Modification in Element of Power System to Improve its Efficiency

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Abstract— As Electric Power System continues to grow in size and complexity, reducing losses can result in substantial savings. While losses in Distribution Lines are due to both Copper loss and Thermal Insulator. Similarly in Electric Machine losses occur due to both Copper loss and Core loss. I am going to present here how to design a highly efficient Power Cable, Motor and Generator. A power cable is an assembly of two or more electrical conductors, usually held together with number of sheath. These numbers of sheath can be replaced by a Polymer, namely Aerogel. Similarly, in Motor and Generator core losses can be nullified by using a very light weight disc type rotor made up of Polymer, namely Ultraconductor Polymer. In this way the total energy loss can be minimized and the overall efficiency of power sector can be maximized.

Index Terms Aerogel, Copper loss, Core loss, Generator, Motor, Polymer, Power Cable, Thermal Insulator, and Ultraconductor

1 INTRODUCTION

ELECTRIC Power has become almost as much of a necessity as water in our everyday life. No one really thinks much about it until an outage occurs and it isn't there. Organs of power sector, namely Generation, Transmission, Distribution, Load Management and Communication need to be given equal importance to ensure healthy growth and functioning. An Electric Power System is a network of electrical components used to supply, transmit and use electric power. The power system can be broadly divided into the Generator that supply the power, the transmission system that carries the power from generating centers to the load centers and the distribution system that feeds the power to nearby home and industries.

In this paper I am going to present how to design a highly efficient Electric Power System. By doing few modification in Motor, Generator and Power Cables, we can increase the overall efficiency of power system.

2 POWER CABLE

The power cable employed for transmission of power at high voltage consists of one central core or a number of cores (two, three or four) of tinned stranded copper or aluminum conductors insulated from each other by paper or varnished cambric or vulcanized bitumen. A metallic sheath of lead or alloy or of aluminum is provided around the insulation to protect it against moisture, gases or other damaging liquids. For protection of metallic sheath against corrosion and from mechanical injury a layer of bedding consisting of paper tape compounded with fibrous material is provided. Over the layer of bedding armoring consisting of one or two layers of galvanized steel wire is provided to save the cable from mechanical injury and over the armoring a layer of fibrous material known as serving, is provided for protection. This provides sufficient protection against mechanical damage.

2.1 Modification

From the construction of power cable it is clear that the reason behind using several layer of insulation is that, a single insulating material cannot protect the conductor from different factors. Using various types of insulators not only results in increase in weight but also it increases the cost of the cable. The cost and the weight of cable can be reduced if we replace the insulating materials with a single material. It is possible, a polymer known as Aerogel has all sort of property which a good insulating material should have. Having all sorts of property made this polymer more effective in comparison to other insulating materials.

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2.1.1 Aerogel

It is often known as "frozen smoke", Aerogel are among the amazing material. When linear polyamides were reacted with a bridging compound to form a three-dimensional covalent polymer. Such polymers are far stiffer than linear polymers, rather like an I-beam compared to a solid round rod of the same weight. They formed the gel at room temperature, and were able to achieve virtually total coupling between the various three-dimensional polymers Such polymers are far stiffer than linear polymers, rather like an I-beam compared to a solid round rod of the same weight. They formed the gel at room temperature, and were able to achieve virtually total coupling between the various three-dimensional polymers. When this gel was subjected to supercritical drying, they were able to form polymer Aerogel would provide as much insulation as three inches of fiberglass. The mechanical properties are rather like those of a synthetic rubber, save that the Aerogel has the same properties (and far smaller thermal conductivity) with only about 10 percent of the weight.

2.1.2 Properties of Aerogel

1) Low Density- Density of Aerogel is as small as 0.14 g/cc.
2) Low Permittivity- Aerogel is low permittivity dielectric materials that are rigid and very strong.
3) Non-hygroscopic- Aerogel are non-hygroscopic in nature.
4) Non-reactive- Being a polymer Aerogel is non reactive in nature.
5) High Insulation Resistance- Quarter-inch sheet of Aerogel provide as much insulation as three inches of fiberglass.
All these properties of Aerogel make it a good replacement for several other insulating materials of electric cables.

3 ELECTRIC MACHINES

The working principle of the Electric Machine is based on Faraday Law of Electromagnetic Induction. In case of Motor, when a rectangular coil carrying current is placed in a magnetic field, a torque acts on the coil which rotates it continuously. When the coil rotates, the shaft attached to it also rotates and thus it is able to do mechanical work. In Generator, the rotor is carrying the armature winding made up of copper. Whenever rotor shaft is rotated by the prime mover, armature winding cut the strong magnetic field an electromotive force is induced in armature windings. Armature windings are connected to slip rings on the shaft and current is collected through brushes.

3.1 Construction

First part of construction is Stator of machine and it is nothing but a permanent magnet. Another part is rotor; it is the non-stationary part of a rotary electric motor, electric generator or alternator, which rotates because the wires and magnetic field of the motor are arranged so that a torque is developed about the rotor's axis.

3.2 Modification

As we know in Electric Machine losses occur due to both Copper loss and Core loss. Several modifications are being done to improve the efficiency of machine. For example, the electrical efficiency of motors can be improved by replacing the standard aluminum electrical conductor in the motor rotor with copper, which has a much higher electrical conductivity. But this modification won't be able to make machine highly efficient. Here I am presenting a modification in rotor of machine to overcome core losses. It will be a rotor made up of polymer, namely Ultraconductor and slots in it carrying winding. The light weight material exhibit very high electrical conductivity is used to reduce rotor core losses as well as windage and frictional losses.

3.2.1 Ultraconductor

It is an electrical conductor, similar to present-day superconductors, having zero measurable electrical resistance in one dimension. They consist of organic polymers that exhibit electrical resistance much lower than the best metallic conductors and are considered a novel state of matter. They are made by the sequential processing of amorphous polar dielectric elastomers.
Ultraconductor exhibit a set of anomalous magnetic and electric properties, including: very high electrical conductivity (> 1011 S/cm -1) and current densities (> 5 x 108 A/cm2), over a wide temperature range (1.8 to 700 K).

4 CONCLUSION

By doing these modification we can develop a highly efficient power system. Aerogel use in power cable will enhance its

electrical and mechanical property. Similarly in electric machine a light weight and highly conductive rotor will nullify the core loss and increase the efficiency of machine. Overall it will reduce the energy loss produced by different factor and will maximize the efficiency of power system.

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