MOL MANNED SYSTEM PERFORMANCE ANALYSIS
# BASIC MOL PROGRAM PLAN

## SCHEDULE

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<tbody>
<tr>
<td>PRE-MOL</td>
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<tr>
<td>BASIC MOL</td>
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## FUNDING

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<tbody>
<tr>
<td>BASIC MOL (MILLIONS OF $)</td>
<td>330.5</td>
<td>552.6</td>
<td>456.5</td>
<td>292.0</td>
<td>119.6</td>
<td>1,751.4</td>
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</table>
BASIC MOL PROGRAM PLAN

THE FIRST SECTION OF THIS BRIEFING IS ADDRESSED TO THE BASIC MOL PROGRAM PLAN AND THE CAPABILITIES ASSOCIATED WITH IT. AS YOU KNOW, THE PRESENT PLAN INVOLVES THREE MANNED FLIGHTS TO DEVELOP THE MANNED AND AUTOMATIC MODES WITH TWO SUBSEQUENT UNMANNED FLIGHTS TO DEMONSTRATE THE AUTOMATIC MODE CONFIGURATION. THE TOTAL COSTS FOR THE BASELINE PROGRAM ARE ESTIMATED TO BE $1.7 BILLION.
# MOL Baseline Operation

**Workcycle for a Normal Day**

**Mission Duration:** 30 Days  
**Orbit:** $80^\circ i$, $80/180$

## Subcycle

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<tr>
<th>Subcycle</th>
<th>1</th>
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<tbody>
<tr>
<td>P/L Activity Areas</td>
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<td>Crew Req'd for P/L Ops</td>
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<td>Readout</td>
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<tr>
<td>Crew #1</td>
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<tr>
<td>Crew #2</td>
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**Decision to Go Another Day**

**Daily Sequence Load**

- Update Ephemeris
  (+ Weather, Target Changes?)

**Tracking Stations**

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**Secret Special Handling**

NRO Approved for Release 1 JULY 2015

- Systems Applications Office  
  FWB - 5-26-66
THE CREW WORKCYCLE FOR A NORMAL DAY IS SHOWN HERE. BOTH CREWMEN WILL BE FULLY OCCUPIED ON THE ACQUISITION AND TRACKING SCOPES AT ALL TIMES OVER THE TARGET AREAS. THIS REPRESENTS VERY BRIEF BUT INTENSIVE CREW ACTIVITY. BETWEEN TIMES OVER THE TARGET CERTAIN PHOTOGRAPHS WILL BE PROCESSED, EDITED AND READ TO THE GROUND. A VERY REASONABLE SLEEP, WORKCYCLE HAS BEEN DEFINED FOR BOTH CREWMEN, WITH LITTLE OVERLAP IN SLEEPING TIMES. CONSIDERABLE TIME IS AVAILABLE FOR VEHICLE SUBSYSTEMS MONITORING AT TIMES BEFORE AND AFTER THE TARGET PASSES.
CREW CONTRIBUTIONS TO MOL PROGRAM

- REDUCE EARLY DEVELOPMENT RISK
- ACCELERATE SYSTEM MATURITY
- ENHANCE TECHNICAL INTELLIGENCE RETURN
- INCREASE MISSION FLEXIBILITY
CREW CONTRIBUTION TO THE MOL PROGRAM

THE PRESENCE OF A MAN IN THE MOL SYSTEM IS EXPECTED TO YIELD DRAMATIC RETURNS IN THE AREAS OF EARLY SUCCESS IN THE DEVELOPMENT PROGRAM; IN THE ENHANCEMENT OF TECHNICAL INTELLIGENCE RETURN; AND THROUGH INCREASED GROWTH AND MISSION FLEXIBILITY.
FUNDAMENTAL MANNED FUNCTIONS FOR ENHANCEMENT OF MOL SYSTEM RELIABILITY

- TROUBLE SHOOTING
- MANUAL OVERRIDE
- MAINTENANCE, REPLACEMENT, AND REPAIR
- BACKUP FAILED SUBSYSTEMS
MISSION P/L DEVELOPMENT RISK

HARDWARE REQUIRING NEW DEVELOPMENT

- ACROSS FORMAT IMC
- V/H SENSOR
- DATA READOUT
- MIRROR DRIVE SERVOS
- ACQUISITION/TRACKING SCOPE
- THERMAL DOOR ASSEMBLY
- DRV LAUNCHER
- MIRRORS
- SENSOR STRUCTURE

ADAPTATION OF EXISTING COMPONENTS

- COMPUTER
- STAR TRACKER
- DATA RE-ENTRY VEHICLE
- CONSOLES/DISPLAYS/INSTRUMENTATION
- THERMAL CONTROL
- MM STRUCTURE
FUNDAMENTAL MANNED FUNCTIONS FOR ENHANCEMENT OF MOL SYSTEM RELIABILITY

THE DESIGN OF THE MOL SYSTEM IS EVOLVING TO TAKE MAXIMUM ADVANTAGE OF THE PRESENCE OF MAN TO CONTINUE THE MISSION IN THE EVENT OF EQUIPMENT FAILURE. THIS WILL BE EFFECTED IN TWO MAJOR WAYS. ONE IS TO PROVIDE ACCESSIBILITY OF EQUIPMENT WHEREVER PRACTICABLE, TO PERMIT TROUBLE SHOOTING, MAINTENANCE, REPLACEMENT AND REPAIR OF FAILED EQUIPMENTS. THE OTHER IS TO PROVIDE CAPABILITIES FOR SWITCHING AND MANUAL OVERRIDE AND TO PLACE THE MAN IN THE OPERATIONAL LOOP TO BACK UP FAILED SUBSYSTEMS.
MAN INCREASES PROBABILITY OF MISSION SUCCESS

- QUICKLY SENSING AND REACTING TO UNEXPECTED FAILURE MODES
- SELECTIVELY INSTALLING SPARES
- REPLACING ANY OF A LARGE NUMBER OF COMPONENTS (USING HIMSELF AS A MULTI-PURPOSE SPARE IN BACK-UP MODE)
- SENSING INCipient FAILURE AND TAKING ALTERNATIVE STEPS PRIOR TO THE FAILURE OCCURRING (AND PERHAPS CASCADING INTO OTHER SUBSYSTEMS)
- DETERMINING WHERE OR WHAT FAILURE ACTUALLY IS (NOT JUST SYSTEM, WHICH IS INSTRUMENTED, BUT AT PART LEVEL)
- IMMEDIATELY ESTABLISH ALTERNATIVE BACK-UP Mode TO PERMIT CONTINUED OPERATION, OR DEGRADED PERFORMANCE, OR MAINTENANCE
- INTERCHANGING PARTS TO RESTORE OPERATION OF FAILED EQUIPMENT
- ADAPTATION OF ITEMS ON HAND TO PERMIT OPERATION WITH PART NOT INTENDED AS SPARE OR ALTERNATIVE
- TROUBLE SHOOTING WITH SIMPLE TEST EQUIPMENT
- DIRECT OBSERVATION AND REPORTING OF FAILURE MODES
MAN INCREASES PROBABILITY OF MISSION SUCCESS

Shown here are a host of specific manned functions which have been defined to keep a mission going by working around equipment failures.
In-Flight Troubleshooting

**Flight Crew Activities**

- Anomaly detected from monitor: alarm or abnormal response
- Observations, switching, select available alternate operating mode
- Reports to ground at station: contact verifies malfunction, gives status
- Localize fault at component level (VTVM, circuit diagram, test points)
- Assess possibilities of fix, available spare, degree of risk
- Confer with ground at station: contact report detail data and proposed action
- Institute fix
- Monitor to assure trouble corrected

**Ground System Activities**

- Detect anomaly from telemetry
- Initiate analysis of probable cause (possible instrumentation malfunction)
- Compare T/M data with crew report make initial recommendations for action
- Continue analysis utilizing specialized manpower, define priority order of corrective actions assessing risk and expediency
- Concur with crew diagnosis and fix, or advise of better alternative, or request additional measurements
- Monitor by T/M
IN-FLIGHT TROUBLE SHOOTING

IN-FLIGHT TROUBLE SHOOTING IS EXPECTED TO BE ONE OF THE MAJOR CONTRIBUTIONS TO EARLY SUCCESS AND MATURITY OF THE MOL SYSTEM. THE PRESENT SYSTEM IS DESIGNED SO THAT MALFUNCTION DETECTION, DIAGNOSIS, AND CORRECTIVE ACTION CAN BE DONE IN PARALLEL, BOTH BY THE FLIGHT CREW AND FROM THE GROUND. HOWEVER, AS IN AIRCRAFT EXPERIENCE THE TWO GROUPS WORKING TOGETHER AS A TEAM ARE EXPECTED TO BE VASTLY MORE EFFECTIVE AT DIAGNOSING AND CORRECTING PROBLEMS THAN EITHER WORKING INDEPENDENTLY. THE RECENT XB-70 EXPERIENCE IS A PERFECT CASE IN POINT. A GROUP OF EXPERTS WITH DETAILED SYSTEM DATA AND ANALYSIS AND THROUGH REPEATED COMMUNICATIONS WITH THE PILOTS FINALLY DIRECTED THE SHORTING OF TWO ELECTRICAL POINTS TO LOWER THE NOSE GEAR, THUS SAVING THE AIRCRAFT. IT IS IMPORTANT TO NOTE THAT THIS PARTICULAR MALFUNCTION AND ITS MEANS OF CORRECTION COULD NOT HAVE BEEN PREDICTED WITH ANY AMOUNT OF FAILURE ANALYSIS AND PREDICTION OF MALFUNCTIONS.
<table>
<thead>
<tr>
<th>SUBSYSTEM</th>
<th>LOCATION</th>
<th>ACCESSIBILITY</th>
<th>E. V. OR I. V.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. EPS:</td>
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<td></td>
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<tr>
<td>FUEL CELL</td>
<td>UNPRESS. COMP</td>
<td>INACCESSIBLE, REDUNDANT</td>
<td>E. V.</td>
</tr>
<tr>
<td>CRYO TANK/LINES</td>
<td></td>
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<tr>
<td>ELECT. CONTR. POWR</td>
<td>PRESS. COMP.</td>
<td>75%, COMMONALITY EMPHASIZED</td>
<td>E. V.</td>
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<tr>
<td>UNIT DISTRIBUTION</td>
<td></td>
<td>80%, SWING OUT PANELS</td>
<td>I. V.</td>
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<tr>
<td>2. EC/LS:</td>
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<tr>
<td>FLUID LOOP/VALVING</td>
<td>UNPRESS. COMP</td>
<td>INACCESSIBLE, REDUNDANT</td>
<td>E. V.</td>
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<tr>
<td>FREON PUMP/MTR, H E</td>
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<tr>
<td>MOLECULAR SIEVE</td>
<td>PRESS. COMP.</td>
<td>100%, HAS REGEN, CAPAB.</td>
<td>E. V.</td>
</tr>
<tr>
<td>FAN</td>
<td></td>
<td>100%, REMOVAL EASY</td>
<td>I. V.</td>
</tr>
<tr>
<td>GAS REGULATOR</td>
<td></td>
<td>100%, THOUGH REDUNDANT</td>
<td>I. V.</td>
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<td>3. ACTS:</td>
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<tr>
<td>HORIZ. SEN. HDS.</td>
<td>EXTERN. VEH.</td>
<td>INACCESSIBLE, REDUNDANT</td>
<td>E. V.</td>
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<tr>
<td>TCA'S</td>
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<tr>
<td>PROP. TANK/LINES/</td>
<td>UNPRESS. COMP</td>
<td></td>
<td>E. V.</td>
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<td>VALVES</td>
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<td>GYROS</td>
<td>PRESS. COMP.</td>
<td>100%, REMOVAL EASY</td>
<td>I. V.</td>
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<tr>
<td>ELECTRONIC CIRC.</td>
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<td>100%, COMMONALITY EMPHASIZED</td>
<td>I. V.</td>
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<td>CARDS</td>
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<tr>
<td>TRNSM/RECVR.</td>
<td></td>
<td>INACCESSIBLE, REDUNDANT</td>
<td>I. V.</td>
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<td>VOICE COMPONENTS</td>
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<td>COMPUTER</td>
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<td>RECORD/TELEPR. HEADS</td>
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<td>TAPES</td>
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<td>100%, CLEAN/REPLACE</td>
<td>I. V.</td>
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<tr>
<td>5. INSTR.</td>
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<td>100%, REPLACE</td>
<td>I. V.</td>
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<tr>
<td>SENSORS/DISPLAYS</td>
<td>PRESS. &amp; UNPRESS</td>
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<td>6. STRUCTURE:</td>
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<td>DOOR/SEALS, LATCH</td>
<td>EXTR. WALL</td>
<td>100%, REPLACE</td>
<td>E. V.</td>
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<td>RADIATOR</td>
<td>EXTERN. VEH.</td>
<td>INACCESSIBLE, REDUND PATHS</td>
<td>E. V.</td>
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</table>
ACCESSIBILITY FOR MAINTENANCE/REPLACEMENT/REPAIR
LABORATORY MODULE

AN EVALUATION HAS BEEN MADE OF THE LABORATORY
MODULE TO ATTAIN A REASONABLE QUANTITATIVE UNDERSTANDING
OF THE DEGREE OF AVAILABILITY OF EQUIPMENTS TO THE CREWMEN
FOR TROUBLE SHOOTING, MAINTENANCE, REPAIR AND REPLACEMENT.
WE FIND THAT TO A GREAT DEGREE AND WHEREVER PRACTICABLE
THE EQUIPMENTS CAN BE MADE AVAILABLE TO THE CREWMEN.
IN GENERAL, WHERE EQUIPMENTS ARE NOT AVAILABLE, IT IS DUE
TO THE FACT THAT EXTRA-VEHICULAR ACTIVITIES WOULD BE RE-
QUIRED. IN MOST OF THESE CASES, THE ALTERNATIVE HAS BEEN TO
MAKE THE EQUIPMENTS REDUNDANT.
MISSION PAYLOAD DEVELOPMENT RISK

AN EVALUATION OF THE LABORATORY MODULE LEADS TO THE CONCLUSION THAT IT IS BASED LARGELY ON STATE-OF-THE-ART DESIGN AND SUBSYSTEMS. THIS IS NOT THE CASE WITH THE MISSION MODULE. ON THE CONTRARY, IT REPRESENTS AN EXTENSIVE ADVANCE IN THE STATE-OF-THE-ART. SHOWN HERE ARE THE CONSIDERABLE NUMBERS OF EQUIPMENTS WHICH REQUIRE NEW DEVELOPMENT AND DESIGN. ALSO SHOWN ARE MAJOR COMPONENTS WHICH, ALTHOUGH PRESENTLY DEVELOPED, REQUIRE ADAPTATION INTO THE SYSTEM.
## ACCESSIBILITY FOR MAINTENANCE/REPLACEMENT/REPAIR

### MISSION PAYLOAD

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<tr>
<th>SUBSYSTEM</th>
<th>LOCATION</th>
<th>ACCESSIBILITY</th>
<th>E. V. OR I. V.</th>
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<tbody>
<tr>
<td><strong>CAMERA &amp; FILM HANDLING</strong></td>
<td>PRES. COMP'T-AFT BULKHEAD</td>
<td>100%</td>
<td>I. V.</td>
</tr>
<tr>
<td><strong>RECONN CONSOLES</strong></td>
<td>PRESS. COMPARTMENT</td>
<td>60%, SWING OUT PANELS</td>
<td>I. V.</td>
</tr>
<tr>
<td><strong>ACQN/TRACKING SCOPE PICKUP HEADS</strong></td>
<td>PRES. COMP'T-CONSOLE EXT. BOTTOM SKIN</td>
<td>0% INACCESSIBLE, REDUNDANT</td>
<td>E. V.</td>
</tr>
<tr>
<td><strong>COMPUTER SUBSYSTEM</strong></td>
<td>PRES. COMP'T-CONSOLE</td>
<td>50%, SWING OUT PANELS</td>
<td>I. V.</td>
</tr>
<tr>
<td><strong>DATA READOUT SUBSYSTEM</strong></td>
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<tr>
<td><strong>PROCESSING</strong></td>
<td>PRES. COMP'T-CONSOLE</td>
<td>100%</td>
<td>I. V.</td>
</tr>
<tr>
<td><strong>SCANNER</strong></td>
<td>PRES. COMP'T-CONSOLE</td>
<td>50%, SWING OUT PANELS</td>
<td>I. V.</td>
</tr>
<tr>
<td><strong>DATA RE-ENTRY VEHICLE LAUNCHER</strong></td>
<td>PRES. COMP'T-BRACKET</td>
<td>25%, BUCKET LOAD ACCESS</td>
<td>I. V.</td>
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<tr>
<td><strong>MISSION PAYLOAD</strong></td>
<td>MISSION MODULE</td>
<td>0% INACCESSIBLE</td>
<td>E. V.</td>
</tr>
<tr>
<td><strong>OPTICAL SENSOR MIRRORS</strong></td>
<td>MISSION MODULE</td>
<td>10%, THERMAL DOOR</td>
<td>E. V.</td>
</tr>
<tr>
<td><strong>DRIVES</strong></td>
<td>MISSION MODULE</td>
<td>0% INACCESSIBLE, REDUNDANT</td>
<td>E. V.</td>
</tr>
<tr>
<td><strong>THERMAL CONTROL</strong></td>
<td>MISSION MODULE</td>
<td>50%, IN OPEN POSITION</td>
<td>E. V.</td>
</tr>
<tr>
<td><strong>HEATER BLANKETS</strong></td>
<td>MISSION MODULE</td>
<td>0% INACCESSIBLE, REDUNDANT</td>
<td>E. V.</td>
</tr>
<tr>
<td><strong>THERMAL DOOR</strong></td>
<td>MISSION MODULE</td>
<td>50%, IN OPEN POSITION</td>
<td>E. V.</td>
</tr>
<tr>
<td><strong>OPS, REF. &amp; CONTROL STAR TRACKER</strong></td>
<td>MISSION MODULE UPPER SKIN</td>
<td>0% INACCESSIBLE, REDUNDANT</td>
<td>E. V.</td>
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</tbody>
</table>
AS MIGHT BE EXPECTED THE ACCESSIBILITY OF THE EQUIPMENTS IN THE MISSION MODULE SEGMENT IS SOMEWHAT LESS THAN THAT OF THE LABORATORY. GENERALLY, THE MISSION MODULE EQUIPMENTS WHICH WILL BE INSTALLED IN THE LABORATORY WILL BE MADE ACCESSIBLE. HOWEVER, CERTAIN EQUIPMENTS ARE LOCATED IN AND AROUND THE OPTICAL SENSOR AND THEREFORE LARGELY INACCESSIBLE. WHERE PRACTICAL, THESE ITEMS WILL BE MADE REDUNDANT. HOWEVER, CERTAIN CRITICAL ITEMS, SUCH AS THE FLAT MIRROR AND, TO SOME EXTENT ITS THERMAL CONTROL, CANNOT BE MADE REDUNDANT AND THEREFORE WILL REQUIRE SPECIAL ATTENTION IN DESIGN.
| SUBSYSTEMS, FUNCTIONS INOPERATIVE                                                                 | MANNED BACKUP ACTIVITY                                                                 | LEVEL OF DEGRADA-
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<tbody>
<tr>
<td>V/H SENSOR, ACROSS FORMAT IMC, STAR TRACKER.</td>
<td>MAN USES ACQUISITION AND TRACKING SCOPE</td>
<td>NONE</td>
</tr>
<tr>
<td>ABOVE, PLUS: DATA RE-ENTRY VEHICLE/launches, wideband data readout</td>
<td>AS ABOVE, PLUS: MAN INFORMS GROUND OF TAKE</td>
<td>NEGLIGIBLE DELAY IN RETURN OF FILM</td>
</tr>
<tr>
<td>ABOVE, PLUS: 1 SGLS COMMAND &amp; TRACK LINK, 2 FUEL CELLS, 1 CRYO TANK, 25% OF THRUSTERS, AUTO MODE</td>
<td>AS ABOVE, PLUS: MAN INITIATES POWER-DOWN MODE, MANUAL $\Delta V$ CONTROL, MANUAL STABILIZATION CONTROL WITH VISUAL REFERENCE</td>
<td>SMALL POSSIBLY REDUCES DURATION</td>
</tr>
<tr>
<td>$\Delta v$, 1 COMPUTER, 1 ACQUISITION AND TRACKING SCOPE, LAB ATTITUDE REFERENCE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ABOVE, PLUS: ALL COMMUNICATIONS EXCEPT SINGLE UP/DOWN VOICE LINK, AUXILIARY MEMORY STORAGE</td>
<td>AS ABOVE, PLUS: OPERATION FROM CUES, ROUGH MANUAL ORBIT ADJUSTMENTS</td>
<td>MODERATE SLIGHT REDUCTION IN TAKE</td>
</tr>
</tbody>
</table>
| ABOVE, PLUS: LOSS OF ALL PROPELLANT, OR LOSS OF ALL POWER, OR LOSS OF ALL CRYO, OR LOSS OF    | CREW RETURNS WITH TAKE IN GEMINI B                                                      | SEVERE MAY REQUIRE MISSION TERMINA-
| ALL STABILIZATION AND CONTROL, OR LOSS OF OPTICS                                                |                                                                                         | TION                                 |

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**SECRET-SPECIAL HANDLING**
BACK UP MAN MISSION MODES WITH DEGRADED SUBSYSTEM

Shown here is the degree to which the man can back up major subsystems to continue the mission in spite of equipment failure. The comparison is based on the assumption that, initially, the system is operating in the automatic mode. The column on the left indicates the subsystems which may fail. The center column indicates the man back-up activity, and the right-hand column indicates the effect of the failure with the man acting as a back up. Moving down the left-hand column, the failure of the subsystems are additive. That is, each row includes the failure in that row and all above. It can be seen that a major portion of the laboratory and mission module subsystems can fail with only a slight reduction in the performance of the system. In effect, the presence of the man and his capability to back up major subsystems simplifies the over-all system in terms of completing mission success.
MANNED OPERATIONAL MODES

- MANNED EXAMINATION FOR ACTIVE INDICATORS
- MANNED ACQUISITION AND TRACKING
WE HAVE DEFINED TWO BASIC MANNED OPERATIONAL MODES FOR THE MOL VEHICLE. THE FIRST INVOLVES AUTOMATIC ACQUISITION AND TRACKING OF TARGETS IN THE ACQUISITION SCOPES AS WELL AS IN THE PRIMARY OPTICS. IN THIS MODE, THE TASK OF CREWMEN IS TO EXAMINE THE TARGETS FOR ACTIVITY INDICATORS WHICH SIGNIFY CONDITIONS OF ESPECIALLY HIGH INTELLIGENCE VALUE, SUCH AS A MISSILE ON A STAND, OR SPECIAL VEHICLES OR EQUIPMENTS BEING PRESENT. WE WILL DISCUSS THIS CONCEPT IN CONSIDERABLE DETAIL.

THE SECOND MODE IS ONE WITH WHICH WE ARE ALL FAMILIAR SINCE IT HAS BEEN, TO DATE, THE PRIMARY MODE DEFINED IN THE BASELINE SYSTEM. IN THIS MODE, THE CREWMAN ACQUIRES A TARGET, CENTERS IT IN THE FIELD OF VIEW, REDUCES THE IMAGE MOTION, AND EVENTUALLY "HANDS THE TARGET" OVER TO THE LARGE OPTICS FOR A PICTURE TAKING SEQUENCE.
CONCEPT OF MANNED EXAMINATION FOR ACTIVE INDICATORS

- IF EITHER PRIMARY HAS ACTIVE INDICATORS, TAKE IT

SECRET SPECIAL HANDLING
CONCEPT OF MANNED EXAMINATION FOR ACTIVE INDICATORS

THE BASIC CONCEPT OF CREWMAN EXAMINATION OF TARGETS FOR ACTIVE INDICATORS IS THAT THE PRIMARY OPTICS WILL BE PROGRAMMED TO OBTAIN TARGETS AUTOMATICALLY AS THOUGH THE CREWMEN WERE NOT PRESENT. THE TWO ACQUISITION SCOPES WILL ALSO BE PROGRAMMED AUTOMATICALLY TO PERMIT OBSERVANCE OF TWO OTHER TARGETS IN THE VICINITY OF THE ONE ASSIGNED TO THE PRIMARY OPTICS. THE PRECISION IN POINTING DATA PROVIDED TO THE ACQUISITION SCOPE WILL INSURE THAT THE TARGET IS IN THE FIELD OF VIEW AND TRACKED WITH PRECISION. THUS, THE ENTIRE TASK OF A CREWMAN WILL BE TO EXAMINE THE TARGET AND MAKE A JUDGEMENT AS TO THE PRESENCE OR ABSENCE OF ACTIVITY INDICATORS.
ACTIVE INDICATOR EXAMINATION AND SPECIAL PHOTOGRAPHY SEQUENCE

TIMES (SEC.)

10 → 2.5 → 3 → 5.2

DISTANCE (N. MI.)

42 → 10.5 → 12.5 → 22

NOTE

WORST CASE - STEREO CAN START ANYWHERE FROM +20° TO -5° (+20° TO -20° AVAILABLE)
ACTIVE INDICATOR EXAMINATION AND SPECIAL PHOTOGRAPHIC SEQUENCE

ONE OF THE KEY QUESTIONS AS TO THE EFFECTIVENESS OF THE CREWMEN IN THE EXAMINATION OF TARGETS FOR ACTIVE INDICATORS IS HOW MUCH TIME IS AVAILABLE FOR THE EXAMINATION. TO ESTABLISH THIS TIME WE FIRST ASSUME THAT THE PRIMARY OPTICS WILL BE LIMITED TO TAKING PICTURES IN THE RANGE OF $\pm 20^\circ$, WITH THE STEREO ANGLE SET AT $15^\circ$. NEXT, WE ASSUME THAT AT THE TIME OF A DECISION THAT ACTIVE INDICATORS ARE PRESENT, THE MIRROR OF THE PRIMARY OPTICS IS AT $-20^\circ$ (AND THE TIME TO ROLL THE MIRROR TO THE NEW TARGET DOES NOT CONTROL). THUS, WE HAVE THE WORSE CONDITION FOR THE TIME FOR CREWMAN EXAMINATION. ALLOWING FOR SLEWING AND SETTLING TIMES OF THE PRIMARY MIRROR AND THE TAKING OF A STEREO PAIR AT $-5^\circ$ AND $-20^\circ$, WE FIND THAT THE CREWMAN HAS TEN SECONDS FOR TARGET EXAMINATION. INITIATION OF THE EXAMINATION OCCURS WHEN THE TARGET IS AT $+36^\circ$ AND ENDS AT ABOUT $+11^\circ$. THE TOTAL TIME FOR EXAMINATION AND OBTAINING A STEREO PAIR IS ON THE ORDER OF 20 SECONDS.
ACQUISITION/TRACKING TELESCOPE CAPABILITIES

IT APPEARS THAT THE ACQUISITION AND TRACKING SCOPE DESIGN WILL PROVIDE THE CAPABILITY OF OBSERVATION AT MAXIMUM RESOLUTIONS OF THREE TO FIVE FEET. AT THE MAXIMUM RESOLUTION THE FIELD OF VIEW WILL BE OF THE ORDER OF 1°, THE SAME AS THAT OF THE PRIMARY OPTICS. AT THIS RESOLUTION IT IS EXPECTED THAT OBJECTS OF THE ORDER OF 10 TO 15 FEET MAY BE DETECTED. VARYING THE OPTICAL POWER OVER A RANGE OF APPROXIMATELY 50 POWER WILL PERMIT MUCH LARGER FIELDS OF VIEW TO BE SCANNED AT CORRESPONDINGLY GROSSER RESOLUTIONS.
MANNED ACTIVE INDICATOR EXAMINATION MODE

TYPICAL TIME LINE

SECTION OF TYPICAL SIMULATION RUN

ROLL ANGLE

-10° 0° 10° 20° 30° 40°

KEY TO PHOTOGRAPHS

P - PROGRAMMED
X - POTENTIAL SPECIAL (X)
• - NOT SPECIAL (X)

⊗ - JUDGED BY CREWMAN #1
△ - JUDGED BY CREWMAN #2

SECRET SPECIAL HANDLING
MANNED ACTIVE INDICATOR EXAMINATION MODE

TYPICAL TIMELINE

-- SECRET-SPECIAL HANDLING

WHS-025-15

 PRIMARY ATS (CREWMAN #1)

Judge Slew Judge Slew Judge Slew Judge Slew

SECONDARY ATS (CREWMAN #2)

Judge Slew Judge Slew Judge Slew Judge Slew

MAIN OPTICS

Slew Settle & V/H Take Track Take Slew Settle & V/H Take Track Take Slew Settle & V/H Take Track Take Slew Settle & V/H Take Track Take

DECISION & INTERDICT

SECONDARY CAMERA

INERT + OUT

TIME IN SECONDS

0 5 10 15 20 25 30 35 40 45 50 55

-- SECRET-SPECIAL HANDLING
OTHER MISSION CAPABILITIES OF MOL BASELINE SYSTEM

BASELINE CAPABILITY

MOBILE LAND TARGETS
MARS SURFACE SURVEY AT 50 N. MI. RESOLUTION

BASELINE CAPABILITY WITH ADDITIONAL DEVELOPMENT
ELINT
SHIP DETECTION AND HRO PHOTOGRAPHS
ASTRONOMY
SECTION OF TYPICAL SIMULATION RUN

### SPECIAL PHOTOGRAPH TAKE ANALYSIS

**Automatic Mode**
- 50% CLOUD COVER
- PHOTOS ARE STEREO PAIRS
- 1.5 PROGRAMMED PHOTOGRAPH REDUCTION FACTOR FOR INTERDICTION OF PROGRAM

<table>
<thead>
<tr>
<th>PHOTOGRAPHS/DAY</th>
<th>CLEAR PHOTOGRAPHS/DAY</th>
<th>SPECIAL CLEAR PHOTOGRAPHS/DAY</th>
<th>PROGRAMMED PHOTOGRAPHS LOST DUE TO INTERDICTION</th>
<th>RETAINED PHOTOGRAPHS/DAY</th>
<th>CLEAR SPECIAL PHOTOGRAPHS/DAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>93</td>
<td>46.5</td>
<td>32.5</td>
<td>5</td>
<td>88</td>
<td>1.85</td>
</tr>
</tbody>
</table>

**Manned Active Indicator Mode**
- 70% OF PROGRAMMED PHOTOGRAPHS ARE POTENTIALLY SPECIAL
- 6% OF POTENTIALLY SPECIAL ARE IN FACT SPECIAL

<table>
<thead>
<tr>
<th>PHOTOGRAPHS/DAY</th>
<th>POTENTIALLY SPECIAL PHOTOS/JUDGED CLEAR</th>
<th>CLEAR SPECIAL PHOTOS/DAY</th>
<th>PROGRAMMED PHOTOS LOST DUE TO INTERDICTION</th>
<th>RETAINED PHOTOGRAPHS/DAY</th>
<th>CLEAR SPECIAL PHOTOGRAPHS/DAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>111</td>
<td>55.5</td>
<td>3.33</td>
<td>5</td>
<td>88</td>
<td>1.85</td>
</tr>
</tbody>
</table>

**CLEAR PHOTOGRAPHS/DAY WITH CREW PARTICIPATION**

\[
\frac{93}{2} + 3.33 - \frac{1.5 \times 3.33}{2} = 47.3
\]

**SPECIAL PHOTOGRAPH OCCURRANCES**

\[
3.33 \text{ HANDLED BY CREW} + 1.85 \text{ RETAINED PROGRAMMED} = 5.18 \text{ TOTAL MANNED}
\]

**MANNED IMPROVEMENT FACTOR**

\[
\frac{5.18}{1.95} = 2.65
\]

---

SECRET SPECIAL HANDLING
SPECIAL PHOTOGRAPH-TAKE ANALYSIS

SHOWN HERE ARE THE RESULTS OF THE ANALYSIS OF THE MANNED EXAMINATION FOR ACTIVE INDICATORS OPERATIONAL MODE. THE RESULTS ARE FOR A TYPICAL OPERATIONAL DAY AGAINST THE 6,000 TARGET DECK USING THE APPROPRIATE OPERATING CHARACTERISTICS OF THE PRIMARY OPTICS AND THE ACQUISITION SCOPES. ON THIS PARTICULAR DAY, THE PRIMARY OPTICS WAS PROGRAMMED AGAINST 93 TARGETS AND INCLUDING THE 50% WEATHER FACTOR RETURNED 46.5 CLEAR PHOTOGRAPHS. OF THESE 32.5 WOULD BE POTENTIALLY ACTIVE YIELDING 1.95 CLEAR, SPECIAL PHOTOGRAPHS. ON THE SAME DAY IT WAS FOUND THAT THE TWO ACQUISITION SCOPES COULD BE PROGRAMMED AGAINST 111 POTENTIALLY ACTIVE TARGETS. OF THESE, 55.5 WOULD BE EXPECTED TO BE CLOUD FREE AND 3.33 CLEAR, SPECIAL PHOTOGRAPHS WOULD BE TAKEN. ASSUMING 1.5 PRE-PROGRAMMED TARGETS TO BE LOST FOR EACH CREW PROGRAMMED TARGET, FIVE PROGRAMMED PHOTOGRAPHS WOULD BE LOST IN THE DAY. THE NET EFFECT OF THIS IS TO REDUCE THE EXPECTED RETURN OF SPECIAL PHOTOGRAPHS FROM THE AUTOMATIC MODE FROM 1.95 TO 1.85 - A NEGLIGIBLE AMOUNT. THE NET CHANGE IN THE CLEAR PHOTOGRAPHS IS NEGLIGIBLE, THE LOSS IN PRE-PROGRAMMED TARGETS BEING ESSENTIALLY BALANCED BY THE INCREASE IN CREW PROGRAMMED TARGETS. THE NUMBER OF CLEAR, SPECIAL PHOTOGRAPHS RETURNED DUE TO CREWMEN PARTICIPATION IS INCREASED BY A FACTOR OF 2.65 OVER THE PURE AUTOMATIC MODE.
### SPECIAL PHOTOGRAPH TAKE PER FLIGHT

<table>
<thead>
<tr>
<th></th>
<th>AUTOMATIC MODE</th>
<th>MANNED/AUTOMATIC MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(MEAN MISSION</td>
<td>(MEAN MISSION</td>
</tr>
<tr>
<td></td>
<td>DURATION = 24</td>
<td>DURATION = 28 DAYS)</td>
</tr>
<tr>
<td>CLEAR PROGRAMMED</td>
<td>1,116</td>
<td>1,324</td>
</tr>
<tr>
<td>PHOTOGRAPHS PER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FLIGHT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLEAR SPECIAL</td>
<td>47</td>
<td>145</td>
</tr>
<tr>
<td>PHOTOGRAPHS PER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FLIGHT</td>
<td></td>
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</tr>
</tbody>
</table>

**NOTE:** PHOTOGRAPHS ARE STEREO PAIRS
SPECIAL PHOTOGRAPH TAKE PER FLIGHT

THE TOTAL CLEAR PHOTOGRAPH RETURN PER FLIGHT IN THE AUTOMATIC MODE IS VERY NEARLY THE SAME AS THAT IN THE MANNED AUTOMATIC MODE, THE SLIGHT REDUCTION BEING DUE TO THE REDUCED MEAN MISSION DURATION IN THE CASE OF THE AUTOMATIC MODE. THE TOTAL CLEAR, SPECIAL PHOTOGRAPHS PER FLIGHT IS RADICALLY DIFFERENT IN THE TWO MODES, REFLECTING A MAJOR INCREASE IN THE SPECIALLY HIGH TECHNICAL INTELLIGENCE TAKE DUE TO THE PRESENCE OF MAN.
SECRET SPECIAL HANDLING

DATA READOUT CAPABILITIES

- STATE-OF-THE-ART DIGITAL SYSTEM ALREADY PROGRAMMED FOR THE SATELLITE CONTROL NETWORK

- READ OUT ~ 30 PICTURES/DAY (15 HIGH RESOLUTION STEREO PAIRS)

- CAPABILITY TO READOUT ALL SPECIAL AND HIGH PRIORITY PHOTOGRAPHS

- PROVIDES APPROXIMATELY ONE DAY SERVICE FROM ACQUISITION TO USER

SECRET SPECIAL HANDLING
DATA READOUT CAPABILITIES

A DIGITAL READOUT SYSTEM ALREADY PROGRAMMED FOR INSTALLATION IN THE SATELLITE CONTROL NETWORK WILL BE INSTALLED IN THE BASELINE MOL SYSTEM. IT WILL HAVE A CAPABILITY OF READING OUT APPROXIMATELY 30 PHOTOGRAPHS PER DAY TO THREE GROUND STATIONS. THUS, ALL OF THE SPECIAL AND HIGH PRIORITY PHOTOGRAPHS MAY BE READ OUT TO THE GROUND WITH APPROXIMATELY ONE-DAY SERVICE FROM ACQUISITION TO USER.
CRISIS RECONNAISSANCE AND MOBILE TARGETS
IN THE MANNED EXAMINATION FOR INDICATORS MODE

- DETAILS OF THE STATUS OF MISSILE LAUNCH SITES, AIRFIELDS
  AND OTHER MAJOR MILITARY INSTALLATIONS COULD BE
  ASCERTAINED

- IN SPECIFIED AREAS, THE PRESENCE OF MOBILE MISSILES,
  LAND VEHICLES, TROOPS, SHIPS AND OTHER EQUIPMENT COULD
  BE ASCERTAINED

- THROUGH THE READOUT SYSTEM, DATA COULD BE MADE
  AVAILABLE TO THE USER ON A DAILY BASIS

-SECRET SPECIAL HANDLING
CRISIS MANAGEMENT AND TACTICAL TARGETS IN THE MANNED EXAMINATION FOR INDICATORS MODE

IT IS NOT EXPECTED THAT THE MOL SYSTEM WILL IN ANY WAY MEET THE TOTAL REQUIREMENTS FOR CRISIS MANAGEMENT AND TACTICAL SITUATION. ON THE OTHER HAND, IT IS EXPECTED THAT IT WILL PROVIDE A VALUABLE ADJUNCT TO THE TOTAL DATA COLLECTED. IN FACT, WHERE SPECIFIC HIGH RESOLUTION PHOTOGRAPHS ARE REQUIRED AND FOR POLITICAL OR FORCE REASONS AIRCRAFT ARE DENIED ACCESS IT MAY BECOME ABSOLUTELY VITAL IN OBTAINING DATA ON WHICH TO BASE DECISIONS. FURTHERMORE, THE READOUT DATA LINK PROVIDES THE MINIMUM ACQUISITION TO USER TIME REQUIRED IN SUCH SITUATIONS.
ESTIMATE OF EARLY TECHNICAL INTELLIGENCE RETURN
FROM BASIC MOL PROGRAM

<table>
<thead>
<tr>
<th></th>
<th>3 M/AM FLIGHTS</th>
<th>2 AM FLIGHTS</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL NUMBER OF CLEAR PHOTOGRAPHS</td>
<td>3,973</td>
<td>2,232</td>
<td>6,205</td>
</tr>
<tr>
<td>TOTAL NUMBER OF CLEAR, SPECIAL PHOTOGRAPHS (CONTAINED IN TOTAL PHOTOGRAPHS)</td>
<td>435</td>
<td>94</td>
<td>529</td>
</tr>
</tbody>
</table>
ESTIMATE OF EARLY TECHNICAL INTELLIGENCE

RETURN FROM BASIC MOL PROGRAM

ASSUMING NO CATASTROPHIC, EARLY FLIGHT FAILURE
AND USING RELIABILITY FIGURES EXPECTED OF THE MATURE
FLIGHT SYSTEM, THE EXPECTED NUMBER OF CLEAR PHOTOGRAPHS
AND CLEAR SPECIAL PHOTOGRAPHS ARE SHOWN HERE FOR THE
FIVE-FLIGHT BASELINE PROGRAM. WITH THESE ASSUMPTIONS,
THE NUMBERS SHOWN CAN BE CONSIDERED THE UPPER LIMITS OF
RETURNS TO BE EXPECTED FROM THE BASELINE DEVELOPMENT
PROGRAM.
BASELINE PROGRAM ATTRIBUTES

1. EARLY SYSTEM MATURITY AND INTELLIGENCE RETURN
2. HIGH ACQUISITION RATE AND AVAILABILITY FOR
   - SPECIAL INTELLIGENCE PHOTOGRAPHS
   - CRISIS RECONNAISSANCE AND MOBILE TARGET INFORMATION
3. OTHER MISSION CAPABILITIES
   - ASTRONOMY
4. COULD CARRY ELINT AND SHIP DETECTION SENSORS
5. SIMPLE GROWTH EVOLUTION TO IMPROVED CAPABILITIES AND ECONOMICS

SECRET-SPECIAL HANDLING
BASELINE PROGRAM ATTRIBUTES

1. LOW RISK DEVELOPMENT PROGRAM

2. EARLY SYSTEM MATURITY AND INTELLIGENCE RETURN

3. HIGH ACQUISITION RATE AND AVAILABILITY FOR
   - SPECIAL INTELLIGENCE PHOTOGRAPHS
   - CRISIS MANAGEMENT AND TACTICAL SITUATION INFORMATION

4. OTHER MISSION CAPABILITIES
   - [REDACTED]
   - ASTRONOMY

5. COULD CARRY ELINT AND SHIP DETECTION SENSORS

6. SIMPLE GROWTH EVOLUTION TO IMPROVED CAPABILITIES AND ECONOMICS

-SECRET SPECIAL HANDLING
BASELINE PROGRAM ATTRIBUTES

In summary, the baseline MOL program clearly provides the highest confidence approach to meeting the Dorian requirements for ground resolution photographs. The early maturity and reliability typical of a manned system can be expected to lead to the earliest operational capability in terms of large numbers of high resolution photographs returned.

The utilization of crewmen in the examination for active indicators will lead to a significantly increased probability of photographing rare events and situations of particularly high intelligence value. Careful consideration of this approach could well lead to a new criterion on which to base the effectiveness of satellite high resolution optical systems. Operating in the same mode, the MOL vehicle may well provide a unique capability to provide high resolution photographs in times of crisis management in tactical situations. The combination of these capabilities with quick readout to the ground could lead to a new era in the collection of data and its quick deliverance to the user.

The baseline vehicle has inherent in it the capability to obtain high resolution photographs and to obtain astronomical data of major scientific significance.

If the sample ELINT and ship detection sensors (to be described next) are developed they could be carried on the baseline vehicle to augment the gathering of intelligence data.

The baseline system is configured so as to evolve with minimum changes into a follow-on program with vastly improved capabilities and economics.
OTHER POSSIBLE BASELINE APPLICATIONS
OTHER POSSIBLE BASELINE APPLICATIONS

HAVING CONCLUDED THE DISCUSSION OF THE PRIMARY MISSION OF THE MOL PROGRAM, WE WILL NOW DISCUSS OTHER POSSIBLE APPLICATIONS OF THE BASELINE VEHICLE.
TYPICAL ELINT INSTALLATION

A RELATIVELY LOW WEIGHT (APPROXIMATELY 500 LBS) ELINT SENSOR PACKAGE HAS BEEN DEFINED WHICH MIGHT BE FLOWN ON ANY ONE OF THE MANNED BASELINE FLIGHTS. WITH A LOW DUTY CYCLE OF APPROXIMATELY 10%, THE AVERAGE POWER REQUIRED IS NOMINAL AS IS THE DRAG DUE TO THE ANTENNA.
FOLLOW-ON PROGRAM ATTRIBUTES

THE FOLLOW-ON PROGRAM IS DESIGNED TO EVOLVE FROM THE BASELINE PROGRAM WITH A MINIMUM OF DEVELOPMENT OF NEW EQUIPMENTS. IT IS ESSENTIAL TO THE ACHIEVEMENT OF [REDACTED] RESOLUTION ON THE GROUND. IN PROVIDING A VEHICLE CONTINUOUSLY ON ORBIT WITH MULTI-SENSOR CAPABILITIES IT REPRESENTS A VAST STEP FORWARD IN THE COLLECTION AND RETURN OF TECHNICAL INTELLIGENCE DATA. THE RECYCLE TIME TO PHOTOGRAPH A SPECIFIC TARGET IS LIMITED ONLY BY ORBITAL MECHANICS AND THE READOUT SYSTEM RETURNS SPECIAL AND HIGH PRIORITY TARGETS ON A DAILY BASIS. THE OPERATIONAL COSTS TO RETURN AN EQUIVALENT AMOUNT OF TECHNICAL INTELLIGENCE DATA EITHER WITH THE BASELINE VEHICLE OR AN UNMANNED VEHICLE WOULD BE FAR GREATER THAN THAT OF THE FOLLOW-ON PROGRAM DESCRIBED HERE.
SECRET SPECIAL HANDLING

TYPICAL ELINT INSTALLATION

INSTALLATION CHARACTERISTICS

- HARDWARE WEIGHT INCLUDING STRUCTURE: 480#
- POWER PENALTY - 250 WATTS OPERATING, 25 WATTS AVERAGE
- DUTY CYCLE - 10% ORBITAL DURATION
- DEPLOYMENT CYCLE - 100%
- PROPULSION PENALTY - 1 FPS/DAY
MOL ELINT SYSTEM

DATA BASE
COLLATERAL & EOB

TARGET DECK
- LOCATIONS
- COARSE SIG. DATA

HIGH ACCURACY
EMITTER POINTING

- AID OPTICAL TARGET
CHOICE

- LOCATE MOBILE TARGETS

TI SIGNAL COLLECTION

- ALL WEATHER/NIGHT

EXOTIC EMITTERS
- AICBM
- ASAT
- SAM
- NEW R&D

PREPASS INTERFEROMETER
CALIBRATION
BORESIGHT ADJUST
ANTENNA DEPLOYMENT
BACK-UP

OPTIMIZE WIDEBAND TRACE PHOTOGRAPHY
INTERFERENCE GATING - f, t, φ, AMPL.
LOWER S/N FOR GOOD RECORDING (8-10 DB)
REAL TIME RECORD MODE ACCOMMODATION

TI TRANSFER
DECISION

MANNED
FUNCTIONS

EDITING, COMMENTARY, RECOVERY
MAINTENANCE CHECK, SPARES USE

SECRET-SPECIAL HANDLING

WH5-025-25

SECRET-SPECIAL HANDLING

APPROVED FOR
RELEASE 1 JULY 2015
MOL ELINT SYSTEM

THE ELINT SENSOR COULD BE USED TO ACQUIRE TARGETS AND ALERT THE CREWMEN TO OBTAIN HIGH RESOLUTION PHOTOGRAPHS. HOWEVER, THE PRIMARY USE OF THE SYSTEM WOULD BE TO ACQUIRE TECHNICAL INTELLIGENCE DATA ON EXOTIC EMITTERS. THE MAN WOULD IMPROVE THE INTELLIGENCE DATA THROUGH INTERFERENCE GATING ON FREQUENCY, TIME PHASE ANGLE AND AMPLITUDE. HIS PRESENCE MAKES POSSIBLE LOW WEIGHT WIDEBAND OSCILLOSCOPE TRACE PHOTOGRAPHY AS AN ANALOG DATA RECORDING METHOD.
MOL ELINT SYSTEM
PERFORMANCE OBJECTIVES

SIGNAL RECEPTION REQUIREMENTS
- 150 MC/S TO 10 KMC/S CONTINUOUS COVERAGE
- SELECTED HIGH PRIORITY BANDS PERMITTED
- SEARCH OVER 5% BANDS, 2 OR MORE SIMULTANEOUSLY
- SENSITIVITY FOR SIDELobe INTERCEPT
- IF BANDWIDTH 1 TO 25 MC/S, SELECTABLE
- SELECTABLE DEMODULATORS
- SELECTABLE DISPLAY & RECORD MODES

DF ACCURACY:
+2° THROUGHOUT COVERAGE ZONE
+1° MAXIMUM IN ZONE 20° TO 40° FORWARD, FOR TRANSFER OF COORDINATES TO ATS
+1/2° AT 22 1/2° FORWARD FOR TRANSFER TO LARGE OPTICS

DF COVERAGE:
+75° -25° INTRACK
+30 CROSSTrack

SIGNAL ENVIRON.

RECEIVERS ➔ SIGNAL PROCESSOR ➔ ANALOG ➔ CRT ➔ CAMERA ➔ READOUT OR RECOVERY

TARGETING INSTRUCTIONS ➔ PROCESSING SELECTIONS ➔ DIGITAL ➔ PARAMETER DISPLAY ➔ N. B. RECORDER

SGLS LINK ➔ MAN ➔
MOL ELINT SYSTEM PERFORMANCE OBJECTIVE

THE SYSTEM IS DESIGNED TO COVER A WIDE FREQUENCY RANGE SEARCHING SEQUENTIALLY OVER VARIOUS PARTS OF THE BAND. CERTAIN SPECIAL CHARACTERISTICS OF SIGNIFICANCE COULD BE SENSED SO AS TO ALERT THE CREWMEN TO PERFORM THE REQUIRED FUNCTIONS TO MAXIMIZE THE RETURN OF INTELLIGENCE DATA. THE COVERAGE OF THE SYSTEM IS WIDE BOTH IN TRACK AND CROSS TRACK; AND THE ACCURACY IS SUCH THAT THE TARGET COULD BE ACQUIRED IN THE ACQUISITION SCOPE TO OBTAIN HIGH RESOLUTION PHOTOGRAPHS IF DESIRED.
MOBILE TARGETS

THE NATURAL EXTENSION OF THE CONCEPT OF EXAMINATION OF TARGETS FOR ACTIVE INDICATORS IS TO CONSIDER THE PROBLEM OF ACQUIRING AND OBTAINING HIGH RESOLUTION PHOTOGRAPHS OF MOBILE TARGETS. IT IS REASONABLE TO EXPECT THAT, AS TECHNOLOGY DEVELOPS, MOBILE TARGETS WILL BECOME INCREASINGLY HIGH PRIORITY TECHNICAL INTELLIGENCE TARGETS.
ACQUISITION AND TRACKING OF LAND MOBILE TARGETS

- GENERAL AREA IN WHICH TO EXPECT MOBILE TARGETS MAY BE KNOWN (E.G. EXPERIMENTAL AIRCRAFT NEAR AIRFIELDS, TRAINS ON TRACKS, ETC).
  ASTRONAUT REQUIRED TO:
  - SCAN AREA AND LOCATE MOBILE TARGETS
  - ACQUIRE TARGETS IN F.O.V. OF BIG OPTICS
  - TRACK MOVING TARGETS

- DATA INDICATES ASTRONAUT CAN SCAN AT LEAST 16 N.M. OF RR TRACK IN ~ 10 SEC AT 3.5X (1.3:1 CONTRAST)

- RESOLUTION SERIOUSLY DEGRADED IF MOVING TARGET IS NOT TRACKED BY ASTRONAUT

TRAINS, TRUCKS, ETC.

\[ \Sigma = +10^\circ \]
\[ \varphi = \pm 20^\circ \]

AIRCRAFT AT 30,000 FT

\[ \Sigma = +10^\circ \]
\[ \varphi = \pm 20^\circ \]
ACQUISITION AND TRACKING OF LAND MOBILE TARGETS

IT APPEARS THAT MANNED OPERATION OF THE ACQUISITION AND TRACKING SCOPE MAY BE ESSENTIAL TO ACQUIRING HIGH RESOLUTION PHOTOGRAPHS OF LAND MOBILE TARGETS. THE GENERAL AREA IN WHICH A SPECIFIC MOBILE TARGET OPERATES MAY BE EXPECTED TO BE KNOWN, I.E., EXPERIMENTAL AIRCRAFT FLYING FROM A GIVEN AIR FIELD, TRAINS IN RAIL CENTERS OR ON SIDINGS, OR TANKS AT A PROVING GROUND. HOWEVER, BECAUSE OF THEIR MOBILITY IT IS IMPOSSIBLE TO KNOW WHERE THEY WILL BE AT ANY GIVEN INSTANT. THE REPEATED EXAMINATION OF THE PRESCRIBED AREAS IS ESSENTIAL TO MAXIMIZE THE PROBABILITY OF OBTAINING HIGH RESOLUTION PHOTOGRAPHS.

IF THE MOBILE TARGETS ARE TRAVELING AT VELOCITIES OF THE ORDER OF 50 MPH OR GREATER THE CREWMAN WILL ACTUALLY HAVE TO TRACK THE TARGET TO OBTAIN HIGH RESOLUTION PHOTOGRAPHS,
DETECTION RADAR SYSTEM INSTALLATION
BASIC MOL VEHICLE

STOWED  DEPLOYED  FEATHERED

RADAR CAPABILITY

INSTALLATION CHARACTERISTICS
- TOTAL HARDWARE WEIGHT - 387#
- POWER PENALTY - 800 WATTS OPERATING, 120 WATTS AVERAGE
- PROPULSION PENALTY - < 1 FPS/DAY
DETECTION RADAR SYSTEM INSTALLATION BASIC MOL VEHICLE

ANOTHER FORM OF MOBILE TARGETS IS SHIPS AT SEA. A LOW WEIGHT ACQUISITION RADAR (APPROXIMATELY 400 LBS) HAS BEEN DEFINED WHICH IS CAPABLE OF DETECTING SHIPS OF THE SIZE OF TRAWLERS OR LARGER IN 100 N. MI. SWATH WIDTH. WITH A REASONABLE DUTY CYCLE, THE POWER REQUIREMENTS AND INCREASED DRAG ARE NOMINAL. THIS SYSTEM COULD BE USED IN AREAS OF SPECIAL INTEREST TO ALERT THE CREWMEN TO ACQUIRE SHIPS AND OBTAIN HIGH RESOLUTION PHOTOGRAPHS.
ACQUISITION OF HIGH-RESOLUTION PHOTOGRAPHS OF SHIPS

- In regions of high ship density, only a small fraction of the available ships can be programmed for high-resolution photography (locations based on detection radar data).

- Astronauts can increase the probability of obtaining photographs of importance by:
  - Selecting ships for visual inspection based on formations, brightness, etc., seen on radar display
  - Programming acquisition scope to point to selected ships
  - Examining selected ships through scope for activity indicators
  - Slaving main optics to acquisition scope in the case of positive indicators
  - Tracking moving ships through main optics to improve resolution
ACQUISITION OF HIGH RESOLUTION PHOTOGRAPHS OF SHIPS

IN REGIONS OF HIGH SHIP DENSITY, ONLY A SMALL FRACTION OF AVAILABLE SHIPS COULD BE ACQUIRED FOR HIGH RESOLUTION PHOTOGRAPHS. SHOWN HERE ARE SOME OF THE MANNED FUNCTIONS WHICH WOULD MAXIMIZE THE RETURN OF DESIRED DATA.
MARS PHOTOGRAPHY

- No mods
- PTS for Initial Acquisition - Manned Pointing through Main Optics
- Exposure time - .004 sec. SO346 (4404 x)
- Resolution -
  - Mol: 50 N. Mi.
  - Ground: 300 N. Mi.
  - Probe: 1 N. Mi.

DISTANT STARS

- Must have modifications
- Either movable plate holder and eyepiece or locked optics with control moment gyrocs
- Pointing to .01 sec. potential control
- Resolution like .1 sec. (Ground like 1 sec.)
- 22 mag with SO346-20 min. exposure
- Limit mag 26 - (20 min. exposure)

ULTRA-VIOLET (FREQUENCIES CUT OUT BY O3 LAYER)

- Ross corrector interchange to Quartz
  (2300-3000A, 1600-2300A)
- Must have control moment gyrocs
- Use SWR films to photograph stars
- Use image converter on optics for manned pointing
ASTRONOMY POTENTIAL

THE BASELINE MOL SYSTEM COULD BE USED WITH NO MODIFICATIONS TO OBTAIN A COMPLETE SURVEY OF THE MARS SURFACE AT A RESOLUTION OF 50 NM. WITH SOME MODIFICATIONS TO OBTAIN PRECISION POINTING THE MOL SYSTEM COULD BE USED TO OBTAIN PHOTOGRAPHS OF DISTANT STARS (OF THE SAME ORDER OF MAGNITUDE AS FROM THE GROUND) WITH RESOLUTION OF AN ORDER OF MAGNITUDE BETTER THAN THAT OBTAINED FROM THE GROUND.

Perhaps the greatest return in scientific knowledge might be achieved through searching for sources of light in the ultraviolet regions. This would require Ross corrector elements made of quartz. Since there is no apriori knowledge of such sources the man would be used with an image converter to search for such sources.
MOL GROWTH POTENTIAL

- IMPROVED PERFORMANCE
- ALTERNATE PAYLOADS
- IMPROVED ECONOMICS
WE TURN NOW TO A DISCUSSION OF MOL GROWTH POTENTIAL IN THE THREE AREAS SHOWN ON THE CHART.
GROWTH CONFIGURATION PAYLOAD WEIGHTS

- Resolution (Focal Length =)
- 70 N. MI. Altitude

WEIGHT INCLUDES:
- Cockpit equipment
- R/V's (6)
- R/V Racks & Launch provisions
- Film
- Contingency (20%)
GROWTH CONFIGURATION PAYLOAD WEIGHTS

THE MAJOR REQUIREMENT AND POTENTIAL FOR GROWTH OF THE MOL SYSTEM IS TO HIGHER RESOLUTION OPTICS. SHOWN HERE ARE ESTIMATES OF THE MISSION PAYLOAD SEGMENT WEIGHT REQUIRED TO OBTAIN GROUND RESOLUTION PHOTOGRAPHS. ASSUMING A REASONABLE EXTRAPOLATION OF THE STATE-OF-THE ART IN DESIGN AND FABRICATION OF MIRROR, IT WOULD APPEAR THAT A APERTURE SYSTEM WEIGHING OF THE ORDER OF 20,000 LBS WOULD BE THE MINIMUM REQUIREMENT.
ADVANCED SENSOR RISKS

- ALIGNMENT
  - Folding to lower structural weight and lower gyro requirements
  - Tighter control to obtain less aberration

- POINTING
  - Smaller FOV to minimize refractive element size and provide better off-axis resolution

- PRODUCTION
  - Rendezvous to provide mission capability within limited sensor production capability
ADVANCED SENSOR RISKS

A GROUND RESOLUTION SENSOR WILL INVOLVE CONSIDERABLE RISKS EVEN BEYOND THAT OF THE PRESENT DORIAN SENSOR. IT IS EXPECTED THAT THE DRIVE SYSTEM FOR POINTING THE ENTIRE SENSOR WOULD CONSIST OF CONTROL MOMENT GYROS WHICH WOULD REQUIRE TORQUE DEVICES CONSIDERABLY LARGER THAN THOSE AVAILABLE TODAY.

TO OBTAIN A MINIMUM WEIGHT SENSOR REQUIRES FOLDING OF THE OPTICS WHICH IN TURN IMPLIES VERY TIGHT ALIGNMENT REQUIREMENTS.

AS THE RESOLUTION IMPROVES AND THE APERTURE INCREASES, THE FIELD OF VIEW TENDS TO REDUCE, THUS REQUIRING GREATER PRECISION IN LOCATING THE TARGET. CAREFUL DESIGN OF THE MAN IN THE LOOP WILL TEND TO MINIMIZE THESE AND OTHER DEVELOPMENT RISKS.

A SENSOR OF THIS MAGNITUDE MAY BE SUFFICIENTLY DIFFICULT AND COSTLY TO FABRICATE, ALIGN AND OPERATE SO AS TO DICTATE A RENDEZVOUS APPROACH; THUS MINIMIZING THE NUMBER OF UNITS WHICH MUST BE ESTABLISHED AND SUBSEQUENTLY DISCARDED.
IMPROVED PAYLOADS AND ECONOMICS
IMPROVED PAYLOADS AND ECONOMICS

THE EVOLUTION OF THE MOL PROGRAM TO GREATER PAYLOAD CAPABILITIES WOULD LEAD TO BOTH IMPROVED PERFORMANCE AND IMPROVED ECONOMICS.
MOL PROGRAM EVOLUTION

M/AM → AM → RAMV → RRV

RENDEZVOUS RESUPPLY

TIII C (U) 12.7K P/L 30 DAY

CONTINUOUS - 60 DAY RESUPPLY CYCLE

MOL FOLLOW-ON PROGRAM

INTEGRAL LAUNCH

M/AM →

TIII LDC 1 - 7 SEG SRM
12.7K P/L - 60 DAY

TIII LDC 1 & 2 - 7 SEG SRM
20.8K P/L - 60 DAY
MOL PROGRAM EVOLUTION

THE MOL BASELINE PROGRAM COULD EVOLVE TO IMPROVE CAPABILITIES ALONG TWO MAIN AVENUES. ONE AVENUE WOULD BE THROUGH THE DEVELOPMENT OF A LARGE DIAMETER CORE T-III AND USE OF THE BASELINE MOL SYSTEM WITH MINOR MODIFICATIONS. THE OTHER AVENUE WOULD BE TO USE THE EXISTING SEVEN-SECTIONS BOOSTER, THE AUTOMATIC MODE VERSION OF THE BASELINE CONFIGURATION AND THE DEVELOPMENT OF A GEMINI VEHICLE WITH AN EXPENDABLE TRAILER FOR RESUPPLY. EITHER AVENUE COULD LEAD TO A CAPABILITY OF 60 DAY LAUNCH INTERVALS WITH A VEHICLE CONTINUOUSLY ON ORBIT. IN ADDITION, EITHER APPROACH WOULD YIELD PAYLOAD CAPABILITIES WHICH WOULD PERMIT LAUNCH OF THE ADVANCED [REDACTED] RESOLUTION SENSOR AND THE ELINT AND SHIP DETECTION SENSORS THUS ESTABLISHING A CONTINUOUSLY ON-ORBIT MULTI-MISSION CAPABILITY.
MOL AUTOMATIC MODE/RENDEZVOUS AUTOMATIC MODE VEHICLE

EXTENDED MISSION SERVICE MODULE (EMSM)

NOSE FAIRING

AUTOMATIC MODE SERVICE MODULE (AMSM)

DOCKING PLANE

MISSION MODULE

LABORATORY PRESSURIZED SECTION

BASELINE SERVICE MODULE (BSM)
MOL AUTOMATIC MODE/RENDEZVOUS AUTOMATIC MODE VEHICLE

THE AUTOMATIC MODE CONFIGURATION OF THE BASELINE PROGRAM WILL BE CONFIGURED SO THAT ITS EXPENDABLES SECTION MIGHT BE USED IN EITHER THE INTEGRAL LAUNCH OR RENDEZVOUS EVOLUTIONARY PROGRAMS. THIS WILL BE ACHIEVED BY CONFIGURING THE AUTOMATIC MODE SERVICE MODULE SO THAT IT HAS EXCESS VOLUME TO ACCEPT ADDITIONAL EXPENDABLES AT A LATER DATE FOR LONGER TIME ON ORBIT. IN ADDITION, ITS INTERFACE WITH THE BASELINE SERVICE MODULE WILL BE DESIGNED SO AS TO PERMIT INSTALLATION OF A DOCKING INTERFACE AT A LATER DATE. WITH THIS APPROACH THE COMBINATION OF THE AUTOMATIC MODE SERVICE MODULE AND THE BASELINE SERVICE MODULE COULD BE USED AS THE EXPENDABLES SEGMENT FOR EITHER THE FOLLOW-ON INTEGRAL LAUNCH OR RENDEZVOUS PROGRAMS.
RENDEZVOUS VEHICLE FAMILY

IN THE RENDEZVOUS PROGRAM, THE BASELINE AUTOMATIC MODE VEHICLE WOULD BE LAUNCHED UNMANNED WITH THE OPTION TO BE OPERATED UP TO 20 - 30 DAYS UNMANNED. SUBSEQUENTLY, A GEMINI VEHICLE WITH THE SAME EXPENDABLES SECTION ATTACHED AS A TRAILER WOULD BE LAUNCHED FOR RESUPPLY. PRIOR TO DOCKING THE EXTENDED MISSION SERVICE MODULE WOULD BE DETACHED FROM THE RENDEZVOUS AUTOMATIC MODE VEHICLE.
RENDEZVOUS VEHICLE CONFIGURATION

DOCKING AND SEPARATION PLANE

RESUPPLY VEHICLE

ORBITING VEHICLE

RRV FUNCTIONS
- ATTITUDE CONTROL (ACTS PROPULSION)
- PRIME POWER SYSTEM
- LIFE SUPPORT EXPENDABLES
- DATA SYSTEM

RAMV FUNCTIONS
- LIFE SUPPORT SYSTEM
- ATTITUDE CONTROL ELECTRONICS
- COMMUNICATIONS AND DATA HANDLING
- ENVIRONMENTAL CONTROL
- HRO OPERATIONS

SECRET SPECIAL HANDLING

60-DAY RESUPPLY CYCLE
RENDZVOUS VEHICLE CONFIGURATION

SHOWN HERE IS THE RENDZVOUS AUTOMATIC MODE VEHICLE WITH ITS EXTENDED MISSION SERVICE MODULE REMOVED AND DOCKED TO THE RESUPPLY VEHICLE. IT IS IMPORTANT TO NOTE THAT THIS APPROACH PERMITS REPLACEMENT OF SEVERAL OF THE MAJOR VEHICLE SUBSYSTEMS WITH EACH RESUPPLY LAUNCH, THUS REDUCING THE COMPLEXITY OF THE RENDZVOUS AUTOMATIC MODE VEHICLE. THIS SHOULD CONTRIBUTE MATERIALLY TO THE DESIRED EXTENDED LIFE-TIME OF THE RENDZVOUS AUTOMATIC MODE VEHICLE.
## COMPARISON OF BASELINE AND FOLLOW-ON PROGRAM CAPABILITIES FOR TECHNICAL INTELLIGENCE DATA RETURN

### FOLLOW-ON PROGRAM

- **6 M/AM FLIGHTS**
- **6 'AM FLIGHTS**
- **3 RAMV + 5 RRV**

<table>
<thead>
<tr>
<th></th>
<th>6 M/AM FLIGHTS</th>
<th>6 'AM FLIGHTS</th>
<th>FOLLOW-ON PROGRAM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TOTAL NUMBER OF CLEAR PHOTOGRAPHS/YEAR</strong></td>
<td>7,946</td>
<td>6,696</td>
<td>16,980</td>
</tr>
<tr>
<td><strong>TOTAL NUMBER OF CLEAR, SPECIAL PHOTOGRAPHS/YEAR</strong></td>
<td>870</td>
<td>282</td>
<td>1,671</td>
</tr>
</tbody>
</table>
OTHER MISSION CAPABILITIES OF MOL BASELINE SYSTEM

BASELINE CAPABILITY

MOBILE LAND TARGETS
MARS SURFACE SURVEY AT 50 N-MI. RESOLUTION

BASELINE CAPABILITY WITH ADDITIONAL DEVELOPMENT

ELINT
SHIP DETECTION AND HRO PHOTOGRAPHS
ASTRONOMY
MEAN MISSION DURATION

RELIABILITY FOR DESIGN LIFE

LAUNCH VEHICLE RELIABILITY ~ .97

30-Day Design Life

MTF, DAYS

.95 (LAB) x .95 (MM) = .90
.77 (LAB) x .83 (MM) = .64
COMPARISON OF BASELINE AND FOLLOW-ON PROGRAM
CAPABILITIES FOR TECHNICAL INTELLIGENCE DATA RETURN

THE INCENTIVE TO EVOLVE FROM THE BASELINE TO THE
FOLLOW-ON PROGRAM IS SHOWN HERE IN TERMS OF THE TECHNICAL
INTELLIGENCE DATA RETURN. SIX FLIGHTS OF THE MANNED AUTOMATIC
MODE, OR THE AUTOMATIC MODE, PER YEAR WOULD YIELD ROUGHLY
THE SAME NUMBER OF CLEAR PHOTOGRAPHS. THE ENHANCEMENT OF
SPECIAL PHOTOGRAPHS IS APPARENT IN THE MANNED EXAMINATION
FOR ACTIVE INDICATORS MODE. THE FOLLOW-ON PROGRAM WITH
CONTINUOUSLY ON-ORBIT OPERATION YIELDS DRAMATICALLY INCREASED
RETURNS IN BOTH CATEGORIES. FURTHERMORE, IT IS EXPECTED THAT
THE RECURRING OPERATIONAL COSTS PER YEAR FOR THE FOLLOW-ON
PROGRAM WILL BE LOWER THAN FOR EITHER OF THE BASELINE SYSTEMS.
FOLLOW-ON PROGRAM ATTRIBUTES

1. **SIMPLE EVOLUTION FROM BASELINE PROGRAM**

2. **MINIMUM DEVELOPMENT RISK FOR [REDACTED] RESOLUTION SENSOR**

3. **CONTINUOUS, ON CALL, OPERATIONAL CAPABILITY**

4. **MAXIMUM ACQUISITION RATE AND AVAILABILITY OF SPECIAL INTELLIGENCE PHOTOGRAPHS**

5. **MINIMUM RECYCLE TIME TO PHOTOGRAPH SPECIFIC TARGETS**

6. **CONTINUOUSLY, ON CALL, MULTI-MISSION SENSOR CAPABILITIES**

7. **MAXIMUM RETURNS OF TECHNICAL INTELLIGENCE DATA AT MODERATE OPERATIONAL COSTS**
PROBABILITY OF MISSION COMPLETION

RENDZVOUS SYSTEM

(80 N.M. Hp, 60 DAY RESUPPLY CYCLE, W/O STANDBY RAMV)

- EFFECT OF LAUNCH RENDZVOUS & DOCKING (STANDBY RRV ASSUMED)
- UPPER LIMIT - EFFECT OF CRITICAL UNREPAIRABLE EQUIPMENT FAILURES (W/O STANDBY RAMV)

- EFFECT OF REPLACEABLE/REPAIRABLE EQUIPMENT FAILURES

- EFFECT OF REPLACEMENT BY RESUPPLY

MISSION TIME FROM INITIAL LAUNCH ~ DAYS

 RRV

 RRV

 RRV

 RRV

 RRV

 RRV

 MISSION COMPLETE
EFFECT OF VEHICLE TYPE, SUBSYSTEM DESIGN, AND MANNED MAINTENANCE ON PROBABILITY OF MISSION COMPLETION

MISSION TIME FROM INITIAL LAUNCH ~ DAYS

PREDICTED PROBABILITY OF MISSION COMPLETION

RAMV 60 DAY S/S (ATTENDED W/ UNLIMITED SPARING)
RAMV 60 DAY S/S (UNATTENDED)
RAMV 30 DAY S/S (UNATTENDED)
BASELINE AM ORBITING VEHICLE (UNATTENDED)

Systems Applications Office
ALP - 5/27/66

SECRET SPECIAL HANDLING

WHS-025 (BU)
TYPICAL PROVISIONS FOR EXPLOITING
MAN'S MAINTENANCE AND OPERATING CAPABILITIES

• CAPABILITY FOR EXTRAVEHICULAR ACTIVITY

• ACCESSIBILITY TO PERMIT MAINTENANCE

• CAPABILITY FOR TROUBLE-SHOOTING

• ESSENTIAL TOOLS AND TEST INSTRUMENTS

• CRITICAL SPARES (INCLUDING SOME ASSORTED VALVES, SWITCHES, RELAYS, FLUID HOSE AND ELECTRICAL CABLE JUMPERS)

• DESIGNED COMMONALITY OF COMPONENTS AND PARTS

• UPSTREAM HAND OPERATED VALVES

• EMERGENCY FACE-MASKS FOR DEMAND CONTROLLED OPEN-LOOP OXYGEN

• SIMPLE ACCESORIES THAT ENABLE MAN TO OPERATE IN DEGRADED MODES (LIKE: RETICLES, CHINA PENCILS, NOMOGRAHPS, STOP WATCHES, FLASHLIGHTS, VACUUM CLEANER, ETC.)

• PROVISIONS FOR EMERGENCY POWER - (WITH SOLAR CELLS)
### MOL Program Cost Summary

**NON-RECURRING DEVELOPMENT COSTS**

<table>
<thead>
<tr>
<th>Description</th>
<th>M/AM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory</td>
<td>547.9</td>
</tr>
<tr>
<td>Gemini B</td>
<td>158.9</td>
</tr>
<tr>
<td>Mission Module</td>
<td>287.5</td>
</tr>
<tr>
<td>Launch Vehicle</td>
<td>221.4</td>
</tr>
<tr>
<td>GSR/TD</td>
<td>46.2</td>
</tr>
<tr>
<td>Other</td>
<td>15.0</td>
</tr>
<tr>
<td>Development Flight Hardware</td>
<td>474.5</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>1751.4</td>
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</table>

**RECURRING**

<table>
<thead>
<tr>
<th>Description</th>
<th>M/AM</th>
<th>AM</th>
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</thead>
<tbody>
<tr>
<td>Laboratory</td>
<td>34.5</td>
<td>29.4</td>
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<tr>
<td>Gemini B or Supply Module</td>
<td>19.2</td>
<td>4.0</td>
</tr>
<tr>
<td>Mission Module</td>
<td>27.0</td>
<td>26.4</td>
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<tr>
<td>Launch Vehicle</td>
<td>18.1</td>
<td>18.1</td>
</tr>
<tr>
<td>Recovery - Tracking</td>
<td>2.0</td>
<td>1.5</td>
</tr>
<tr>
<td>Other</td>
<td>2.0</td>
<td>1.2</td>
</tr>
<tr>
<td><strong>Subtotal per Flight</strong></td>
<td>102.8</td>
<td>80.6</td>
</tr>
</tbody>
</table>
TOTAL PROGRAM COST COMPARISON

| M/AM      | 39,700 | 4,350 |
| AM        | 33,500 | 1,400 |
| INTEGRAL L.| 56,750 | 6,220 |
| RENDEZVOUS| 82,160 | 8,249 |

YEARS OF OPERATION

TOTAL PHOTOS TARGETS (FIVE YEARS)

TOTAL SPECIAL PHOTOS TARGETS (FIVE YEARS)
ELEMENTS AND COSTS FOR POSSIBLE INTEGRAL-LAUNCH FOLLOW-ON

<table>
<thead>
<tr>
<th>NON-RECURRING COST - M$</th>
<th>RECURRING COST - M$</th>
</tr>
</thead>
<tbody>
<tr>
<td>TWO MANNED DEVELOPMENT FLTS</td>
<td>215.0</td>
</tr>
<tr>
<td>VEHICLE MODIFICATIONS (OV)</td>
<td>50.0</td>
</tr>
<tr>
<td>T-III LDC DEVELOPMENT</td>
<td>106.6</td>
</tr>
<tr>
<td>TOTAL</td>
<td>371.6</td>
</tr>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

---SECRET-SPECIAL HANDLING

WHS-025 (BU)
IMPROVEMENT FACTORS DUE TO MOL CREW

- 50% CLOUD COVER

$F = 0.70 \quad t_j = 10 \text{ SEC.}$

FRACTION OF POTENTIALLY ACTIVE INDICATORS WHICH ARE IN FACT ACTIVE
### ESTIMATED SPARES INVENTORY BY SUBSYSTEM - BASELINE VEHICLE

<table>
<thead>
<tr>
<th>SUBSYSTEM</th>
<th>NUMBER OF SPARED ITEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELECTRICAL POWER</td>
<td>--</td>
</tr>
<tr>
<td>ENVIRONMENTAL CONTROL/LIFE SUPPORT</td>
<td>7</td>
</tr>
<tr>
<td>CRYOGENICS</td>
<td>--</td>
</tr>
<tr>
<td>ATTITUDE CONTROL AND TRANSLATION</td>
<td></td>
</tr>
<tr>
<td>ELECTRONICS</td>
<td>22</td>
</tr>
<tr>
<td>PROPULSION</td>
<td>--</td>
</tr>
<tr>
<td>COMMUNICATIONS/DATA HANDLING</td>
<td>10</td>
</tr>
<tr>
<td>INSTRUMENTATION/MONITOR-ALARM</td>
<td>13</td>
</tr>
<tr>
<td>MISSION MODULE</td>
<td>5</td>
</tr>
<tr>
<td>STRUCTURE</td>
<td>5</td>
</tr>
</tbody>
</table>

62
DESIGN WEIGHT

ORBITING VEHICLE WEIGHT

T-III LDC 1 GROWTH
INTEGRAL LAUNCH

TYPICAL 60 DAY VEHICLE WGT. = 41,000 LBS

T-III LDC 1 LAUNCH CAPABILITY (~42,300 LBS)

i = 90°, 80/180 N. MI.

MISSION DURATION DAYS

ORBITING VEHICLE WEIGHT

DESIGN WEIGHT

EXPERDABLES
"OFF-LOADING"

NRO APPROVED FOR RELEASE 1 JULY 2015

SECRET SPECIAL HANDLING

WHS-025 (BU)
MAINTENANCE/REPLACEMENT/REPAIR

BASELINE LABORATORY VEHICLE - 30 DAYS

PROBABILITY OF MISSION SUCCESS

MANNED-AUTOMATIC VEHICLE
(SPARES AND REDUNDANCY)

RISE DUE TO MAN
UTILIZING ALTERNATE
OPERATING MODES
(OR MAN AS A
WORKING SUBSYSTEM)

DROP DUE TO
ADDITION OF
BASIC EC/LS
SUBSYSTEM
REQUIRED TO
SUPPORT MAN

WEIGHT OF ADDED SPARES AND REDUNDANCY ~ LBS

SECRET SPECIAL HANDLING
### Switching and Override Function of Crew

- Crew monitors systems operations and takes remedial action in critical cases of subsystem malfunctions.
- Can switch to standby unit or override automatic switching as applicable for corrective action.

<table>
<thead>
<tr>
<th>Subsystem</th>
<th>Switching</th>
<th>Override</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Power</td>
<td>--</td>
<td>27</td>
</tr>
<tr>
<td>Attitude Control and Translation</td>
<td>5</td>
<td>111</td>
</tr>
<tr>
<td>Environmental Control/Life Support</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>Communications and Data Handling</td>
<td>--</td>
<td>95</td>
</tr>
<tr>
<td>Mission Module</td>
<td>23</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>38</td>
<td>285</td>
</tr>
</tbody>
</table>
FAILURE MODES THAT CAN CAUSE LOSS OF ATTITUDE CONTROL

- BUS SHORTED TO GROUND - ECPU SWITCHES FUEL CELLS OFF BUS A UNTIL SHORT IS CLEARED
- ACTS EQUIPMENT SHORTS TO GROUND - BLOWS FUSE

CREW CAN TROUBLE SHOOT EITHER FAILURE, TAKE CORRECTIVE ACTION TO FIX FAULT AND COMPENSATE FOR DEGRADED MODE BY OPERATING VEHICLE

REMOTE GROUND ACTION COMMANDS SWITCHES WHERE PROVIDED

GROUND + CREW COORDINATION PROVIDES MOST EXTENSIVE FAULT ANALYSIS AND BEST ASSURANCE OF OPTIMUM REMEDIAL ACTION
NON-RECURRING COST - M$

- DESIGN OF BSM - "PROVISIONS FOR"
  DOCKING INTERFACE (BOTH ENDS)
- DESIGN OF AMSM - "PROVISIONS FOR"
  DOCKING INTERFACE
  ADDITIONAL LENGTH FOR FUTURE REQ.

SYS ENGR & DOCUMENTATION 1.5
GSE/TD .5
TEST HARDWARE 1.0

TOTAL 6.0

TWO SETS RRV HARDWARE FOR GRND TEST 22.0
DOCKING SYSTEM DEVELOPMENT 50.0
TRAINERS/SIMULATION, DOCKING 70.0
DESIGN/INTEGRATION, RRV DEV. 50.0

RRV DEV. & DEMO. FLIGHTS, 1 EA. 98.2
EXTRA LAUNCH PAD 60.0
ADDITIONAL AGE FOR RRV LAUNCH 15.0
MCC EQUIPMENT 4.0

TOTAL 369.2

TOTAL 375.2

PROBABLE ADDITION TO BASE MOL PROGRAM COST
---SECRETSPECIAL HANDLING---

**ACQUISITION AND TRACKING SCOPE WEIGHTS**

<table>
<thead>
<tr>
<th></th>
<th>5 - INCH</th>
<th>10 - INCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>LENS</td>
<td>30 LBS</td>
<td>150 LBS</td>
</tr>
<tr>
<td>TRACKING MIRROR</td>
<td>10 (GLASS)</td>
<td>40 (Be)</td>
</tr>
<tr>
<td>RELAY</td>
<td>34</td>
<td>44 *</td>
</tr>
<tr>
<td>SERVOS</td>
<td>8</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>82 LBS</td>
<td>294 LBS</td>
</tr>
<tr>
<td>X2</td>
<td>164 LBS</td>
<td>588 LBS</td>
</tr>
</tbody>
</table>

* INCLUDES DIRECT VIEW ZOOM EYEPIECE AND TV RELAY TO CONSOLE

---SECRETSPECIAL HANDLING---
<table>
<thead>
<tr>
<th>ON-ORBIT MAINTENANCE/REPLACEMENT/REPAIR</th>
<th>PRE-LAUNCH CHECKOUT/TEST/CORRECTIVE ACTION</th>
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</thead>
<tbody>
<tr>
<td><strong>DESIGN PROVISIONS</strong></td>
<td></td>
</tr>
<tr>
<td>- Accessibility</td>
<td>- Accessibility</td>
</tr>
<tr>
<td>- Interchangeability</td>
<td>- Interchangeability</td>
</tr>
<tr>
<td><strong>STATUS AND OPERATING DATA</strong></td>
<td></td>
</tr>
<tr>
<td>- Instrumentation</td>
<td>- Instrumentation</td>
</tr>
<tr>
<td>- Monitor/Alarm &amp; Telemetry</td>
<td>- Monitor/Alarm &amp; Telemetry &amp; Umbilical</td>
</tr>
<tr>
<td><strong>TROUBLE SHOOTING</strong></td>
<td></td>
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<tr>
<td>- Equip. Test Points</td>
<td>- Equip. Test Points</td>
</tr>
<tr>
<td>- Panel &amp; J-Box Access Panels</td>
<td>- Panel &amp; J-Box Access Panels</td>
</tr>
<tr>
<td>- Circuit &amp; Pin Diagram &amp; Data</td>
<td>- Circuit &amp; Pin Diagram &amp; Data</td>
</tr>
<tr>
<td><strong>REPLACE FAULTY EQUIPMENT</strong></td>
<td></td>
</tr>
<tr>
<td>- Disconnect &amp; Plug-In Features</td>
<td>- Disconnect &amp; Plug-In Features</td>
</tr>
<tr>
<td>- Available Spare Replacement</td>
<td>- Available Spare Replacement</td>
</tr>
<tr>
<td>- Tools and Test Check Equip.</td>
<td>- Tools and Test Check Equip.</td>
</tr>
</tbody>
</table>

The design provisions, and procedures to perform on-orbit maintenance/replacement/repair are basically the same as required for pre-launch test and checkout operations. Thus, for all practical purposes, the implementation to accomplish on-orbit trouble shooting and corrective action is inherent in the basic vehicle if adequate spares are provided on-orbit.