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Advanced space transportation systems, BARGOUZIN booster

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Abstract

In the framework of Advanced Space Transportation Systems Studies sponsored by CNES in 2006, a study called “BARGOUZIN” was performed by a joint team led by ASTRIUM ST and TSNIIMASH. Beyond these leaders, the team comprised MOLNIYA, DASSAULT AVIATION and SNECMA as subcontractors.

The “BARGOUZIN” concept is a liquid fuelled fly-back booster (LFBB), mounted on the ARIANE 5 central core stage in place of the current solid rocket booster. The main originality of the concept lies in the fact that the “BARGOUZIN” features a cluster of VULCAIN II engines, similar to the one mounted on the central core stage of ARIANE 5. An astute permutation strategy, between the booster engines and central core engine is expected to lead to significant cost reductions. The following aspects were addressed during the preliminary system study:

- engine number per booster trade-off/abort scenario analysis,
- aerodynamic consolidation,
- engine reliability,
- ascent controllability,
- ground interfaces
- separation sequence analysis,
- programmatics.

These topics will be briefly presented and synthesized in this paper, giving an overview of the credibility of the concept.

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Abbreviations: AoA, aerodynamic angle-of-attack; ARIANE 5, Europe’s main commercial heavy launcher; ASTRIUM, ASTRIUM (formerly EADS SPACE Transportation); BURAN, Russian space shuttle; CAD, computer assisted design; CNES, Centre National d’Etudes Spatial; EAP, Etage d’Accélération à Poudre (Solid rocket booster on Ariane 5); ELA, Ensemble Lancement Ariane (Ariane Launch Pad); EPC, Etage Principal Cryogénique (Cryogenic Core Stage on Ariane 5); ESC-B, Etage Supérieur Cryogénique-B (Cryogenic Upper Stage version B on Ariane 5, to be developed); FCS, flight control system; LFBB, liquid fly-back booster; RTLS, return to launch site; SSME, space shuttle main engine; VULCAIN II, main rocket engine of ARIANE 5

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1. Introduction

The French Centre National d'Etudes Spatiales (CNES) Launchers Directorate (DLA) has been working with TSNIMASH and other Russian parties during the past few years to define the BARGOUZIN concept, a launcher composed of an ARIANE 5 central core with two cryogenic fly-back boosters. EADS Space Transportation, with the association of DASSAULT-AVIATION and SNECMA joined the team in the framework of the BARGOUZIN 4 study. The main objectives of BARGOUZIN 4 were to consolidate some technical choices, considering reusable VULCAIN II engines and to converge on a reference concept in perspective of future studies.

2. The BARGOUZIN concept

The “BARGOUZIN” concept is a liquid fuelled fly-back booster (LFBB), mounted on the ARIANE 5 central core stage (EPC) in place of the current solid



Fig. 1. BARGOUZIN reference configuration.

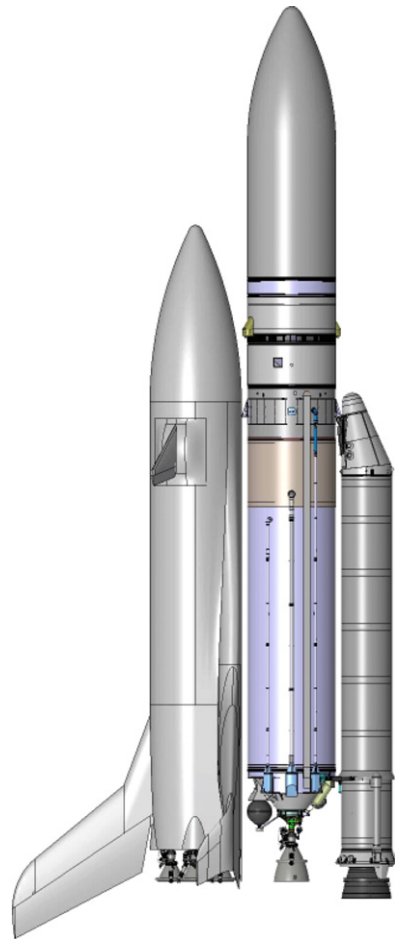


Fig. 2. BARGOUZIN booster/EAP comparison.

rocket booster. The main originality of the concept lies in the fact that the “BARGOUZIN” features a cluster of VULCAIN II engines, similar to the one mounted on the central core stage of ARIANE 5. An astute permutation strategy between the booster engines and central core engine is expected to lead to significant cost reductions as no new rocket engine has to be developed for the concept. A given engine is flown a certain number of times on the booster and consumed on the last flight on the central core. A certain number of re-usabilities is therefore requested for the VULCAIN engine to perform this type of mission. The generic BARGOUZIN composite concept is shown in Fig. 1.

A comparison between the current EAP and the BARGOUZIN booster attached to the central core stage (EPC) of ARIANE 5 is shown in Fig. 2.

The BARGOUZIN booster is sketched hereafter in Fig. 3.

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