Montana based, Absaroka Energy, LLC is developing the Gordon Butte Pumped Storage Hydro Project (the Project), through its single purpose subsidiary, GB Energy Park LLC (GBEP). The proposed facility will be located on private land in Meagher County, Montana, three miles west of the small town of Martinsdale. The Project is designed to take advantage of the unique geological features of Gordon Butte to create a closed-loop pumped storage hydro facility. This facility will provide ancillary and balancing capabilities to the regional energy grid, promote the development of new renewable energy generation, and offer multiple services to facilitate stability, reliability, growth and longevity to existing energy infrastructure and resources in the state and region.

Project Data:

- Estimated Average Annual Energy: 1300 GWh
- Estimated Installed Capacity: 400 MW
- Number of Proposed Turbine-Generators: 4
- Two Reservoirs Sized at About 4,050 Acre-Feet Each
- Head (elevation difference between reservoirs): 1,025 Feet
- Four Ternary Pump-Generators.
INTERCONNECTION AND TRANSMISSION

Once built, the Project will be able to efficiently balance and optimize the electrical load and generation in the regional transmission grid. Customers of the facility will use power from the grid to pump water to the upper reservoir. When energy is needed, the process will be reversed and water will flow down the penstock, and through the generators. This cycle can occur utilizing the full capacity of the reservoirs or any proportionate flow scheme. The minute-to-minute operation of the facility will be driven by the demands of the electrical grid and the services to be provided. This Project will be connected to the regional transmission system by way of a 230kV line which will connect to the 500kV Colstrip line six miles behind the reservoirs.

Utilizing a closed loop pumped hydro storage system (a clean and robust rechargeable hydro battery) allows the grid to be operated in a stable and balanced manner. The Project provides the capability to “firm up” variable generation, allow thermal plants to run at peak efficiency, provide storage for run of river hydro, and offer a fast acting mechanism for grid operators to ensure the health and longevity of Montana’s current energy infrastructure, as well as lessen the need to construct new transmission lines.
INTEGRATING AND OPTIMIZING THE PENETRATION OF RENEWABLES

An increasing amount of the country’s energy production comes from either renewable generation or non base load natural gas combustion turbines.

This, along with changing environmental regulations, has created the need for tools that allow energy to be stored and moved around the electrical system on a minute-to-minute basis.

Figure 4 is a six-month profile illustrating the behavior of wind production at a single site near Martinsdale, MT. This graph shows how wind ramps up and down very quickly, making it an extremely variable energy resource. As renewable energy generation becomes more common, the ability to manage the minute-to-minute operation of the system will become increasingly difficult. Failure of the system, due to a sudden drop in energy production, can create catastrophic results. Therefore, tools must be added that will ensure system failures do not occur. In other parts of the world renewable penetration in major transmission grids exceeds fifty percent. In order to manage the same variable generation sources, fast reacting pumped storage units have been deployed. These units are able to ramp up and down quickly in order to provide minute-to-minute support of the system. The equipment configuration designed for GBEP has been selected to replicate these fast acting tools.

Figure 4: Martinsdale Wind Profile
TERNARY CONFIGURATION

The Project will be sized at 400 MW

A full turn cycle filling or draining one of the reservoirs will take 8-9 hours. Two lined reservoirs of equal holding capacity will be constructed with full perimeter embankments of earth and roller compacted concrete. The surface area of the reservoirs are 50 acres for the upper and 80 acres for the lower, with depths of 50 to 75 feet to accommodate the 4,050 acre-feet capacity. The hydraulic connection between the upper and lower reservoir will be a single concrete and steel lined shaft. The shaft will run vertically, underground, from the upper reservoir, to a point where it will meet up with a horizontal tunnel. The horizontal, steel, and concrete lined tunnel, will connect the vertical shaft to the underground powerhouse (see Figure 2).

Both the shaft and tunnel will be eighteen feet in diameter and will carry water in either direction. The powerhouse will be located adjacent to the lower reservoir and constructed below grade to ensure proper submergence of the pumping units during all operating conditions. The powerhouse will hold all four of the pump-generators. The ternary style pump-generators will be configured in a hydraulic short circuit arrangement (see Figure 5). There are many advantages of this type of configuration including; the ability to pump and generate at the same time and the ability to switch from pumping to generation in seconds; and these mode changes can occur without changing the rotational direction of the units.

Figure 5: Ternary Arrangement

Figure 6: KOPS II Stack (view of the pump)
There are currently no hydraulic short circuit pump turbine arrangements of this kind in the United States.

There is a facility of this character operating in Austria. KOPS II has been designed to meet the European electricity demands and consists of three ternary hydroelectric sets containing a Pelton turbine, torque converter, motor-generator and a pump. A picture of one of the pump turbine sets at KOPS II is provided in Figure 6. (The view is from the bottom of the stack looking from the pump up to the coupling just below the motor generator).

The ternary pump-generator unit allows the system to run between zero and full load without any major loss in efficiency. A graph of the operational behavior of the hydraulic short circuit pump-generator arrangement, and its ability to quickly switch between pumping and generating, is illustrated in Figure 7. There are many advantages to an environmentally friendly power generation system such as KOPS II, and GBEP hopes to introduce these benefits to Montana and the Northwest region.
LAND

One of the unique aspects of the Project is that the entire site is located on private land. The private land is part of a large ranch (approximately 50,000 acres) that is owned and controlled by a single landowner. The careful selection of this Project site ensures that it will not adversely affect any of the protected and conserved land within Montana. GBEP has a positive relationship with the landowner and has executed an agreement to acquire the land and easements necessary to build and operate the Project.

ENVIRONMENTAL

GBEP hired multiple consulting firms that have completed environmental resource studies of the Project site in the following areas:

- Aesthetic Resource
- Botanical and Wetlands Resources
- Cultural and Historical Resources
- Fisheries and Aquatic Resources
- Geology and Soils Resources
- Recreation and Land Use Resources
- Water Resources
- Wildlife Resources
- Socioeconomic Resources

Based on the study reports, our experts have determined there would be no significant impacts from the proposed construction and operation of the facility.
WATER

Initial Fill and Evaporation Loss - Once the reservoirs are constructed, one reservoir will need to be filled with water prior to operation. GBEP has received a Permit To Appropriate Water (40A 30069150) from the Montana Department of Natural Resources and Conservation, with a priority date of July 30, 2014. This water right will be utilized for the initial fill of the lower reservoir and annual make-up water (estimate 400 acre-feet) for the Project’s operation. GBEP has executed an agreement with the Project site landowner to utilize existing diversion and irrigation infrastructure for the conveyance of water to the lower reservoir. The Montana Department of Environmental Quality has issued GBEP a waiver on the 401 Water Quality Permit, as there will be no water discharge from the facility.

PUBLIC INTEREST / HELPING COMMUNITIES

The Montana State Department of Commerce Energy Promotion and Development Division estimates the Project will create 350 construction jobs over three years.

Once energized, the Project will support twenty to twenty-four, full-time, well paying jobs, injecting direct and indirect revenue into local communities for decades. The Project will also provide Federal, State, and Local governments with a sustainable tax base over its lifetime.

“The Gordon Butte Project represents Montana taking a leadership role in defining the nation’s energy future. This state-of-the-art facility provides an incredible opportunity to preserve our natural legacy while creating jobs where they are needed most.” said Governor Bullock. “Innovative energy solutions like this are good for the economy of our rural communities, and provides exciting new opportunities for students and workers alike.”
STAKEHOLDER PARTICIPATION

Absaroka has participated in, and presented the project to many industry forums and stakeholder groups. These include, but are not limited to; DOE’s Transmission Infrastructure Program, WAPA, FERC, NTTG, WECC, Montana Department of Commerce, Energy Promotion & Development Division’s Wind & Transmission Working Group, Western Governors Association, AWEA and the Montana Wind Summit. In 2012, Absaroka initiated a Transmission Discussion Group comprised of nine entities representing industry, environmental, political, legal, and landowner interests. Absaroka has developed and is executing a Public Participation Plan in which the company has engaged many individual landowners, landowner organizations, and county commissioners to share information, and gain feedback on the Project and its potential impacts and benefits. Absaroka is currently engaged in many high-level discussions with interested subscribers/off-takers including; utilities, transmission service providers, and renewable energy developers.

LICENSING AND CONSTRUCTION

The Federal Energy Regulatory Commission (FERC) is an independent agency that regulates the interstate transmission of electricity, natural gas, and oil. One of FERC’s responsibilities is the licensing of new hydropower projects. GBEP has received two successive preliminary permits from FERC, and last year filed a Notice of Intent and a Preliminary Application Document (NOI / PAD) to file for an original hydro-license for the facility. Three public hearings and two public site visits on the Project have occurred; August 2013 in Harlowton, MT., June 2014 in both Helena, MT. and Martinsdale, MT. Since these meetings, GBEP has continued to engage with Local, State and Federal agencies, NGOs, Meagher County Commissioners, Native American Tribes, local landowners, the Montana Congressional Delegation, Montana’s Governor and other interested parties. GBEP has recently executed a preliminary agreement with the Barnard Companies to become the Engineering, Procurement, and Construction (EPC) Contractor. As both Barnard and GBEP are Montana based companies, the partnership results in a truly “Made In Montana” arrangement.
FOR MORE INFORMATION

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FERCs involvement with the project can be found on the FERC eLibrary at:  
http://www.ferc.gov/docs-filing/elibrary.asp using docket number: P-13642