Abstract — This work presents neutronics models of a small and large fast-spectrum molten chloride-salt reactor. The models are similar to designs being pursued by industry, and they may serve as generic preconceptual and simplified neutronics models that provide information for decision making in licensingrelated areas. The two models were created using Serpent, a Monte Carlo neutron transport code, and Moltres, a neutron diffusion core simulator tool. Specifically, this study focused on exploring the applicability of diffusion theory to fast molten salt reactor (MSR) models, the capabilities of an open-source, MSR-oriented simulation tool (Moltres), and optimal energy-group structures. The proposed two-step method involves group-constant generation with Serpent and a multigroup diffusion solution by Moltres. Three energy-group structures were applied. The accuracy of the solutions was determined through comparisons between the two-step and Monte Carlo flux and multiplication factor solutions. The findings indicated diffusion theory captures neutronics with minimal error for the large MSR and yielded best results with the 27-group structure. The 27-group structure yielded an average group flux error below 2% and keff agreement between diffusion and transport solutions within 30 pcm. The accuracy of the two-step method decreased for the very small (high-leakage) fast chloride MSR, but the neutronics were captured acceptably well with the 33-group structure. In addition to exploring the capabilities of Moltres, this work contributes to the sparse literature involving open-source models of fast-spectrum MSRs. Future work is noted as expanding the capabilities of the neutronics models to incorporate thermal hydraulics.