For offshore wind turbines (OWTs) located in relatively shallow water, the design is influenced by the occurrence of breaking waves. The strongly nonlinear properties associated with the wave breaking process result in challenges in modelling their impact loads on the structures. The total impact loads are normally calculated as the sum of a slowly varying quasi-static load and an impulsive slamming load. The quasi-static load is normally calculated using Morison's equation and the slamming load is approximated by the Goda model or the Wienke-Oumeraci model. Given the dynamic properties of OWTs, structural resonances might be excited by the impulsive slamming load. Therefore, there is a clear need to evaluate the response effect excited by the slamming load. In this paper, the response of a vertical pile subjected to a severe breaking wave case is investigated by a combination of data from a large-scale experiment and numerical simulations. The slowly varying quasi-static load obtained in a non-breaking wave packet is modelled using Morison's equation with the wave kinematics obtained from a fully nonlinear potential flow solver OceanWave3D. The governing parameters used in a slamming load model are estimated using the Monte Carlo method and verified by comparing the experimental data with the numerical simulation results. It is found that the slamming coefficient and the curling factor are close to the values found by the Wienke-Oumeraci model, however the impact duration is significantly larger than the values found by the Goda model and the Wienke-Oumeraci model, which is important for the assessment of the dynamic responses of OWTs.