Dave - Final Version

22

DEC. 18, 1986

Historical Summary of the HEXAGON Program

On April 18, 1986, one of this nation's most successful imaging reconnaissance programs came to an abrupt, dramatic conclusion due to the explosion of a Titan 34D Launch Vehicle. That day would have marked the beginning of the twentieth and last HEXAGON mission. Since June 15, 1971, nineteen HEXAGON missions have returned eighty-six reentry vehicles containing nearly five million feet of broad area search and mapping imagery; seventy-four vehicles containing imagery from the twin optical bar panoramic cameras and the other twelve with images from the mapping camera system. This imagery has been the mainstay of the Nation's area search capabilities and provided invaluable intelligence information to policy makers of four administrations. Also, the photography has been crucial to the production of mapping, charting and geodesy (MC&G) products which are essential to modern weapon systems. ~~(TS/B)~~

By the early 1960s, the U.S. was routinely operating the CORONA (KH-4) low resolution broad area search and the early GAMBIT (KH-7) medium resolution reconnaissance systems. Imagery collection requirements at that time suggested a need for a system having the coverage of CORONA with GAMBIT resolution. Not even the most advanced version of the CORONA system, MURAL, would satisfy this requirement. A revolutionary new system was needed.

Between 1962 and 1966 the NRO studied various designs before settling on the HEXAGON configuration. (TS/B)

The HEXAGON project officially commenced April 30, 1966, as a joint Program A and B activity. Program B directed the development of the search camera system while Program A was responsible for the satellite vehicle; reentry vehicles; and mapping camera; as well as satellite integration, test, and launch. In 1974 the responsibility for the search camera system was transfered to Program A to allow Program B to focus attention on the new electro-optical imaging system [redacted] development. (b)(1) (b)(3)
(TS/B)

The heart of the HEXAGON system was two 60 inch focal length, 20 inch aperture, optical bar panoramic cameras built by Perkin Elmer Corporation, Danbury, Connecticut. These cameras, which were tilted 10 degrees forward and aft, could collect continuous stereo imagery of the earth, at 60 degrees either side of nadir, covering a total panoramic scan width of 360 nautical miles. The HEXAGON spacecraft carried four large reentry vehicles built by McDonnell-Douglas Corporation, St Louis, Missouri, each with the capability to carry 75,000 feet of exposed 6.6 inch wide photographic film. A fifth reentry vehicle for the mapping camera, the well proven Mark IV system, was built by General Electric, Philadelphia, Pennsylvania. The Mark IV system was also the work horse of the GAMBIT and CORONA programs. The mapping camera was built by the Itek Corporation, Lexington, Massachusetts. This 12 inch focal length framing camera allowed the Defense Mapping Agency to produce metric products with accuracies of 23 meters horizontal and 17 meters vertical. These systems were maintained on orbit with a satellite bus built by Lockheed Missile and Space Company, Sunnyvale, Callifornia.

~~(TS/B)~~

The entire system was almost 60 feet long and weighed over 25,000 pounds at launch. The first 16 satellites were launched from Vandenberg AFB using the Martin Marietta Titan 3D booster. The last three missions used the more capable Titan 34D system. The HEXAGON vehicles were operated from the Air Force Satellite Control Facility (AFSCF) supported by a worldwide network of tracking stations. At the completion of each mission segment, the reentry vehicles were recovered by the AFSCF's Hawaii-based recovery group. Eastman Kodak Corporation of Rochester, New York, manufactured the mission photographic film and, after return to earth, processed the film and reproduced the imagery. Nearly 16 million feet of imagery products were produced for each mission. A summary of HEXAGON flights is shown in Figure xx.

~~(TS/B)~~

Over the years the HEXAGON program was marked by continued improvements. The first systems were designed for a 30 day orbital life. Improvements to the satellite bus and camera system allowed the later missions to collect imagery for 270 days. As the mission duration increased and our ability to predict weather using the Defense Meterological Satellite Program (DMSP) satellites improved, the quantity of cloud free imagery

Approved for Release: 2020/12/07 C05132402

also increased. Additional intelligence collection resulted from a 50 percent increase in HEXAGON's photographic film capacity. This increase from 200,000 feet on Mission 1 to 300,000 feet on Mission 19 resulted from added capacity on reentry vehicles and development of ultra-thin based film. The later films were only one and one half thousandths of an inch thick. To better use this film a larger film looper was added beginning with Vehicle 17. This device decreased the inter-operation film waste while increasing utilization by 15 percent. These improvements led to a dramatic increase of cloud free imagery permission; from 8.3 million square nautical miles on the early satellites to 29 million square nautical miles on the later systems. As the quantity of useful imagery grew, so did the quality of the imagery. The HEXAGON program saw significant improvements in photographic film emulsions and development techniques. These better films combined with spacecraft/camera image motion compensation improvements led to significant image quality gains. Early missions had best ground resolved distances of 29 inches. Mission 19 produced the best reading of 15 inches. ~~(TS/B)~~

To produce metric products from the early mission's imagery, photogramists first had to accurately plot the location of key points using the mapping camera imagery, then transfer these points to the pan camera imagery. Beginning with Vehicle 17, improvements were made to the pan camera, and solid state stellar sensors were added to the spacecraft. With these modifications metric products could be produced directly from HEXAGON pan camera imagery. ~~(TS/B)~~

Over the past 15 years, the HEXAGON system has imaged 315.5 million cloud free square nautical miles of the earth's surface in support of national standing intelligence search, special intelligence search, exotic film and MC&G requirements. Standing intelligence search has allowed us to monitor the activities of our adversaries on a periodic basis to assess changes in their military posture. Special intelligence search has allowed us to monitor activities such as mobile missiles, ICBMs, nuclear proliferation, and ground order of battle in response to current intelligence needs. Beginning with Vehicle 4 each system's film supply included a small amount of color and false color IR films. These films were used against intelligence problems relating to narcotics trafficking; Soviet grain production; camouflage, concealment and deception; and Biological Warfare/Chemical Warfare (BW/CW) testing. The MC&G imagery has been used to produce a wide variety of precise hardcopy and digital metric data bases. As many of these requirements overlapped, the operations personnel at the AFSCF consolidated imaging operations to insure maximum effective use of the satellite. ~~(TS/TK)~~

Completion of the HEXAGON program marks the end of 25 years of film return imaging satellite systems. The Intelligence Community witnessed dramatic improvements in both image quality and quantity as we developed the technology necessary for intelligence collection from space. The CORONA and GAMBIT programs both made significant technological strides. HEXAGON, one of the most complex satellites ever orbited, went far beyond the accomplishments of the earlier programs. The importance of the intelligence acquired by these programs, and the enhancement to our national security, cannot be overstated. ~~(TS/B)~~

HEXAGON FLIGHT PERFORMANCE HISTORY

Figure XX

FLIGHT	LAUNCH DATE	MISSION DURATION (DAYS)	FILM USED (FEET)	PHOTO OPERATIONS	CLOUD FREE AREA*
1	15 June 71	31	172,640	430	8.3
2	20 Jan 72	40	156,115	426	15.4
3	07 Jul 72	57	185,325	720	16.4
4	10 Oct 72	68	218,346	731	12.0
5	09 Mar 73	63	218,338	638	12.7
6	13 Jul 73	75	212,432	666	12.4
7	10 Nov 73	103	213,633	700	14.3
8	10 Apr 74	106	215,616	774	11.9
9	29 Oct 74	130	228,112	759	14.4
10	08 Jun 75	120	226,206	789	13.5
11	04 Dec 75	117	168,291	850	17.3
12	08 Jul 76	155	237,894	1050	12.5
13	27 Jun 77	176	234,974	1068	16.4
14	16 Mar 78	178	245,854	1471	20.1
15	16 Mar 79	188	291,680	1501	21.5
16	18 June 80	261	290,940	1442	24.1
17	11 May 82	204	300,030	2112	26.8
18	20 Jun 83	270	303,880	1787	29.1
19	25 Jun 84	108	162,410	1005	16.4

20 18 Apr 86

~~(TS/B)~~

*(Million Square Nautical Miles)

Approved for Release: 2020/12/07 C05132402