Aquaporins are water channel proteins with excellent water permeability and solute rejection, which makes them promising for preparing high-performance biomimetic membranes. Despite the growing interest in aquaporin-based biomimetic membranes (ABMs), it is challenging to produce robust and defect-free ABMs that can be easily scaled up. In the current study, a thin film composite (TFC) ABM was prepared by the interfacial polymerization method, where AquaporinZ-containing proteoliposomes were added to the m-phenylene-diamine aqueous solution. Control membranes, either without aquaporins or with inactive (mutant) aquaporins, were also similarly prepared. The separation performance of these membranes was evaluated by cross-flow reverse osmosis (RO) tests. Compared to the controls, the active ABM achieved significantly higher water permeability (∼4L/m²hbar) with comparable NaCl rejection (∼97%) at an applied pressure of 5bar. Its permeability was ∼40% higher compared to a commercial brackish water RO membrane (BW30) and an order of magnitude higher compared to a seawater RO membrane (SW30HR), which clearly demonstrates the great potential of the TFC ABM for desalination applications.