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Generator Based On Superconduction

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Abstract:-

This paper represents to obtain better results from permanent magnet synchronous generators, a method of creating superconducting synchronous generators for wave power conversion has been proposed. The generator produces a strong magnetic field from the superconducting magnet's ability to capture strong magnetic fields. The performances of superconducting synchronous generators, such as induced voltage, power density and efficiency, are better than permanent magnet synchronous generators. The generator model is verified by finite element method to verify the accuracy and precision of the generator design. Superconductors could be a solution for building wind turbine generators, especially offshore wind farms, because superconductors are lightweight and have no electrical resistance. Recently, superconducting generators are expected to replace conventional generators in today's generators. They are known for their lightness, small size, high performance and many other advantages. The self-excited SCG has an exciting response and has additional features that can be used to improve the stability of the transducer.

Introduction:-

With the increasing depletion of renewable energy resources in the world and increasing environmental problems, humanity urgently needs to seek renewable energy to replace the depleted fossil energy. The research focus at home and abroad has shifted to renewable energy [1-2]. Renewable energy mainly includes wind energy, solar energy and ocean energy [3-4].Ocean energy reserves are large and widely distributed. It is a renewable energy with great potential. Wave energy is more intense than wind and solar energy. It is permanent and predictable. Data show that the world's wave energy resources are more than 1 terawatt, and the annual energy production capacity is 2,000 terawatt hours [5]. Our country is located in the Western Pacific and is rich in marine energy. Relevant information shows that my country's energy wave development capacity is over 100 million degrees.

BASIC METHODOLOGY:-

1. THEORY OF SUPERCONDUCTIVITY:-

Superconductivity is a phenomenon that is not preserved under certain conditions (temperature, current density, external magnetic field). It was first discovered in 1911 by Dutch physicist Kamerlingh Onnes while studying the low-temperature resistance of metals. He found that at 4.2K the resistance of mercury was so small that it had no value. This is called superconductivity [13]. As can be seen from Figure 1, after a temperature of 4.2k, the resistance of mercury suddenly dropped to zero. The temperature of the material with superconductivity is called the critical temperature and this is the Tc of the material [14] [15]. Like all elements and components, electronic material is not visible, even some good materials (copper, gold, platinum, etc.). Therefore, it can be said that the material that has no resistance at the critical temperature is called a superconductor. Table I lists some superconducting elements and compounds.

2. BASIC MODEL OF THE SUPERCONDUCTING GENERATOR:-

Generators are an important part of wave energy production systems. Increasing the efficiency of the generator plays an important role in improving the performance of the wave energy generator. The rise of superconducting materials, especially high-temperature superconducting (HTS) materials, has led to increased performance of traditional electronic materials such as superconducting electronics.

As shown in Figure 1, the superconducting synchronous generator has a stator with three-phase windings, a rotor with superconducting block magnets, and a shaft. Compared with permanent magnet synchronous generators, superconducting synchronous generators use superconducting magnets to provide the excitation magnetic field. Since superconducting magnets are capable of generating strong magnetic fields, superconducting synchronous generators have stronger excitation magnetic field than modern magnet synchronous generators. Therefore, it has higher speed and torque.

3. STRUCTURE PARAMETERS OF THE SUPERCONDUCTING SYNCHRONOUS

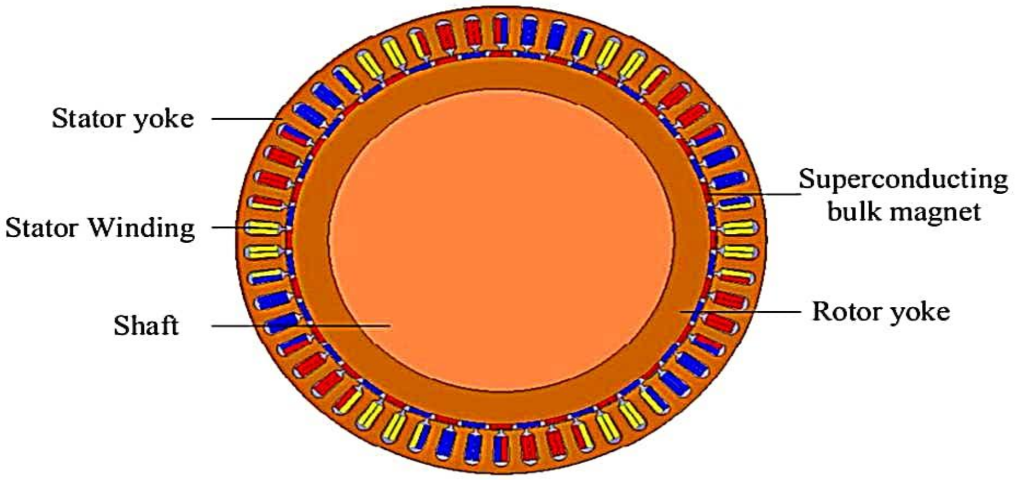

Figure 1. Finite element model of the superconducting synchronous generator.

GENERATOR:-

It Is well known that generators that produce electricity have a lower value when the characteristics of the energy wave are analyzed. Therefore the nominal speed of the generator is 60 rpm. The generator model. Has 48 poles and 54 holes, and the winding adopts slits. Concentrated winding distribution.

Permanent magnets have four types of permanent magnets: tangential type, radial type, hybrid type and axial type. The superconducting block magnet structure used in the electric machine is a radial tile-like surface-mounted rotor magnetic circuit structure. Since there is no superconducting material in the Maxwell finite element analysis software, the relative magnetic permeability of the superconducting magnet is defined as 1 and the remaining magnetic field is defined as 3T in the Maxwell software.

WORKING:-

The operating models used in the past for older generators such as synchronous permanent magnet generators or generators and asynchronous generators are now also used for superconducting generators. The difference between the two is the windings of the superconducting machine. These windings can support a stronger magnetic field than conventional generators. Using this coil in many areas will also increase the efficiency of the motors; making them more compact and environmentally friendly.

Superconducting generators have a coil cover to support the coil under centrifugal force and a damper to prevent high-frequency magnetic fields. There is also a cooling system and a rotating seal that controls temperature and temperature. The metal core Is made of non-magnetic stator wire, and the stator coil is made of copper. Electric current is applied to the superconducting coil made of the superconducting material of the slip ring. There are three types of insulation, the first is the shield that prevents the magnetic field from escaping into the environment, the second is the vacuum forming machine vacuum insulation, and the last one is the vacuum cleaner. That is, it is the insulation layer.

ADVANTAGES:-

1) Efficiency- by using superconducting wire for the field windings there won't be any loss in the rotor winding and in armature bars as in the conventional generator.

2) Smaller and lighter- the capacity can be increased without using additional space the equipment are simplified and it is less costly.

3) System impact- due to the superconductors the armature reactance is reduced and by this the spinning reserve is reduced and then it has the ability to permit the power factor correction without adding capacitors or synchronous reactors to the power system.

FUTURE SCOPE:-

There are many exciting future directions of research in superconducting materials. Their low loss, compact structure, and nonlinear properties make them ideal candidates for realization of the landmark predictions of metamaterial theory, including the near-perfect lens, evanescent wave amplification, hyper-lensing, transformation optics and illusion optics.

Many superconductors have intrinsic properties that make them suitable for use as photonic crystals.

Superconducting ceramics have shown the most promise for future technologies because of their relatively high critical temperatures.

There are many exciting possibilities to extend the frequency coverage of superconducting materials from low RF range (below 10 MHz) to the upper limits of superconductivity in the multi-THz domain.

CONCLUSION:-

Carefully designed superconducting generators can meet the best of competing and often conflicting electrical, economic, thermal, reliability and demand requirements of all types. [6] Basically, as the operating temperature increases, thermal efficiency increases and electrical efficiency decreases Electrical safety and energy density increase at the expense of mechanical energy and vibration tolerance. The complexity of advanced technologies should not compromise reliability. Reduced investment costs, impact. The result of all technologies is the performance of their resources and the development of resources Simply put superconducting generators can do this thanks to their small area/volume ratio, that is, they are compact, Because superconductors operate in DC mode. In terms of power loss, Superconductor AC conduction is limited due to the large surface/volume ratio of the superconductor therefore, the cooling loss is large and the power loss is relatively higher due to the AC mode market.

Although AC superconducting generators can achieve advantages such as higher efficiency, smaller size and weight, lower costs, and greater stability, these advantages are easily offset by single reliability. If it is less reliable than a regular machine, even a few more days of electricity per year can show its balance. It is a more complex and advanced machine than its solid counterpart

REFERENCES:-

1] ZHANG, Ning, et al. "Haidian District, Beijing 100084, China; 2. Gansu Provincial Electricity Trading Center, Lanzhou 733050, Gansu Province, China); Impact of Large·Scale Wind Farm Connecting With Power Grid on Peak Load Regulation Demand [J]." Power System Technology 1 (2010).

2] Array, London. "London Array Project." (2007).

3] Leung, Dennis YC, and Yuan Yang. "Wind energy development and its environmental impact: A review." Renewable and Sustainable Energy Reviews 16.1 (2012): 1031-1039.

4] Scots, M. "Offshore wind installation ships: gaming the market." New Energy Finance (2008): 5.

5] Salama, K., et al. "High current density in bulk YBa2Cu30x supercon-ductor." Applied Physics Letters 54.23 (1989): 2352-2354.

6] Pena, R., J. C. Clare, and G. M. Asher. "Doubly fed induction generator using back-to-back PWM converters and its application to variable-speed wind-energy generation." IEE Proceedings-Electric Power Applications 143.3 (1996): 231-241.

7] Muller, S., M. Deicke, and Rik W. De Doncker. "Doubly fed induction generator systems for wind turbines." Industry Applications Magazine, IEEE 8.3 (2002): 26-33.

8] Kadam, D. P., and B. E. Kushare. "OVERVIEW OF DIFFERENT WIND GENERATOR SYSTEMS AND THEIR COMPARISONS."

9] Li, H., and Zhe Chen. "Overview of different wind generator systems and their comparisons." IET Renewable Power Generation 2.2 (2008): 123-138.

10] Spooner, E., and A. C. Williamson. "Direct coupled, permanent magnet generators for wind turbine applications." IEE Proceedings-Electric Power Applications 143.1 (1996): 1-8.

11] Rodriguez Zermeno, Victor Manuel. "Computation of superconducting generators for wind turbine applications." (2012).

12] Sderlund, L., et al. "A permanent-magnet generator for wind power applications." IEEE Transactions on Magnetics 32.CONF-950691- (1996).

13] R.A.F. Saleh, "Superconducting generators: control and stability", VDM Publishing, Germany, 2010.

14] T. Nitta, Y. Shirai, T. Okada, Y. Imai, and Y. Kobayashi, "High response excitation control of superconducting generator for stability of superconducting field winding", IEEE Trans. Applied Superconductivity, vol. 10, no. 1, pp. 935-938, March 2000.

15] T. Nitta, S. Tanaka, and T. Okada, "Characteristics of superconducting at high response excitation", Electrical Engineering in Japan, vol. 112, no. 5, pp. 26-35, 1992, Translated from Denki Gakkai Ronbunshi, vol. 111-B, no. 4, pp. 389-395, April 1991.

16] J. L. Kirtley, "Large system interaction characteristics of superconducting generators", Proc. of the IEEE, vol. 81, no. 3, pp. 449-461, Mar. 1993.

17] H. F. Wang, Y. S. Hao, B. W. Hogg, and Y. H. Yang, "An adaptive power system stabilizer based on turbine governor control", IEE International Conference on Advances in Power System Control, Operation and Management, APSCOM-93, 7-10 Dec. 1993, vol. 1, pp. 285-289.

18] R.A.F. Saleh, "Superconducting generators: control and stability", VDM Publishing, Germany, 2010.

19] T. Nitta, Y. Shirai, T. Okada, Y. Imai, and Y. Kobayashi, "High response excitation control of superconducting generator for stability of superconducting field winding", IEEE Trans. Applied Superconductivity, vol. 10, no. 1, pp. 935-938, March 2000.

20]T. Nitta, S. Tanaka, and T. Okada, "Characteristics of superconducting generator at high response excitation", Electrical Engineering in Japan, vol. 112, no. 5, pp. 26-35, 1992, Translated from Denki Gakkai Ronbunshi, vol. 111-B, no. 4, pp. 389-395, April 1991.

21] J. L. Kirtley, "Large system interaction characteristics of superconducting generators", Proc. of the IEEE, vol. 81, no. 3, pp. 449-461, Mar. 1993.

22] H. F. Wang, Y. S. Hao, B. W. Hogg, and Y. H. Yang, "An adaptive power system stabilizer based on turbine governor control", IEE International Conference on Advances in Power System Control, Operation and Management, APSCOM-93, 7-10 Dec. 1993, vol. 1, pp. 285-289.

23] H. Kaminosono, Superconducting generators, 2004. (in Japanese)

24] Swarn S. Kalsi, David Madura, and Mike Ingram, "Superconductor synchronous condenser for reactive power support in an electric grid," IEEE Trans. Appl. Supercond., vol. 15, no. 2, pp. 2146-2149, June, 2005.