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Richardson varieties play an important role in Schubert calculus and total positivity for flag varieties. Leclerc defined a cluster algebra inside the coordinate ring of each open Richardson variety for a symmetric Kac-Moody group, and Muller and Speyer studied these cluster algebras in the case of Richardson varieties in Grassmannians. We will show how to realize the quantized coordinate ring of each open Richardson variety as a normal localization of a prime factor of a quantum Schubert cell algebra. Using a combination of ring theoretic and representation theoretic methods we produce large families of toric frames for all quantum Richardson varieties by constructing sequences of normal elements in chains of subalgebras. This gives a method to control the size of Leclerc's cluster algebras from below and ultimately to relate them to the coordinate rings of the Richardson varieties (for all symmetrizable Kac-Moody algebras). (Received January 20, 2015)