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WORKING PAPERS

ELECTRO OPTICAL IMAGERY SYSTEM

COLLECTION VEHICLE DESIGN STUDIES

VOLUME I

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2.0 SYSTEM REQUIREMENTS

2.1.0 MISSION REQUIREMENTS

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2.1.1 Program Description

2.1.1.1 System Configuration

The [redacted] System consists of three separate segments.

(1) Collection Vehicle

[redacted] placed in a polar orbit, to perform an intelligence gathering mission. The payload portion of the collection vehicle consists of an optical section to gather and resolve the target image, a photosensor array to translate the image light energy to electrical energy, processing equipment to present the electrical energy in a format for transmission and a wideband data link to allow transfer of this energy to the ground via a relay satellite. Delineation of the system requirements for this satellite is the primary purpose of this document.

(2) Relay Satellite

One or more satellites placed in [redacted] orbits and [redacted] orbits to transfer data to and from the collection vehicles to a dedicated ground station. The use of the relay satellites provides a two fold purpose:

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(a) Allows for continuous real time contact between the collection vehicle and the ground station during payload operation.

(b) Provides privacy of payload data transmission. A description of the requirements placed on the relay satellite is given in _____.

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(3) Dedicated Ground Station

A ground station located near the [redacted] whose purpose is to:

(a) Receive payload data from the relay satellites.

(b) Translate the payload electrical data into hard copy for use by the Photo Interpretor. (Also provide a hard copy of the payload data in digital form to the Photo Interpretor, for later use.)

(c) Receive tracking and housekeeping telemetry data from the Collection Vehicles (via the relays) and transmit commands to the Collection Vehicles. (Via the relays.)

The Ground Station will include, one or more remote RF receiving points (located within [redacted] and a central processing area (located in [redacted] proper) connected by microwave links.

A description of the requirements placed on the ground station is given in _____.

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2.1.1.2 Payload Data Storage

There shall be no storage of payload data provided for in the Collection Vehicle. All payload data, shall be transmitted to the ground (via the relay satellite) in real time. Such

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transmission shall be accomplished by a "single hop", between Collector Vehicle, relay satellite and ground station.

2.1.1.3 Payload Data Security

There shall be no encryption or any other form of security of payload data provided for in the Collection Vehicle.

2.1.1.4 Quantity of Satellites

The baseline quantity of satellites in orbit at any one period of time shall be:

1) Collection Vehicles - [redacted]

(2) Relay Satellites - [redacted]

Although the baseline number of satellites is as given above, no design constraint shall be imposed by any subsystems of the Collection Vehicle on increasing the above quantities. Subsequent program growth may increase the above quantities.

2.1.1.5 Mission Modes

Baseline intelligence missions for the collection vehicle shall be

1) Search/Surveillance - This mission requires large quantities of recent world wide data. Where, "recent" is interpreted to mean several days to a few weeks depending on target type and location. In the search mode, a systematic survey of a large geographic area is made, while in the surveillance mode, repetitive images of specific targets and target complexes are obtained to permit analysis and detect changes in status.

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2) Indications/Warning - This mission requires access to a predefined geographical area, with system response time held to less than a few days.

It is intended that the [redacted] System shall have growth capability to eventually allow the addition of Crises Management to the mission baseline. Crises Management is defined as a mission requiring access in a few hours to an arbitrary target, anywhere in the world, with consistent resolution.

All of the missions described above shall achieve complete global coverage by the system and shall deliver a resolution of 2 - 3 feet at nadir. The area of primary interest shall be the Sino-Soviet Block, but access to all parts of the world, excluding the poles, shall be possible.

2.1.1.6 Fabrication and Test Cycle

The Collection Vehicle fabrication and test cycle shall allow for a minimum amount of testing at the launch site and other remote locations. All sections of the Collection Vehicle except the optical section shall be fabricated and tested at the [redacted] facility. The structure for the optical section shall be procured/fabricated at the [redacted] facility and delivered to the optical subcontractor. Final fabrication and system testing of this section shall be accomplished at the optical facility and then it shall be shipped directly to a test facility at the launch site for integration into the remainder of the Collection Vehicle. Testing at the site facility shall consist of final alignment and minimal mission profile checks prior to transfer to the pad and final launch countdown.

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1.2 Mission Parameters

1) Resolution - 2 feet

2) Ground Frame Size - 3 NM X 3 NM

3) Average Target Area Size - 2.5 NM X 2.5 NM

4) Satellite Altitude - Collection Vehicle - 283 NM

[redacted]

5) Frame Time - [redacted]

6) Targets/Revolution - Maximum of [redacted] per Collection Vehicle

7) Target Revolution - Maximum of 6 per Collection Vehicle

8) Maximum Target Rate - 3 targets per minute per Collection Vehicle

9) Targets/Daily - Maximum of [redacted] targets per Collection Vehicle

10) Launch Date - Early calendar year 1973

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2.2 GENERAL REQUIREMENTS

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2.2.1 RELIABILITY

2.2.1.1 General

The Collection Vehicle shall be designed for an orbital life of

There shall be no limitation on this orbital life imposed by any subsystem as a result of normal ground test time.

2.2.1.2 System Reliability Figure of Merit (RFM)

The Collection Vehicle shall have an RFM given by Table 2.2.1.2-1.

Table 2.2.1.2-1 - Collection Vehicle RFM

Mission Length	RFM	Confidence Level
	.95	90%
	.88	75%
	.6	75%

2.2.1.3 Subsystem Reliability Figure of Merit

The subsystem apportionment of the Collection Vehicle RFM shall be as given in Table 2.2.1.3-1.

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Table 2.1.3-1 - Subsystem RFM Apportionment

Subsystem	90% Confid. Level	75% Confid. Level	75% Confid. Level
Structure	.999	.999	.999
Environmental Control	.999	.998	.997
Separation	.999	.999	.999
Stabilization	.99	.98	.90
Orbit Adjust	.999	.99	.92
Electrical Power Distribution	.999	.99	.97
Optics	.999	.998	.99
Sensor	.999	.995	.99
Processor	.99	.98	.9
Backup Command (1)	.99	.98	.96
Command	.999	.98	.94
Relay Acquisition and Information Transmission	.99	.98	.96
Telemetry, Tracking & Cmd Communication (2)	.99	.98	.94
Monitor & Alarm S/S (1)	.99	.98	.96

(1) NOTE: RFM's for these subsystems are not in line with the other Collection Vehicle subsystems.

(2) NOTE: Does not include diagnostic telemetry-not in line with the other Collection Vehicle subsystems. RFM for this service shall be .95, .9 and .5 respectively.

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2.2.1.4 Design Requirements

1. No single piece part or harness wire failure shall cause mission catastrophic failure.

2. Flight proven or already qualified hardware shall be utilized whenever possible. Where an already existing piece of hardware can perform the mission function, new design approaches shall not be used.

3. Protected functions (e.g. enabled) shall be provided to service all irreversible vehicle functions.

4. Electrical control of Electro Explosive Devices (EED'S) shall be provided by redundant and isolated circuits.

5. Each pyro-activated device shall be operated by redundant EED'S or dual bridge-wire EED'S.

6. All piece parts utilized in the components of the Collection Vehicle, shall have sufficient "burn-in" time to have passed through the infant mortality period prior to installation in the device. All such piece parts shall have lot traceability, from initial construction to component installation.

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7. All piece parts utilized in the components of the Collection Vehicle shall be on the approved parts list, prior to its incorporation on to manufacturing drawings.

8. All electrical piece parts shall be derated by 50% in power dissipation.

9. All components shall have "green" line and "red" line limits established for their usage. That is, each component shall have a minimum and maximum operating time established for usage prior to launch.

2.2.1.5 Failure Modes

Each subsystem of the Collection Vehicle shall undergo a failure modes analysis to identify each possible single failure mode and the alternate path of operation. This analysis shall be documented in each subsystem specification. Where alternate paths degrade mission performance, such degradation shall be analysed and the mission impact identified.

2.2.1.6 Reliability Reporting

All reliability prediction analysis shall be performed in accordance with TRA-873-74.

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