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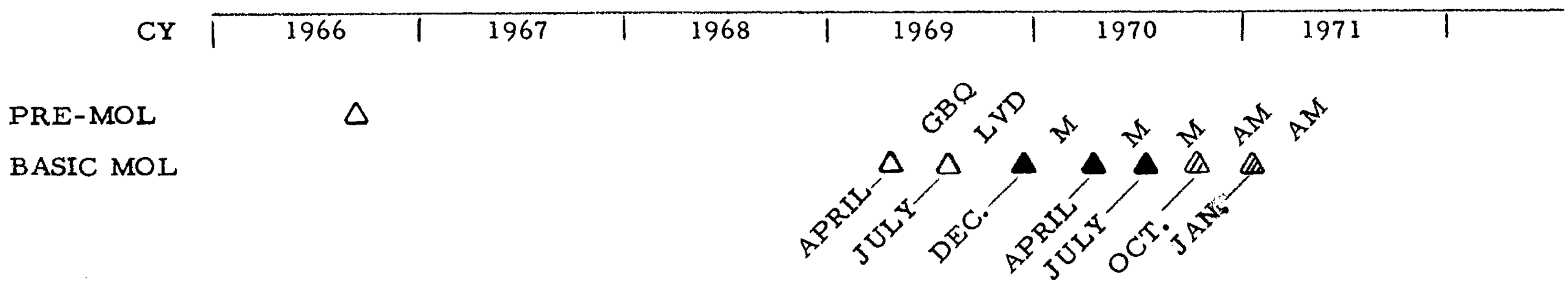
7 June 1966

MOL MANNED SYSTEM PERFORMANCE ANALYSIS

BASIC MOL PROGRAM PLAN

SCHEDULE



FUNDING

FY	1967	1968	1969	1970	1971	TOTAL
BASIC MOL (MILLIONS OF $)	330.5	552.6	456.5	292.0	119.6	1,751.4

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.

~~SECRET~~ SPECIAL HANDLING

WHS-025-2

MOL BASELINE OPERATION
WORKCYCLE FOR A NORMAL DAY

MISSION DURATION - 30 DAYS
ORBIT: $80^{o}i$, 80/180

SUBCYCLE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
P/L ACTIVITY AREAS				▨	▨	▨	▨	▨	▨	▨	▨			▨	ZI	ZI
CREW REQ'D FOR P/L OPS				2	2	2	2	2	2	2	2			1		
READOUT		X				X		X		X				X		
CREW #1	REST/SLEEP											VEH. MONITOR				
CREW #2	VEH. MONITOR			PAYLOAD OPERATIONS								REST/SLEEP				
DECISION TO GO ANOTHER DAY											▲					
DAILY SEQUENCE LOAD			▲													
UPDATE EPHEMERIS (+ WEATHER, TARGET CHANGES?)			▲	▲		▲	▲	▲	▲	▲						
TRACKING STATIONS		●		●	●	●	●	●	●	●	●			●	●	●

~~SECRET~~ SPECIAL HANDLING

MOL BASELINE OPERATION
WORKCYCLE FOR A NORMAL DAY

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

- O TROUBLE SHOOTING
- O MANUAL OVERRIDE
- O MAINTENANCE, REPLACEMENT, AND REPAIR
- O BACKUP FAILED SUBSYSTEMS

MISSION P/L DEVELOPMENT RISK

HARDWARE REQUIRING NEW DEVELOPMENT

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

ADAPTATION OF EXISTING COMPONENTS

- O COMPUTER
- O STAR TRACKER
- O DATA RE-ENTRY VEHICLE
- O CONSOLES/DISPLAYS/INSTRUMENTATION
- O THERMAL CONTROL
- O 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.

~~SECRET~~ SPECIAL HANDLING

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IN-FLIGHT TROUBLESHOOTING

FLIGHT CREW ACTIVITIES	GROUND SYSTEM ACTIVITIES
• ANOMALY DETECTED FROM MONITOR-ALARM OR ABNORMAL RESPONSE	• DETECT ANOMALY FROM TELEMETRY
• OBSERVATIONS, SWITCHING, SELECT AVAILABLE ALTERNATE OPERATING MODE	• INITIATE ANALYSIS OF PROBABLE CAUSE (POSSIBLE INSTRUMENTATION MALFUNCTION)
• REPORTS TO GROUND AT STATION-CONTACT VERIFIES MALFUNCTION, GIVES STATUS	• COMPARE T/M DATA WITH CREW REPORT MAKE INITIAL RECOMMENDATIONS FOR ACTION
• LOCALIZE FAULT AT COMPONENT LEVEL (VTVM, CIRCUIT DIAGRAM, TEST POINTS)	• CONTINUE ANALYSIS UTILIZING SPECIALIZED MANPOWER. DEFINE PRIORITY ORDER OF CORRECTIVE ACTIONS ASSESSING RISK AND EXPEDIENCY
• ASSESS POSSIBILITIES OF FIX, AVAILABLE SPARE, DEGREE OF RISK	
• CONFER WITH GROUND AT STATION-CONTACT REPORT DETAIL DATA AND PROPOSED ACTION	• CONCUR WITH CREW DIAGNOSIS AND FIX, OR ADVISE OF BETTER ALTERNATIVE, OR REQUEST ADDITIONAL MEASUREMENTS
• INSTITUTE FIX	
• MONITOR TO ASSURE TROUBLE CORRECTED	• MONITOR BY T/M

~~SECRET~~ SPECIAL HANDLING

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.

ACCESSIBILITY FOR MAINTENANCE/REPLACEMENT/REPAIR
LABORATORY MODULE

SUBSYSTEM	LOCATION	ACCESSIBILITY	E. V. OR I. V.
1. EPS:			
FUEL CELL	UNPRESS. COMP.	INACCESSIBLE, REDUNDANT	E. V.
CRYO TANK/LINES	"	" "	E. V.
ELECT. CONTR. POWR UNIT	PRESS. COMP.	75%, COMMONALITY EMPHASIZED	I. V.
DISTRIBUTION	"	80%, SWING OUT PANELS	I. V.
2. EC/LS:			
FLUID LOOP/VALVING	UNPRESS. COMP.	INACCESSIBLE, REDUNDANT	E. V.
FREON PUMP/MTR, H E	"	" "	E. V.
MOLECULAR SIEVE	PRESS. COMP.	100%, HAS REGEN. CAPAB.	I. V.
FAN	"	100%, REMOVAL EASY	I. V.
GAS REGULATOR	"	100%, THOUGH REDUNDANT	I. V.
3. ACTS:			
HORIZ. SEN. HDS.	EXTERN. VEH.	INACCESSIBLE, REDUNDANT	E. V.
TCA'S	"	" "	E. V.
PROP. TANK/LINES/ VALVES	UNPRESS. COMP.	" "	E. V.
GYROS	PRESS. COMP.	100%, REMOVAL EASY	I. V.
ELECTRONIC CIRC. CARDS	"	100%, COMMONALITY EMPHASIZED	I. V.
4. COMM/DATA: MGMNT:			
TRANSM/RECVRS	"	INACCESSIBLE, REDUNDANT	I. V.
VOICE COMPONENTS	"	" "	I. V.
COMPUTER	"	" "	I. V.
RECORD/TELEPR. HEADS	"	100%, CLEAN/REPLACE	I. V.
TAPES	"	100%, REPLACE	I. V.
5. INSTR.			
SIGNAL COND	"	100%, CHANNEL SWAPPING	I. V.
SENSORS/DISPLAYS	PRESS. & UNPRESS	50%, REDUND/REPL	I. V.
6. STRUCTURE:			
DOOR/SEALS, LATCH	EXTR. WALL	100%, REPLACE	E. V.
RADIATOR	EXTERN. VEH.	INACCESSIBLE, REDUND PATHS	E. V.

ACCESSIBILITY FOR MAINTENANCE/REPLACEMENT/REPAIR
LABORATORY MODULE

AN EVALUATION HAS BEEN MADE OF THE LABORATORY MODULE TO ATTAIN A REASONABLE QUANTATATIVE 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 REQUIRED. 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.

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ACCESSIBILITY FOR MAINTENANCE/REPLACEMENT/REPAIR
MISSION PAYLOAD

SUBSYSTEM	LOCATION	ACCESSIBILITY	E. V. OR I. V.
CAMERA & FILM HANDLING	PRES. COMP'T-AFT BULKHEAD	100%	I. V.
RECONN CONSOLES	PRESS. COMPARTMENT	60%, SWING OUT PANELS	I. V.
ACQN/TRACKING SCOPE	PRES. COMP'T-CONSOLE	25%, SWING OUT PANELS	I. V.
PICKUP HEADS	EXT. BOTTOM SKIN	0% INACCESSIBLE, REDUNDANT	E. V.
COMPUTER SUBSYSTEM	PRES. COMP'T-CONSOLE	50%, SWING OUT PANELS	I. V.
DATA READOUT SUBSYSTEM			
PROCESSING	PRES. COMP'T-CONSOLE	100%	I. V.
SCANNER	PRES. COMP'T-CONSOLE	50%, SWING OUT PANELS	I. V.
DATA RE-ENTRY VEHICLE	PRES. COMP'T-BRACKET	25%, BUCKET LOAD ACCESS	I. V.
LAUNCHER	PRES. COMP'T BOTTOM	50%, DRV LOAD HATCH	I. V.
OPTICAL SENSOR			
MIRRORS	MISSION MODULE	0% INACCESSIBLE	E. V.
DRIVES	MISSION MODULE	10%, THERMAL DOOR	E. V.
THERMAL CONTROL			
HEATER BLANKETS	MISSION MODULE	0% INACCESSIBLE, REDUNDANT	E. V.
THERMAL DOOR	MISSION MODULE	50%, IN OPEN POSITION	E. V.
OPS. REF. & CONTROL			
STAR TRACKER	MISSION MODULE UPPER SKIN	0% INACCESSIBLE, REDUNDANT	E. V.

ACCESSIBILITY FOR MAINTENANCE/REPLACEMENT/REPAIR

MISSION PAYLOAD

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.

~~SECRET~~ SPECIAL HANDLING

BACKUP MANNED MISSION MODES WITH DEGRADED SUBSYSTEMS

SUBSYSTEMS, FUNCTIONS INOPERATIVE	MANNED BACKUP ACTIVITY	LEVEL OF DEGRADATION WITH RESPECT TO AUTO MODE
V/H SENSOR, ACROSS FORMAT IMC, STAR TRACKER.	MAN USES ACQUISITION AND TRACKING SCOPE	NONE
ABOVE, PLUS: DATA RE-ENTRY VEHICLE/ LAUNCHES, WIDEBAND DATA READOUT	AS ABOVE, PLUS: MAN INFORMS GROUND OF TAKE	NEGLIGIBLE DELAY IN RETURN OF FILM
ABOVE, PLUS: 1 SGLS COMMAND & TRACK LINK, 2 FUEL CELLS, 1 CRYO TANK, 25% OF THRUSTERS, AUTO MODE ΔV, 1 COMPUTER, 1 ACQUISITION AND TRACKING SCOPE, LAB ATTITUDE REFERENCE	AS ABOVE, PLUS: MAN INITIATES POWER-DOWN MODE, MANUAL ΔV CONTROL, MANUAL STABILIZATION CONTROL WITH VISUAL REFERENCE	SMALL POSSIBLY REDUCES DURATION
ABOVE, PLUS: ALL COMMUNICATIONS EXCEPT SINGLE UP/DOWN VOICE LINK, AUXILIARY MEMORY STORAGE	AS ABOVE, PLUS: OPERATION FROM CUES, ROUGH MANUAL ORBIT ADJUSTMENTS	MODERATE SLIGHT REDUCTION IN TAKE
ABOVE, PLUS: LOSS OF ALL PROPELLANT, OR LOSS OF ALL POWER, OR LOSS OF ALL CRYO, OR LOSS OF ALL STABILIZATION AND CONTROL, OR LOSS OF OPTICS	CREW RETURNS WITH TAKE IN GEMINI B	SEVERE MAY REQUIRE MISSION TERMINATION

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

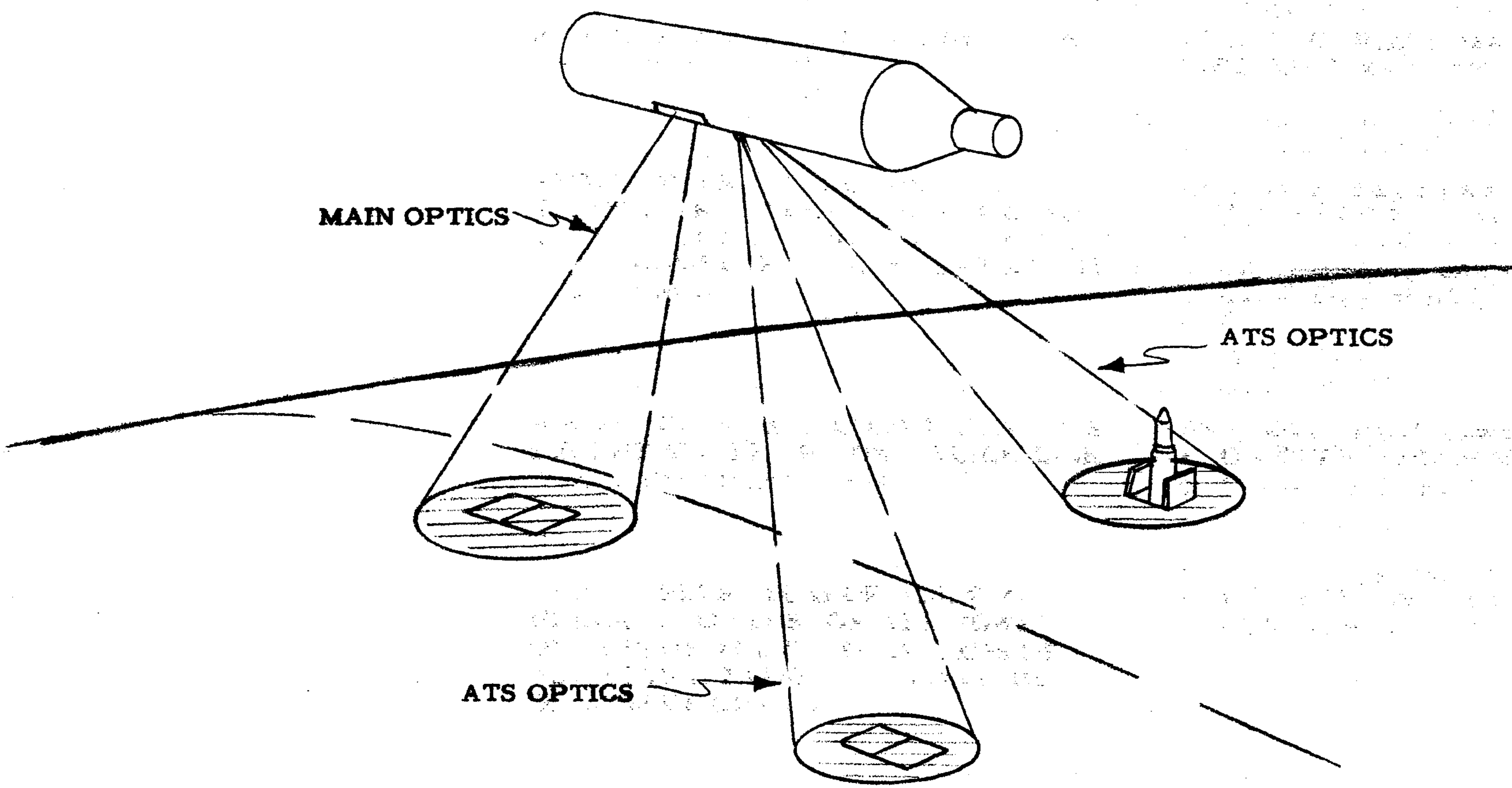
- MANNED EXAMINATION FOR ACTIVE INDICATORS
- MANNED ACQUISITION AND TRACKING

MANNED OPERATIONAL MODES

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

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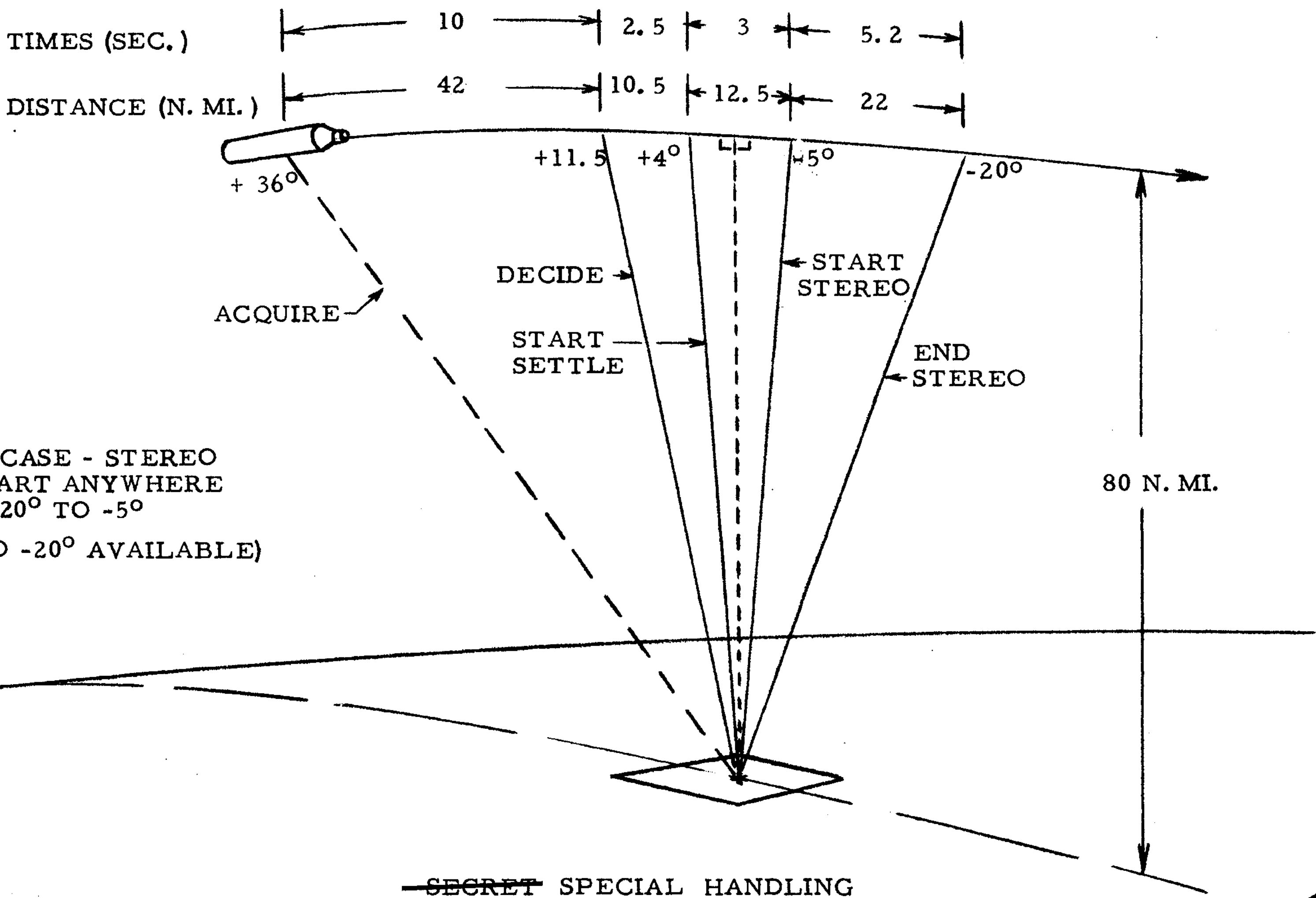
CONCEPT OF MANNED EXAMINATION FOR ACTIVE INDICATORS

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



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°. NEXT, WE ASSUME THAT AT THE TIME OF A DECISION THAT ACTIVE INDICATORS ARE PRESENT, THE MIRROR OF THE PRIMARY OPTICS IS AT -20° (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° AND -20°, 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.

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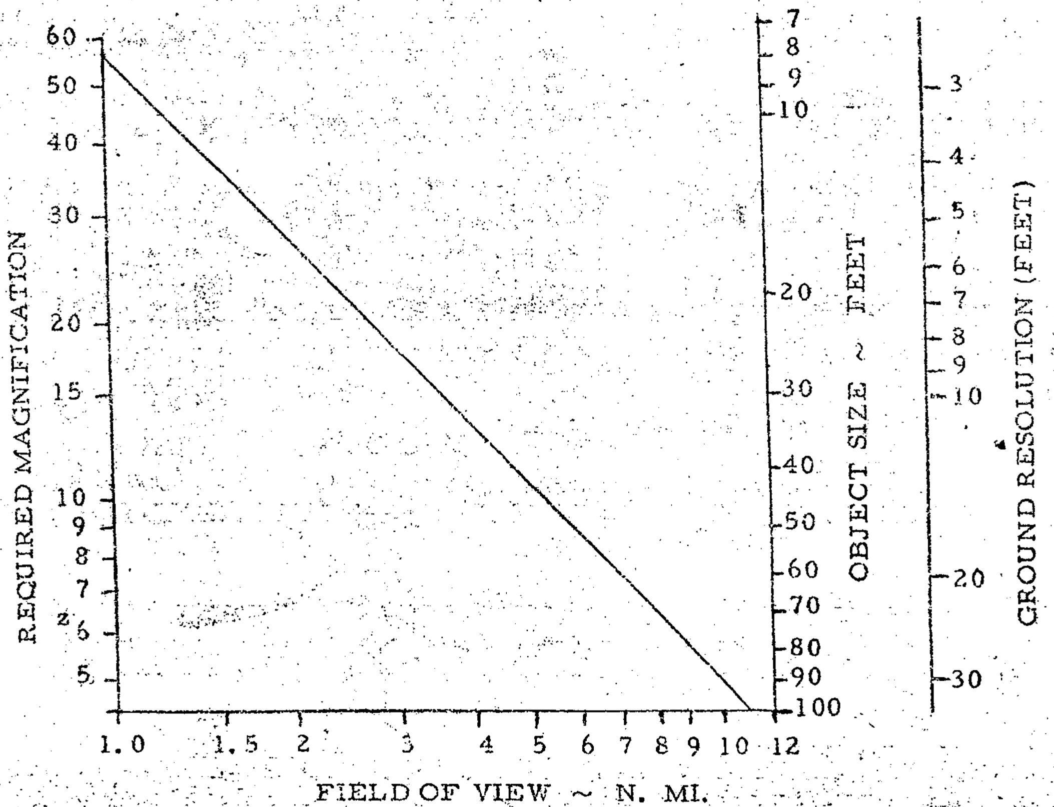
ACQUISITION/TRACKING TELESCOPE CAPABILITIES



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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

EXCEPT FOR GENERAL CORRELATION IN ROLL ANGLE, IT IS EXPECTED THAT THE THREE OPTICAL SYSTEMS WILL BE PROGRAMMED ESSENTIALLY INDEPENDENTLY OF EACH OTHER. THEREFORE, THE MAIN OPTICS WILL BE PROGRAMMED AUTOMATICALLY TO MAXIMIZE THE TAKE OF 15° STEREO PAIRS IN THE RANGE OF $\pm$ 20°. THE TWO ACQUISITION SCOPES WILL SIMULTANEOUSLY BE ACQUIRING NEARBY TARGETS FOR EXAMINATION AND JUDGEMENT AS TO THE PRESENCE OF ACTIVE INDICATORS. AT ANY POINT THAT A CREWMAN MAKES A POSITIVE JUDGEMENT, THE AUTOMATIC MODE IS INTERRUPTED AND THE PRIMARY MIRROR IS SLEWED TO THE POSITION OF THE ACQUISITION SCOPE MIRROR. THE PRIMARY OPTICS THEN ACQUIRES A 15° STEREO PAIR AND SUBSEQUENTLY RETURNS TO THE NEXT TARGET PROGRAMMED IN THE AUTOMATIC MODE. DEPENDING ON THE POINT IN THE PHOTOGRAPH-TAKING SEQUENCE, AT WHICH THE PRIMARY OPTICS WAS INTERRUPTED, ONE OR TWO OF THE TARGETS ORIGINALLY PROGRAMMED FOR THE PRIMARY OPTICS MAY BE LOST.

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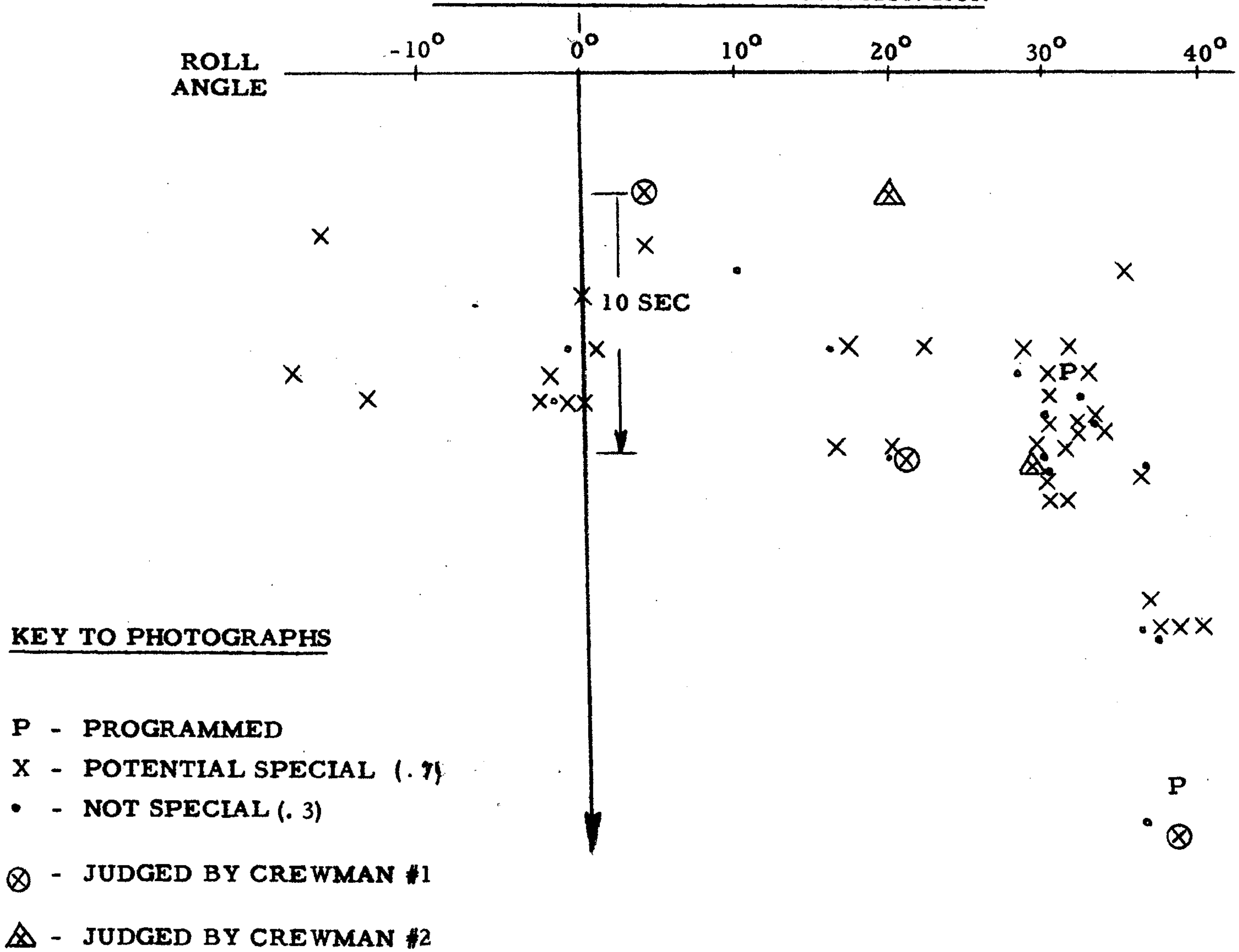
SECTION OF TYPICAL SIMULATION RUN



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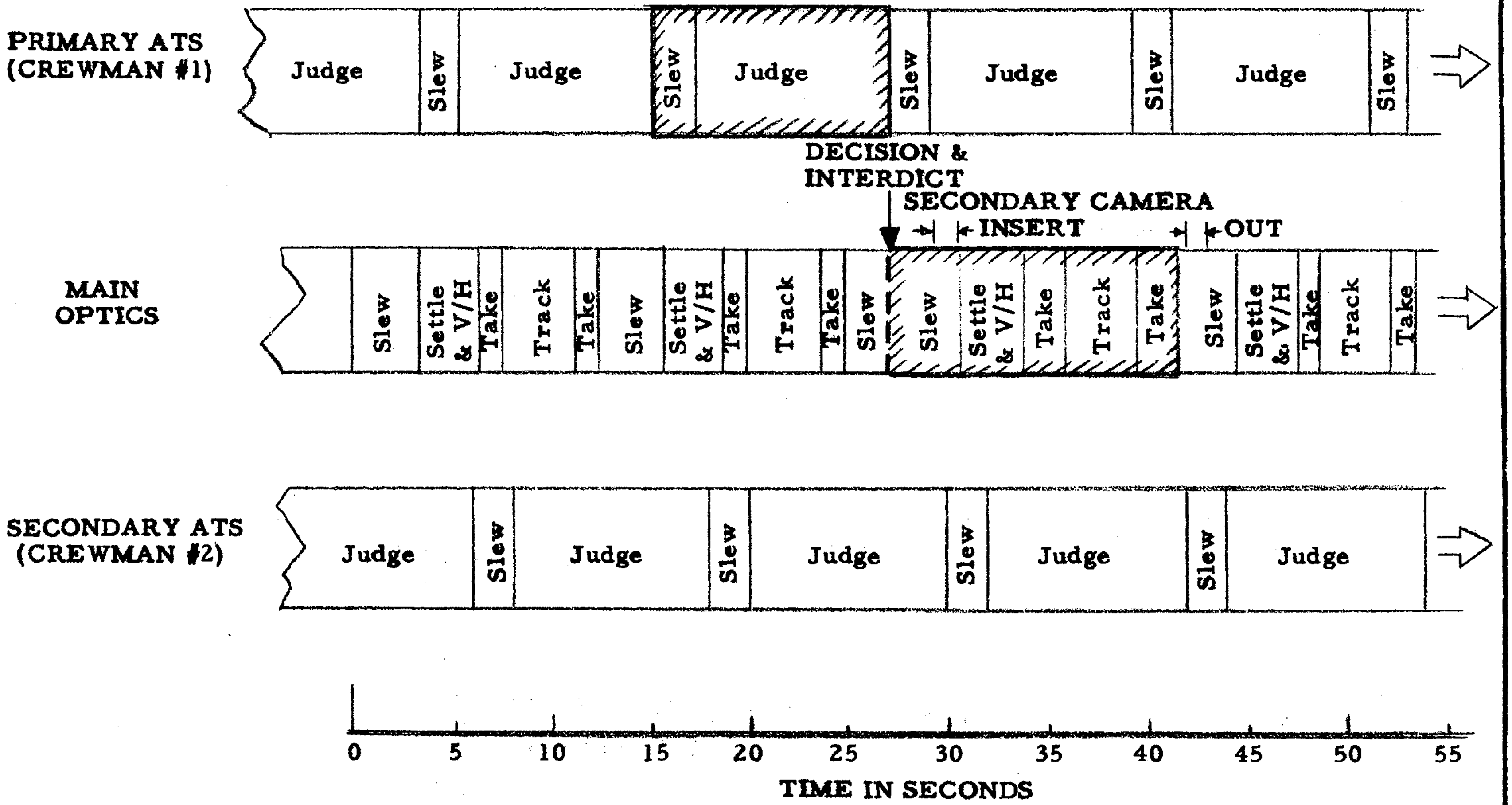
MANNED ACTIVE INDICATOR EXAMINATION MODE

TYPICAL TIMELINE



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OTHER MISSION CAPABILITIES OF MOL BASELINE SYSTEM

BASELINE CAPABILITY

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

BASELINE CAPABILITY WITH ADDITIONAL DEVELOPMENT

- ELINT
- SHIP DETECTION AND HRO PHOTOGRAPHS
- ASTRONOMY

~~SECRET~~ SPECIAL HANDLING

SECTION OF TYPICAL SIMULATION RUN

SHOWN HERE IS A SAMPLE OF THE DISTRIBUTION OF TARGETS IN THE 6,000 TARGET DECK USED IN THE ANALYSIS. THE VERTICAL LINE INDICATES THE GROUND TRACE OF THE ORBITING VEHICLE. THE ROLL ANGLE REQUIRED TO ACQUIRE THE TARGET IS PLOTTED AT THE TOP OF THE CHART. THE TARGETS MARKED "P " ARE THOSE FOR WHICH THE PRIMARY OPTICS WAS AUTOMATICALLY PROGRAMMED. THE TRIANGULAR AND CIRCULAR TARGETS WERE PROGRAMMED FOR THE INDIVIDUAL CREWMEN. IT CAN BE SEEN THAT THEY WERE CHOSEN SO AS TO MINIMIZE THE ROLL ANGLE BETWEEN THE PRIMARY OPTICS AND THE ACQUISITION SCOPE TARGETS THUS MINIMIZING THE TIME FOR CREWMAN REPROGRAMING. SEVEN TENTHS OF THE TARGETS IN THE SAMPLE ARE MARKED AS CROSSES INDICATING THEIR POTENTIALITY FOR HAVING ACTIVE INDICATORS. ANY OF THESE ARE, THEREFORE, POTENTIAL TARGETS FOR THE ACQUISITION SCOPE. IT CAN BE SEEN THAT IN HIGH DENSITY TARGET AREAS THAT MORE TARGETS EXIST THAN CAN BE HANDLED IN THE TIME OVER TARGET. THE REMAINING THREE TENTHS OF THE TARGETS ARE DOTTED INDICATING NO POTENTIALITY FOR THE PRESENCE OF ACTIVE INDICATORS. THEY ARE THEREFORE TARGETS WHICH ONLY WOULD BE PROGRAMMED FOR THE PRIMARY OPTICS.

SPECIAL PHOTOGRAPH TAKE ANALYSIS

- 50% CLOUD COVER
- PHOTOGRAPHS ARE STEREO PAIRS
- 70% OF PROGRAMMED PHOTOGRAPHS ARE POTENTIALLY SPECIAL
- 6% OF POTENTIALLY SPECIAL ARE IN FACT SPECIAL
- 1.5 PROGRAMMED PHOTOGRAPH REDUCTION FACTOR FOR INTERDICTION OF PROGRAM

AUTOMATIC MODE

- 93 PROGRAMMED PHOTOGRAPHS/DAY
- 93 X 0.50 = 46.5 CLEAR PROGRAMMED PHOTOGRAPHS/DAY
- 46.5 X 0.70 = 32.5 POTENTIALLY SPECIAL CLEAR PROGRAMMED PHOTOGRAPHS/DAY
- O 32.5 X 0.06 = 1.95 CLEAR SPECIAL PROGRAMMED PHOTOGRAPHS PER DAY

MANNED ACTIVE INDICATOR MODE

- 111 POTENTIALLY SPECIAL PHOTOGRAPHS/DAY
- 111 X 0.50 = 55.5 POTENTIALLY SPECIAL PHOTOGRAPHS JUDGED CLEAR
- 55.5 X 0.06 = 3.33 CLEAR SPECIAL PHOTOGRAPHS PER DAY
- 3.33 X 1.5 = 5.0 PROGRAMMED PHOTOGRAPHS LOST DUE TO INTERDICTION
- 93 - 5 = 88 RETAINED PROGRAMMED PHOTOGRAPHS/DAY
- $\frac{88}{93}$ X 1.95 = 1.85 CLEAR SPECIAL PROGRAMMED PHOTOGRAPHS PER DAY

- CLEAR PHOTOGRAPHS/DAY WITH CREW PARTICIPATION $= \left[\frac{93}{2} + 3.33 - \frac{1.5 \times 3.33}{2}\right] = 47.3$
- SPECIAL PHOTOGRAPH OCCURRANCES

3.33	HANDLED BY CREW
+1.85	RETAINED PROGRAMMED
5.18	TOTAL MANNED

- MANNED IMPROVEMENT FACTOR + $\frac{5.18}{1.95} = 2.65$

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

	AUTOMATIC MODE (MEAN MISSION DURATION = 24 DAYS)	MANNED/AUTOMATIC MODE (MEAN MISSION DURATION = 28 DAYS)
CLEAR PROGRAMMED PHOTOGRAPHS PER FLIGHT	1,116	1,324
CLEAR SPECIAL PHOTOGRAPHS PER FLIGHT	47	145

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.

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

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.

~~SECRET~~ SPECIAL HANDLING

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

	3 M/AM FLIGHTS	2 AM FLIGHTS	TOTAL
• TOTAL NUMBER OF CLEAR PHOTOGRAPHS	3,973	2,232	6,205
• TOTAL NUMBER OF CLEAR, SPECIAL PHOTOGRAPHS (CONTAINED IN TOTAL PHOTOGRAPHS)	435	94	529

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

   [redacted]
   - 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 [redacted] 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 [redacted] 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

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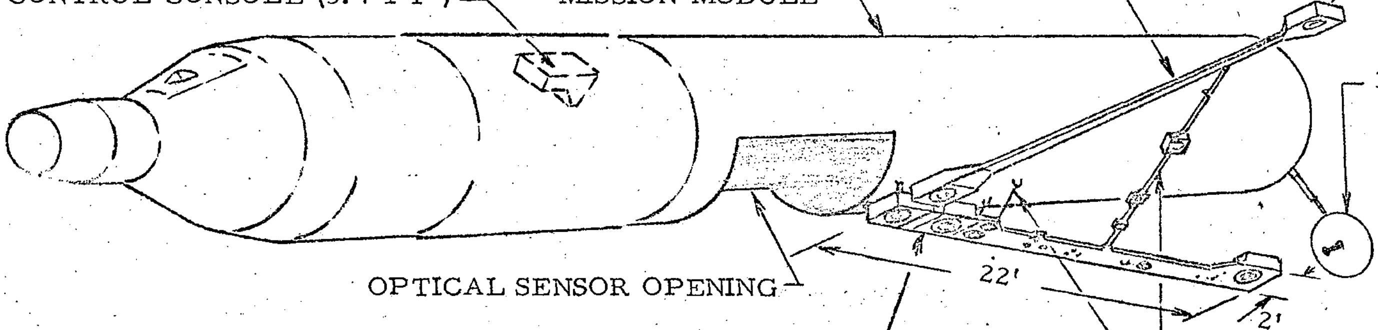
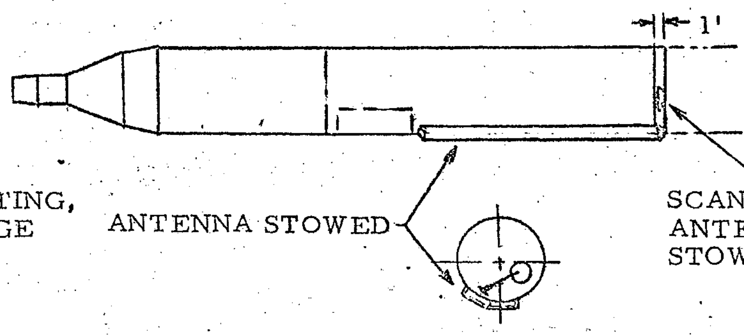
TYPICAL ELINT INSTALLATION





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

~~SECRET~~ SPECIAL HANDLING

MOL ELINT SYSTEM

~~SECRET~~ SPECIAL HANDLING

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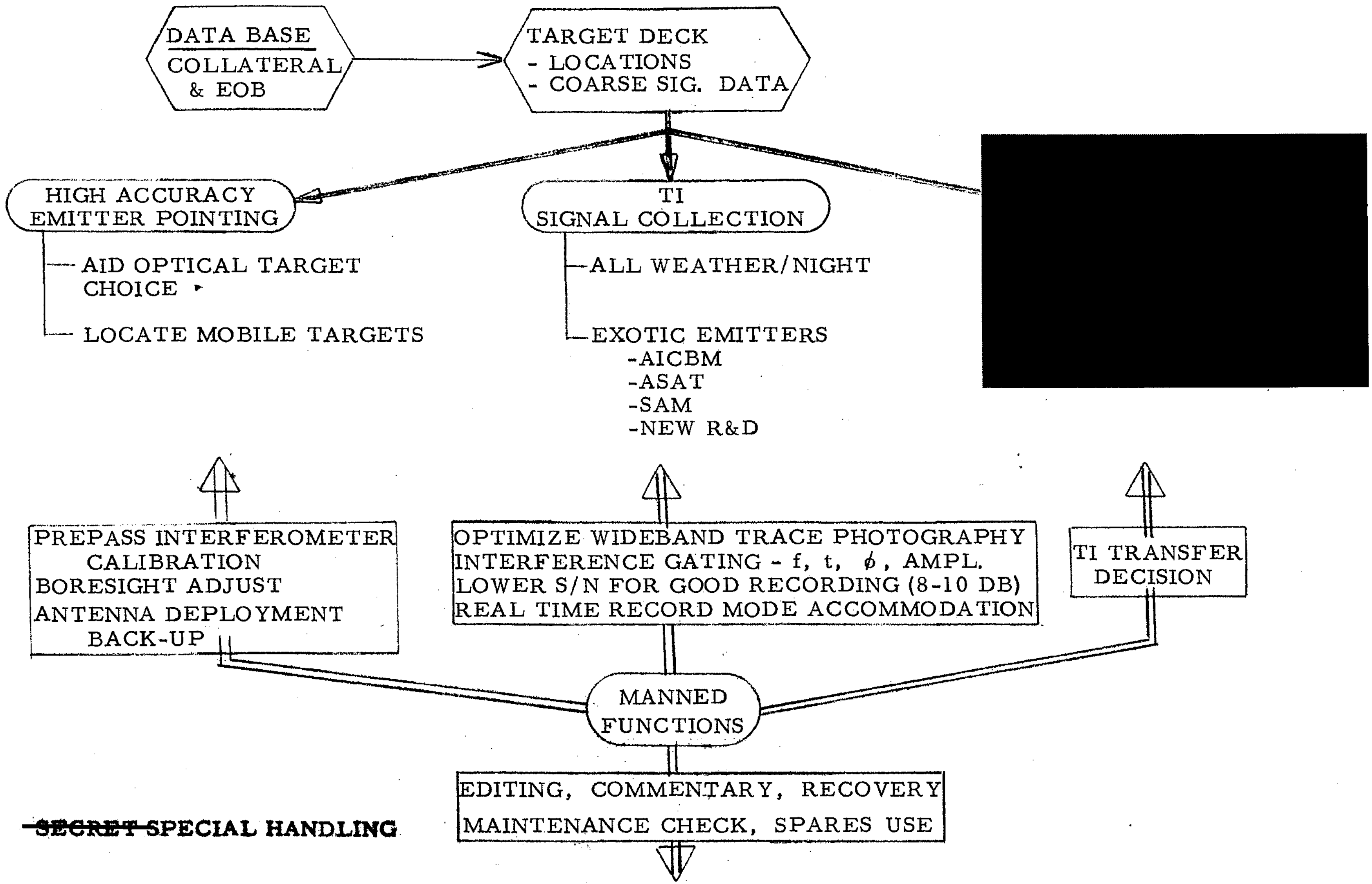

~~SECRET~~ SPECIAL HANDLING

MOL ELINT SYSTEM

THE ELINT SENSOR COULD BE USED TO ACQUIRE TARGETS AND ALERT THE CREWMEN TO OBTAIN HIGH RESOLUTION PHOTOGRAPHS [redacted] 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

~~SECRET~~ SPECIAL HANDLING
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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:

$\pm 2^\circ$ THROUGHOUT COVERAGE ZONE

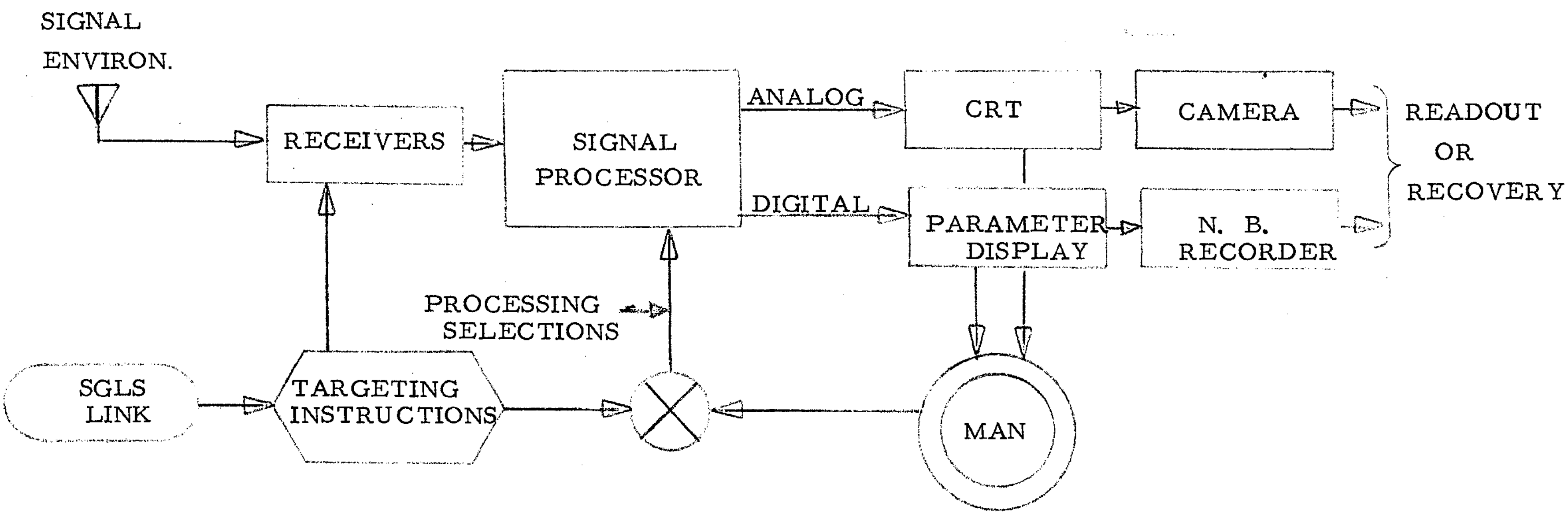
$\pm 1^\circ$ MAXIMUM IN ZONE 20° TO 40° FORWARD, FOR TRANSFER OF COORDINATES TO ATS

$\pm 1/2^\circ$ AT 22 $1/2^\circ$ FORWARD FOR TRANSFER TO LARGE OPTICS

DF COVERAGE:

$+75^\circ$ -25° INTRACK

± 30 CROSSTRACK



~~SECRET~~ SPECIAL HANDLING

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

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.

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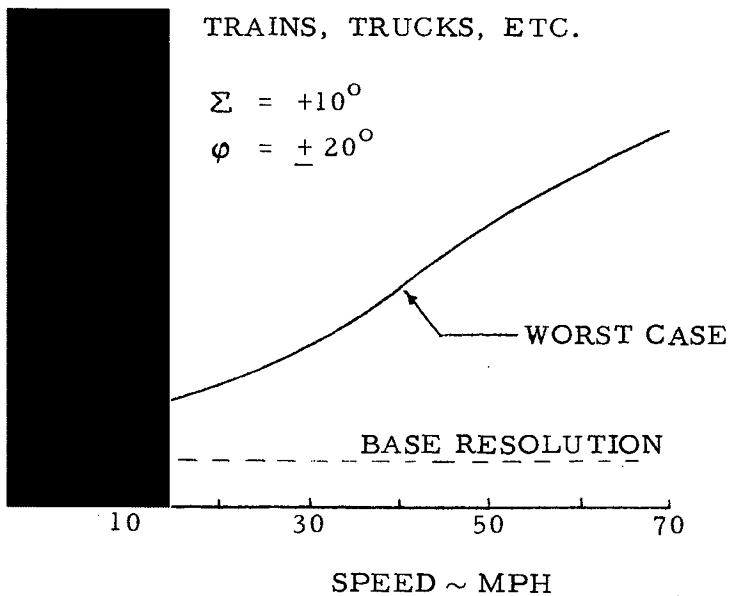
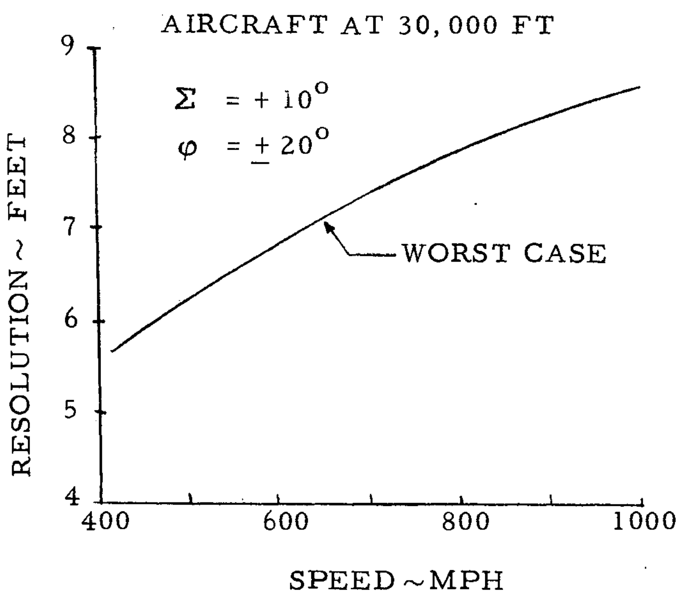
ACQUISITION AND TRACKING OF LAND MOBILE TARGETS

- 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 SERIOSLY DEGRADED IF MOVING TARGET IS NOT TRACKED BY ASTRONAUT





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.

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~~SECRET~~ SPECIAL HANDLING

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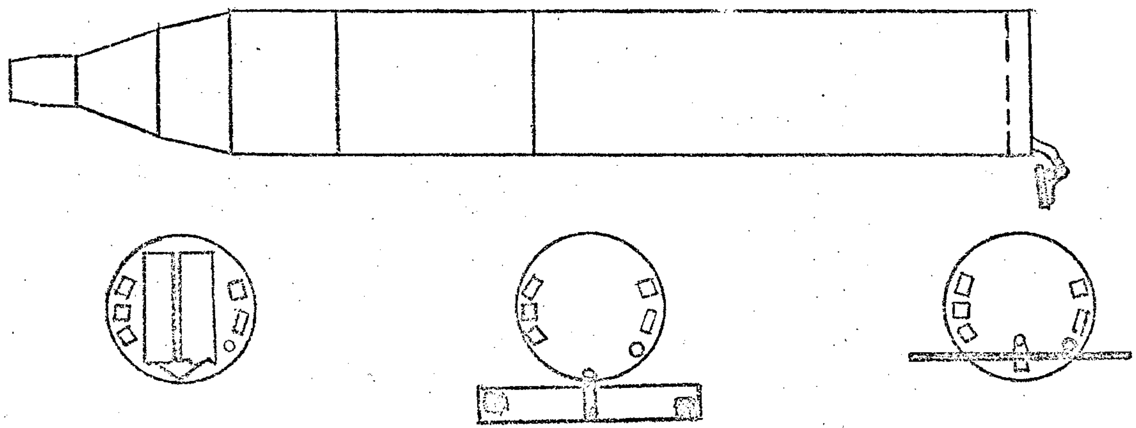
DETECTION RADAR SYSTEM INSTALLATION
BASIC MOL VEHICLE



RADAR CAPABILITY

[redacted]

INSTALLATION CHARACTERISTICS

- TOTAL HARDWARE WEIGHT - 387#
- POWER PENALTY -800 WATTS OPERATING, 120 WATTS AVERAGE
- PROPULSION PENALTY - <1 FPS/DAY

~~SECRET~~ SPECIAL HANDLING

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.

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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.

+9
36

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[redacted]

[redacted]

ASTRONOMY POTENTIAL ~~SECRET~~ SPECIAL HANDLING

WHS-025-32

MARS PHOTOGRAPHY

- o NO MODS
- o PTS FOR INITIAL ACQUISITION - MANNED POINTING THROUGH MAIN OPTICS
- o EXPOSURE TIME - .004 SEC. SO346 (4404 x) -
- o RESOLUTION - MOL 50 N. MI.
  GROUND 300 N. MI.
  PROBE .1 N. MI.

DISTANT STARS

- o MUST HAVE MODIFICATIONS
- o EITHER MOVABLE PLATE HOLDER AND EYEPIECE OR
  LOCKED OPTICS WITH CONTROL MOMENT GYROS
- o POINTING TO .01 SEC. POTENTIAL CONTROL
- o RESOLUTION LIKE .1 SEC. (GROUND LIKE 1 SEC.)
- o 22 MAG WITH SO346-20 MIN. EXPOSURE
- o LIMIT MAG 26 - (20 MIN. EXPOSURE)

ULTRA-VIOLET (FREQUENCIES CUT OUT BY O_3 LAYER)

- o ROSS CORRECTOR INTERCHANGE TO QUARTZ
  (2300-3000A, 1800-2300A)
- o MUST HAVE CONTROL MOMENT GYROS
- o USE SWR FILMS TO PHOTOGRAPH STARS
- o USE IMAGE CONVERTER ON OPTICS FOR MANNED POINTING

~~SECRET~~ - SPECIAL HANDLING

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.

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MOL GROWTH POTENTIAL

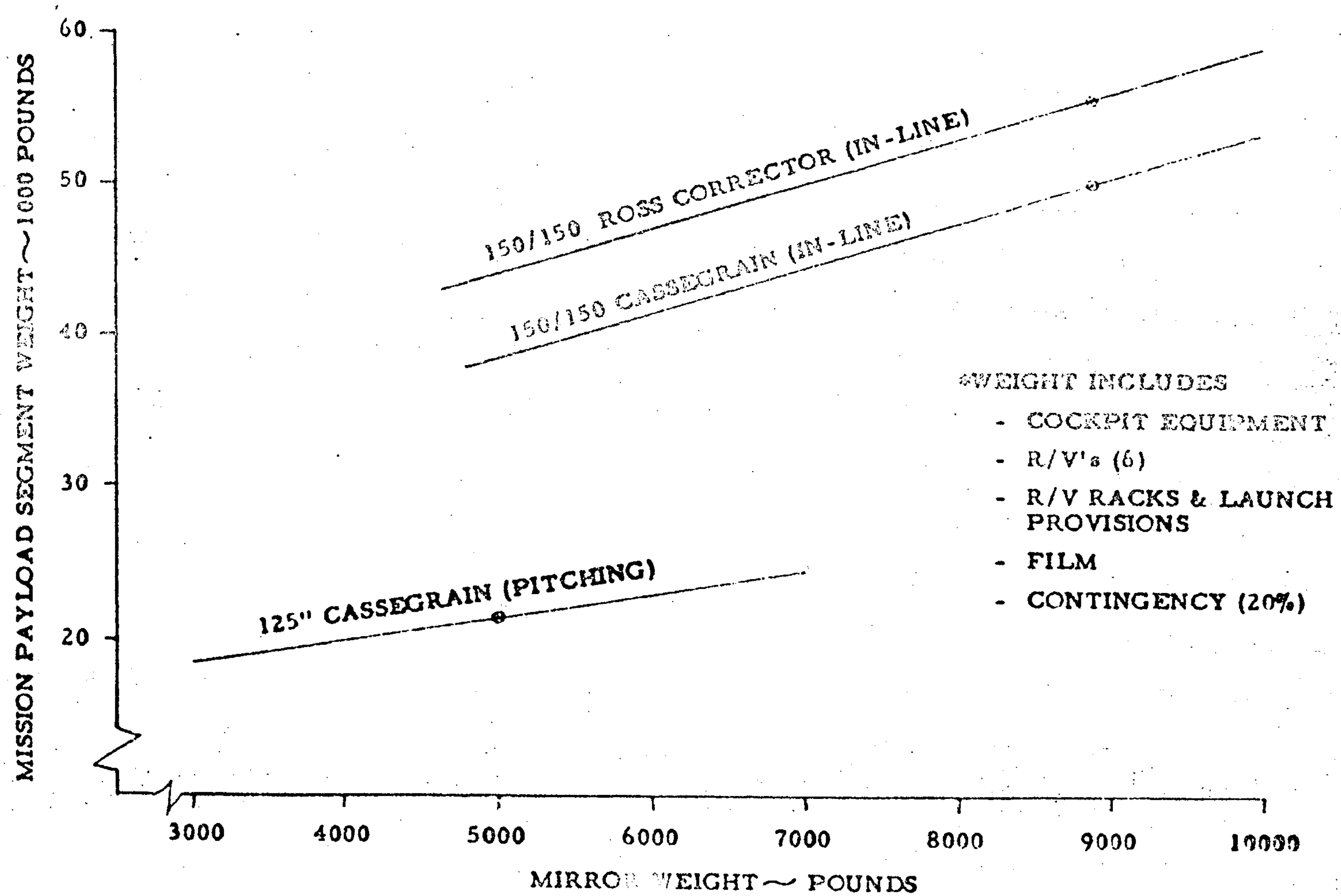
- IMPROVED PERFORMANCE
- ALTERNATE PAYLOADS
- IMPROVED ECONOMICS

MOL GROWTH POTENTIAL

WE TURN NOW TO A DISCUSSION OF MOL GROWTH POTENTIAL IN THE THREE AREAS SHOWN ON THE CHART.

GROWTH CONFIGURATION PAYLOAD WEIGHTS

- [redacted] RESOLUTION (FOCAL LENGTH = [redacted]
- 70 N. MI. ALTITUDE



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 [redacted] GROUND RESOLUTION PHOTOGRAPHS. ASSUMING A REASONABLE EXTRAPOLATION OF THE STATE-OF-THE ART IN DESIGN AND FABRICATION OF MIRROR, IT WOULD APPEAR THAT A [redacted] APERTURE SYSTEM WEIGHING OF THE ORDER OF 20,000 LBS WOULD BE THE MINIMUM REQUIREMENT.

[redacted]

[redacted]

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ADVANCED SENSOR RISKS

- [redacted]
- 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 [redacted] 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.

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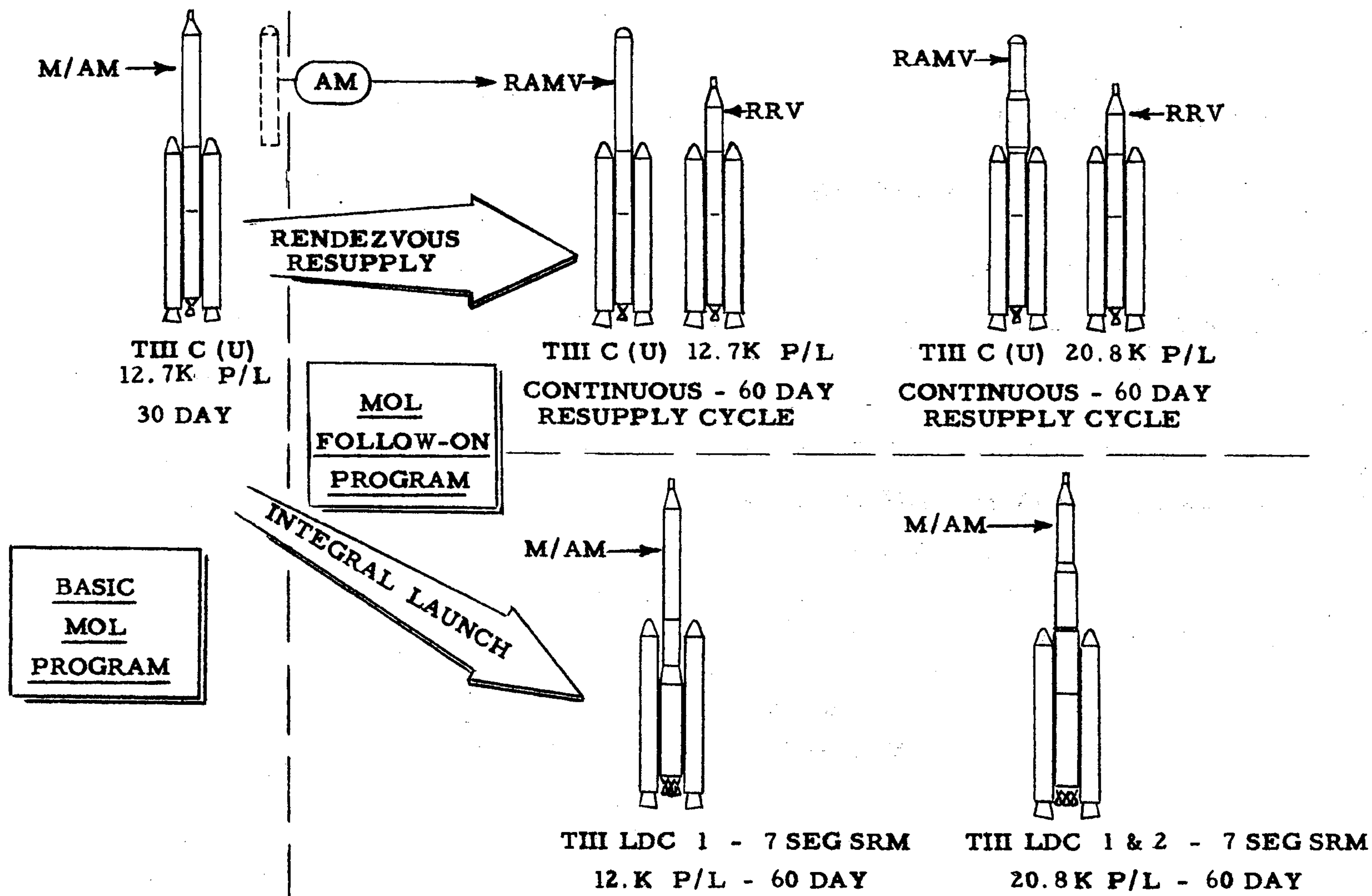
IMPROVED PAYLOADS AND ECONOMICS

IMPROVED PAYLOADS AND ECONOMICS

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

~~SECRET~~ SPECIAL HANDLING

MOL PROGRAM EVOLUTION

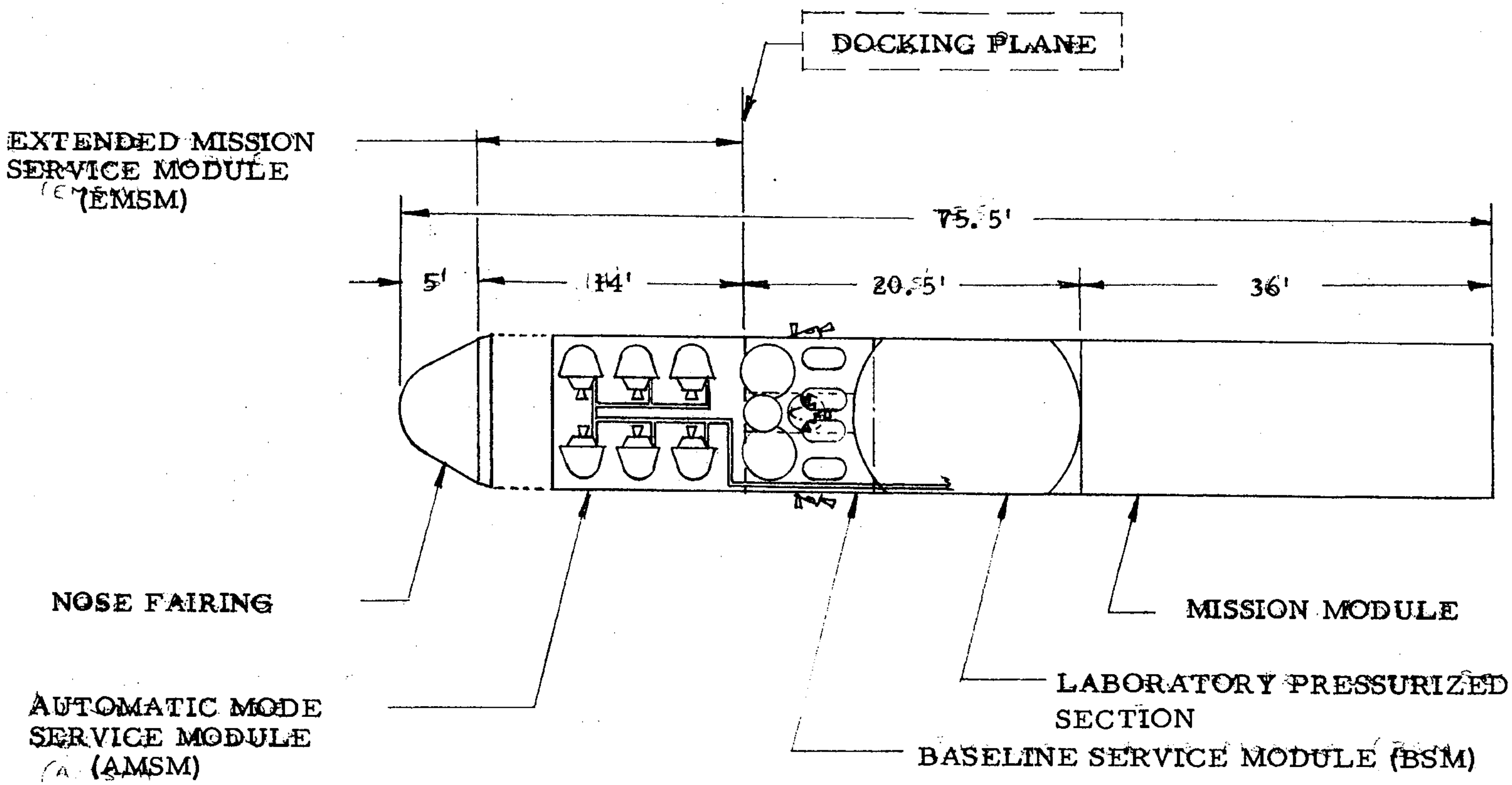


~~SECRET~~ SPECIAL HANDLING

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-SEGMENTS 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

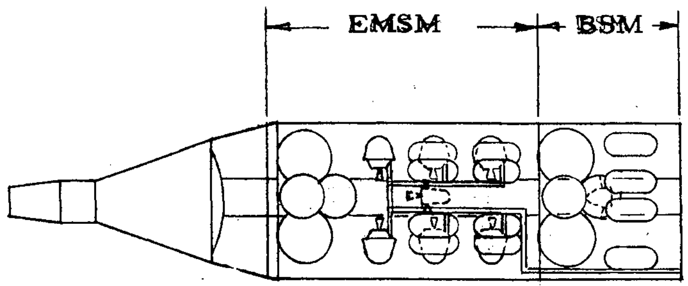


MOL AUTOMATIC MODE/RENDEZVOUS AUTOMATIC MODE VEHICLE

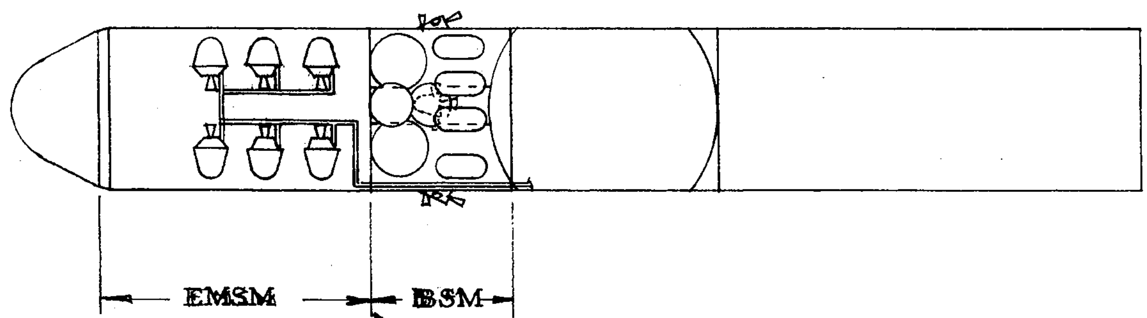
THE AUTOMATIC MODE CONFIGURATION OF THE BASELINE PROGRAM WILL BE CONFIGURED SO THAT ITS EXPENDABLES SECTION MIGHT BE USED IN EITHER THE INTEGRAL LAUNCH OR RENDEZVOUS EVOLUTIONARY PROGRAMS. THIS WILL BE ACHIEVED BY CONFIGURING THE AUTOMATIC MODE SERVICE MODULE SO THAT IT HAS EXCESS VOLUME TO ACCEPT ADDITIONAL EXPENDABLES AT A LATER DATE FOR LONGER TIME ON ORBIT. IN ADDITION, ITS INTERFACE WITH THE BASE-LINE 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 RENDEZ-VOUS PROGRAMS.

RENDEZVOUS VEHICLE FAMILY

o RENDEZVOUS/RESUPPLY VEHICLE (RRV)



o RENDEZVOUS/AUTOMATIC MODE VEHICLE (RAMV)



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.

NRO APPROVED FOR
RELEASE 1 JULY 2015

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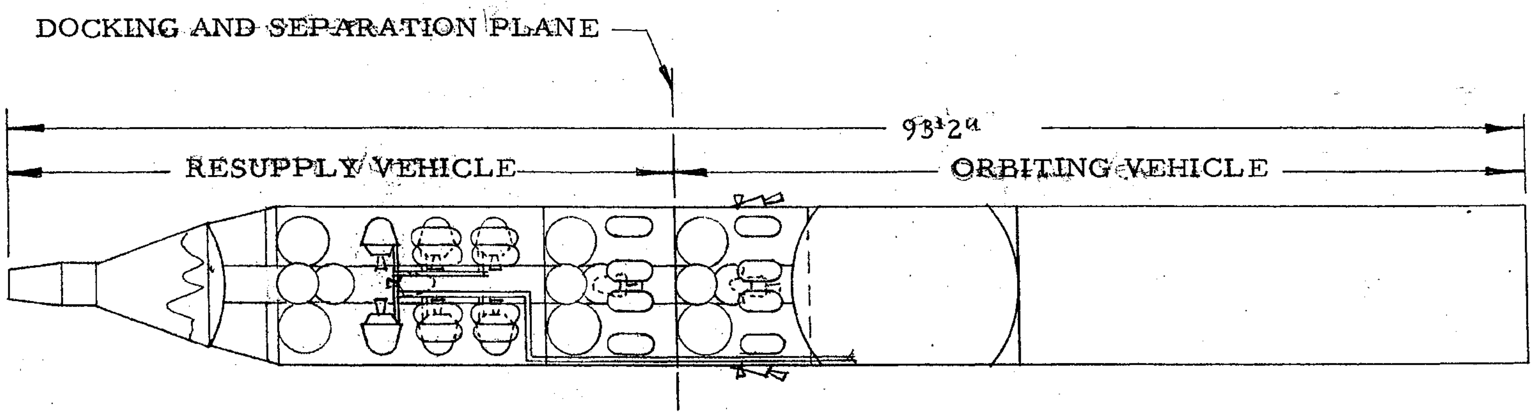
RENDEZVOUS VEHICLE CONFIGURATION

o 60 DAY RESUPPLY CYCLE



RRV FUNCTIONS

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

RAMV FUNCTIONS

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

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RENDEZVOUS VEHICLE CONFIGURATION

SHOWN HERE IS THE RENDEZVOUS 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 RENDEZVOUS AUTOMATIC MODE VEHICLE. THIS SHOULD CONTRIBUTE MATERIALLY TO THE DESIRED EXTENDED LIFE-TIME OF THE RENDEZVOUS AUTOMATIC MODE VEHICLE.

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COMPARISON OF BASELINE AND FOLLOW-ON PROGRAM CAPABILITIES FOR TECHNICAL INTELLIGENCE DATA RETURN

	6 M/AM FLIGHTS	6 AM FLIGHTS	FOLLOW-ON PROGRAM (CONTINUOUSLY ON-ORBIT) (3 RAMV + 5 RRV)
● TOTAL NUMBER OF CLEAR PHOTOGRAPHS/YEAR	7,946	6,696	16,980
● TOTAL NUMBER OF CLEAR, SPECIAL PHOTOGRAPHS/YEAR	870	282	1,671

OTHER MISSION CAPABILITIES OF MOL BASELINE SYSTEM

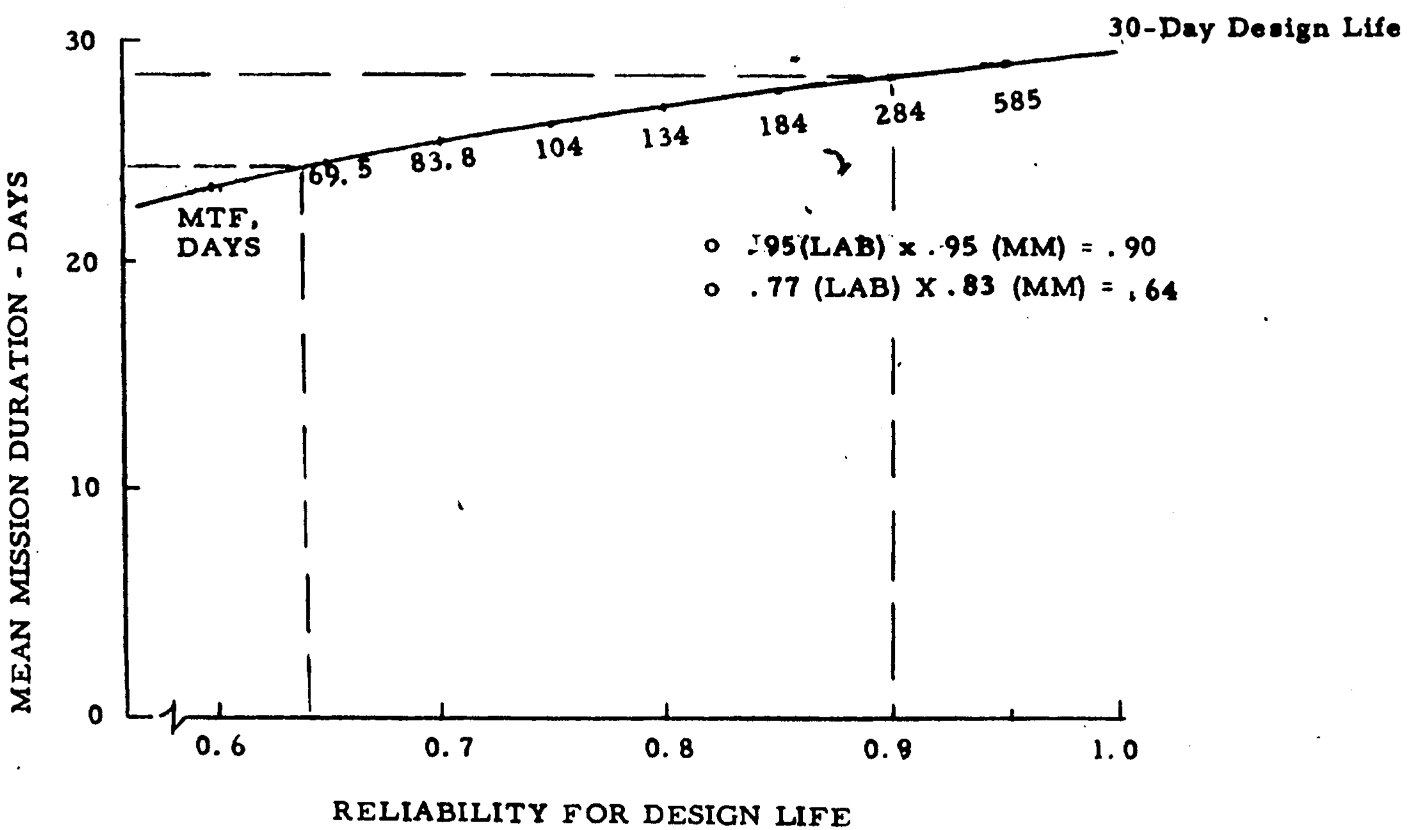
BASELINE CAPABILITY

[redacted]
- 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



LAUNCH VEHICLE RELIABILITY ~.97

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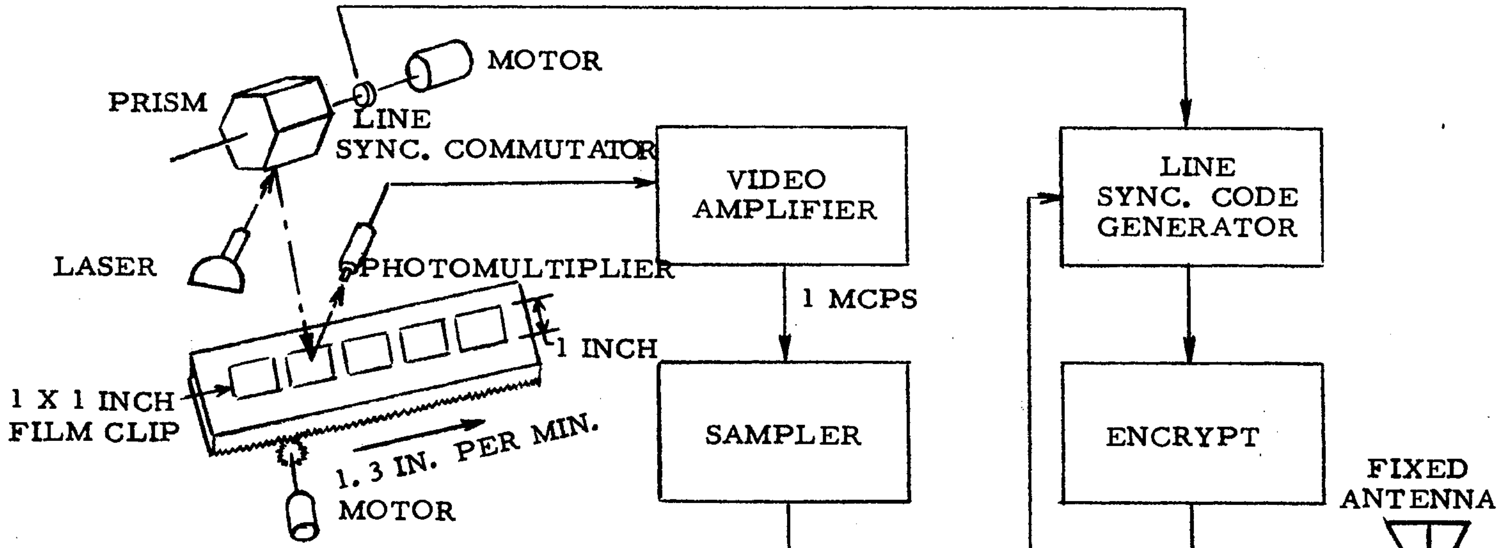
COMPARISON OF BASELINE AND FOLLOW-ON PROGRAM CAPABILITIES FOR TECHNICAL INTELLIGENCE DATA RETURN

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

SCANNER CONFIGURATION



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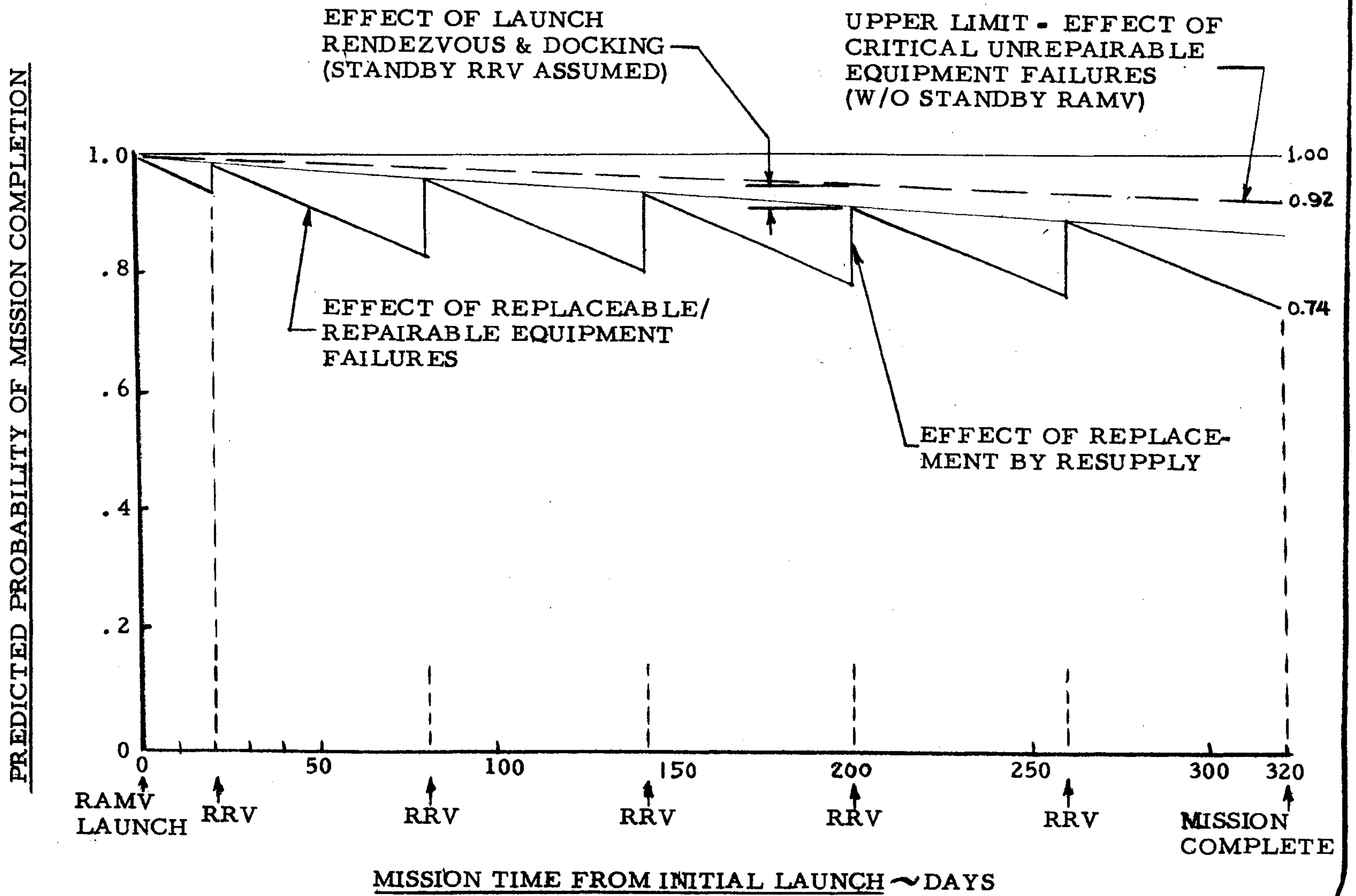
PROBABILITY OF MISSION COMPLETION

RENDEZVOUS SYSTEM

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



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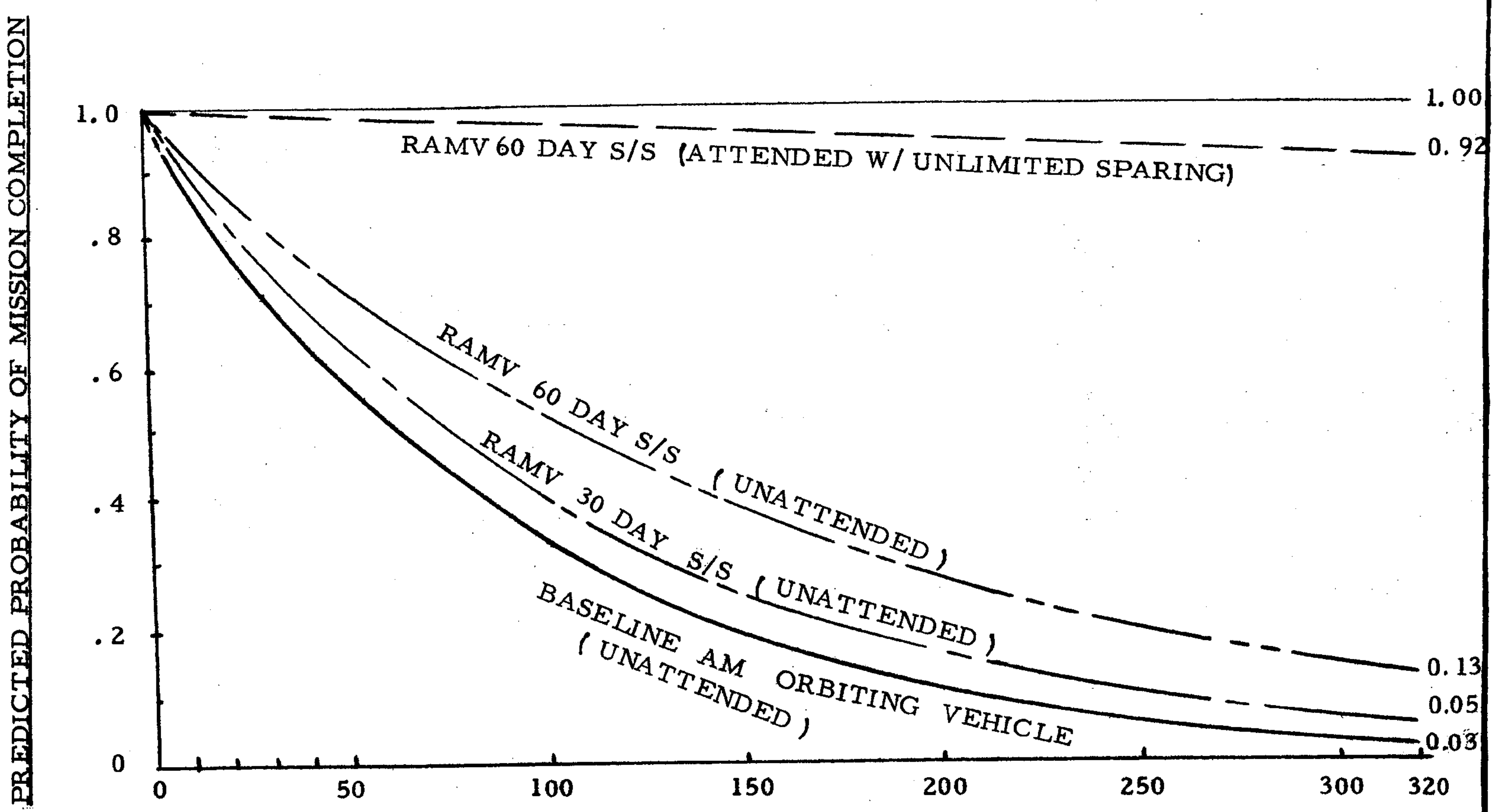
EFFECT OF VEHICLE TYPE, SUBSYSTEM DESIGN, AND MANNED MAINTENANCE ON PROBABILITY OF MISSION COMPLETION



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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 ACCESSORIES THAT ENABLE MAN TO OPERATE IN DEGRADED MODES (LIKE: RETICLES, CHINA PENCILS, NOMOGRAPHS, STOP WATCHES, FLASHLIGHTS, VACUUM CLEANER, ETC.)
- PROVISIONS FOR EMERGENCY POWER - (WITH SOLAR CELLS)

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MOL PROGRAM COST SUMMARY

(MILLIONS OF DOLLARS)

NON-RECURRING DEVELOPMENT COSTS	M/AM
LABORATORY	547.9
GEMINI B	158.9
MISSION MODULE	287.5
LAUNCH VEHICLE	221.4
GSR/TD	46.2
OTHER	15.0
DEVELOPMENT FLIGHT HARDWARE	474.5
SUBTOTAL	1751.4

RECURRING	M/AM	AM
LABORATORY	34.5	29.4
GEMINI B OR SUPPLY MODULE	19.2	4.0
MISSION MODULE	27.0	26.4
LAUNCH VEHICLE	18.1	18.1
RECOVERY - TRACKING	2.0	1.5
OTHER	2.0	1.2
SUBTOTAL PER FLIGHT	102.8	80.6

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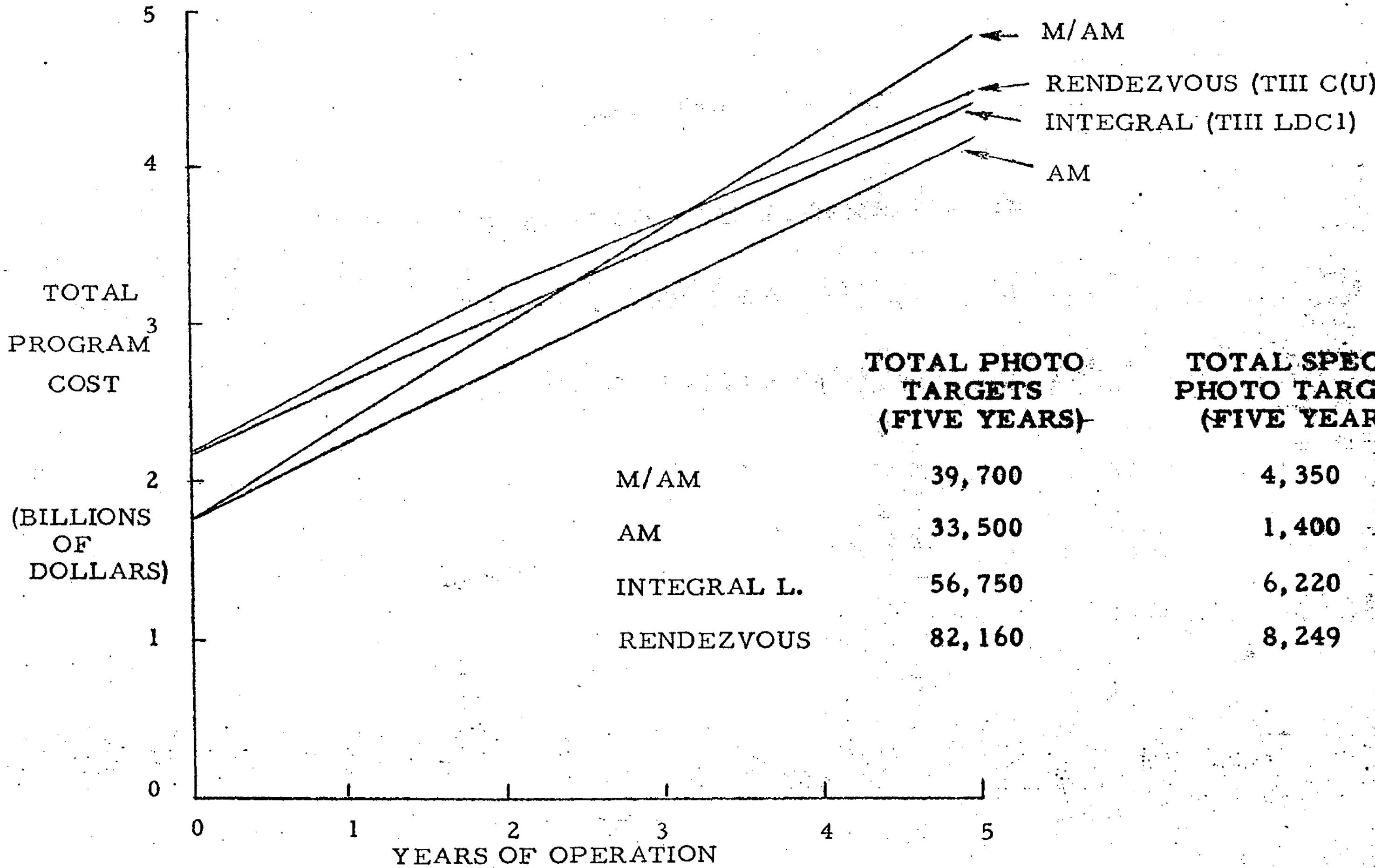
TOTAL PROGRAM COST COMPARISON



	TOTAL PHOTO TARGETS (FIVE YEARS)	TOTAL SPECIAL PHOTO TARGETS (FIVE YEARS)
M/AM	39,700	4,350
AM	33,500	1,400
INTEGRAL L.	56,750	6,220
RENDEZVOUS	82,160	8,249

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ELEMENTS AND COSTS FOR POSSIBLE INTEGRAL-LAUNCH FOLLOW-ON

NON-RECURRING COST - M$	
TWO MANNED DEVELOPMENT FLTS	215.0
VEHICLE MODIFICATIONS (OV)	50.0
T-III LDC DEVELOPMENT	106.6
TOTAL	371.6

RECURRING COST - M$	
T-III LDC	23.0
GEMINI B	19.2
LABORATORY VEHICLE	34.5
MISSION MODULE	27.0
RECOVERY-TRACKING	2.0
OTHER	2.0
TOTAL	107.7

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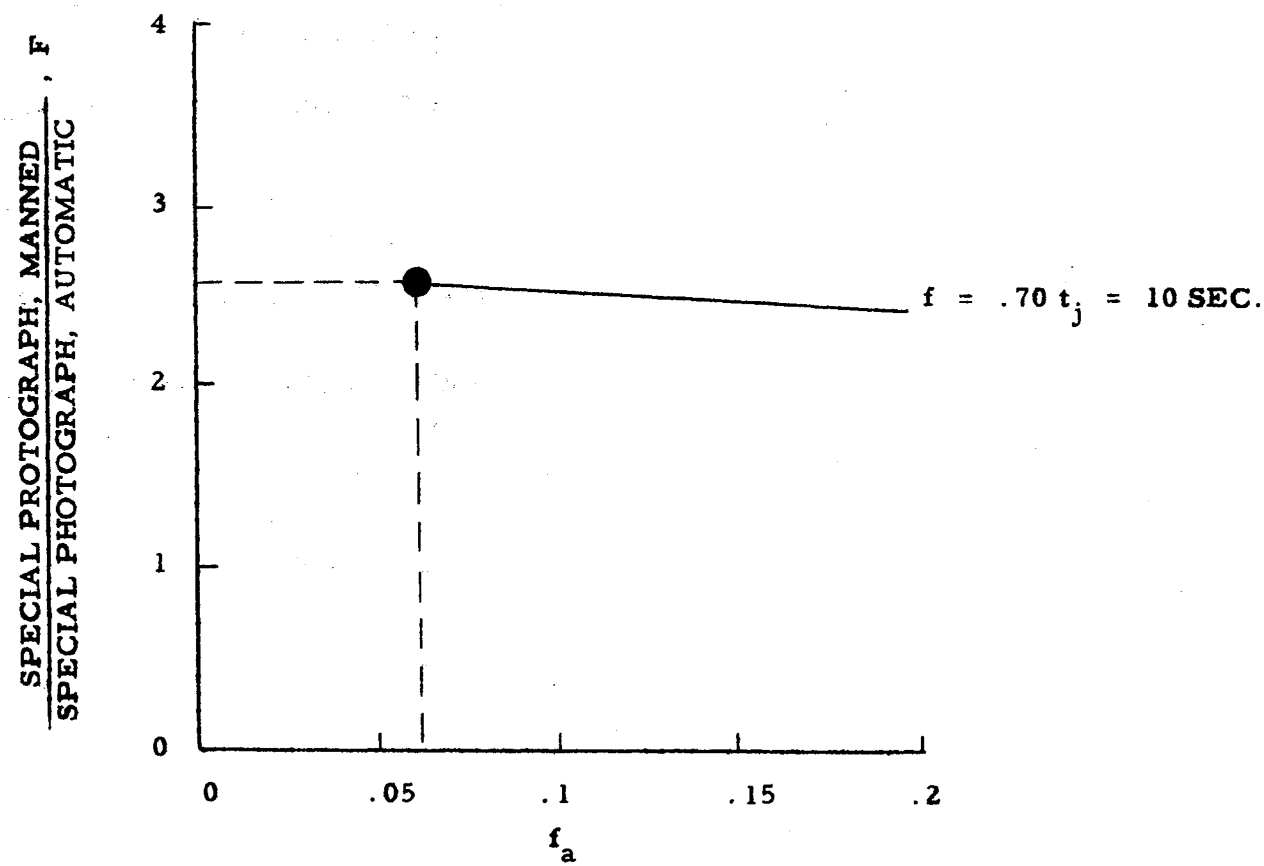
IMPROVEMENT FACTORS DUE TO MOL CREW

● 50% CLOUD COVER



FRACTION OF POTENTIALLY
ACTIVE INDICATORS
WHICH ARE IN FACT ACTIVE

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MAINTENANCE/REPLACEMENT/REPAIR

ESTIMATED SPARES INVENTORY BY SUBSYSTEM - BASELINE VEHICLE

SUBSYSTEM	NUMBER OF SPARED ITEMS
ELECTRICAL POWER	--
ENVIRONMENTAL CONTROL/LIFE SUPPORT	7
CRYOGENICS	--
ATTITUDE CONTROL AND TRANSLATION	
ELECTRONICS	22
PROPULSION	--
COMMUNICATIONS/DATA HANDLING	10
INSTRUMENTATION/MONITOR-ALARM	13
MISSION MODULE	5
STRUCTURE	5
	62

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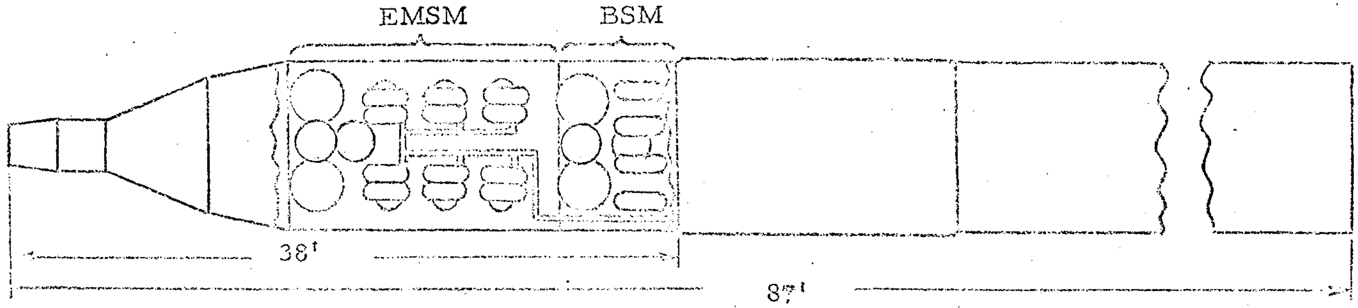
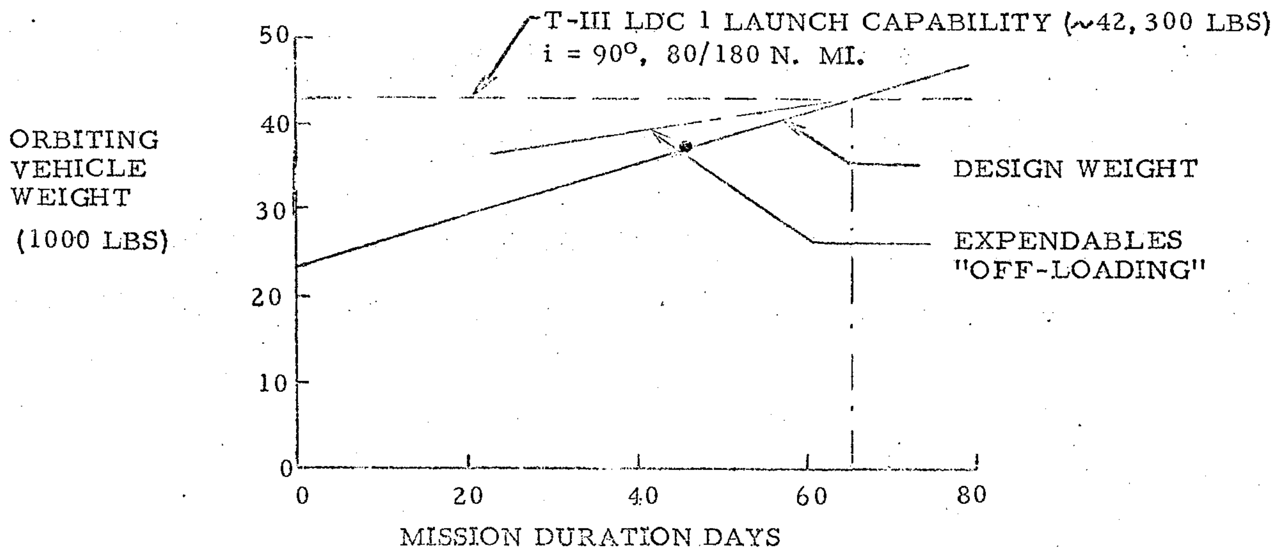
T-III LDC 1 GROWTH
INTEGRAL LAUNCH



o TYPICAL 60 DAY VEHICLE WGT. = 41,000 LBS



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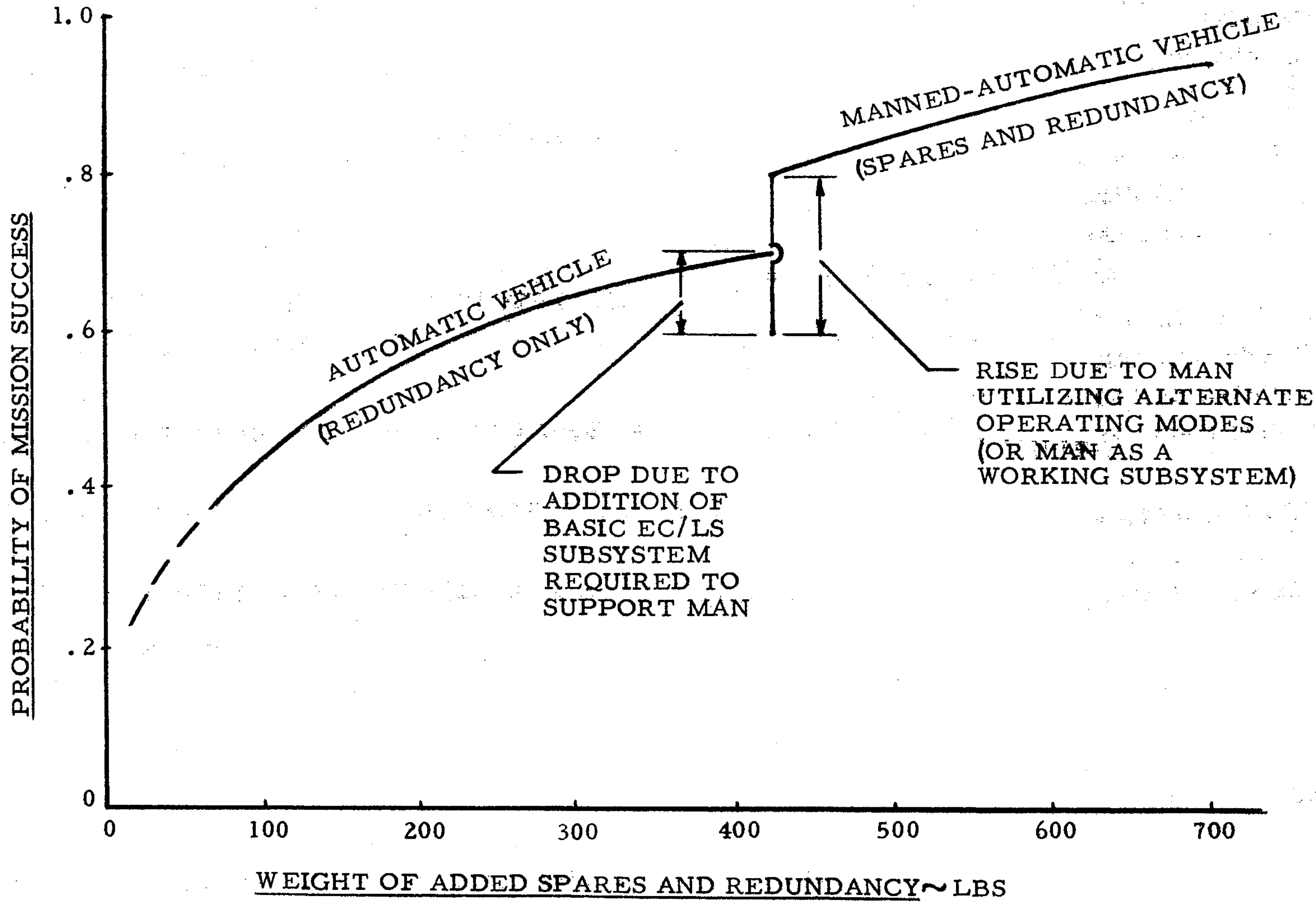
MAINTENANCE/REPLACEMENT/REPAIR

BASELINE LABORATORY VEHICLE - 30 DAYS



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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.

	NUMBER OF FUNCTION	
SUBSYSTEM	SWITCHING	OVERRIDE
ELECTRICAL POWER	--	27
ATTITUDE CONTROL AND TRANSLATION	5	111
ENVIRONMENTAL CONTROL/LIFE SUPPORT	10	15
COMMUNICATIONS AND DATA HANDLING	--	95
MISSION MODULE	23	37
	38	285

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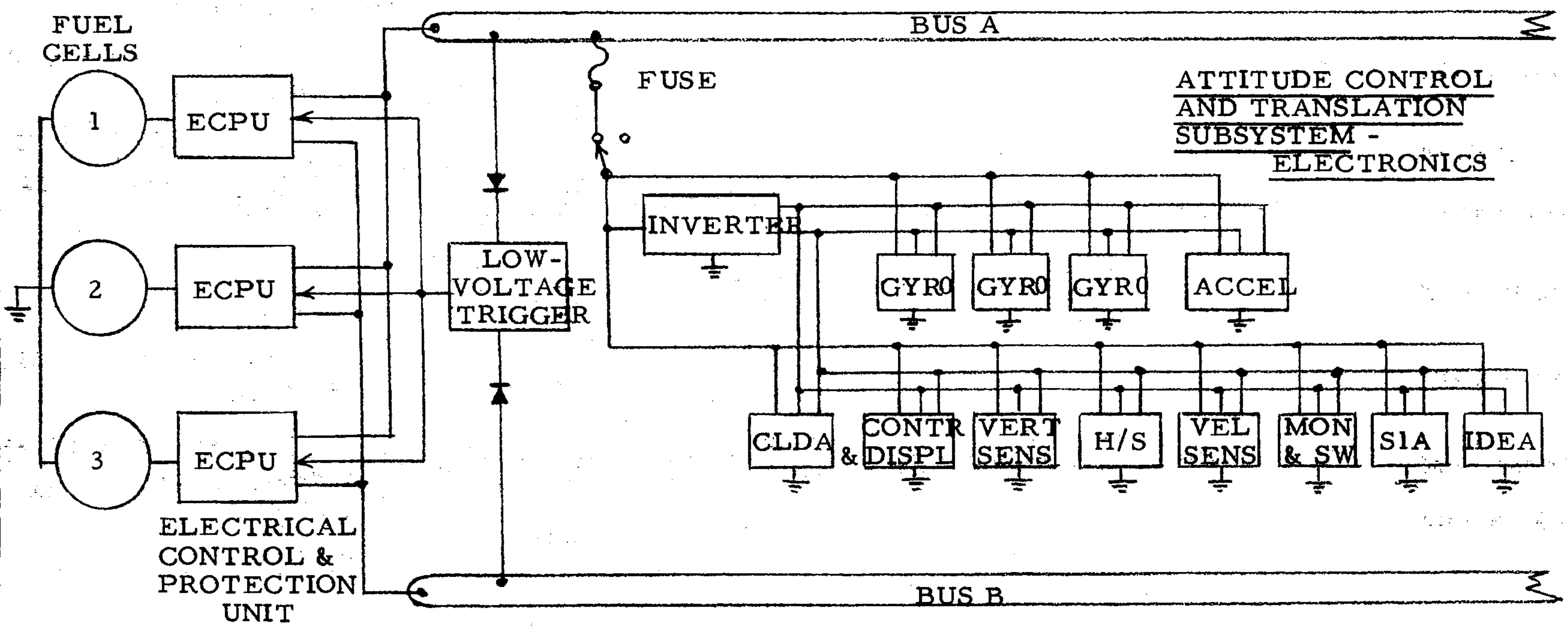
TROUBLE SHOOTING BY CREW

TYPICAL EXAMPLE

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

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POSSIBLE FOLLOW-ON PROGRAM ELEMENTS AND COSTS RENDEZVOUS/RESUPPLY

TIII C (U)

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.	3.0
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

RECURRING COST - M$

RAM V:	
BASELINE M/AM	102.8
GEMINI B	-19.0
AM SERVICE MODULE	+ 4.0
TOTAL	87.8
RRV:	
GEMINI B	19.2
RRV MODULE	10.0
TIII C (U)	18.1
DATA CAPSULE SYS.	1.8
TOTAL	49.1

△ PROBABLE ADDITION TO BASE MOL PROGRAM COST

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ACQUISITION AND TRACKING SCOPE WEIGHTS

	5 - INCH	10 - INCH
LENS	30 LBS	150 LBS
TRACKING MIRROR	10 (GLASS)	40 (Be)
RELAY	34	44 *
SERVOS	8	60
	82 LBS	294 LBS
X2	164 LBS	588 LBS

* INCLUDES DIRECT VIEW ZOOM EYEPIECE AND TV RELAY TO CONSOLE

B4

B

ON-ORBIT MAINTENANCE/REPLACEMENT/REPAIR (BASELINE VEHICLE)

ON-ORBIT MAINTENANCE/ REPLACEMENT/REPAIR	PRELAUNCH CHECKOUT/ TEST/CORRECTIVE ACTION
DESIGN PROVISIONS	
o ACCESSIBILITY	o ACCESSIBILITY
o INTERCHANGEABILITY	o INTERCHANGEABILITY
STATUS AND OPERATING DATA	
o INSTRUMENTATION	o INSTRUMENTATION
o MONITOR/ALARM & TELEMETRY	o MONITOR/ALARM & TELEMETRY & UMBILICAL
TROUBLE SHOOTING	
o EQUIP. TEST POINTS	o EQUIP. TEST POINTS
o PANEL & J-BOX ACCESS PANELS	o PANEL & J-BOX ACCESS PANELS
o CIRCUIT & PIN DIAGRAM & DATA	o CIRCUIT & PIN DIAGRAM & DATA
REPLACE FAULTY EQUIPMENT	
o DISCONNECT & PLUG-IN FEATURES	o DISCONNECT & PLUG-IN FEATURES
o AVAILABLE SPARE REPLACEMENT	o AVAILABLE SPARE REPLACEMENT
o TOOLS AND TEST CHECK EQUIP.	o TOOLS AND TEST CHECK EQUIP.

- 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.