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Small Launchers: Concepts and Operations (7)

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RESULT OF CONCEPTUAL DESIGN FOR KOREAN SMALLSAT-DEDICATED LAUNCH VEHICLE

Abstract

Due to the successful development and launch of the Nuri, Korea secured its own liquid engine-based launch vehicle. In response to the increasing demand for small satellite launches, the plan have been included in the national space development program to develop a smallsat-dedicated launch vehicle, based on the design, production, and operational technology of the launch vehicle secured through the Nuri. Based on this plan, the Korea Aerospace Research Institute has been conducting preliminary technology development research on a two-staged smallsat-dedicated launch vehicle, capable of launching a 500 kg payload into a 500 km sun-synchronous orbit. In addition, in order to secure competitiveness in the launch service market, target launch prices have been set, and cost analysis and development plans have been established in consideration of mass production with private companies. To reduce development costs and time by using the technology of the Nuri, the 75-tonf class kerosene-liquid oxygen engine used in the first and second stages of the Nuri was selected as the first stage engine. For the second stage engine, a newly developed high-performance engine using methane fuel was considered to achieve the target performance. When launching the two-stage launch vehicle at the Naro Space Center, the first stage must separate at an altitude of approximately 100 km due to geographical conditions of Korea. It was essential to reduce the weight of the fuselage in order to satisfy this requirement with the performance of the first stage engine already determined. Hence it was considered to apply a common bulkhead type propellant tank to both the first and second stages, which was not applied in the Nuri. The performance of the engine and the target structural ratio were set, and the staging of the launch vehicle that satisfied the target performance was designed. A trajectory design using ASTOS was performed to confirm whether the target performance was achieved. The overall shape and subsystem configuration were designed by referring to the data of the Nuri and the other launch vehicles in same class. The requirements and mass budget for each subsystem was then detemined. Conceptual design of each subsystem was performed to

satisfy the mass and requirements assigned, and the conceptual design result of the entire launch vehicle was derived by synthesizing the design results of each subsystem. The results derived from this study are expected to serve as basic data when starting system development in the future.