Spacecraft thermal protection systems are at risk of being damaged due to airflow produced from Environmental Control Systems. There are inherent uncertainties and errors associated with using Computational Fluid Dynamics to predict the airflow field around a spacecraft from the Environmental Control System. This research describes an approach to quantify the uncertainty in using Computational Fluid Dynamics to predict airflow speeds around an encapsulated spacecraft without the use of test data. Quantifying the uncertainty in analytical predictions is imperative to the success of any simulation-based product. The method could provide an alternative to traditional "validation by test only" mentality. This method could be extended to other disciplines and has potential to provide uncertainty for any numerical simulation, thus lowering the cost of performing these verifications while increasing the confidence in those predictions.