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SPACETRIPS

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spaceTRIPS is an European project involving 4 countries, French, Italy, Germany and Latvia, and 6 partners, 3 from industry (Heptyom, AREVA, Thales Alenia Space) and 3 public laboratories, the Centre National de la Recherche Scientifique (CNRS, Grenoble), The Helmholtz-Zentrum Dresden-Rossendorf (HZDR, Dresden Germany) and the Institute of physics of the University of Latvia (IPUL, Salaspils, Latvia). This project is focused on the production of electricity in space by a new process based on the combination of thermoacoustic to produce mechanical energy from a heat source and on an MHD electrical generator to produce electricity. For the space application, the expected level of power is 200 W electric. In space, the heat source will be composed by nuclear elements able to deliver the thermal power during approximately 100 years. The level of power at the heat source will be about 1000 W at a temperature of about 1100 K. The cold source will be constituted by radiative cooler at a temperature of about 400 K. The thermo acoustic is a system able to produce a sonic wave on the form of pressure and velocity oscillation (vibration) which is spontaneously generated when a temperature gradient imposed on each extremity of a regenerator or a stack, is higher than a critical value that depends on several parameter and especially on the gas in which the process occurs. This vibration is transmitted to the MHD generator with the objective to transfer mechanical energy into electricity. To do that the vibration is applied at a liquid sodium located in a toroidal channel submitted to a radial DC magnetic field generated by a toroidal magnet. This produces an induced toroidal AC current that generates an AC induced magnetic field, which, by induction, produces electric current on an external coil. Therefore, there is no mechanical interaction between the external coil and the internal part of the generator as it can be seen on the figure 1.

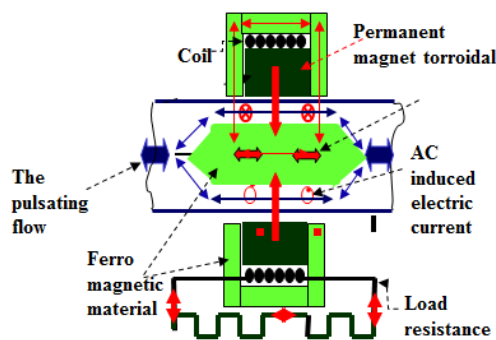


Figure 1. *Schematic representation of the MHD generator*

The coil is connected with the load. The process is interesting for space in the sense that it does not involve any moving mechanical part, it is quasi static. The Thermo acoustic/MHD generator was designed by the design office of the CNRS Grenoble, constructed and tested by the Latvian scientists of IPUL. The tests are promising. For them of course the heat source is simulated by external resistances when the cold source is simulated by cold water.

The connection between the two engines, thermoacoustic and MHD generators, is based on the Impedance adaptation that means that the relation between velocity and pressure drop must be the same for the two engines. The process is compatible with all the energy sources in particular with the solar source, the waste recoveries, etc at level of temperature between 200 up to 1000° C, and the power level can reach more than 100 kW.

ALEMANY A. «Onboard power generation to explore space»,
cordis@publications.europa.eu, June 2017