As the number of combined-cycle units increases, efficient modeling approaches for these units play important roles for independent system operators (ISOs). Based on various combinations of combustion turbines (CTs) and steam turbines (STs), the combined-cycle unit could work at different configurations (modes) with different efficiencies. In this paper, we propose an edge-based formulation for the combined-cycle units in the unit commitment problem to improve the accuracy and effectiveness of current modeling approaches. Our formulation can 1) clearly describe the transition processes among different configurations so as to satisfy the ISO financial offer submission requirements and (2) capture physical constraints of each turbine, including the exact min-up/down time and time dependent startup cost, in the combined-cycle units so as to increase the operational flexibility while ensuring system feasibility. This model fits well with the current U.S. deregulated electricity market. The final numerical studies show that our approaches perform better than the current configuration-based modeling approach.