For the National Contact Point, Euratom, H2020.

Development of a Fuel Cell Emergency Power Plant for Extreme Operating Conditions on a Nuclear Power Plant. (Turtle_N)

Topic: New innovative approaches to reactor safety. NFRP-03-2014. EURATOM Fission.

Web page:
https://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/2306-nfrp-03-2014.html#tab1

Background to the project:
In a nuclear power plant the emergency power supply is made with diesel engines. The diesel generators, will automatically secure the electricity supply to the nuclear power plant in the case of a potential, albeit improbable, loss of power supply. Subsequently this emergency generating power capacity will be used in the case that the electricity supply from external grids and the plant's main generator has ceased.
In 2012 the European Commission published legislation on nuclear stress test (Commission Européenne - MEMO/12/731 04/10/2012) were in the point 2 remark the following: «What is the danger if a nuclear power plant is hit by a tsunami or an earthquake?» and give the following answer «under conditions of extreme external impact, such as a tsunami or large earthquake, there is the risk that important safety functions of the plant could be destroyed, including the cooling and electricity supply systems.» «As happened in Fukushima, this could include the corresponding backup systems, thereby stopping the normal cooling functions needed to prevent the fuel inside the reactor core from becoming too hot and possibly melting». From this document we can deduce that in the design of the EU reactors units is necessary to adding measures that take in consideration a higher earthquake risk and a higher flooding risk associated with the stopping of the diesel generators under extreme environmental impact.
There are 145 nuclear reactors units on the European Union. Few reactors are over land with a relevant probability to have an earthquake on the next 50 years. Other reactors are near rivers, lakes or near the sea shore and having a risk of flooding. Unfortunately there are particular circumstances were booth risks can be associated, v.g. in Belgium. This double risk of flooding and earthquake can be found in the nuclear reactors of United States and particularly on Japan. A possible solution to face the risk associated at the extreme environmental dynamics can only be found at the European level.
The proposed solution is to use a hydrogen´s fuel cell associated with a local water electrolyser on the emergency power system and to supply with power the batteries for back-up of the nuclear reactor. In the today marked there are stationary emergency power supplies with fuel cell and electrolysers for electricity production. This system made of fuel cell and electrolyser can be assembled on laboratory, closed inside a vessel and tested for similar earthquakes and water flooding. These complete vessel tests was not done by the industry and the results will serve the nuclear industry.

Expected Results, Lead users, and dissemination plan:
The hardware of a complete arrangement made with a fuel cell coupled to an electrolyser and booth inside a vessel is expected to produce the same electrical power and during a longer time period than the today standard electrical batteries in a nuclear power plant emergency system.
The lead users will be (i) fuel cell manufacturers, (ii) the electrolyser manufacturer, (iii) the nuclear power plant owners, (iv) and the design engineers that will integrate the components and will test his integrity under conditions of flooding and earthquake.

The introduction of a electrolyser for the local production of hydrogen and with the consequent fuel cell for a stationary emergency power system in a nuclear power plant will enable, by one side, the introduction of a source of renewable energy in the nuclear station and, by other side, it will be a ultimate reserve of energy for an emergency situation on a nuclear power plant.
A detailed output power and duration time that will be obtained in the stationary mode will be published. The results of complete hardware inside a vessel for the water test proof and for the earthquake test will be also published.
The results of this project will be delivery to the European Hydrogen and Fuel Cell Technology Platform and to the Sustainable Nuclear Energy Technology Platform that will disseminate these results inside their associate. This will open the future development of prototypes of fuel cells inside the nuclear power plants.

Partners:
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Expected Budget: €3,000,000 Horizon 2020 contribution (Maximum €4,000,000)

Duration: 36 months.

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Version 2. by M.P.Alonso. Instituto Superior Técnico. Universidade de Lisboa. 12 May 2014.

