International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

RENEWABLE GRAVITY BATTERY FOR SOLAR ENERGY STORAGE

1) Sourabh Dadan Singh, 2) Rajendra Harishchandra Kajikar, 3) Chetan Dharmaraj Gawali, 4) Rushikesh Bharat Rajguru, 5) Prof.Vijaykumar.S. Patil

[1]Student, [2]Student, [3]Student, [4]Student, [5]Assistant Professor
Sandip Polytechnic, Nashik, Department of Electrical Engineering

ABSTRACT :

Energy warehousing is the concept of storage of energy generated by renewable energy storage in mega-watt hours with bulk capacities and supplies grids during power outages or peak loads. By considering the future of energy storage we find out that storage of energy in chemical batteries is not a cost-effective alternative and involves risks of fire and explosions It cannot be suitable for placed near load centers due to safety risks and is again polluting the environment during its life span decommissioning. Interconnected grids and consumers' energy usage patterns during a certain time in a day make peak load situation onto the grids to avoid this we will need bulk energy storage /warehousing solutions with minimal or zero usage of chemical processes and with minimum or zero carbon footprint.

In this project of renewable gravity battery, we are designing and implementing a demonstration modal of battery using gravity acting on a counterweight of an approximate size 30-40 kg operated through a motor gearbox dynamo setup powered through solar panels. During the availability of solar energy, the counterweight will be charged upward against gravity. Whenever we need energy back, we release the lever and the weight will try to move downwards with gravity rotating the dynamo and producing energy back is directly ready to utilize. Engineering challenges involved in this setup are a selection of solar panels selection of DC Gear motor drives dynamo selection belt or wire rope for 40 Weight and pulley for the motor shaft, and a selection of gear ratio which will decide the charging and discharging time of the battery.

Introduction :

The global energy landscape is currently experiencing a transition characterized by the integration of intermittent energy sources into the power grid. These variable renewable energy sources necessitate effective energy storage solutions to ensure seamless integration across various time intervals. In this context, batteries serve as viable options for short-term energy storage, while pumped hydro storage offers substantial long-term energy storage capabilities. However, these technologies fall short in providing long-term energy storage solutions for grids with limited demand. This paper introduces a novel storage concept known as Mountain Gravity Energy Storage (MGES), which aims to address this gap in storage services. MGES systems operate by relocating sand or gravel from a lower storage area to a higher elevation. The potential energy stored increases with the height difference, making this technology dependent on the local topography. The cost of MGES ranges from $50 to $100 per MWh of stored energy and $1 to $2 million per MW of installed capacity. MGES presents a promising solution for micro-grids, particularly in small islands and remote regions, as well as in power systems where electricity prices are elevated and the demand for energy storage is below 20 MW, with requirements for monthly or seasonal storage.

In recent years, energy storage has emerged as a significant issue within the renewable energy industry. Conventional batteries are increasingly viewed as less effective and sustainable as the global focus shifts toward renewable energy sources. The gravity battery, also referred to as Gravitricity, represents an innovative energy storage solution that is gaining traction in this sector. This technology utilizes surplus energy to elevate heavy objects, which can then be released to generate power when required. This paper emphasizes the necessity for alternative energy storage systems and explores the potential of gravity batteries to overcome the shortcomings of traditional batteries. It offers a comprehensive examination of gravity battery technology, including a needs assessment, problem statement, manufacturers, advantages, disadvantages, and its potential to supplant existing batteries in power systems. The conclusion drawn is that gravity battery technology presents a viable alternative to conventional batteries and necessitates further research and development to enhance its integration into the renewable energy landscape.

Grids typically function within a costly energy framework due to several complexities. These include (I) the necessity of ensuring energy security, which encompasses the logistics involved in the importation and storage of fossil fuels; (ii) the obligation to consistently meet electricity demand, presenting challenges related to the provision of substantial backup capacity and the management of emissions and techno-economic impacts associated with partial load operations; and (iii) the occurrence of low electricity demand, which limits the feasibility of implementing an economically viable baseload electricity generation system. The integration of variable renewable energy (VRE) sources, such as wind and solar, holds significant promise for reducing electricity expenses in small islands and micro-grids. Nevertheless, VRE necessitates an additional flexibility solution to address the issues of intermittency and seasonal fluctuations in supply. Furthermore, electricity demand in smaller grids often experiences considerable variation influenced by holiday periods and weather conditions.

LITERATURE SURVEY :

Here are several companies investing in gravitational energy storage 4. Energy Vault consists of building a head difference with massive concrete blocks. The disadvantage of this technology is that the head difference between the lower and upper storage sites is low [25,26]. Another solution proposes to dig a well in the ground to create the required head for storing potential energy. However, the excavation costs of the well would considerably increase the costs of the plant [27–31]. There are also proposals for using train tracks to carry a concrete mass from the lower to the upper storage site [32–35]. Apart from having to construct rail tracks, the weight of the train itself is almost equal to the weight of the concrete block. However, the trains do not store energy, and thus imply larger energy losses. The slope of the train tracks also reduces the total power output, when compared to a vertical descent as proposed in this paper [36]. Reference [37] presents a review of EES technologies including the gravel energy storage technology to a vertical descent as proposed in this paper [36]. Reference [37] presents a review of EES technologies including the gravel energy storage technology.

Discussion and Methodology :

1. Discussion

Experimental Design and Setup

Energy Storage

During periods of excess electricity generation (such as when renewable energy sources like wind or solar power produce more electricity than is immediately needed), the surplus electricity is used to raise a heavy mass, typically in a vertical shaft or tower. This process involves using electric motors or winches to lift the mass.

Potential Energy

As the mass is raised to a higher position, it gains gravitational potential energy due to its increased height above the ground. The potential energy is directly proportional to the height and mass of the object, as given by the

Equation

Potential Energy (PE) = mass (m) x gravity (g) x height (h).

Energy Storage Medium

The potential energy stored in the elevated mass serves as a form of energy storage. The height to which the mass is raised and the mass of the object determine the amount of energy stored. This system is economically efficient in the sense that it does not require fossil fuels or special regulations (height difference) unlike the pumped gravity hydro [9]. In addition, it does not use the expansion of gas turbines and air turbines. However, it is constrained by the limited availability of natural reservoirs located underground and, in its efficiency, compared to batteries. Furthermore, in the compression of air, there tends to be a rapid increase in the temperature of the air, hence, a part of the energy stored during the process is lost in the attempt to realize a reversible cycle process system.

RESOURCES AND CONSUMABLES :

Sr. No.	Name Of the Material	Specifications	Quantity
1	Solar Panel	12V, 80 Watt Monocrystalline solar Panel	1
2	Solar charge controller	20 Amp solar charge controller	1
3	DC Gear Motor generator set	//Selection pending	1
4	Voltmeter Display	0-100V DC Voltmeter dislay 1.25 inch	1
5	Current display	0 – 20 Amp DC Current display, 1.25 Inch	1
6	Body frame channels	30*30mm Mild steel square channels	20 feet
7	Bearing holders	BM8 Series Plastic ABS Bearing mount	4
8	Ball bearing for shaft	Ball bearing 628ZZ	4
9	Rope Pulley	Nylon Machined U Shaped Pulley	1
10	Wire rope	3mm Rubber coated wire rope	5 mtr
11	Gravity mass	25 KG Cement Block	1
14	ON/Off Switch	6 Amp, ON/OFF Type Switch	1
15	Connecting Wires	0.5Sq.mm, Red & Black Zinc Coated Copper Wire	10 Meter Roll
18	Fitting Screws and fasteners	M5 High tensile screw nuts with spacer	20

Conclusion :

The alternative gravity storage system is very simple, and all its components are quite reachable in terms of availability in the market. The basic difference between this alternate gravity storage system and other gravity storage tech - an inquest currently in the literature is that this concept can be applied both domestically for household utilization or on a commercial scale depending on the electricity demand.

The gravity battery project offers a renewable energy storage solution by harnessing gravitational potential energy. With its simple design and low maintenance requirements, it provides a sustainable alternative to traditional battery systems. With continued development and support, the Gravity Battery has the potential to significantly contribute to global energy sustainability efforts.

Acknowledgment

We would like to express our sincere gratitude to Prof. P. M. Dharmadhikari, Principal of Sandip Polytechnic, Nashik, for their support, which made this research possible. We are also thankful to Prof. Spatial, H.O.D of the Electrical Engineering Department for providing the necessary resources and facilities to conduct this research. A special thank you to Prof. Yashwant Dhanraj Mahajan and staff members, technical staff members of the Electrical Engineering Department for their valuable technical support and insightful discussions, which greatly enhanced the quality of this work. And the greenhouse gases without which this study would not have been feasible. Finally, we would like to thank our colleagues in the Electrical Department for their continuous encouragement and constructive feedback throughout the research process. Last but not least thanks to all my friends and the people who are directly or indirectly related to our paperwork planning References

REFERENCE :

1. Gravitricity based on solar and gravity energy storage for residential applications, Oluwole K. Bowoto1 · Omonigho P. Emenuvwe2 · Meysam N. Azadani, 20 April 2021

2. GRAVITY BATTERY Kaushik Patil*1, Sachin Patil*2, Roshan Patil*3, Akshata Biradar*4, Prof. P.A. Chougule*5, April 2024

3. Energy Mountain Gravity Energy Storage: A new solution for closing the gap between existing short- and long-term storage technologies Julian David Hunt1, Behnam Zakeri1,2, Giacomo Falchetta3, Andreas Nascimento1, Yoshihide Wada1, Keywan Riahi1

4. Revolutionizing Renewable Energy Integration: The Innovative Gravity Energy Storage Solution Natarajan Karuppiah1*, Patil Mounica1, J N Bhanutej2 , S Saravanan3, Rakshith Reddy1, Riaz Israni4