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Overview of the achieved coupling experiments on zero power facilities

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The scientific and technological challenges relative to the integration, in a nuclear power facility, of the three main components of an ADS (an accelerator delivering a high-energy particle beam, a heavy metal spallation target acting as a neutron source when bombarded by ions and a subcritical multiplying medium possibly comprising significant amounts of MA and/or LLFP) are numerous. Their resolution requires going through several stages with tests successively at low, intermediate and high power and, in a first step, to consider separately the “accelerator / target spallation” and “neutron source / subcritical multiplying medium” systems. This is the direction taken in Europe in the early 2000s after first tests at low power at CERN and in France were successfully achieved (FEAT in 1994, TARC in 1996 and MUSE-1/2/3 experiments in 1995, 1996 and 1998). The objective of presentation is to give an overview of “neutron source / subcritical multiplying medium” coupling experiments at low power that were performed since.

This talk starts with a few words about the interest of zero power reactors for ADS research and a reminder of the objectives and main lessons drawn from experiments evoked above. Then, we present a review of initiatives launched world-wide with the aim to conduct low-power experiments involving the coupling of a subcritical core with an external neutron source, mostly provided by D-D / D-T generators. We give main features of experiments that were completed (list below) before focusing a bit more on major programs (the MUSE-4/GUINEVERE/FREYA suite and the Yalina-B experiment in Europe, the ADS R&D activities at KURRI/KUCA in Japan), their most significant characteristics (neutron spectrum, characteristics of the source, experimental program content) and their main outcomes. In particular, the major accomplishments with respect to the representativity of the experiments and the key issue of the control and monitoring of subcritical levels are underlined. The overview is extended to initiatives that have not gone beyond the stage of opportunity or feasibility study (in Brazil, Czech Republic and UK). The main features of larger projects (RACE, TRADE plus, SAD) that had to stop prematurely are also reminded. Last, some highlights on possible next steps are given.

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