EXCLUSIVE

Recent Advances Reported At International MHD Symposium

The 16th International Symposium on Engineering Aspects of MHD held in Pittsburgh May 16-18 heard reports on the most recent advances in fossil-fuel based Magnetohydrodynamics experimentaion. The most important advances in the last year included the first MHD generator running for 250 continuous hours, the successful testing of a coal-fired MHD generator with potassium seed removal of sulfur, a new record for efficient electricity conversion, and developments in the testing of electrode and channel materials for test generators.

The most exciting advance reported on at the conference, though not included in the published technical papers which went to press before the tests were concluded, was the running of the Soviet U-25 pilot plant for 250 continuous hours. One of the major problems in developing commercial MHD has been the manufacture of electrode and channel materials which could withstand temperatures of 3,000 degrees over long duration. The 250 hour continuous running was one of the criteria the U-25 had to meet to begin the third and last stage of the Soviet program, which will be the construction of a 1,000 MW commercial demonstration plant.

The remaining test for the U-25 is operation with a superconducting magnet which is being sent from the USA's Argonne National Labs next month. The magnet has just been successfully tested and is operational at its projected 5 tesla strength. It will be tested on a by-pass loop of the U-25 channel that has one tenth the mass flow of the main channel. As soon as results are generated, the Soviets will "cut metal" on the commercial demonstration plant.

Also not included in the conference papers was the testing of the University of Tennesee Space Institute's coal-fired test generator with a coal-potassium mix. The potassium is added as a "seed" to increase ionization of the coal plasma and through recent tests, also bonded

What Is Magnetohydrodynamics?

The conventional thermal method for generating electricity is to burn a fossil fuel (coal, oil, or natural gas) and use that heat to boil water to produce steam. The steam turns turbines that rotate through a magnetic field, producing an electric current. Because the fuel burns at over 23,000 degrees, but the turbine material can handle temperatures of only approximately 600 degrees, a good deal of the heat energy is dissipated and simply lost. As a result, thermal power plants operate at a rate of efficiency between 30 and 40 percent.

The development of fusion reactions and the study of the properties of plasmas (ionized gases) led scientists to postulate the following: large pulses of fusion energy could be converted — as from thermonuclear explosions — into huge quantities of electricity, that is Magnetohydrodynamics (MHD). Instead of converting heat to mechanical energy (to turn turbines) that would then interact with a magnetic field to produce a current, a hot ionized gas could be pushed directly through a magnetic field, generating current essentially with no moving parts. The plasma, or working fluid, could be produced either by fusion reactions or by burning fossil fuels at extremely high temperatures. Electricity would be produced directly by the interaction between the electrical potential of the plasma and the external field.

In fossil - fuel - based MHD, the gas produced from burning the fuel does not completely ionize, so a "seed" — a metal with a low ionization temperature, such as potassium — is introduced to increase the ionization rate and the electrical conductivity of the plasma. Most commercial MHD designs are "open cycle," where the plasma, which has dropped about 1,000 degrees after going through the MHD duct, is then put through a further steam-turbine cycle similar to a conventional thermal generator. By thus using the plasma's heat "twice," efficiency is raised to between 50 and 60 percent.

In the case of coal-based MHD, the potassium seed, in addition to enhancing the ionization rate, also chemically bonds with any sulfur in the coal, therefore providing a pollution-free combustion process. Researchers at University of Tennessee Space Institute announced recently that 95 percent of the sulfur was removed by their MHD generator, and that they had developed ways to recycle the potassium seed.