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L PROGRAM - KEY FEATURES

MARK I PAN CAMERA SYSTEM

1. Characteristics

a. Operational ground resolution capability of 3 to 5 feet or better at high and 2:1 contrast, respectively, from 110 n. miles including degradation due to uncompensated image motion and vehicle stabilization residuals. Camera dynamic resolution test specification - 80 l/mm AWAR @ 2:1 contrast on SO-132 using MIL-STD-150A. Scale 1/120,000.

b. Altitude - System specifications are for orbits in the altitude range over target from 90 to 175 nautical miles. The design readily accommodates elliptical orbits permitting versatile operational use. Design altitude - 110 n. miles.

c. Orbit Life - 4 days - selected targets on command - ground selectivity of 5 alternate programs.

d. Coverage ± 42.3 nautical mile swath width at 110 nautical miles over 22° panoramic scan. Format 4.5 x 25 inches. About 3,600 photos each 7.5 x 42.3 nautical miles or approximately 1,000,000 square nautical miles vertical coverage at 110 n. miles.

e. Lens, diffraction limited, 66" f/5. Lens-film resolution with SO-132 100 l/mm AWAR at 2:1 contrast. 175 l/mm AWAR at high contrast - 150 lbs.

f. Mirror - 26½" diameter beryllium - 40 lbs.

g. Film - Capacity - 75 lbs., corresponding to 8,000 feet of 5" 3-mil Estar film.

h. Overlap - Minimum 10% nominal at nadir maintained for full V/h range.

i. Stereo - ± 15° fore and aft. 30° convergence.

j. Exposure - Exposure selectable by inserting one of ten fixed slits prior to launch providing 1/75 to 1/1500 second exposure at nominal

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V/h. Slits available in ½ f-stop increments permitting the use of two films at any time of year.

k. Filter - Wratten 12.

l. Film Type - SO-130, SO-206, or SO-132 film may be used depending on mission requirements. SO-132 for ground illumination greater than 2,800 ft-candles corresponds to solar altitude greater than 22° or for noon launch corresponds to April 10 to September 5 for 35° to 75° north latitude. SO-206 will increase latitude to 68° or cover same latitudes as 132 for 9 additional weeks at a slight penalty in image quality. For solar altitude less than 22°, SO-206 for maximizing area of best resolution or SO-130 for maximizing northern-most latitude of operation.

m. IMC - IMC and cycling rate are variable proportional to V/h in the range of .0208 to .0458 rad/sec corresponding to cycling rate of 1-1/3 to 3 seconds per frame. IMC is accurate to within ½% of commanded value. The V/h rate is programmed internally to the camera as a function of time. Ten V/h functions and ten V/h generator start times can be selected by ground command. Each of the ten functions can be adjusted independently before launch for the best three-line segment approximation to the expected V/h over the full altitude range.

n. Environment - Unpressurized, temperature 70 ± 10°F. Passive thermal control for autofocus.

o. Weight - Pan Camera 610 lbs. - Cassette 15 lbs. Film - 75 lbs. Stellar/Index 20 lbs., Total photo system 720 lbs.

2. Distinguishing Features

The panoramic camera system incorporates the following features:

a. Roll Steering - The entire camera may be rolled up to 30° for specific objective targeting. This is an aid to more rapid attainment of target coverage, provides for targets not directly along the flight path and

also afford a means of avoiding known adverse weather conditions. The IMC system is automatically adjusted during roll steering to prevent significant resolution loss. The roll steering is accomplished in 5 discrete angles of 0°, ± 15°, and ± 30° offering a total available target swath width of 192 n. miles. The system permits 200 roll excursions per mission with a maximum response time of 30 seconds required for rolling from one 30° extreme to the other. Approximately 5 seconds are required for rolling a 15° increment.

b. Stereo - Stereo is provided as an aid to photo-interpretation. The direction the camera looks is controlled by rotating the mirror to the forward, vertical, or aft position and holding it stationary while panoramic scanning is accomplished. The camera accomplishes a stereo "burst" by exposing 8 frames with the camera looking forward 15°, then 8 frames with the camera looking back 15° over the same area. The camera will automatically shut off unless commanded to repeat an additional "burst" of 16 frames.

c. Film Transport - Unexposed film is intermittently supplied to the platen and is held stationary during photography. Transport is controlled to provide constant film tension with a straight through film path for maximum reliability and minimum film damage. The spools are controlled such that they counter-rotate in the same plane each at a uniform speed thus minimizing vehicle disturbance and internal vibration and also requiring less power. The camera comes up to speed without wastage of film or loss of overlap synchronization upon receipt of start command for operational versatility.

d. Panoramic Scan - Scan is accomplished by rotation of the lens about its nodal point, thus offering maximum possible resolution and permitting image motion compensation by translation of the lens along its axis of rotation by a flat plate cam. A multi-lobed bearing permits

both rotation and translation. The lens drive employs energy-conserving techniques including extremely low friction to reduce the power required for panoramic scanning. To meet precise IMC, the scan velocity is controlled by a high performance drive using a precision AC tachometer and a DC torquer which eliminates direct mechanical coupling. The focal plane shutter driven by a high accuracy mechanism is coupled to the lens by a precision synchro.

e. Structure - The structure is semi-monocoque magnesium for maximum rigidity per unit weight incorporating titanium fittings for maximum strength to weight where required. The camera is mounted in the vehicle by a single mounting flange at the C.G. offering high resistance to vehicle structural and thermal stresses on the camera. The structure consists of three parts bolted together at the main mounting flange. The aft section contains the lens, mirror, and all electronics necessary for their operation. The inner-tube supports the platen and references it to the lens nodal point providing vibration and thermal isolation. The outer tube supports the film transport system and all electronics necessary for its operation. The three sections may be readily and quickly disassembled to provide access to any part of the camera system. The structures are produced by use of special jigs and fixtures during manufacture such that a structural section is interchangeable with the mating section of any other structure. This feature facilitates ease and rapidity of both assembly and field operations.

f. Electronics Configuration - The amplifiers and control circuitry of the camera are built-in plug-in easily replaceable modules. Multiple usage of modules simplifies spares provisioning. Maximum reliability is achieved by use of silicon transistors screened by X-ray inspection and by conducting a 200-hour burn-in on all

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amplifiers prior to installation.

g. Auxiliary Data - Recorded on a digital data clock on each frame. May be read by human or machine.

Time to 1/100 second - 29 bits

Scan Velocity Error, 10%

Stereo Mirror Position

Roll Steering Position

h. Stellar/Index Cameras - Stellar and index cameras are coordinated with Pan photography, to provide attitude, cartographic, and position information. The stellar and index cameras operate to expose 1 frame for every 10 panoramic frames providing 55% overlap. These may be operated independent of the panoramic, and both have 400 frame capacity.

Index Camera - 38 mm f/1.5 - $2\frac{1}{4}$ x $2\frac{1}{4}$ inch format on 70 mm film.

Stellar Camera - 35 mm f/1.4 approximately. 1-inch circular format on 35mm film.