Ghana has adopted the Borehole Disposal System (BDS) for the permanent disposal of disused sources in storage. The design of the BDS incorporates the engineered barrier system (EBS) and natural barriers. The safety of the BDS requires confidence in the ability of the EBS on the host environment to provide containment of the disused sources for the requisite timescale. A scoping was used to demonstrate how stable the EBS would be under the conditions prevailing in the host environment for the long-term safety of the BDS. The failure times of the EBS were determined based on the hydrogeological and geochemical data from the site. Variations in the thicknesses of the engineered barriers and the order of the design of these barriers to contain the disused sources influenced the failure times. The required times for the decay of the radionuclides to exemption levels demonstrated that, the engineered barriers would provide enough containment for the disused sources for disposal under anaerobic conditions for the considered scenarios.