Gravity energy storage palikir

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Renewable energy of any form has been observed over time to have high investment costs and therefore necessitate its operation where its resource is readily available.

The utilization of the gravity to store energy of any form is an idea in its infant stage [4]. Study shows that the pumped hydroelectric storage system (PHES) still remains the current most harnessed form of storage in the world on a long term and on a large scale [5]. Along the years, a lot of variations have been seen in the traditional layout of the pumped hydroelectric storage (PHES) but much recently, several works have been done on dry (i.e. Waterless) forms of gravity storage.

Similarly, the compressed air gravity storage is also an improved modification of Pumped hydro gravity energy storage technology. It is a combination of the concept of gravity storage and compressed air. This is actually an interesting way to increase the water pressure. Here, a pressure vessel with an air compressor pot was included to the normal gravity storage components to form this system. High atmospheric pressure corresponds to an increasing Pump hydro storage (PHS) height difference. For example, adding 2 mpa to atmospheric pressure equals raising water by 200 m. In this way, the energy is stored in the compressed air and released in the stored mode when discharging. This gravitational storage of compressed air solves some of the problems encountered by bulk energy storage.

This system is economically efficient in the sense that it does not require fossil fuels or special regulations (difference in height) 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 limited availability of natural reservoirs located underground and, in its efficiency, compared to battery. Furthermore, in compression of air, there tend to be a rapid increase in the temperature of air, hence, a part of the energy stored during the process is lost in the attempt to realize a reversible cycle process system.

Vee model design approach

Furthermore, Thomas Morstyn et al., developed the design of Gravity energy storage using suspended weights for abandoned mine shafts. Energy is stored in this system by delivering current from the electrical network to raise the suspended weights along the rail set up in the system. The main components of this system include mine shaft, suspended weight, an induction motor connected to the weights by ropes and an active inverter (front end) designed to provide bidirectional interface between the electrical network set up and electric motor.

In the same way, another area of interest where gravity storage is applied lately is the ocean shore. The latest ocean storage technology under rapid research and development is the DOGES (Deep ocean gravity storage.). It works basically via a combination of solar, mechanical and hydrostatic input. In the system, when energy is supplied to the photovoltaic cell which floats on the ocean surface, it is used to power a turbine or pump

situated on the ocean bed hat is used to force water out of a storage tank on the ocean bed [17, 18].

The system works basically by harnessing the influence of potential energy, where the maximum stored energy is the difference in potential energy between an empty and a filled tank. The system is obviously technologically and economically viable for locations around the deep oceans of sufficiently large depths reaching 500 m. But the challenges to its implementation and operation are mostly Cavitation, mooring effect (which has to do buoyancy effect on the storage structure when pipes are empty under the ocean) and hydro turbine management which are quite expensive to deal with [17, 19].

Essentially, this research is geared towards designing a storage system using non-conventional methods and radical ideas with little similitude to previous research but totally different in functionality.

This design will store energy using the principle of potential energy conservation to store large amounts of energy during the daylight hours and release the stored energy during the night hours proportionately. The method adopted in this research requires a comparatively small battery for just smoothing out the power output (acting as a buffer and not primarily for storage purpose), only when it is required in the adjacent building with electrical loads as shown in the schematic in Fig. 2 below.

Isometric layout model of the design

A vee model approach will be adopted for the development of this design and its verification within along the design process. This model approach will analyse the different stages of the design the process taken to arrive at the design that make up the system lifecycle using simulation within all the stages of the design from specification and design concept to real-time simulation for rapid prototyping and design, testing and validation of the system functionality [16, 20, 21]. The chart below shows a detailed view of the path the model lifecycle will take from the start to validation of the system.