ADE (DRDO) Lakshya

B. Harry, ver 1.0, Nov 27, 2006

HISTORY

The Lakshya ('Aim') is remotely piloted high speed target drone system developed by the Aeronautical development establishment (ADE) of DRDO. The drone, remote piloted by a ground control station (GCS) provides realistic towed aerial sub-targets for live fire training. The drone is ground or ship launched from a zero length launcher and recovery is by a two stage parachute system developed by ADRDE (DRDO), for land or sea based recovery. The drone has a crushable nose cone, which absorbs the impact of landing, minimizing damage. The flight path may be controlled or pre-programmed, based upon the type of mission.

When the requirement for a pilotless target aircraft (PTA) arose in 1976, appropriate feasibility studies were carried out by ADE to provide for a target system that catered to the requirements of all 3 services of the armed forces. HAL was tasked with carrying out the feasibility study for the powerplant, on completion of which, a mere 4.5 crore was sanctioned on Sept.1980.In 1978, the first RPV Target Towing Unit (TTU) was formed at Kalaikunda. Known as the Chakor Pilotless Target Aircraft (CPTA) squadron, it was equipped with an improved version of the simplistic Northrop MQM/BQM-74 Chukar RPV. Between December 1985 and July 1986, four Lakshya PTA prototypes powered by Microturbo TRI-60-5 engines were launched for trials. While the first two launches were successful for planned flight times of 20 and 38 minutes respectively, the next two launches failed. By June 1994, 18 Lakshya PTA prototypes were fabricated by ADE itself and 43 trials were conducted, 24 of which were between December 1985 and February 1992.Due to rigorous evaluation and stringent quality control, a total of 10 prototypes were lost during the testing phase between 1985 and 1990.The project was formally closed on June 1994 and a final closure report was issued in April 1995 after incurring a total expenditure of Rs 21.82 crore.

Hawker Hunters and the Chukar RPVs of the TTU unit at Kalaikunda were formally relieved of their duties when the first 6 Lakshya drones were introduced into the unit in 1998.Laskhya units are manufactured and overhauled at HAL's Aircraft division , Bangalore. The Lakshya was formally inducted into the services by CAS AY Tipnis, on 9 November 2000 at Interim test range (ITR) Chandipur. On May 9, 2002, an upgraded version of the Laskhya featuring the new engine from HAL was flown from ITR Chandipur, bringing user trials to a close. On Nov.6 2002, HAL announced that they had received an initial order for 25 Lakshya drones and that limited series production to satisfy the order for all three services by mid-2003, had already begun. By 16 Jan. 2003, the drone had completed over a 100 flights. The Lakshya is actively in service with all the three branches of the Armed Forces. Despite inherent delays, the Lakshya has continuously evolved into a world class, state of the art system comparable to or better than any of it's class in the world. Production is expected to continue as requirements arise. The drone has already become a major player in the R&D sector, significant events including the test of Akash and Trishul missiles against targets simulated, notably the 4 test firings of the former between March and September 2001.

One squadron of six drones,a single GCS(*right*) and the related payload is estimated to cost between $2 and $4 million. One GCS can handle upto five drones at a time.

Despite recent induction, the project has already begun to demonstrate export prospects. On 8 July 2001, Israel made a public announcement that it was keen to purchase the Lakshya system and that negotiations for the same had already started. This was confirmed by the scientific advisor to the Defence minister, V.K. Atre, on 18 March 2002, when he announced that the system would soon be demonstrated and sold to a foreign customer, at the inauguration of a five-day Indo-UN workshop on Satellite-Aided Search and Rescue (SASAR). It was finally confirmed in early 2003 that Israel had already evaluated the drone and carried out extensive trials in November 2002. However, Israel finally purchased a Chukar variant instead.

On April 2003, the first modified Reconnaissance version of the Lakshya commenced flight trials. This version was fitted with oblique cameras and a digital onboard computer with a faster datalink enabling the drone to carry out completely autonomous operations. The development of this version was formally announced by Dr VK Aatre, Scientific Advisor to the Defence Minister, during his lecture on "Evolving Battlefields and Role of Technology" organized by Bangalore Science Forum on 5 July, 2003.

The media is often known to claim [1] a cruise missile version of the Lakshya with a 300 kg warhead but such developments are not officially accepted and both HAL and DRDO remain mum on the issue.

A full scale mockup of the Lakshya,on display at the DRDO pavilion at Aero-India-2003. The Lakshya,which is the first indigenous drone to enter service, makes consistent appearances at all defence expositions (Picture © B Harry)

PAYLOAD

TOW TARGET

This advanced weapon training system may be installed on the underwing pylons of the Lakshya or TTU aircraft. It is used for training personnel using Anti-Aircraft guns and SAMs/AAMs and can cater to asymmetric flights. The system is designed by ADE Bangalore and is manufactured by Bharat Dynamics ltd.(BDL)

Speed	Mach 0.7
Altitude	500-5000 m
Length	2385 mm
Diameter	185 mm
Presentation	45 min

JATO BOOSTER

Rocket booster for initial launching of Lakshya. Develops adequate thrust for the smooth take-off of the drone. Manufactured by BDL with the propellant developed and supplied by High Energy Materials Research Laboratory (HEMRL).

Weight	16.8 kgs
Disengagement .Altitude	100 m
Op.time	1.2 sec.
Weight	145 kgs

AIR TARGET IMITATOR

Aerial target for practice firing of IR homing SAMs and AAMs. Provides the IR signature of heat seeking SAMs and adequate consistency while glowing. Manufactured by Bharat dynamics ltd.(BDL)

Range	4800 m
Max.Altitude	800 m
Visibility	Upto 5 km

AVIONICS AND SYSTEMS

The Flight control electronics (FCE) of the Lakshya employ an analogue electronic design backed by an ASIC to performs flight control and recovery functions of the aircraft. In addition to altitude stabilization and other flight control functions, the FCE provides command on auto-piloting. Electromechanical actuators for flight controls are the standard sets developed by ADE for UAV applications. The vertical gyro used on the drone delivers pitch and roll electrical signals representative of aircraft attitude through 360^{o} in roll and $\pm$ 85^{o} in pitch through corresponding synchros.

The Lakshya employs two types of scoring systems, one being a Acoustic miss distance indicator developed by ADE and the other being a CW doppler.The 1.8 kg Acoustic miss distance indicator is used for measuring the miss distance of projectiles (surface-to-air) and thus evaluate the performance and proficiency of the Artillery crew. It provides the miss distance, direction of fire and the real time score. This system can keep score of up to 300 rounds per minute for ammunition ranging from 20 mm to 105 mm and telemeters the information to the GCS up to 20 km away.

Scoring accuracy : +/- 1 m for 0 to 5 m miss distance and +/- 0.25 m (15%) for a miss distance > 5 m.

The Acoustic miss distance indicator (*left*) and the Flight control system (*right*) of the Lakshya.Both these sets have been developed by ADE for universal UAV applications

The ground based telecommand system operates at the UHF/L band and consists of a compatible Ground control station (GCS) and a compact airborne unit. The GCS offers mission planning and simulator facilities and is used to plan, validate and execute each UAV mission.

FLIGHT PERFORMANCE AND PROPULSION

The Lakshya's typical mission includes 3 g maneuvers and the airframe is stressed to withstand up to 6 g. It has a 50 minute endurance at a speed of Mach 0.56 and an altitude of 1500 m.

The drone was initially powered by a Microturbo TRI-60-5 turbojet (14 engines were imported at a cost of Rs 6.57 crore) but now features HAL's indigenous PTA-Engine-7 which was tested on December 2000. The PTAE-7 is a turbojet with a 4 stage axial flow compressor and single stage turbine with an annular straight flow combustion chamber. Three flight tests at Balasore achieved all performance requirements at different altitudes up to six kilometers. The engine features a digital electronic fuel control system with a high-speed engine alternator and transonic compressor whose performance is claimed to exceed those of imported engines. HAL approached DRDO for the rotor and stator castings as the imported castings were not upto standards. DMRL labs of DRDO took up the development, upgraded the fine grain castings technology, hither to be used for the small JFS castings and produced four castings in accordance with the acceptance norms. These castings were fit in the engine and successfully test flown. One engine with these castings had completed 20 endurance cycles, against 4-6 cycles given by the Microturbo engines.

HAL's indeginously developed PTA Engine-7 (Picture courtesy: The Week)

PERFORMANCE AT ISA SEA-LEVEL STATIC CONDITIONS	
Overall pressure ratio	4.65
Mass flow rate	6.68 kg/sec
Specific fuel consumption	1.15 kg/hr/kg-f at 29,500 rpm
Weight	69 kg
Engine TWR	5.8

SPECIFICATION

Type/Role	Lakshya PTA	Remote piloted target drone
		Battlefield reconnaissance drone (dev.)
Performance	Range (loaded) / Endurance	Radius of 150 km in a racecourse track / 50 minutes at Mach 0.56 at an altitude of 1,500 m.
	Operating Altitude	984 ft with towed sub-target
		29,504 ft max. / 900 ft min.
	Speed	Mach 0.58 (low)
		Mach 0.8 (hi)
	Rate of Climb	25 m/sec at Sea level
	G load	+6
Powerplant	Microturbo TRI-60-5 (350-450 daN Thrust), eventually replaced by HAL PTA- Engine-7 (373 daN thrust)	
Weight	705 kg MTOW	
Internal fuel	190 kg	

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