Fox Islands Wind Project
Quality Management Plan

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By
Team 2
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PSS Version History

Version #	Date	Author	Key Differences
1.0	10/3/2024	Group 2	Initial Draft
1.1	10/4/2024	Group 2	Revised Quality Policy
1.2	10/7/2024	Group 2	House of Quality (HOQ)

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1. INTRODUCTION

1.1. Purpose of Quality Management Plan

The Quality Management Plan (QMP) will define the quality objectives, standards, and roles and responsibilities for the Fox Islands Wind Project. This plan has been developed to ensure that the deliverables meet and exceed stakeholder expectations in a safe manner:

- By reducing electricity costs
- Promoting environmental sustainability
- Ensuring continued community support

It is intended to provide a basis for guiding the quality planning, quality assurance, and quality control activities during the project life cycle. This QMP will also offer a structured method of overseeing performance against pre-determined quality parameters with plans for rectifying any off-type performance as and when necessitated. To address the possible issues for the construction and operating phases, and also the future sustainability of the project, this plan complies with the related laws and regulations as well as with the industry standards. In addition, it is the means of interaction with the project stakeholders, thus providing an open and consistent approach to meeting the chosen quality standards. Therefore, the QMP will improve overall project efficiency and bring maximum benefits to the community.

1.2. Parent or Sponsor Organization Overview

Project Background

Fox Islands Electric Cooperative was founded in 1974 as a community-owned transmission and distribution cooperative to serve the Fox Islands of North Haven and Vinalhaven, located off Maine's coast. FIEC provides the islands with electricity by purchasing power from the New England Grid and managing the local distribution network. This includes the submarine electric cable between the islands and the mainland for a constant electricity supply to the community. Fox Islands Wind Project aims to provide opportunities to reduce the cost of electricity on the islands by taking advantage of available local renewable wind energy with reduced reliance on imported electricity from the mainland. FIEC is dedicated to serving the year-round community's needs and addressing high energy costs among its residents while nurturing energy independence by leveraging renewable energy.

Project Overview

Electricity prices on the Fox Islands currently reach $0.29/kWh, primarily due to high delivery charges and the limited number of customers to absorb these costs. The high cost of electricity threatens the sustainability of the year-round community. As a result, FIEC is researching alternative energy solutions, starting with a wind speed study by the University of Massachusetts Renewable Energy Research Laboratory, which confirms the viability of a wind project.

The community votes overwhelmingly in favor of the wind project, with 384 to 5 votes, giving it the green light to proceed. The Fox Islands Wind Project aims to build three 1.5 MW wind turbines, capable of generating enough electricity to cover more than half of the island's electricity needs annually.

Budget Breakdown

The estimated total project cost for the Fox Islands Wind Project is $14.5 million.

- For a total installed capacity of 4,500 kW, three turbines will be provided at 1.5 MW each, giving a cost per kilowatt of approximately $3,222.22.
- This includes $10 million for the wind turbine equipment and installation, at an average cost of $2,222.22 per kW.
- $2 million for site preparation and construction, at an average cost of $444.44 per kW
- $1 million for integration with the electrical grid, at an average of $222.22 per kW
- $500,000 for environmental and permitting costs, at an average of $111.11 per kW
- $1 million for contingencies and miscellaneous expenses, at an average of $222.22 per kW.

Major Deliverable	Sub-Deliverable	Estimated Cost (USD)
1. Initiation & Planning		
	1.1 Project Charter	$20,000
	1.2 Scope Statement	$15,000
	1.3 Wind Analysis & Environmental Study	$50,000
	1.4 Stakeholder Management Plan	$10,000
	1.5 Communication Plan & Meetings	$5,000
2. Education Materials & Community Vote		
	2.1 Project Management Education Materials	$5,000
	2.2 Community Vote	$5,000
3. Risk Management Plan		
	3.1 Risk Identification and Assessment	$7,000

	3.2 Risk Mitigation Strategies	$3,000
4. Financing and Permitting		
	4.1 Investor Agreement & Loan Procurement	$1,000,000
	4.2 Tax Equity Investors	$4,500,000
	4.3 Legal Documents	$25,000
	4.4 Permitting Strategy	$15,000
5. Procurement and Construction		
	5.1 Procure Wind Turbines and Construction Materials	$10,000,000
	5.2 Permit & Site Selection	$25,000
	5.3 Material Shipment Schedule	$5,000
	5.4 Construction Schedule Management	$10,000
	5.5 Site Preparation and Construction	$2,000,000
	5.6 Safety Management Plan	$15,000
6. System Testing & Grid Integration		
	6.1 System Testing	$25,000
	6.2 Grid Integration	$20,000
	6.3 Performance Monitoring and Reporting	$10,000
7. Quality Management		
	7.1 Quality Management Plan	$15,000
	7.2 Quality Control and Assurance Processes	$10,000
	7.3 Continuous Improvement Initiatives	$5,000
8. Community Engagement		
	8.1 Public Information Sessions	$15,000
	8.2 Ongoing Stakeholder Communication	$5,000
9. Budget Allocation Plan		
	9.1 Budget Allocation	$10,000
	9.2 Logistics & Weather Investigation	$10,000
10. Project Closure		
	10.1 Final Project Review	$10,000
	10.2 Handover and Training	$10,000

1.3. Define Quality Standard

One of the fundamental steps in project quality management is establishing clear, well-defined quality standards that guide the entire process from design to implementation. These standards assist in the fact that every detail of the project – from the design of the turbine to the assessment of the impact on the environment – follows generally accepted standards. The Fox Islands Wind Project should incorporate the following internationally recognized standards:

- ISO 9001: This is the most commonly used quality management standard worldwide, and guarantees that the procedures of a project deliver the expectations and legal standards of customers. The Fox Islands Wind Project could therefore use ISO 9001 to implement a clear working model for the entire project to monitor and enhance each phase to adhere to stringent quality measures across the design, production, and deployment of the wind project (International Organization for Standardization [ISO], 2015).

- IEC 61400: This standard is peculiar to wind turbines and contains design specifications for wind turbine systems. It contains provisions for physical protection, geometric configuration, and behavior under different environmental loads. Adhering to the IEC 61400 guidelines will assist the Fox Island Wind Project to standards of equipment durability, safety, and reliability, especially under the conditions around Fox Island (IEC, 2019).

- ISO 14001: This standard is more specific to environmental management systems making it appropriate for renewable energy projects including wind farms. It enables the organization to discharge its environmental obligations logically to enhance its sustainability. In the case of the Fox Islands Wind Project, implementation of the ISO 14001 standard signifies that the project tackles environmental concerns of the projects in a way that is in agreement with the environmental legislation of the country its location and generally recognized Iso principles of environmental management (ISO, 2015).

- Internal Quality Benchmarks: Besides external sources, the Fox Islands Wind Project can also develop its internal quality standards that are compatible with the company goals, as well as that of the environmental impact and safety standards on the company's performance. Such could be noise reduction standards, recommended service life of turbines, and improved energy storage beyond compliance with legally prescribed standards.

1.4. Parent Organization Quality Policy

Fox Islands Electric Cooperative is committed to providing safe, affordable, and sustainable electric power to its customers. In a nutshell, our policy of quality stands on the cornerstone is of:

- **Providing a quality renewable energy solution** that meets the needs of all stakeholders of the project. It tends to bring down electricity costs for residents from **$0.29/kWh to approximately $0.05/kWh**. The drastic reduction in electricity costs is expected to go a long way toward improving the financial stability of year-round residents, who are sensitive to electricity costs compared to wealthy seasonal residents.
- **Ensuring the regulatory requirements are met** and considering the latest best practices in the industry: the **project will follow all set guidelines** related to renewable energy and safety; thus, it ensures all regulations touching on the project life will be met.
- **Enhancing continuous improvement in all aspects of energy generation, distribution, and customer service.** The Fox Islands Wind Project will act as a model for any other small island communities grappling with similar problems to realize just how feasible locally generated renewable energy can be.
- **Community involvement for transparency and development of contentment with the wind energy project.** Attract seasonal residents based on the sustainability feature of the project.

The project also has other objectives, including **carbon footprint reduction** associated with electricity consumption on the islands by a large generation of the required electricity on the island, hence reducing the necessity to use the mainland grid. This will offer long-term savings. Another subsidiary objective of the project is the **sale of the excess energy to the mainland during the off-peak periods** and, therefore, even reduce further costs to residents.

Aspect	Quality Requirements	Quality Planning	Quality Assurance	Quality Control
Noise Levels	Maintain noise levels: 60 dBA (day), 50 dBA (night)	Set standards based on Maine DEP regulations.	Train team on noise management protocols.	Regular noise monitoring with calibrated meters.
		Establish noise monitoring locations.	Conduct audits to verify compliance.	Compare measurements against DEP standards.
		Identify potential community impact from noise.	Quarterly review and analysis of noise data.	Use SPC charts to track noise levels over time.
Environmental Impact	Minimize disruption to local ecology.	Conduct an environmental assessment.	Ensure ongoing compliance with mitigation measures.	Perform environmental audits (flora/fauna).

	Monitor wildlife, vegetation, and water quality.	Set metrics for ecological health monitoring.	Train on best practices for ecological preservation.	Track changes in biodiversity indices.
		Plan for mitigation based on assessment outcomes.	Quarterly environmental review.	Document and act on environmental standards.
Community Satisfaction	Address noise and visual impact concerns.	Identify community expectations via surveys and meetings.	Regular community feedback sessions.	Conduct surveys to gauge satisfaction.
	Conduct community meetings before and after construction.	Develop a plan to handle community concerns post-construction.	Provide public access to project updates and results.	Analyze survey data and take corrective action if necessary.
Turbine Reliability	Target: 11,600 MWh annual output.	Establish performance benchmarks for turbines.	Conduct training on maintenance procedures.	Measure turbine output and downtime.
	Ensure turbines withstand island weather conditions.	Set metrics for downtime, and maintenance frequency.	Internal audit for performance and maintenance.	Compare energy output to target metrics.
		Plan for preventive maintenance.	Quarterly review of maintenance and reliability metrics.	Investigate the root cause if performance deviates from targets.

2. HOUSE OF QUALITY MATRIX

2.1. Role of the HOQ in Project Quality Management

The House of Quality (HOQ) matrix refers to a strategic tool in Quality Function Deployment that links customer requirements to a project's technical specifications. It systematically connects the 'what' – customer needs – with the 'how' – technical solution – so that project teams know which features to prioritize and identify trade-offs during the design phase. As for the Fox Island Wind Project, the HOQ matrix can be useful in the identification of key customers' needs, such as ''Reliable Energy Supply'' and ''Environmental Sustainability'' as well as to check on the technical specifications. Therefore, by prioritizing the requirements based on their importance, the project team will be able to assign the highest priority to the solution that will address the most critical needs of the local community and, at the same time, ensure that technical choices like turbine type and maintenance strategies are aligned with these priorities (Hauser & Clausing, 1988).

Furthermore, the HOQ matrix helps carry out trade-offs and competitive benchmarks, which are essential for making informed design decisions (Govers, 1996). For example, a strong relationship between the customer's requirement for long-term durability and a technical feature such as advanced turbine design can help guide the team toward investing more resources in this area. At the same time, the competitive analysis section allows the project team to compare their solution with others in the market, ensuring that the Fox Island Wind Project maintains a competitive edge by focusing on features that matter most to customers. In this way, the HOQ not only helps optimize the technical aspects of the project but also ensures that the final product is well-aligned with customer expectations.

2.2. House of Quality Matrix

House of Quality

Project title:	Fox Islands Wind Project
Project leader:	Dia Khosla, Giang Trao (Vanessa), Ray Wang
Date:	Oct 7, 2024

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Correlation:

+	.	--
Positive	No correlation	Negative

Relationships:

9	3	1	
Strong	Moderate	Weak	None

	1: low, 5: high	Desired direction of improvement (↑,0,↓)	↑	0	↑	↑	0		Competitive evaluation (1: low, 5: high)			
	Customer importance rating	Functional Requirements (How's) → Customer Requirements - (What's) ↓	Wind Turbine Capacity (MW)	Grid Integration	Noise Reduction Technology	Off-Grid Capabilities	Energy Storage Systems	Weighted Score	Satisfaction rating	EcoWinds Solutions	TerraTurbine Energy	Others
1	5	Reliable Energy Supply	9	3	1	3	1	85	4	4	5	4
2	5	Reduced Electricity Costs	3	9	9	3	9	165	3	3	2	4
3	4	Environmental Sustainability	3	1	9	1	1	60	2	2	2	3
4	3	Aesthetic Integration	3				1	12	3	4	1	3
5	4	Efficient Operation	3	3	1	3	9	76	3	3	5	2
6	2	Local Job Creation	1	3	1	1	1	14	3	4	4	2
7	3	Long-Term Durability	1	3	9		3	48	3	3	4	3
8	2	Energy Independence	3	3	1	1	1	18	2	3	1	3
9	3	Corrosion - Resistant	9	3	1	3	1	51	4	4	4	3
		Technical importance score	131	106	124	59	109	529				
		Importance %	25%	20%	23%	11%	21%	100%				
		Priorities rank	1	4	2	5	3					
		Current performance	3	4	2	2	4					
		Target	5	5	4	4	5					
		Benchmark	5	5	4	4	5					
		Difficulty	4	3	4	4	5	1: very easy, 5: very difficult				
		Cost and time	4	4	2	2	3	1: low, 5: high				
		Absolute Weight	131	111	127	101	109					
		Absolute Factor	0.23	0.19	0.22	0.17	0.18					
		Relative Weight	32.8	22.2	29.2	11.1	22.9					
		Relative Factor	0.28	0.18	0.24	0.09	0.19					
		Priority to improve	2	4	1	3	5					

Fox Islands Wind Project - House of Quality Matrix

Summary

- Noise Reduction Technology has the highest priority for improvement, given its high importance and relatively lower cost and difficulty.
- Wind Turbine Capacity (MW) is also a high priority, with significant room for improvement, although it has a higher associated cost and difficulty.
- Grid Integration and -Grid Capabilities are moderate priorities.
- Energy Storage Systems has the lowest priority for improvement due to its high difficulty and existing effective performance.

Prioritization of these technical requirements makes it easier for the Fox Island Wind Project to channel its efforts into the best areas to invest in while being economical and avoiding complex problems. It is evident here that potential for sizeable, near-term enhancements are observed with Noise Reduction Technology and Wind Turbine Capacity while improving Grid Integration as well as revising Off-Grid Capabilities should be considered as feasible, but longer-term objectives. Again, the Energy Storage Systems as efficacious as they are need to be revisited in the future when the project is falling into place and when new technologies are available rendering enhancements in this aspect cheaper. This strategic prioritization is in concord with the concept of House of Quality where the result is both a customer-oriented prioritization and technical feasibility.

2.3. Company A & B Overview

Company A: EcoWinds Solutions

EcoWinds Solutions has established itself as being reliable in the renewable energy industry, especially in wind energy solutions: economical and harmonized installations. As a firm that promotes environmental conservation and friendly urban architectures, EcoWinds has developed into an expert on construction projects that adapt both to advanced technology for efficient energy usage and natural landscapes that characterize given regions. Hence, when developing the HOQ, we chose EcoWinds Solutions as the company to be compared, given that their strengths are in affordable, aesthetically integrated wind solutions that would be appropriate for the Fox Island Wind Project.

Company B: TerraTurbine Energy

TerraTurbine Energy is recognized for providing clients with its long-term durability and reliable energy supply in the wind energy industry. Focusing on building infrastructure that stands the test of time, TerraTurbine has successfully numerous high-performance wind projects for areas that offer challenging environmental conditions. Their focus on reliability and cutting-edge energy storage systems has made them a go-to provider for large-scale projects requiring stable and long-lasting energy solutions. We chose TerraTurbine Energy for comparison because their expertise in reliability and durability is vital for ensuring the Fox Island Wind Project meets its long-term energy goals.

2.4. Key takeaways

Prioritizing Energy Reliability and Cost Reduction

- Top Customer Concerns: Reliable Energy Supply and Reduced Electricity Costs both have the highest importance ratings (5).
- Technical Focus: Wind Turbine Capacity (relationship score of 9) and Grid Integration (score of 3) should be prioritized to enhance energy reliability and cost-effectiveness.

The highest customer importance ratings are given to Reliable Energy Supply and Reduced Electricity Costs, highlighting that these are the primary concerns for the Fox Island stakeholders. The technical focus on Wind Turbine Capacity and Grid Integration, which have strong relationships with these customer requirements, aligns with these priorities. This suggests that increasing turbine capacity and optimizing grid integration should be top priorities to enhance energy reliability and cost-effectiveness, ultimately improving customer satisfaction. By focusing on these areas, the project can ensure it delivers on critical operational needs (Hauser & Clausing, 1988).

Environmental Sustainability and Efficiency

- Sustainability Priority: Despite having slightly lower importance (4), Environmental Sustainability remains crucial.
- Technological Links: Noise Reduction Technology (relationship score of 9) strongly aligns with environmental sustainability goals.

Even though Environmental Sustainability is rated with slightly lower importance, however, it remains essential for the project. The high compatibility between Noise Reduction Technology and environmental sustainability means that there is a strong incentive to invest in technologies that reduce impact on the environment. Similarly, Efficient Operation is connected with Energy Storage Systems as well which again, has a score of 9 with Energy Storage Systems, the efficient operation of a system can be maintained and energy can be stored to provide for continued smooth running. These findings align with prior research, which emphasizes the importance of sustainability in energy projects (Govers, 1996).

Competitive Positioning

- Competitor Comparison: TerraTurbine Energy excels in Reliable Energy Supply and Efficient Operation, while EcoWinds Solutions leads in Aesthetic Integration.
- Fox Island Strengths: The project has competitive advantages in Wind Turbine Capacity but needs to focus on Noise Reduction Technology and Corrosion Resistance.

In comparison to competitors, TerraTurbine Energy leads in Reliable Energy Supply and Efficient Operation, while EcoWinds Solutions excels in Aesthetic Integration. Competitive advantages of the Fox Island Wind Project are high in Wind Turbine Capacity, but areas that require attention include Noise Reduction Technology and Corrosion Resistance. According to Akao (1990), by concentrating on these areas of operation as identified in the HOQ’s “priority to improve”, the constructive project will be able to stay relevant and also tackle any inadequacies in comparison to other industrial players.

Balancing Cost and Performance

- Key Technical Areas: Wind Turbine Capacity (25%), Noise Reduction Technology (23%), and Energy Storage Systems (21%) are the most important technical areas.

- Challenges: Improvements must balance cost and time constraints, particularly for Energy Storage Systems and Noise Reduction Technology, which are more difficult to enhance.

The technical areas with the greatest importance are all the technical areas that contribute directly to the nature and performance of the renewable energy project and have greater impacts on customer satisfaction as well, these include: Wind Turbine Capacity, Noise Reduction Technology, and Energy Storage Systems. However, these improvements will have to be balanced with cost and time factors that will always be key constraints. Similarly concluded in earlier research, cost-effective measures are integral in massive projects such as wind energy (Chan & Wu, 2002). Based on the matrix developed here, increasing the ratio of Energy Storage Systems and Noise Reduction Technology poses relative difficulty; making it important to address such areas in order to enhance the overall success of the project in the future.

Local Economic Impact

- Job Creation: Though Local Job Creation ranks low, involving local contractors can provide additional benefits.

While Local Job Creation ranks as the least important factor, but the project team should still consider how the maximal involvement of local contractors can help bring other advantages. According to Akao (1990), collaborating with local businesses and contractors not only addresses community economic concerns but may also improve stakeholder support, which is crucial for long-term project sustainability.

In conclusion, by utilizing the insights provided by the House of Quality matrix, the Fox Island Wind Project team defines the most important technical requirements to stakeholders and pays much attention to the key issues, such as reliable energy supply, cost reduction, and sustainable power generation. The matrix also identifies opportunities with regard to noise reduction and corrosion control to improve the competitiveness of the project. Making sure the performance metrics do not deviate from the cost aspects guarantees that the project will meet customer requirements and technical applicability for sustainable future development (Cohen, 1995).

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