## EXECUTIVE SUMMARY

Task 4.2 aims to test high-voltage insulation in a cryogenic environment - specifically in liquid hydrogen ($LH_2$), which is ideal for the operation of the magnesium diboride superconductor.

The insulation samples were prepared out of various lapped polymer tapes and Kraft paper and were made to mimic a real cable insulation structure. They were tested in liquid nitrogen ($LN_2$) and gaseous helium at 77 K, showing a good voltage breakdown behaviour. These results together with previous tests in $LN_2$ and literature knowledge indicate that results in $LH_2$ are expected to be even better.

For the $LH_2$ measurements, it was not possible to adapt the existing $LN_2$ equipment already developed at ESPCI, hence a new dedicated equipment had to be designed and built from scratch. This unforeseen challenge changed the timeline of the task and resulted in a new measurement system with no equivalent in the world. The setup is currently ready for $LH_2$ tests, but there were additional difficulties in finding an appropriate $LH_2$ testing platform compatible with the requirements for voltage breakdown tests. Recently, a solution has been found and the remaining measurements are expected to be carried out by the end of 2025.

This first version of deliverable D4.2 provides a detailed presentation of the insulation samples, the measurement system in $LN_2$, the corresponding testing procedure, the data analysis method, as well as the measurement results. Additionally, the deliverable describes the design of the new measurement system for $LH_2$, which complies with the safety requirements for operation in hydrogen and has already been qualified and fully tested using $LN_2$. This first version of the deliverable will be completed with the results in $LH_2$ as soon as they become available.

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