This paper presents a three dimensional numerical simulation of premixed methane-air low swirl stabilized flame, the field has a simple geometry describing a LBS (low swirl burner) kind with 50mm of nozzle diameter. RANS Standard κ – ε model for turbulence coupling to Probability density function model for combustion are used to provide their applicability limits and their capacities to predict governing flame parameters by varying CH4 mass fraction at inlet which shows the optimum operating area of the burner in terms of procured energy and flame stability interesting by thermal NO apparitions. Results are compared and validated with experimental and LES numerical simulation works cited in references. They offered good similarity for all flame parameters studied. Equivalence ratio of CH4 was increased from 0.6 to 1.4, that show apparition of zones with important mass fraction of thermal NO due to the existence of high temperature areas in flame zone. Otherwise, the flow field wasn't disturbed in terms of recirculation zones apparitions who remained absent for all cases. Actual investigation works to find equilibrium between the maximum of generated temperature and the minimum of thermal NO pollutant emissions for low swirl burners. Used models haven't showed limits of applicability, results were clear and precise and offer a significantly gain in time and CPU used range