Risk Retirement

Supplementary Material for paper:

Risk Retirement – Decreasing Uncertainty and Informing Consenting Processes

for Marine Renewable Energy Development

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The accompanying paper discusses a process for facilitating consenting for a small number of marine renewable energy (MRE) devices (most likely one or two devices), for which each potential risk need not be fully investigated for every project. In place of these investigations, the recommendation is for MRE developers to rely on what is already known from already consented projects, from related research studies, or findings from analogous offshore industries. When larger arrays of MRE devices are planned, or when new information comes to light, these risks can be revisited and new decisions on the level of risk retirement can be made. The intent of the process is to provide assistance to regulators in their decision-making and to inform the MRE community of what is likely to be required for consenting and licensing small development, as well as helping to distinguish between perceived and actual risk to the marine environment. Risk retirement will not take the place of existing regulatory processes, nor will it completely replace the need for all data collection before and after MRE device deployment; these data are needed to verify the risk retirement findings and add to the overall knowledge base.

Under OES-Environmental, the process for risk retirement has been developed to provide a community consensus on the level of risk perceived to exist for certain stressor-receptor interactions. The risk retirement process helps determine which interactions of MRE devices and the marine environment are low risk and may be “retired”, and which may need further data collection or mitigation to reduce the risks to an acceptable level. Sufficient data are needed for risk retirement; transferring data and information from consented projects can assist regulators in determinations for consent and license applications, as well as inform developers and other stakeholders about the expected level of data collection needed for those applications. If data from baseline assessments and post-installation monitoring programs are collected consistently, the resulting knowledge can be evaluated and applied to future projects to increase understanding of the environmental effects, support efficient consenting processes, and reduce scientific uncertainty. OES-Environmental has focused on risk retirement for underwater noise, electromagnetic fields, habitat changes, and changes in oceanographic systems.

OES-Environmental has developed the risk retirement pathway (Figure 1) to guide risk retirement for MRE developments. The steps in the risk retirement process are:

1. Define the risk and determine if it is a likely/plausible risk for a particular project (if not, the risk can be retired);

2. Determine whether sufficient data exists to demonstrate the significance of the risk (if so, and the risk is acceptable, the risk can be retired);
3. Collect additional data to determine whether the risk is significant (if not, the risk can be retired);
4. Apply existing mitigation measures to determine whether the risk can be mitigated (if so, the risk can be retired); and
5. Test novel mitigation measures to determine whether the risk can be mitigated (if so, the risk can be retired).

If these steps continue to indicate that the risk is significant, the project will need to be redesigned, relocated or perhaps abandoned. Between and among the steps in the risk retirement process there is a need to examine available data and mitigation measures in order to provide feedback among steps.

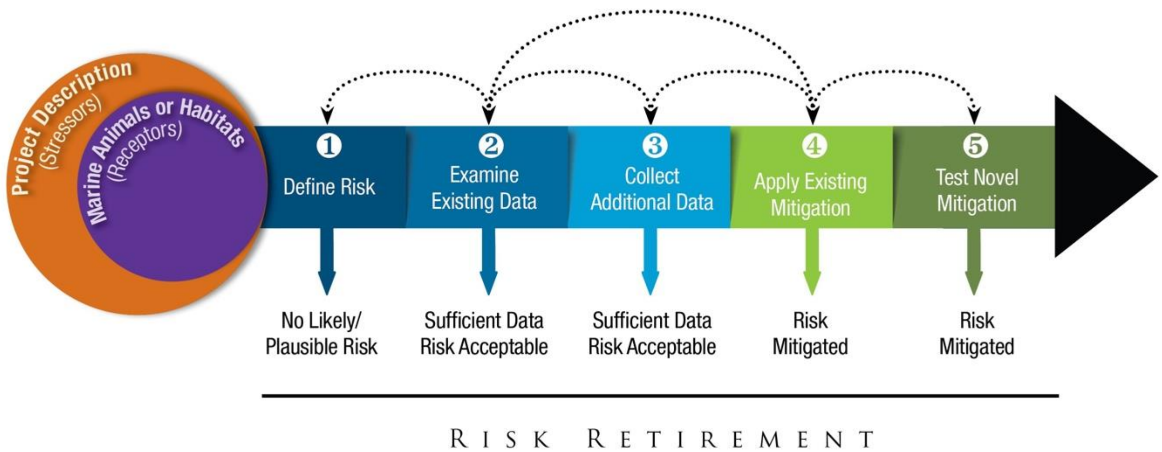

Figure 1S. Risk retirement pathway. Starting on the left, the project must be described (orange circle), followed by identifying the presence of animals or habitats that may be at risk (purple circle). Five stage gates follow that allow retirement of risk at each stage. The dotted lines and arrows above indicate the transferability of datasets from previously consented projects and research studies that inform each step in the process and create feedback loops.

Data transferability

A key aspect of using the risk retirement process is ensuring that datasets from consented MRE projects are readily available and catalogued so that a project subject to consenting and licensing can be compared to an already consented project by stressor-receptor interactions, the size and technologies involved in the projects, and the methodologies used to collect data. The process of data transferability is a primary aspect of the second and subsequent stage of the risk retirement pathway (examine existing data) and consists of four components, which are described below and shown graphically in Figure 2:

1. Data transferability framework
2. Data collection consistency table
3. Monitoring datasets discoverability matrix
4. Best management practices (BMPs)

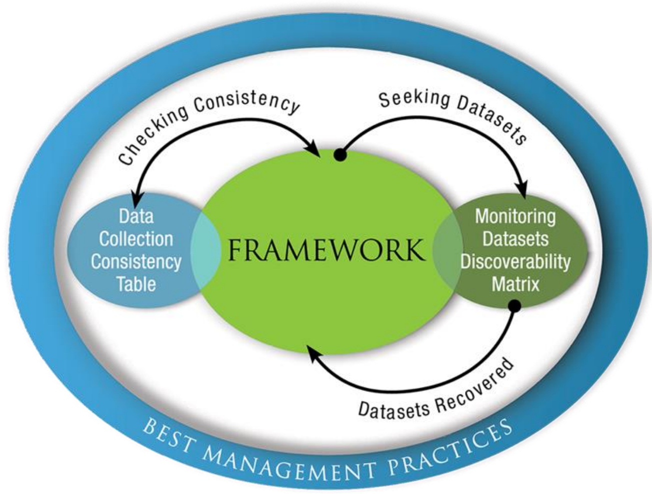

Figure 2S. Relationship of the four components that make up the data transferability process.

OES-Environmental has engaged with regulators, technical experts, and other stakeholders through surveys, workshops, and direct interactions to inform the development of the data transferability process.

Data transferability framework

The data transferability framework has been developed to: bring together datasets from already consented projects in an organized fashion; compare the applicability of each dataset for use in consenting future projects; assure data collection consistency through preferred measurement methods or processes; and guide the process for data transfer.

The framework can be used to develop a common understanding of data types and parameters to determine and address potential effects, to engage regulators to test the framework, and to set limits and considerations for how the BMPs can be applied to assist with effective and efficient siting, consenting, post-installation monitoring, and mitigation.

Data collection consistency

Inherent in the effort to enable the application of monitoring data from already consented projects in one location to projects in another is the need to understand the similarity of the data. Ensuring that data from already consented projects are compatible with the needs of future projects, and that multiple datasets from one or more projects can be pooled or aggregated, requires that data be collected consistently. To date, few efforts have prescribed or compared specific collection methods, instrumentation, or analyses.

MRE is an international industry with consenting processes and research norms that differ among countries, regions, and data collection efforts, such that the use of specific protocols or instruments for all pre- or post-installation monitoring data collection and research studies would be difficult to enforce. However, encouraging the use of consistent data collection processes, reporting units, and analyses could increase confidence in the transfer of data from already consented projects to future projects. The data collection consistency table (Table 1) provides preferred measurement methods or processes, reporting units, and the most common methods of analysis or interpretation/use of data.

Monitoring datasets discoverability matrix

The monitoring datasets discoverability matrix classifies monitoring datasets from already consented projects for six stressors (i.e., collision risk, underwater noise, electromagnetic fields, habitat change, displacement / barrier effect, changes to oceanographic systems). The matrix is an interactive tool that will allow regulators, developers, and other users to discover datasets and evaluate the consistency of information for transfer of those data and knowledge from an already consented project to future projects. While some level of site-specific data collection may be needed for each MRE project, the goal is to increase the efficiency of consenting processes and decrease the need for new monitoring when applicable data already exists. The matrix is available at: https://tethys.pnnl.gov/monitoring-datasets-discoverability-matrix

Applying the data transferability process

A series of steps are needed to implement the data transferability process, ensuring that datasets identified are appropriate for transfer. Four variables characterize each dataset:

1. Stressor (collision risk, underwater noise, electromagnetic fields, habitat change, displacement/barrier effects, or changes to oceanographic systems)
2. Site condition (depth and width of channel most commonly, ambient noise level, etc.)
3. Technology (tidal device bottom mounted, tidal device in the water column, wave device, etc.)
4. Receptor (marine mammals, fish, diving seabirds, invertebrates, sediment transport, etc.)

Transferring data and information from an already consented project to a future project consists of five steps or check points that are considered to be critical, necessary, or desirable but perhaps not always necessary:

1. The interaction should be defined by the four variables (listed above), and the two datasets must have been collected consistently; this is a critical step.
2. The projects should be the same size, either single devices or large arrays; this step is necessary.
3. The same receptor species are at risk for both projects; this step is desirable to the extent possible.
4. The type and design of the tidal or wave device should be the same; this step is desirable.
5. The wave or tidal energy resource should be similar; this step is desirable.

Table 1S. Data collection consistency table, listing methods for data collection, reporting units, and analysis.

Stressor	**Process or measurement tool**	**Reporting unit**	**Analysis or interpretation**
Collision risk	Sensors include: • Active acoustic only • Active acoustic + video • Other	• Number of visible targets in field of view • Number of collisions	• Number of collisions or close interactions of animals with turbines to validate collision risk models.
Underwater noise	• Fixed or floating hydrophones	Amplitude: dB re 1 • μPa at 1 m Frequency: • Broadband • Specific frequencies	• Sound outputs compared to regulatory action levels. Generally reported as broadband noise.
Electromagnetic fields (EMF)	Source: • Cable (shielded or unshielded) • Other	• AC or DC • Voltage • Amplitude	• Measured EMF levels to validate existing EMF models around cables.
Habitat change	• Underwater mapping with sonar video • Habitat characterization from mapping existing maps	• Area of habitat altered, specific for each habitat type	• Compare potential changes in habitat to maps of rare and important habitats to determine if they are likely to be harmed.
Displacement/ barrier effect	Population estimates by: • Human observers • Passive or active acoustic monitoring • Video	• Population estimates for species under special protection	• Validation of population models • Estimates of jeopardy • Loss of species for vulnerable populations
Changes in oceanographic systems	• Numerical modeling, with or without field data validation	• No units • Indication of data sets used for validation, if any	• Data collected around arrays to validate models.

Best management practices

The BMPs were developed to help guide the data transferability process with practical steps for implementation (Table 2).

Table 2S. Best management practices for data transferability, including the purpose of each BMP and the interested parties who would benefit from their use.

Best management practices	Purpose	Interested parties
BMP 1: Meet the necessary minimum requirements to be considered for data transfer.	Ensure minimum thresholds including using same interactions, are met for transferring data.	Regulators, as well as MRE device developers and consultants.
BMP 2: Determine likely datasets that meet data consistency needs and quality assurance requirements.	Ensure methods used to collect / analyze data are compatible and will help to determine the validity of comparing the datasets.	Regulators, as well as MRE device developers and consultants.
BMP 3: Use models in conjunction with and/or in place of datasets.	Encourages the use of numerical models to simulate interactions.	Researchers, consultants, regulators.
BMP 4: Provide context and perspective for datasets to be transferred.	Encourages the use of available and pertinent datasets to enhance the interpretation of data and information.	Device developers, consultants, regulators, researchers.