AMHYCO project – advances in H_2/CO combustion, recombination and containment modelling

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Severe accidents in nuclear power plants potentially dangerous to both humans and the environment. To prevent and/or mitigate the consequences of such an event, it is paramount to have adequate accident management measures in place to ensure the containment integrity. During a severe accident, one of the potential threats to the containment is the release of combustible gases — especially hydrogen and carbon monoxide — leading to a combustion risk in the air and steam-filled nuclear containment building. In modern plants, Severe Accident Management Guidelines (SAMG) as well as dedicated mitigation hardware are in place to minimize/mitigate this combustion risk and, thus, protect the containment integrity and to avoid the release of radioactive material into the environment.

Advancements in SAMGs are in the focus of AMHYCO, an EU-funded Horizon 2020 project officially launched on October 1st, 2020. The project consortium consists of 12 organizations (from six European countries and one from Canada) and is coordinated by the Universidad Politécnica de Madrid (UPM). AMHYCO benefits from worldwide experts in combustion science, accident management and nuclear safety in its Advisory Board. Thereby AMHYCO covers the most used PWR reactor designs in continental Europe, Westinghouse-type, Siemens-KWU-type and VVER-type.

In the proposed paper, the progress of the first two years of the AMHYCO project is being presented. A comprehensive bibliographic review has been conducted, providing a common foundation to build the knowledge gained in the course of the project. After an extensive set of accident transients simulated both for phases occurring inside and outside the reactor pressure vessel, a set of challenging sequences from the combustion risk perspective for different power plant types were identified. At the same time, three generic containment models for the three considered reactor designs have been created to provide the full containment analysis simulations with lumped parameter models, 3-dimensional containment codes and CFD codes. In order to further consolidate the model base, combustion experiments and performance tests on passive auto-catalytic recombiners under explosion prone H_2/CO atmospheres were performed at CNRS (France) and FZJ (Germany).

Finally, it is worth saying that the experimental data and engineering models generated from the AMHYCO project are useful for hydrogen and synthesis gas safety. The SAMG for nuclear containments are also applicable for hydrogen management in confined spaces for any industry in which this risk is present (chemical, aerospace, transport, etc.).

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