The SuperCable: Dual Delivery of Hydrogen and Electric Power

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The prospect of transporting of large amounts of electric power over long distance superconducting dc cables was first considered in the 1960s by Garwin and Matisoo.[1] They envisioned the construction of a 100 GW, 1000 km, dc superconducting transmission line based on the then newly discovered type II compound, Nb_3Sn, refrigerated throughout its entire length by liquid helium at 4.2 K. With the advent of practical and commercially available long length high temperature superconductor tapes in recent years, and the desire to move the US to a hydrogen-based transportation economy, their original concept takes on an additional dimension – the use of hydrogen as a cryogen to both enable superconductivity and as an energy delivery agent in and of itself. The author has addressed previously the significant societal benefits to be derived from the dual delivery of hydrogen and electricity over such a "SuperCable.[2]" In the present paper, we present an engineering scoping design for a cable system to carry 1000 MW dc bipolar via superconducting wires and 500 MW hydrogen electrical equivalent, as either liquid or pressurized cold supercritical gas, over 100 km scale distances. Issues of constant current control of electric power flow to minimize ac losses, management of thermal heat in-leak and vacuum requirements are also considered. Finally, we point out the capability of a long distance SuperCable, not only to deliver hydrogen, but to store it for subsequent conversion to electricity in amounts on the energy scale of large pumped hydro facilities. Realization of such an energy storage capacity would truly revolutionize the marketing of electricity.

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[1] R. L. Garwin and J. Matisoo, Proc. IEEE **55**, 538 (1967).

[2] P. M. Grant, "Energy for the City of the Future," The Industrial Physicist, February – March, 2002, p. 22.