System, Construction and Integration Issues for Long Distance, High Capacity, Ceramic HTSC dc Cables

It has long been held that the optimal deployment of superconducting materials for the transmission of electric power would be as high current, low voltage dc cables. Present HTSC ceramic material development is rapidly approaching a stage whereby sufficiently long wires at reasonable cost are becoming available for such application. However, a host of other issues arise when insertion of a multi-kilometer, high current, low impedance cable into the present ac grid network is contemplated. Among these are ripple suppression and management of supply/load variations by voltage control rather than through current as is the case for present conventional HVDC lines and cables, both which require novel circuit topology for ac/dc inverter/converter station design. Moreover, these stations must also provide for the dissipation of the enormous amount of energy stored in the magnetic field of the cable under fault conditions resulting from the very high current, possibly as much as 100 kA, being conducted. Finally, because effective point-to-point cable distances are likely to exceed 10 kilometers and perhaps be located in extremely remote areas, attention must be given to cable construction details – monaxial vs. coaxial, and optimal segment lengths for transportation to the field, for example – and on-site fabrication of a large number of superconducting ceramic joints between each segments. A preliminary survey of possible approaches to each of these issues is presented.