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3P21 - Development of 3D Electromagnetic Thermal Fluid Simulation for Elucidation of Gas Contamination Process of Circuit Breaker

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The objective of this simulation is to elucidate the arc phenomenon in the circuit breaker at opening process. Ablation is one of the quenching methods. It has been reported that the occurrence of ablation contributes to decrease the arc temperature, because the energy loss increases with increasing the ablation and convection loss affected by ablation gas. Moreover, the physical properties of the gas change with the ablation gas. Therefore, it is important to analyze temporal transition of the energy loss and the temperature distribution under consideration of the process of ablation gas mixing. However, few reports have researched the focusing on the contamination process of ablation gas. The circuit breaker has a nozzle clogging phenomenon. The nozzle clogging occurs by closing the outlet with an electrode and an arc during the opening process. This prevents the arc quenching and extinguish, and the pressure in the circuit breaker rises. The high pressure derived from high temperature increases the flow velocity of arc, while the discharge flow rate decreases. Thus, the balance between pressure rises and heat flow exhausts is important. From the above, the current interruption can be improved by elucidation of temporal transition of arc temperature distribution with changing the open timing. In this paper, the gas contamination process under consideration of the ablation contamination during the opening process of circuit breaker is elucidated using the development of 3D electromagnetic thermal fluid simulation. As a result, the mixing process of the ablation gas plays an important role for quenching and extinguish the arc, because the nozzle clogging occurs with increasing the pressure rise and heat flow velocity of arc, and the energy loss increases with increasing the ablation and convection loss affected by ablation gas in the case of each contamination and opening timing.

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