Abstract: Improving the efficiency of induction motors, which are the most energy-consuming electric machines in the world, saves much energy. The efficiency can be increased by improving cooling performance as well as by using better materials or by improving electromagnetic performance with better design. This paper presents the relationship between the efficiency or the losses and the temperature of coils with experiments as well as simulations by changing parameters such as the load, the flow rate of cooling air. The losses and the efficiency are calculated from an equivalent circuit method as well as experiments. Coil temperatures variation affects much on the efficiency. The internal cooling method is better than that of external cooling for the coil temperature reduction. Several cooling methods are compared focusing on the fan efficiency and performance, from which the values of the efficiencies of the motors are expected. The fan efficiency as well as the fan performance should be considered for the optimum fan design to increase the total efficiency of a motor. The simulations are validated by the comparison with the experiments.

Keywords: Induction motors, cooling, temperature measurement, efficiency, losses, equivalent circuits.

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Discussion Deadline: March 2002

Energy Development and Power Generation

Modeling and Performance of Microscale Thermophotovoltaic Energy Conversion Devices

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Abstract: We analyze the feasibility of energy conversion devices that exploit microscale radiative transfer of thermal energy in thermophotovoltaic devices. By bringing a hot source of thermal energy very close to a receiver fashioned as a *pn*-junction, the near-field effect of radiation tunneling can enhance the net power flux. We use the fluctuational electrodynamic approach to microscale radiative transfer to account for the spacing effect, which provides the net transfer of photons to the receiver as a function of the separation between the emitter and receiver. We calculate the power output from the microscale device using standard thermophotovoltaic device relations. The results for the performance of a device based on indium gallium arsenide indicate that a ten-fold increase in power throughput may be realized with little loss in efficiency. Furthermore, we develop a model of the microscale device itself that indicates the influence of semiconductor band-gap energy, carrier lifetime, and doping.

Keywords: Microscale transport, thermophotovoltaic energy conversion.

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Discussion Deadline: March 2002

Market Constrained Optimal Planning for Wind Energy Conversion Systems Over Multiple Installation Sites

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Abstract: This paper presents two market dependent optimization algorithms that can be used to plan wind energy conversion system (WECS) installations simultaneously over several sites of interest to a utility, within the scope of (a) available WECS models, (b) power demand of the utility, and (c) wind characteristics at each site; both (b) and (c) being variable with time and subject to seasonal changes. A suitable case study illustrates application of the planning algorithms to a scenario comprising of eight installation sites, using a representative market database consisting of thirty-seven available models of WECS.

Keywords: Wind energy, energy conversion, optimization methods.

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Discussion Deadline: March 2002

Insulated Conductors

B.C. Hydro 15 kV Cable Explosion

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Abstract: This investigation was prompted by a cable fault explosion inside a cable duct that housed a BC Hydro 15 kV underground standby feeder cable. The incident occurred in September, 1998 at a housing complex in Vancouver, British Columbia, Canada. Damage to the building vault was extensive and could very easily have resulted in severe injury or a fatality had anyone been in the immediate area of the vault. A failure analysis investigation revealed the cause of the explosion was an accumulation of combustible gases that were decomposition products of the polymeric cable components, which were liberated from the cable by a long duration high impedance fault. Several unusual circumstances had to occur concurrently to allow the explosive condition to develop. The events that led to the explosion are discussed in terms of the failure mechanism of the cable and the effects of reclosure arcing.

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Power Engineering Education

Power Engineering Education and the Internet: Motivation and Instructional Tools

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Abstract: Alternatives in the application of the Internet are applied to power engineering education. Because the student perception of power engineering is often that this is an old technology, new ways to effectively present the challenges, and the opportunities as well, are needed. The Internet and innovative graphic and textural materials are suggested to effectively present the case for power engineering as a valuable career. This is suggested to build on student interest in these computer technologies. The contents of web sites for this purpose are described, and the educational pedagogy of the method is discussed.

Keywords: Internet, power engineering education.

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An Integrated Virtual Learning System for the Development of Motor Drive Systems

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Abstract: This paper describes the basic concept of an integrated virtual learning system as an instructional tool for the development of DSP-based control schemes for motor drive applications. The system is comprised of a graphical user interface (GUI) front-end and a hardware-in-the-loop custom digital signal processor (DSP) for rapid prototyping and efficient testing of digital control algorithms. The circuit design and control algorithm development of a pulse width modulation (PWM) voltage source inverter (VSI) for three-phase brushless dc (BLDC) motor control applications is used to describe the functions of the system. It is shown that the virtual learning system provides a