Vol. 11 (3): 371-376 (2021)

NUCLEAR FUSION, THE ARC REACTOR, AND INNOVATIVE NUCLEAR TECHNOLOGY

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Received March 2021; Accepted April 2021; Published May 2021;

DOI: https://doi.org/10.31407/ijees11.302

ABSTRACT

A new keystone for fusion energy has been achieved, namely high temperature superconductors (HTS), now available on industrial scale: they are able to tear down one of the most concerning issues of this research field, since it could be possible indeed to shrink the size of a tokamak without undermine its power, making fusion energy a credible solution for medium-term energy supply. The development of HTS leads to the design of Affordable Robust Compact (ARC) reactor, a compact Tokamak; this one has the prospective to reach the trade-off towards commercial production of electricity with nuclear fusion power. The actual cutting-edge technologies show some interesting and fashionable engineering design solution, that will be tested and verified in the future years. However, many issues have not been solved yet or there are still great opportunities in their development, for instances: the risk of erosion of the first wall, the thermomechanical analysis and safety of the vacuum chamber and many other ones. In an experimental reactor there will be many obstacles: the effect of disruption should be restricted to avoid damages to delicate structures of reactor, the components should be design in order to evacuate the huge amount of heat, at last but not least, a new generation of control system is required. In this scenario new materials, like HEA (high entropy alloys), could bring breath of fresh air to fusion world, their excellent mechanical properties would solve engineering problems related to harsh environment where they have to operate. Although these new materials might have a huge impact if they were introduced in the next decades, for this reason many aspects must be investigated, especially due to safety requirement of nuclear fusion plants.

Keywords: SPARC, ARC, High and medium entropy alloys, Fusion experimental Reactor Design