

Agency: Commerce, Community and Economic Development**Grant Recipient: Kodiak Electric Association, Inc.****Federal Tax ID: 920010172****Project Title:****Project Type:** Remodel, Reconstruction and Upgrades

AEA - Kodiak Electric Association Terror Lake Hydroelectric Facility Expansion

State Funding Requested: \$7,500,000
One-Time Need

House District: 36 / R**Brief Project Description:**

Expanding Terror Lake's capacity with a third turbine generator unit will significantly enhance the stability of Kodiak Electric Association's (KEA) electrical infrastructure, provide the foundation for integrating additional renewable energy sources onto the KEA grid, and reduce dependence on diesel fuel by supplying ample backup capacity for peak loads and outages of the existing hydro turbine-generator units.

Funding Plan:

Total Project Cost:	\$15,907,950
Funding Already Secured:	(\$248,160)
FY2012 State Funding Request:	<u>(\$7,500,000)</u>
Project Deficit:	\$8,159,790

Funding Details:

The total project cost is estimated at \$15.9 million. The grant request is for \$7.5 million. In an earlier round of the Renewable Energy Fund, the project was granted \$248,160. This grant request would put the project near a 50/50 match with KEA. The total project cost includes the engineering, purchase, and installation of the third hydroelectric turbine at Terror Lake.

Detailed Project Description and Justification:

The Terror Lake Hydroelectric Facility was constructed in 1984 with two turbine generator units and an empty bay for a future third unit. Expanding Terror Lake's capacity with a third turbine generator unit will significantly enhance the stability of Kodiak Electric Association's (KEA) electrical infrastructure, provide the foundation for integrating additional renewable energy sources onto the KEA grid, and reduce dependence on diesel fuel by supplying ample backup capacity for peak loads and outages of the existing hydro turbine-generator units. This is a one-time capital investment.

KEA provides electricity to approximately 5,800 meters on Kodiak Island in a service area that includes the region in and around the City of Kodiak, the U.S. Coast Guard Base, Bell's Flats, Chiniak, Pasagshak, and Port Lions. The Terror Lake Hydroelectric Facility is the primary source of KEA's energy supply, and is the cornerstone to KEA's renewable energy generation system.

The Terror Lake powerhouse was constructed in 1984 with two vertical axis impulse Pelton-type turbine generator units and an empty bay for a future third unit. A third turbine was not installed during the initial project construction because system loads at that time only warranted 20 megawatts (MW) of hydropower capacity. A study conducted for the Alaska Power Authority (now the Alaska Energy Authority) in June 1983 determined that the additional generation capacity of a third

turbine generator would not be needed until after 1995. Currently, there are significant periods when KEA's load surpasses the 20 MW capacity of Terror Lake's two turbines.

KEA is dedicated to providing the Kodiak community with cost-effective renewable power, and the community strongly supports the direction toward self-reliance obtained by reducing the use of fossil fuels. Terror Lake's hydropower provides the base load capacity needed to backup the other forms of renewable energy that are more variable in their energy output (i.e., wind, wave, tidal, river in-stream). Unfortunately, the current capacity at Terror Lake has been surpassed by the growing load demand. This lack of hydropower capacity, in effect, imposes a limit on the amount of renewable energy that can be stably integrated onto KEA's isolated grid system. A solution to this limit on renewable energy integration would be the expansion of Terror Lake's capacity with a 10 MW third turbine generator.

In addition to providing the necessary capacity for other forms of renewable energy on KEA's system, another benefit to expanding the capacity of Terror Lake by 10 MW with a third turbine generator is the ability to cover peak loads. Over the past decade, peak loads on the system have averaged 24 MW. Diesel-powered generation is currently required for these periods of high demand and the need for diesel-fueled supplemental capacity will continue to grow in the future as peak loads increase. Increasing Terror Lake's capacity to 30 MW with a third turbine generator will mitigate the use of diesel fuel by maximizing the use of wind power from the Pillar Mountain Wind Farm and covering the remaining peak loads with hydropower. The third turbine would also provide backup capacity to the two existing hydro generating units when offline for maintenance and repair, thereby eliminating the need to run diesel generators continuously to meet the system demand. The enhanced stability to KEA's grid resulting from this additional hydropower capacity also delays distribution infrastructure costs, and allows for additional renewable sources of energy (i.e., Phase II of Pillar Mountain Wind Project, potential tidal or wave projects) to be integrated onto the KEA system in the future.

The savings provided to the Kodiak community as a result of Terror Lake's capacity expansion are enormous. It is estimated that over the 50-year life of this project, the net present value (NPV) as compared to diesel power alone will be \$81,164,518 per the AEA Round IV Grant Fund Model.

KEA has begun the process to install a third turbine generator unit at Terror Lake to increase the facility's generating capacity to 30 MW. A regulatory review of KEA's Federal Energy Regulatory Commission (FERC) license assessed the feasibility of modifying the facility for additional capacity and found no major issues regarding the FERC amendment process or related permitting approvals associated with installation of the third unit. Fortunately, the engineers of Terror Lake had the foresight to design the facility for this future expansion; the powerhouse already contains an empty bay for the third turbine and the power tunnel, penstock, and tailrace are large enough to accommodate a flow corresponding to 30 MW of capacity without modification. An engineering review found no substantive reason that the Unit 3 addition would not be feasible with respect to electrical, protection, control, communications, and instrumentation.

The major economic benefit of this project is the savings from diesel fuel costs and emissions. As renewable solutions are developed and Terror Lake is expanded with a third unit to provide additional capacity and stability, more benefits will be realized by the Kodiak community.

Project Timeline:

The application process for the FERC license capacity amendment is currently under way, and is expected to be completed by spring 2012. Construction to install the third turbine could be completed by fall of 2013.

Entity Responsible for the Ongoing Operation and Maintenance of this Project:

Kodiak Electric Association, Inc.

Grant Recipient Contact Information:

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Has this project been through a public review process at the local level and is it a community priority? ☒ Yes ☐ No

Kodiak Electric Association, Inc.

Terror Lake Unit 3 Hydroelectric Project – Facility Expansion

Kodiak Electric Association, Inc (KEA) Vision Statement: ***Endeavor to produce 95% of energy sales with cost effective renewable power solutions by the year 2020.***

Project Description

The Terror Lake Unit 3 Hydroelectric Project – Facility Expansion consists of the installation of a third hydroelectric turbine and related infrastructure capable of producing and transmitting an additional 11.25 Megawatts (MW) in the existing Terror Lake Hydroelectric Facility. Terror Lake Hydroelectric Facility is KEA's existing hydroelectric power plant with two turbine units that supply about 80% of KEA's power. The original engineers of the Terror Lake facility had the foresight to design the facility for the expansion to three turbines. The original design assumed the day would arrive when additional capacity would be required. That day has arrived. Kodiak's growing electric demand has surpassed the current capacity of Terror Lake Hydroelectric Facility. Expanding the capacity by adding another 11.25 MW turbine generator will enhance the stability of KEA's isolated grid system, allowing additional forms of renewable energy to be integrated and Kodiak's dependence on diesel fuel to be minimized. The third hydroelectric turbine at Terror Lake is the cornerstone necessary for KEA to achieve its renewable energy vision.

Project Benefit

As KEA strives to implement more renewable resources, the future must include a generation source that increases our capacity and system stability. Hydroelectric power is a unique form of renewable energy in that it is a dispatchable base load that can respond quickly to system demand. It is this key attribute of hydropower that would allow KEA to integrate more variable sources of renewable energy, like wind, onto its isolated grid.

The Terror Lake reservoir acts like a battery for KEA's Pillar Mountain Wind Project Phase I, as well as for future renewable energy projects like Pillar Mountain Wind Project Phase II. An energy storage system is necessary for the variability of wind energy. The reliability of wind energy on a minute-to-minute basis is uncertain because winds could be gusting one minute and then suddenly calm. This unpredictability requires KEA to have sufficient capacity available to meet load requirements. Currently, diesel generation is utilized to meet KEA's increased load demand, which is neither economical nor environmentally friendly.

Due to grid stability under KEA's current configuration, the contribution of renewable energy resources has reached its maximum. An additional 11.25 MW of power provided by a third hydroelectric turbine would supply the necessary capacity and enhanced frequency stability to assist in supporting additional sources of variable renewable power, like Pillar Mountain Phase II, which is the addition of three more

1.5 MW wind turbines. Thus, Terror Lake Hydroelectric Facility is the cornerstone for additional renewable energy. Without the expanded hydro capacity, the addition of future variable renewable energy on KEA's system will not be feasible.

The third hydroelectric turbine has many other straight forward benefits which are as follows:

- Peak Load Capability – Currently, KEA's peak load is over 26 MW, which cannot be met with the two Terror Lake hydroelectric units. An additional unit will allow KEA to cover peak loads without utilizing diesel fuel.
- System Redundancy – The current Terror Lake hydroelectric units are over 27 years old. They require more maintenance time to keep them reliable. The third hydroelectric turbine would bring redundancy to allow KEA time to properly maintain the units during low electric load seasons and not operate with diesel power.
- Greater Efficiency – Operating with a brand new hydroelectric turbine, along with operational efficiencies, will allow Terror Lake to produce an estimated additional 2.9 million kWh per year.
- Grid Stability – Three Terror Lake hydroelectric turbines enhances KEA's grid stability, saves future distribution costs, and allows KEA to add more variable wind power to the system, thereby providing better quality electricity.

Alaska Energy Authority (AEA) Review

This project is part of the Alaska Renewable Energy Fund Round IV. It was ranked #6 by AEA and had a very positive benefit to cost ratio of 2.21.

Economic Analysis

The Terror Lake Unit 3 Hydroelectric Project has a great economic benefit to the community of Kodiak, and that benefit continues to grow as the price of diesel rises. As stated above, the benefit to cost ratio is 2.21. The benefit to cost ratio is calculated on only the direct benefits of the project. The greatest benefits are what it brings in the future to our community. As stated earlier, this project will allow for the expansion of wind power on KEA's generation system. Once Pillar Mountain Phase II is added, the combined savings at today's fuel price of the third hydroelectric turbine at Terror Lake with the additional wind power would be almost 17 cents per kilo-watt hour (kWh) for 16.7 million kWh per year. At the current fuel price of \$3.51 per gallon, the net savings to Kodiak would be approximately \$2.8 million in the first year.

Community Support

After KEA's great success with Pillar Mountain Phase I, the community is very excited about the installation of Pillar Mountain Phase II. To accomplish this, the third hydroelectric turbine is integral. AEA gave the maximum score to KEA for community support during their evaluation. KEA has general community support as well as resolutions of support from the Kodiak Island Borough, the City of Kodiak, the U.S. Coast Guard Base, and the Kodiak Chamber of Commerce.

Current Status and Schedule

The project is currently underway. The system substation upgrade necessary for this project is in the construction phase. The design engineering for the turbine generator is underway with a purchase scheduled for this year in early fall. Due to long lead times for these types of units (16 months), the actual installation will be completed during the summer of 2013. KEA has received waivers from the U.S. Fish and Wildlife Service (USFWS), specifically their Endangered Species Act (ESA) Branch, National Marine Fisheries Service (NMFS), US Army Corps of Engineers (USACE), Alaska Department of Fish and Game (ADF&G), State Historic Preservation Officer (SHPO), and the Alaska Department of Natural Resources (DNR) Water Resources Division stating that there are no environmental concerns for the project. This allows KEA to move forward with the application for the FERC permit. FERC has seen no issues with the project and estimates a permit should be finalized by early 2012.

Funding Source and Cost

The funding for this project will be a combination of grants from the Alaska Renewable Energy Fund, General State Appropriation Grant, and KEA. KEA has secured low interest financing through a federal clean renewable energy bond program for the remainder of the funding. From the current cost estimates, KEA costs and state funding are at approximately 50/50. The total cost of the project is estimated at \$15,274,550.

Conclusion

KEA is excited about this project and all the benefits that it will bring our community. The third hydroelectric turbine at Terror Lake will bring efficiency, redundancy, peak load capability, and a platform to build off of for expanding wind generation on Pillar Mountain. The benefits to the community will be lower costs, renewable power, and a stable cost platform for the future. Terror Lake Hydroelectric Facility was built with this project in mind, and the time is now to add it to the system to achieve KEA's vision: "Endeavor to produce 95% of energy sales with cost effective renewable power solutions by the year 2020."