ELECTRIFYING THE 21ST CENTURY

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At the turn of the millennium, the U.S. National Academy of Engineering named electrification as the greatest engineering achievement of the 20th century. Rightly so, for readily available electric energy is a key cornerstone of our modern economies. With electricity, energy can be readily transported and then either used directly to power a wide variety of electronic devices or efficiently converted into a host of other forms such as light, heat, or mechanical power. The electrification of a major portion of the world in the 20th century was truly a monumental achievement. Yet challenges remain to keep 21st century engineers busy, with the most significant being sustainability of energy resources and bringing electrification to the one-third of the world's population that has not yet benefited from it. This is very important in order to keep our ever-progressing human society more fruitful and to bring its benefit to every country and every population on the planet, while leaving the global environment intact with traces of human activities as minimal as possible.

Solving these challenges will require contributions from many different aspects of science and engineering. Even when we restrict our topic to the electric power system, diversification of subtopics may not allow even specialists in the related fields to cover them all. It is therefore worthwhile to bring this topic to JAFoE 2003 where interaction among participants can be expected.

The focus of this session will be on the newer engineering technologies necessary to provide this sustainable energy system of the future. Traditionally, economies of scale drove the creation of ever larger centralized power plants, with fossil fuels the primary fuel source. But this is now changing with distributed power resources poised to provide alternative ways of delivering electric power. Particularly important will be micro gas turbines and fuel cells. In addition, since the reserves for fossil fuels are limited, there is an increasing need to supplement our energy supply with more renewable resources, such as solar, wind, tidal, and geothermal resources. But there are significant engineering challenges associated with the integration of such resources, particularly those related to their low energy density and weather-dependent energy output characteristics. Hence it is not realistic to totally replace the existing energy system with these new sources. The most realistic path should be gradual integration to the existing energy system, while using conventional fuels as efficiently as possible.

But the integration of these smaller, more dispersed generation sources will require major changes to the electric distribution system, which was originally designed to move power in a single direction. The electric grid of the future could also benefit tremendously from better energy storage technology, particularly as significant amounts of weather dependent renewable resources (such as wind and solar) are added to the generation mix. Last, it is important to consider the impact of liberalization and deregulation of the electricity industries since this provides not only the framework for the ultimate implementation of new technologies but also directly impacts the lives of all.

To cover these topics the session has been divided into the following areas, with the first two talks covering issues related to the network system and business environment, and the second two talks related to emerging technologies in generation and storage.