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Literature Survey on Micro-hydro Systems

M.Tech. Scholar Ram Pravesh Chauhan, Prof. Dr Shweta Chourasia
Department of Electrical & Electronics Engineering
Bhopal Institute of Technology and Science, Bhopal M.P India

Abstract- Hydroelectricity is electricity produced by the generators that are pushed by the water movement. This is one of the widely used sustainable power. One of the major advantages of the hydro power after constructing the plant is wastage is not created.22% of the word power is generated by hydroelectricity, which constitutes around about 78% of power from inexhaustible natural resources. The yearly hydroelectric creation of India is 115.6 TWh with an introduced limit is 33.6 GW. Miniature hydro is a word utilized for hydroelectric force establishments that commonly produce a power up to 300 KW of intensity. In a recent trend for controlling of most of the industrial loads is mainly based on semiconductor devices which cause such loads to be more sensitive against power system disturbances. Thus, the power quality problems have gained more interest recently. This paper presents a review of different method for energy generation and smart energy management system.

Keywords- Power quality, Flexible AC transmission system (FACTS) devices, UPFC, SVC, STATCOM.

I. INTRODUCTION

In the last two decades, power demand has increased substantially while the expansion of power generation and transmission has been severely limited due to limited resources and environmental restrictions. As a consequence, some transmission lines are heavily loaded and the system stability becomes a power transfer-limiting factor. Utilities aim to provide their customers with an ideal sinusoidal voltage waveform. By definition, ideal sinusoidal voltage waveform has the characteristics: constant magnitude at the required level, constant frequency and balance in case of three phase operation. Naturally, this is not always possible because of normal system variations and due to the unavoidable incidents that temporarily can affect the operation, such as short circuits faults.

II. LITERATURE SURVEY

Several models of hydropower generation were investigated by scientists. The existing models depend up on the requirement involved in the study. Some of these models were simply analytical while others were constructed from robust system models showing the dynamic characteristics.

N.P. A. Smith(1996) [1], This paper describes a new approach to controlling induction generators on stand-alone micro-hydro systems. The turbine power-speed characteristic and the relatively high magnetic saturation of modern induction machines are used to reduce the control equipment required. The implementation of the control approach is described along with considerations regarding generator selection and efficiency.

Chen, Q., & Xiao, Z. (2000) [2]. Regulating the frequency and load is generally undertaken by the hydroturbine generating set in an electric power system. Therefore, it is important for the hydroturbine generating set to operate safely and steadily, and it is necessary to study the dynamic behavior so as to design the control strategy effectively and realize safe and stable operation. This paper mainly discusses the dynamic behavior modeling of a real machine set under the status of a single machine set with region load according to the field test with a recursive least squares estimation (RLSE) algorithm. The results demonstrate that the hydroturbine generating set has nonlinear characteristics on the status of a single machine set with a region load. It will take the error with the linear model to describe their behavior. The paper also studies the nonlinear model with an artificial neural network and it is proved that its modeling accuracy is high.

J Ram Prabhakar and K. Ragavan (2013)[3], This paper presents a control of distributed generation (DG) system subjected to sudden rise in demand, faults on the distribution feeder and unbalanced load condition. The effects of line to ground faults on the system are investigated and control measures are taken to stabilize the generator speed and to improve voltage quality at the point of common coupling (PCC). The static shunt compensator (STATCOM) is connected at PCC to provide voltage support during sudden demand rise and fault on feeder. Moreover, the STATCOM control is devised such that even during unbalanced load condition the converter current and hydro-turbine-driven induction generator current is balanced. Owing to this, the double power frequency oscillations in the dc-link voltage and torque pulsations in generator can be averted. The STATCOM also supplies reactive power to the load. In addition to this,

generation-demand mismatch is moderated using real and reactive power controllers.

Gbadamosi S. L and Ojo O. Adedayo(2015) [4], Hydroelectricity is an important component of world renewable energy supply and hydropower remains a major source of electricity generation due to its environmental friendly nature. This paper aimed at modeling and simulating hydropower plant with a view of increasing the efficiency and stability of the generating station. The hydropower plant model was developed using Matlab/Simulink software. The designed model comprises: Hydraulic turbine (PID governor, servomotor and turbine), Synchronous generator and an excitation system. The dynamic response of the system to the disturbances on the system network was studied. A three phase fault was introduced in the SHPP model at 0.1 sec and cleared at 0.2 sec. The simulated result shows that the generated voltage quickly regained its stability on the removal of the fault, the stator currents went into transient after the fault was cleared and become stable at 0.4 sec. The excitation voltage also regains its stability but it was slower and the speed of the rotor was out of stable after the occurrence of the disturbance on the system. The simulated result shows an improvement in the static and dynamic behavior of SHPP and an increase in the generating performance of the generating station.

V. Valsan and P. Kanakasabapathy(2017)[5], This work attempts to design and implementation of a cost effective, smart energy management system (SEMS) for stand-alone micro-hydro system installed in a remote tribal village. Major tasks of the smart energy management system are voltage regulation of self-excited induction generator, wireless load management in micro-grid (micro-hydro system) and to increase the utilization efficiency of the system in real time by effective energy management strategy.

Sweeka Meshram, Ganga Agnihotri and Sushma Gupta(2017)[6], The renewable energy systems (RESs) are an attractive option to electrify the community as they are environment friendly, free of cost, and all-pervading. The efficiency of these energy systems is very low and can be improved by integrating them in parallel. In this paper, hydro (7.5 kW) and solar systems (10 kW) are taken as RESs and connected with the utility grid. Due to the intermittent nature of both the hydro and photovoltaic energy sources, utility grid is connected to the system for ensuring the continuous power flow. The hydro power generation system uses the self excited induction generator (SEIG) and converters. The AC/DC/AC converter is used as interface to connect the hydro turbine to the utility grid to adjust the generated voltage to the utility grid voltage. The solar generation system is the combination of PV array, boost converter, and solar inverter. The control of both the hydro and solar power plants is provided through the constant current controller. The analysis has been done to verify the existence of the proposed system. Results demonstrate that the proposed system is able to be put into service and can feed the community.

R. Dhakal et al.,(2017)[7] Micro hydropower is a very promising renewable energy source for off-grid energy generation in remote areas where the resource exists. This study focuses on integrating an innovative new design of micro hydropower system called the Gravitational Water Vortex Power Plant into existing water infrastructure. Three types of existing water infrastructure are considered applicable for hydropower integration: irrigation canals, reservoirs and weirs. The theoretical designs for the civil works for the low-head gravitational water vortex power plant integrated into these structures are given and the costs of construction are estimated. A scalable system of 1.6kW is also designed and integrated in an existing irrigation canal for the technical performance evaluation and validates the theoretical economical study. The study concludes that the performance of turbine is mostly suitable for rural electrification and to integrate in cost-effective way, the civil works and installation cost should be greatly reduced.

David Restrepo ,Bonie RestrepoCuestas Adriana Trejos (2017)[8], The integration of renewable energy sources to create microgrids is drawing growing interest to address current energy-related challenges around the globe. Nevertheless, microgrids must be analyzed using specialized tools that allow to conduct operation, technical and economic studies. In that regard, this paper presents a case study in which the software HOMER Energy Pro was implemented to design and analyze the performance of a microgrid. Such microgrid comprises a photovoltaic system, a wind system and a diesel plant. The parameters of the energy systems are based on information about local weather conditions available in databases. Finally, this analysis is performed under two conditions: stand-alone and grid-tied.

S. Das and A. K. Akella(2018)[9], In this paper a control strategy for the power management in an isolated micro hydro-PV-battery based hybrid renewable energy system is presented. The overall control strategy consists of two level control structures. The top level control structure determines the various reference powers for the various components and the device level controller acts according to the top level controller. The top level controller also controls the load in order to avoid systems blackout in case of insufficient power generation and storage power. The overall control strategy ensures that the system power flow at different time is balanced between the supply and demand. The proposed control strategy is implemented in MATLAB/Simulink software and is tested under different solar radiation, water flow rate and load demand.

N. R. Nair and D. P. Kanakasabapathy(2018[10],This paper aims to integrate a Solar Photovoltaic (SPV) system into the grid using synchronverter technology. It also

reviews the modelling of the converter controller and analyses its performance under continuously varying input conditions. The capability of the converter to maintain synchronism under extreme conditions were also investigated. The results presented were based on a simulation study done in MATLAB/Simulink. The rising demand for energy invites the contribution of renewable sources as alternative sources of energy. The major drawback of these sources is their inherently varying nature. They depend mostly on power converters for energy conversion and maximum power point tracking (MPPT). The increased penetration of such power converter based generation is degrading the stability of the existing grid, since synchronous generators based conventional energy generation is no longer capable of maintaining the grid stability. Synchronverter technology is a promising solution to this problem. To contribute to the stability of the system, here, synchronous machine dynamics is used to control the grid connected inverter.

Fadoul Souleyman Tidjani, Abdelhamid Hamadi, Ambrish Chandra, Benhalima Saghir, Benadja Mounir, Mohammed Garoum,(2019) [11], Energy management using state flow for designing an intelligent micro-grid for a specific combination vehicle to building (V2B) in specific geographic region is proposed. Renewable energy based PV solar with impact of ambient temperature is also undertaken in both STC and NOCT mode. In this paper, a complete energy system design is analyzed and simulated under different scenarios and operation condition. Backup energy storage system including plug-in hybrid electric vehicle and diesel generator are used to ensure an uninterruptible power supply in case of low solar irradiation. A direct voltage control is adapted to regulate the ac load voltage. The under study system is validated by simulation using Matlab/Simulink.

Qijuan Chen, Xuhui Yue, Dazhou Geng, Donglin Yan, Wen Jiang(2020)[12], Power take-off is an indispensable link in wave energy utilization, and its efficiency should be comprehensively investigated at both full load and part load for the effective conversion in variable wave conditions. However, up to now, the research about this issue is still scarce because of its complexity and difficulty. To overcome this obstacle, this paper studies the overall conversion efficiency of the constant-pressure hydraulic power take-off (CPHPTO) of a floating-pendulum wave energy converter, at a wide range of the system pressure, system flow-rate and shaft speed, via the efficiency test and fitting formulas. Furthermore, the integrated characteristic curves, which consist of the characteristic curves and operating curves, are proposed to deal with the four-dimensional data obtained from the experiment or fitting. The results show that the integrated characteristic curves of the CPHPTO are available and play an important role in the optimal design and efficient operation. The stable operating region can also be defined when plotting the operating curves. In general, the integrated characteristic curves are suitable for the preliminary design and further optimization of the similar CPHPTOs for different kinds of oscillating-body wave energy converters.

Dazhou Geng, Yang Zheng, Qijuan Chen, Xuhui Yue, Donglin Yan (2021)[13], in this paper, a novel structure of the power regulation module in the hydraulic PTO is proposed. The proposed module comprises a pressure compensation valve and a throttle valve, which greatly enhances the stability of the hydraulic PTO under irregular wave circumstances. The complete state-space equations for the floater and hydraulic PTO emphasizing dynamic behaviors of the power regulation module are established and the modeling accuracy of hydraulic PTO in the system is validated with experimental data. The influences of key parameters of the power regulation module on the hydraulic PTO stability are also researched and the opening size of throttle valve is controlled to adjust the steady values of hydraulic PTO. The results demonstrate that the fluctuations of hydraulic motor speed and generator output power can be effectively suppressed by the proposed power regulation module and their steady values can be sensitively adjusted by controlling the opening size of throttle valve. This study provides a promising approach to increase the power quality of hydraulic PTO.

S. Hussain, C. Z. El-Bayeh, C. Lai and U. Eicker(2021)[14], Home Energy Management Systems (HEMSs) may not be able to solve network issues, especially in the presence of high penetration level of Electric Vehicles (EVs) and decentral renewable energy. To solve the problem, Grid Energy Management Systems (GEMSs) were introduced. However, because of the contradictory nature of the main objectives of HEMS which are economical oriented on end-users, e.g., cost minimization, and GEMS which are technical oriented on system operators, e.g., maximization of system stability and power quality cannot be satisfied simultaneously. Hence, a multi-level energy management system seems to be necessary to improve the techno-economic performance of the distribution system while satisfying end-users, electricity retailers, and the system operator. Because of the significance of the subject, this paper presents the state-of-the-art regarding different energy management systems at home, aggregator, and network levels. The advantages and disadvantages of each system are discussed and compared, considering their main elements such as objective functions, constraints, optimization algorithms, communication protocols, and impact of EVs. The challenges and limitations in hierarchical energy management are explained. Finally, some future research directions are suggested to improve the multi-level energy management system.

A. M. Al-Ghaili, H. Kasim, N. M. Al-Hada, B. N. Jørgensen, M. Othman and J. Wang(2021)[15], Energy management systems in buildings (EMSs-in-Bs) play key roles in energy saving and management to which an efficient energy management system in buildings (EMS-in-Bs) design contributes. Different scope-based designs of EMS-in-Bs are reviewed. The objective is to highlight different scope-based designs of EMS-in-Bs in which scopes of reviewed papers aim to implement a function of, for example, "monitor energy performance", "estimate energy-use", or "control energy-use". This paper aims to constitute a comprehensive conception of how efficient such an EMS-in-Bs to perform more than one scope (i.e., function). Meaning, is the proposed EMS-in-Bs able to perform several sequential functions? This paper's contribution is to give a function-focused EMS's review utilizing the scope of reviewed papers. That is, reviewed papers are classified based on the scope/function the selected EMS-in-Bs is designed for.

This could help select an EMS-in-Bs to perform certain scope/function(s). Another contribution is that, numerous EMSs-in-Bs are reviewed in a classified way so that the most adequate EMS-in-Bs for a certain scenario considering the performed scopes/functions e.g., "monitor" are highlighted. Findings showed that "control-optimize"-functioned EMS-in-Bs achieved highest energy-saving rates ~30% compared to "estimate-predict" with 10%. Findings, insights given by reviewed studies, current problems faced, future directions, and remarks are drawn in conclusion. Analysis done on reviewed papers has found that the highest and lowest averaged-energy saving rates were obtained with papers whose their scopes are implementing "control"-with-"optimize" and "estimate"-with-"predict", respectively. Energy saving rates for these two classes of scopes have been equal to 22.57% and 10%, respectively. We recommend that there is a need to enhance the estimation- and prediction-related EMS-in-Bs to achieve a higher energy saving rate.

Susmita Bandyopadhyay, Vipina Valsan, P Kanakasabapathy,(2021)[16], The generation of power from renewable energy sources (RES) is increasing day by day because they are eco-friendly, more reliable and have less maintenance cost. A hybrid microgrid system has numerous decentralized loops. Therefore, proper coordination among hybrid microgrid subsystems with required performance is essential. In this paper, a hybrid solar and micro-hydro system model is proposed which includes islanded and grid connected hydro with the solar PV system. The hydropower generation uses the synchronous generator that regulates the voltage using a load controller for standalone operation. The analysis of the whole system is carried out and verified in the Simulink and can be implemented in the Amrita Micro-Hydro system with the Solar DC microgrid at Komalikuddi tribal village in Idukki district, one of the 101 villages adopted by Mata Amritanandamayi Math.

Jaiswal, Prashant & Goad, Shalini(2021) [17], This paper applicable for improving power quality by regulation of voltage and frequency of an isolated micro hydropower generation. Based on a capacitor excited synchronous generator and feeding linear load and electronic load controller. The electronic load controller based on a three phase uncontrolled diode bridge rectifier with a chopper and an auxiliary load. The complete electromechanical system is modeled and simulated in MATLAB using Simulink and simpower system block set.

Felipe Condon,José M. Martínez,Ali M. Eltamaly,Young-Chon Kim and Mohamed A. Ahmed,(2023)[18], The advances in the Internet of Things (IoT) and cloud computing opened new opportunities for developing various smart grid applications and services. The rapidly increasing adoption of IoT devices has enabled the development of applications and solutions to manage energy consumption efficiently. This work presents the design and implementation of a home energy management system (HEMS), which allows collecting and storing energy consumption data from appliances and the main load of the home.

Two scenarios are designed and implemented: a local HEMS isolated from the Internet and relies on its processing and storage duties using an edge device and a Cloud HEMS using AWS IoT Core to manage incoming data messages and provide data-driven services and applications. A testbed was carried out in a real house in the city of Valparaiso, Chile, over a one-year period, where four appliances were used to collect energy consumption using smart plugs, as well as collecting the main energy load of the house through a data logger acting as a smart meter. To the best of our knowledge, this is the first electrical energy dataset with a 10-second sampling rate from a real household in Valparaiso, Chile. Results show that both implementations perform the baseline tasks (collecting, storing, and controlling) for a HEMS. This work contributes by providing a detailed technical implementation of HEMS that enables researchers and engineers to develop and implement HEMS solutions to support different smart home applications.

III.PROBLEM STATEMENT

Electricity has become an essential part of human lives in recent years and their dependence on electricity has also increased exponentially. Electricity is now integrated with every aspect of human livelihood such as health, work, and entertainment, etc. This increase in dependence on electricity and the increase of the world population have resulted in a significant increase in electricity demand. This excessive generation of electricity produces a considerable amount of greenhouse gas emissions, which makes it a substantial contributor to climate change. Therefore, the electrical power industry took the initiative

to increase generation from renewable energy resources to alleviate these effects on climate change.

Power system stability and control is very important in generation of electricity by hydro plant. Voltage stability is achieved by using FACTS Devices, there are so many FACTS Devices are available they have some advantage and disadvantage too. We have already discussed about the hydro system with using the FACTS device & without the FACTS device in this literature review. We found the number of facts device available for the power quality improvement like SVC UPFC. The fact device are performs different capacities like voltage direction, & reactive power control & provide better result for the voltage compensation & reactive power control. So it is required to place fact devices in a aperticular places to for voltage stability and contrl. In hydro plant, voltage regulation, harmonic elimination and neutral current compensation are important. and So by using off STATCOM system we can reached to steady stat condition by the under simulated time and power quality will be improved.and able to conrol the flow of electivity from power plant.

IV. CONCLUSION

In this paper I read different authors idea for management of hydropower. This major focus in this article is on various hydro power plants and turbines, it exhibited that hydro is an establishment of the generation of electrical energy which is refined unfathomable significance for the environmental and commercial concerns. Of course, this article showed different types of hydropower turbines; it presented a general depiction of hydropower turbines structures and there various parts and execution. From the above assessment, it will in general be given a standard to reach about the suitable hydropower structure and turbine which can be used in the different hydropower projects.

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