A 2-MW high-temperature superconducting (HTS) generator with 24 pole pairs has been designed for the wind turbine application. In order to identify potential challenges and obtain practical knowledge prior to production, a full-size stationary experimental setup, which is one pole pair segment of the full generator, has been built and tested. The experimental setup comprises a consequent-pole HTS rotor and a conventional three-phase copper stator. This paper first presents the electromagnetic designs of the full generator and the setup, then it goes to compare the performance of the full generator and the setup in terms of the flux density, the operating condition of the HTS winding, and the force-generation capability. Finite element (FE) software MagNet is used to carry out numerical simulations. The findings show that the HTS winding in the setup is a good surrogate for these that would be used in the full generator. The FE simulations also tell that the maximum tangential force generated in the setup is 3.77% lower than that in the full generator. Good agreement between the values of interest in the setup and those projected in the full generator has revealed a cost-effective prototyping methodology for developing HTS machines.