

The Challenge:

1) Develop a framework where DOE-sponsored project data can be submitted, organized, tracked, protected, curated, and disseminated in compliance with federal data and metadata standards

2) Ensure the framework accepts project data for all types of DOE projects

3) Collect high-level data from all DOE projects in the categories of testing, levelized cost of energy, and design

4) Help increase testing success by implementing a knowledge sharing and communication tool for MHK-related instrumentation and testing that can be used by the international community

Program Strategic Priorities

Technology Maturity

- **Test and demonstrate prototypes**
- Develop cost-effective approaches for installation, grid integration, and operations and maintenance
- **Conduct R&D for innovative MHK systems & components**
- Develop tools to optimize device and array performance and reliability
- Develop and apply quantitative metrics to advance MHK technologies

Deployment Barriers

- Identify potential improvements to regulatory processes and requirements
- Support research focused on retiring or mitigating environmental risks and reducing costs
- Build awareness of MHK technologies
- Ensure MHK interests are considered in coastal and marine planning processes
- Evaluate deployment infrastructure needs and possible approaches to bridge gaps

Market Development

- Support project demonstrations to reduce risk and build investor confidence
- Assess and communicate potential MHK market opportunities, including off-grid and non-electric
- Inform incentives and policy measures
- Develop, maintain, and communicate our national strategy
- Support development of standards
- Expand MHK technical and research community

Crosscutting Approaches

- Enable access to testing facilities that help accelerate the pace of technology development
- Improve resource characterization to optimize technologies, reduce deployment risks, and identify promising markets
- **Exchange data information and expertise**

Legend:
- **Key Priorities**
- Additional Priorities

Project Strategic Alignment

Crosscutting Approaches

- Enable access to testing facilities that help accelerate the pace of technology development

- Improve resource characterization to optimize technologies, reduce deployment risks, and identify promising markets

- **Exchange data information and expertise**

The Impact

- A single repository of project data (e.g., reports, measurements, costs, drawings)

- Direct pipeline for project data dissemination that ensures maximum public access and benefit and impact of DOE's investment in technology development

- Broader impact by providing data to support: design basis development; standards development; technology innovation, technology evaluation, and optimization; certification; design methodology; ecosystem and wildlife impacts; long-term monitoring; tool validation; and strategic planning

- High-quality uniform data sets from all projects that allow industry-wide cross-cutting analysis

Project Strategic Alignment

Technology Maturity

- **Test and demonstrate prototypes**

- Develop cost-effective approaches for installation, grid integration, and operations and maintenance

- **Conduct R&D for innovative MHK systems & components**

- Develop tools to optimize device and array performance and reliability

- Develop and apply quantitative metrics to advance MHK technologies

- Time and cost of measurement and testing campaigns can be reduced

- More comprehensive and higher quality data, along with much more reliable measurement systems

- Higher impact analysis and findings

Final Products

- MHK Data Repository (MHKDR)

- Content models

- MHK Instrumentation Database

- Community of Practice

- Test Wiki

Technical Approach

Develop a data flow from the user to U.S. Office of Scientific and Technical Information, Data.gov, DOE Data Explorer, and Science.gov for scheduled data release
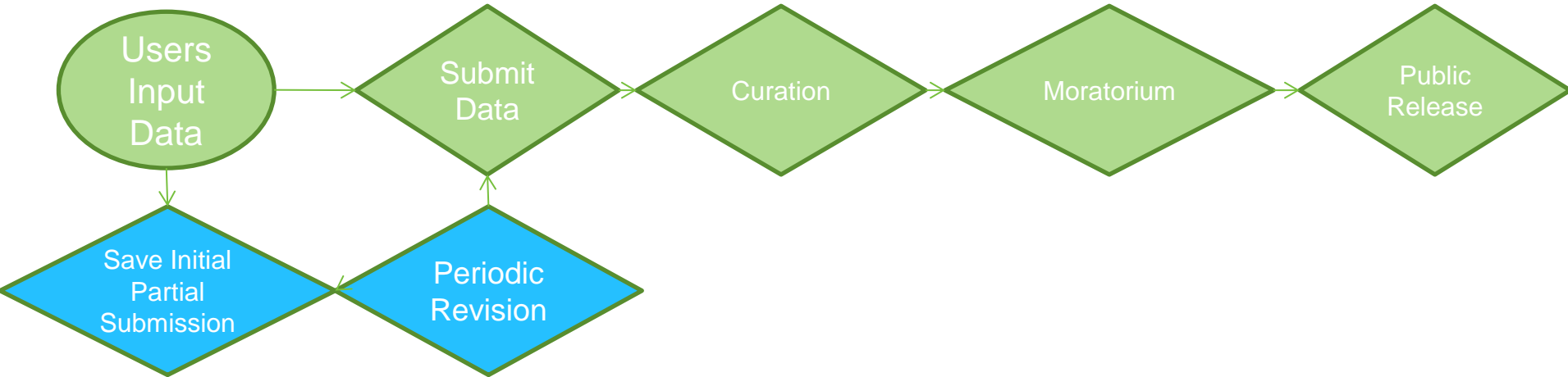
Develop a set of content models that collect a subset of common data in a structured form that allows quick data aggregation between projects

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Develop a centralized and secure data repository and set of content models by:

- Using the OpenEI framework for the front end

- Storing data securely on the cloud

- Leveraging National Renewable Energy Laboratory expertise and existing tools in data storage, dissemination, and protection

- Complying with federal data and metadata standards and requirements

- Engaging the MHK community to determine the minimal data set of highest value for the content models

- Performing online training to educate national labs and DOE awardees on MHKDR and content model use

Technical Approach

Establish a centralized user-driven database and community for sharing information on MHK instrumentation and lessons learned from laboratory testing and field deployments to help the emerging MHK community achieve greater success in technology development.

Contributors/Users

- Device Developers
- Test Facilities
- National Labs and Universities
- Instrument/Sensor and hardware Manufacturers
- Regulatory Agencies
- Public Stakeholders
- Other Instrumentation Users

Community of Practice

- Open forum for discussion and blogging
- Q&A
- Events

Instrumentation Database

Instrumentation Data Archive

Search by:
- Keywords
- Specifications
- Uses

Test Wiki

- Overview of various tests
- Link to applicable standards
- List of needed instruments

Some of the Benefits to the MHK Community

Quick instrument/sensor identification, selection and application

Sharing knowledge, experience, lessons learned, and best practices

Online site for discussion and for questions and answers

Identify gaps in measurement capabilities

Matching testing standards to measurements and Instrumentation specs

- Released the MHKDR in 2015
- Developed 10 content models that were released in 2016
- Released MHK Instrumentation Database, Community of Practice, and Test Wiki in 2016 to support international collaboration and dissemination of testing experience.
- Hosted training sessions for the Instrumentation Database to the international community
- Established a curation methodology and trained content curators
- Curated many submissions and placed them in the pipeline for public release and use
- Completed seeding of the Instrumentation Database

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- DOE-sponsored project data are now accessible to the public and indexed on national search engines (subject to moratorium)

- MHK community can now share experience and easily search a large set of instrumentation

- Almost 190 GB of data submitted to the MHKDR from 103 submissions, with 792 resources; 2,536 page views, 72% from the United States in last six months

- 119 recorded site downloads from the MHKDR (~20,000+ direct downloads – likely from bots or users with higher security settings on their browser)
  - Advanced WEC Dynamics and Controls, Test 1 yielded 29.59% of total downloads

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- 4,313 page views in the last six months from the following top countries: United States, United Kingdom, Saudi Arabia, Japan, India, Sweden, Ireland

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- Project Initiation: October 2014
- Project is ongoing and on schedule
- MHKDR was developed on schedule and within budget
- Instrumentation Database, Community of Practice and Test Wiki were developed on schedule and within budget
- All content models were successfully completed, vetted with industry, and posted for use

Project Budget

Budget History					
FY2014		FY2015		FY2016	
DOE	Cost Share	DOE	Cost Share	DOE	Cost Share
		$315k*		$150k	

*Includes instrumentation database funding in FY15 ($165k)

- **Project has spent 67% of total funds to date**
- **Costs have been in line with project plans**

Research Integration & Collaboration

Partners, Subcontractors, and Collaborators:
None

Communications and Technology Transfer:
- MHKDR online: https://mhkdr.openei.org/
- MHKDR training webinars: https://www.youtube.com/watch?v=A01IhLnENvE
- MHK content models online: https://mhkdr.openei.org/models/
- MHK content model training webinars: https://www.youtube.com/watch?v=9btwB5rnUg0
- MHK Instrumentation Database, Community of Practice and Test Wiki: http://en.openei.org/wiki/MHK_ISDB

Next Steps and Future Research

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FY17/Current Research:

- Develop features that increase the utility of the MHKDR to DOE and the MHK community, that yield a more user-friendly interface, and that make data entry into content models consistent and less burdensome
- Continue to ensure user submissions are compliant with federal guidance, award contracts, and of high quality
- Provide technical assistance to all data submitters
- Perform the necessary maintenance, including the timely application of critical security patches, to ensure the continued success of the MHKDR
- Continued curation of new submissions and support for data submitters, including dissemination of submitted data

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FY17/Current research:

- By the end of FY17, we anticipate over 5,000 downloads by hundreds of organizations, including international universities, research institutions, state and local governments, venture capital firms, and other national labs
- Continued development of the MHK data community, Instrumentation Database, Community of Practice to meet user needs
- Host a third instrumentation workshop focused on identifying measurement gaps and defining solution pathways to meet the measurement needs of the MHK community