Folding and stabilization of recombinant proteins remains a consistent challenge for industrial and therapeutic applications. Proteins derived from thermophilic bacteria often have superior stability and expression qualities, however the set of available functionalities are limited. To develop a generalizable approach to protein folding and stabilization, we tested the hypothesis that a thermostable shell would impart thermostable qualities to an internalized protein. The 14 nm ferritin shell from *Archaeoglobus fulgidus* is unusual in that it has 432 symmetry and large, 4nm pores permissive of substrate access. This assembly was extensively engineered to accommodate macroglobular proteins in its 8nm aqueous core and controllably open and close in response to mild pH titration. Denatured green fluorescent protein (GFPuv), horseradish peroxidase (HRPc), and renilla luciferase (rLuc) fused to tES subunit were used as templates for folding and stabilization. Using a novel in vitro refolding protocol, shells were assembled around denatured proteins during the folding process. tES provides steric accommodation and charge complementation to green fluorescent protein (GFPuv), horseradish peroxidase (HRPc), and Renilla luciferase (rLuc), improving yields of functional in vitro folding by approximately 100-fold. The encapsulated protein has shown enhanced stability in extreme conditions including high temperature, denaturants and proteolytic cleavage.