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LOCKHEED DORIAN RESUPPLY STUDY

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LOCKHEED HAS CONDUCTED A PRELIMINARY STUDY SHOWING THE FEASIBILITY OF CONDUCTING UNMANNED RESUPPLY IN SUPPORT OF THE DORIAN MISSION. THE STUDY EMPHASIZED THE USE OF THE RESUPPLY IN CONJUNCTION WITH UNMANNED DORIAN OPERATION (DESIGNATED AS P-66 BY LOCKHEED). THE RESUPPLY CONCEPT CAN ALSO BE APPLIED TO THE MANNED DORIAN/MOL SYSTEM. THE STUDY REPORTS ON BOTH TECHNICAL AND COST FACTORS.

RESUPPLY APPROACHES

INITIAL OPERATION	RENDEZVOUS AND RESUPPLY	EXTENDED OPERATION
MANNED AUTOMATIC MOL/DORIAN	MAN ASSISTED	MANNED
MANNED AUTOMATIC MOL/DORIAN	MAN ASSISTED	UNMANNED
MANNED AUTOMATIC MOL/DORIAN	UNMANNED	UNMANNED
UNMANNED MODE MOL/DORIAN	UNMANNED*	UNMANNED
P-66	UNMANNED*	UNMANNED

*MANNED ASSISTED RENDEZVOUS, DOCKING AND CAMERA ALIGNMENT CHECK AN ALTERNATE CONSIDERATION.

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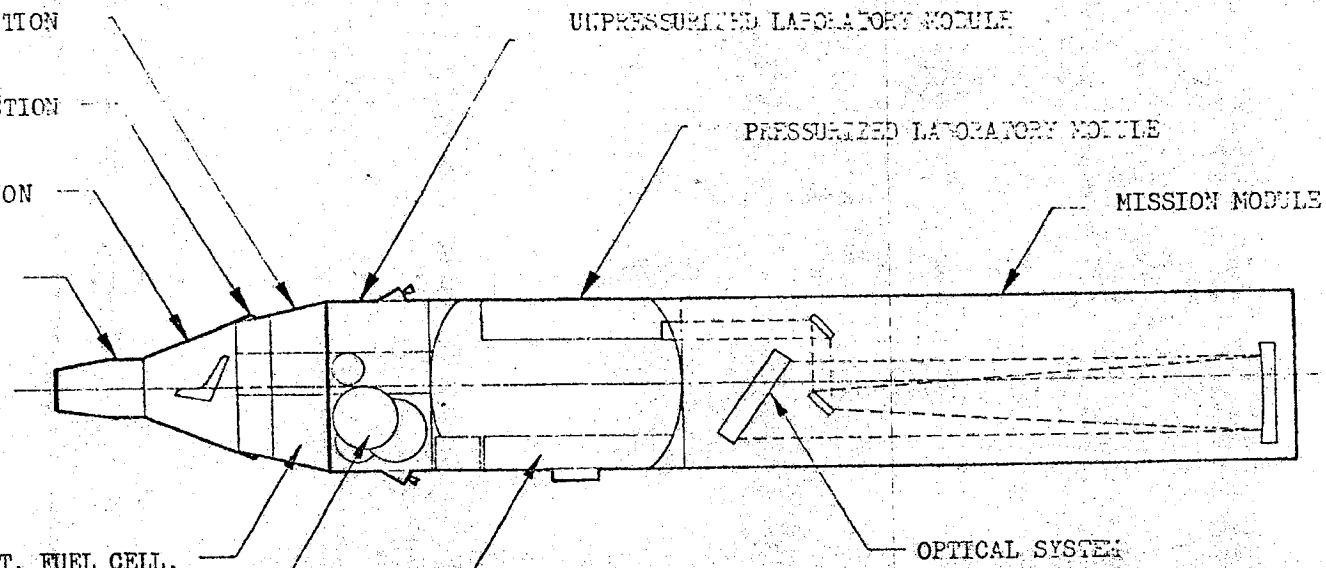
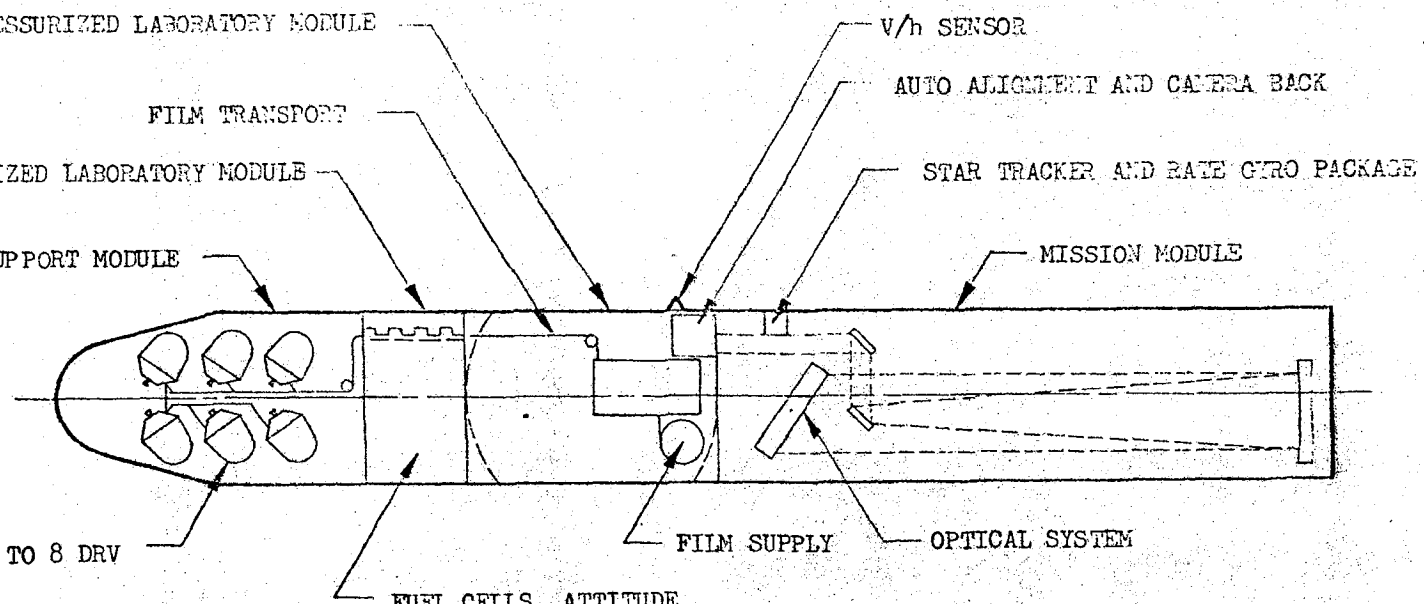
THE MOL/DORIAN SYSTEM IS PRESENTED TO ESTABLISH A POINT OF REFERENCE FOR THE STUDY.



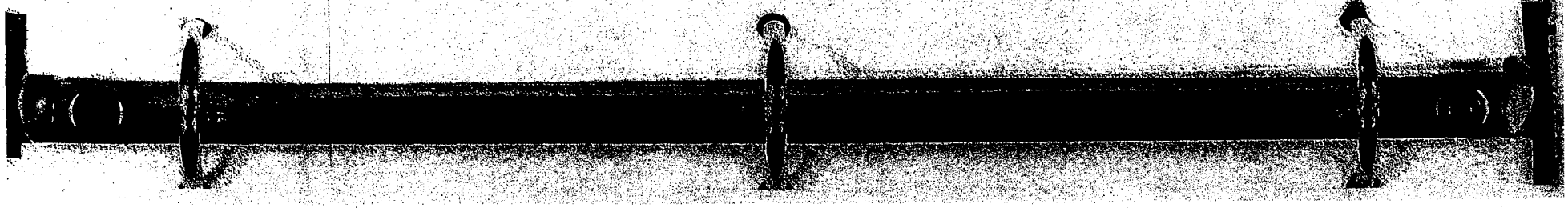
MOL/DORIAN SYSTEM

THE UNMANNED AUTOMATIC MOL/DORIAN SYSTEM CONCEPT IS ALSO PRESENTED TO ESTABLISH A POINT OF REFERENCE FOR THE DORIAN RESUPPLY STUDY. THE CONCEPT IS A DIRECT COPY OBTAINED FROM THE FUNDED UNMANNED DORIAN SYSTEM STUDY (P-66) AND DORIAN MISSION TARGETING SOFTWARE PROPOSAL RFP.



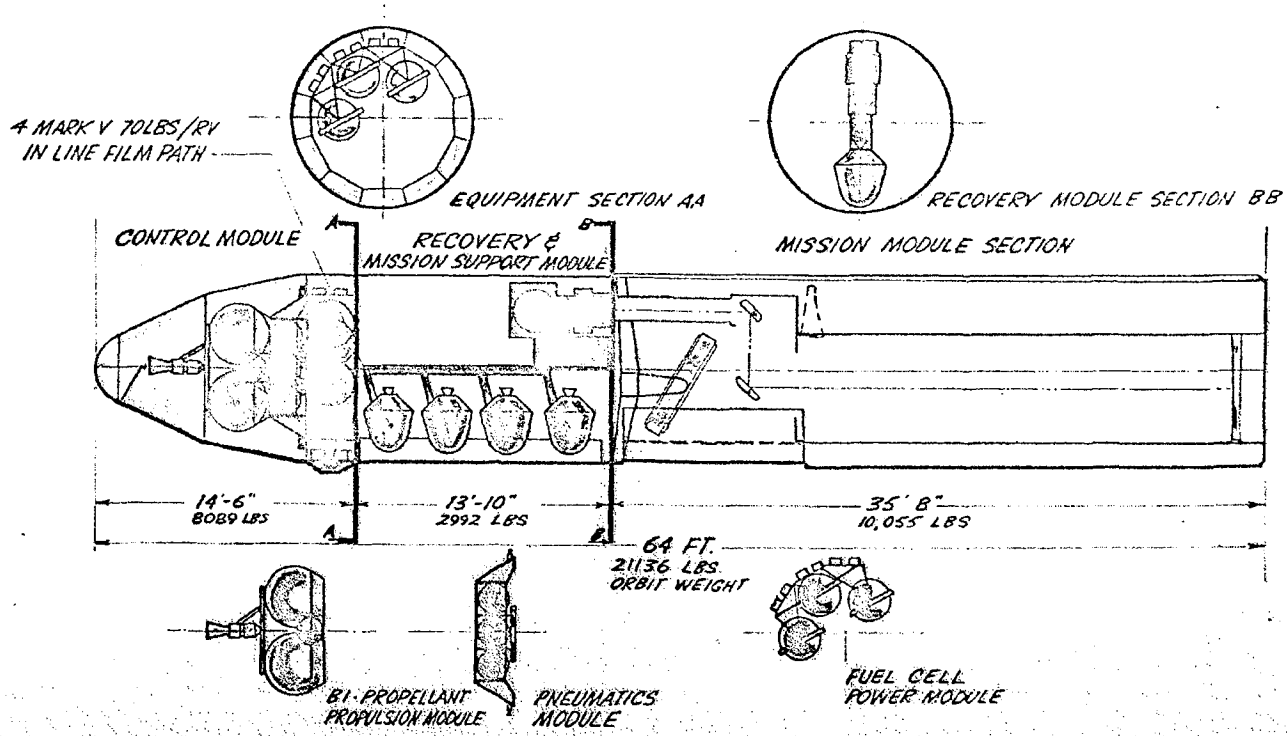
UNMANNED AUTOMATIC MOL/DORIAN SYSTEM CONCEPT

THE LOCKHEED UNMANNED DORIAN SYSTEM (P-66) PRESENTED REPRESENTS THE CONFIGURATION PROPOSED TO THE AIR FORCE AS A RESULT OF THE FUNDED UNMANNED DORIAN STUDY (17 JUNE 1966). THE P-66 CONCEPT EMPHASIZES SUBSYSTEM MODULARITY IN THE CONTROL AND MISSION SUPPORT MODULES. THE APPLICATION OF THIS MODULARITY CONCEPT IS CONTINUED ON THE DORIAN RESUPPLY TO FACILITATE SIMPLIFIED RESUPPLY INTERFACES.



30 DAY DORIAN SYSTEM

TITAN IIID-5 SEGMENT BOOSTER - 97° INCLINATION, 70-170 N.M. ORBIT



P66 UNMANNED DORIAN SYSTEM

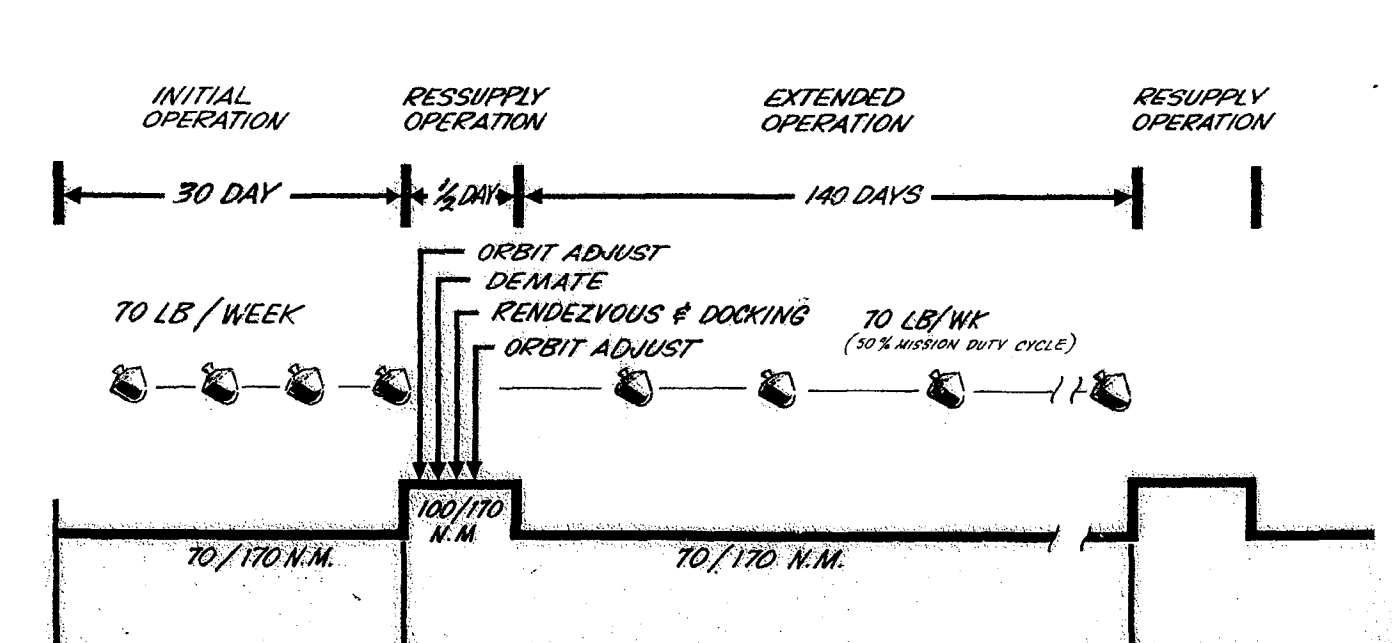
UNMANNED RESUPPLY OF THE P-66 UNMANNED DORIAN SYSTEM WAS CONSIDERED IN THIS STUDY. OTHER ALTERNATIVES SUCH AS MOL/DORIAN RESUPPLY AND MAN-ASSISTED RESUPPLY HAVE BEEN CONSIDERED ONLY IN TERMS OF DETERMINING ROM COSTS. HOWEVER MANY OF THE FACTORS DEVELOPED HERE FOR THE P-66 SYSTEM ARE PERTINENT TO MOL/DORIAN RESUPPLY.

GROUND RULES AND APPROACHES

- MAINTAIN TOTAL SYSTEM OPERATION AS LONG AS PAYLOAD SYSTEM IS OPERABLE
- RESUPPLY EXPENDABLES AND/OR EQUIPMENT TO EXTEND LIFE
- P-66 ORBIT (70 NM/170 NM, 97° INCL.)
- LONG TERM MATERIAL USAGE RATE 65-70 LB/2 WEEKS
- TITAN CLASS BOOSTERS FOR INITIAL LAUNCH
- MINIMUM COST BOOSTER FOR SUPPORT LAUNCHES
- UNMANNED MISSION AND RESUPPLY OPERATIONS

FOR THE PURPOSE OF THIS STUDY A TYPICAL OVERALL MISSION OPERATIONAL PROFILE WAS CONCEIVED. THE BASIC PREMISE IS A 30 DAY DORIAN MISSION WITH 70 LBS FILM USAGE PER WEEK ON 60 DAY CENTERS (THIS PREMISE WAS USED FOR FUNDED UNMANNED DORIAN STUDY). AS SUCH, THE RESUPPLY SYSTEM PROVIDES SUFFICIENT FILM LOAD FOR A 50% MISSION DUTY CYCLE, I.E., 70 LBS FILM/2 WEEKS. HOWEVER, SUFFICIENT EXPENDABLES ARE PROVIDED TO OPERATE THE VEHICLE IN THE 70 NM/170 NM ORBIT CONTINUOUSLY AFTER RENDEZVOUS AND DOCKING. THIS PROVIDES THE FLEXIBILITY TO PHOTOGRAPH TARGETS OF OPPORTUNITY AT ANY TIME. CAPSULE RECOVERY CAN BE SCHEDULED AFTER EVERY SYNCHRONOUS CYCLE OPERATION.

OVERALL OPERATION



THE RENDEZVOUS AND DOCKING OPERATION UTILIZES APPROACHES DEVELOPED IN THE GEMINI PROGRAM. IT IS CONSIDERABLY SIMPLER THAN THE UNMANNED INSPECTION MISSION FOR WHICH LMSC HAS BEEN DEVELOPING EXPERIMENTAL HARDWARE AND SOFTWARE FOR TWO YEARS.

THE ACQUISITION AND TRACKING RADAR AND DOCKING ADAPTER CAN BE SIMILAR TO THOSE USED ON THE GEMINI PROGRAM. BOTH COMPLETELY AUTOMATIC AND SEMI-AUTOMATIC RENDEZVOUS AND DOCKING (MAN IN THE GROUND LOOP) ARE CONSIDERED AS FEASIBLE METHODS.

RENDEZVOUS AND DOCKING OPERATION

- TARGET EPHEMERIS KNOWN
  - EITHER DIRECT ASCENT OR PARKING ORBIT RENDEZVOUS MAY BE USED
- COOPERATIVE TARGET
  - ADJUST ORBIT FOR RENDEZVOUS AS REQUIRED
  - STABLE
  - BEACON TO AID ACQUISITION AND CLOSING
- DOCKING SYSTEM
  - LARGE INTERFACE AREA FOR ELECTRICAL MATING AND MECHANICAL ALIGNMENT DEVICES
  - ACQUISITION AND TRACKING RADAR
  - ACQUISITION OPTICS
  - COMPUTER
  - BEACON ON PARENT VEHICLE

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DEMATE OPERATION

- MISSION MODULE SEGMENT RETAINS HOUSEKEEPING CAPABILITY AFTER SEPARATION
  - ATTITUDE CONTROL
  - POWER
  - RENDEZVOUS AIDS
  - TT&C
- EXPENDED SEGMENT TRANSFERRED TO LOW ORBIT AFTER SEPARATION TO AVOID COLLISION AND IMPROVE DE-ORBIT.

REPLACEMENT CANDIDATES

- EXPENDABLES
  - FILM
  - RE-ENTRY VEHICLE
  - ORBIT ADJUST PROPELLANT
  - ATTITUDE CONTROL GAS
  - FUEL CELL REACTANT
- VEHICLE EQUIPMENT (RELIABILITY CONSIDERATION)
  - FUEL CELL
  - ATTITUDE REFERECE
  - ATTITUDE ELECTRONIC
  - T, T & C
  - COMPUTER
- MISSION SUPPORT EQUIPMENT (RELIABILITY CONSIDERATION)
  - CAMERA MECHANICS
  - ATTITUDE DETERMINATION EQUIPMENT (STAR TRACKER, GYRO)
  - V/h SENSOR
  - TRACKING MIRROR SERVO AND LOGIC

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RESUPPLY OF EXPENDABLE ITEMS IS SIMPLIFIED BY REPLACING, COMPLETELY OR IN PART, THE SYSTEMS IN WHICH THE EXPENDABLES ARE USED. THE COST AND WEIGHT PENALTIES ASSOCIATED WITH THIS APPROACH ARE MINOR COMPARED WITH RELIABILITY GAINS FROM SIMPLIFIED DOCKING INTERFACES. IN GENERAL, EXPENDABLE RESUPPLY INTERFACES HAVE BEEN REDUCED TO MECHANICAL ATTACHMENT AND ALIGNMENT AND ELECTRICAL CONNECTORS

EXPENDABLE RESUPPLY CONSIDERATIONS

EXPENDABLE RESUPPLY ITEM	HARDWARE ITEMS RESUPPLIED TO SIMPLIFY INTERFACES	REMAINING INTERFACES	REQUIRED TECHNOLOGY	REASONS FOR RESUPPLY
ORBIT ADJUST PROPELLANT	TANKS, PLUMBING, MOTOR	ALIGNMENT WITH VEHICLE POWER COMMAND STATUS DATA	SELF ALIGNMENT DEVICES ELECTRICAL CONNECTORS	PROPELLANT DEPLETION
REACTION CONTROL PROPELLANT	TANKS, PLUMBING, THRUSTERS	SAME AS ABOVE	SAME AS ABOVE	PROPELLANT DEPLETION
FUEL CELL REACTANTS	TANKS, PLUMBING, FUEL CELLS	POWER COMMAND STATUS DATA	SAME AS ABOVE	REACTANT DEPLETION
FILM, RV's	FILM TRANSPORT	ALIGNMENT WITH CAMERA POWER COMMAND STATUS DATA FILM FEED THRU CAMERA	SAME AS ABOVE, ALSO CUT AND SPLICE OR SEPARABLE CAMERA BACK	FILM SUPPLY & RV DEPLETION
	FILM TRANSPORT, CAMERA MECHANISM	ALIGNMENT WITH ROSS TUBE* POWER COMMAND STATUS DATA FRAME DATA	SELF ALIGNMENT DEVICES LARGE CAPACITY SIGNAL INTERFACE (400-600 LEADS)	DAMAGED FILM SUPPLY

*ALIGNMENT MAY BE AUTOMATIC WITH FILM TRANSPORT INSTALLATION

RESUPPLY OF EQUIPMENT IS BASED ON TWO CRITERIA

- o EXPECTED LIFE
- o COMPLEXITY OF INTERFACES

TO SIMPLIFY INTERFACES IT IS DESIRABLE TO GROUP THOSE UNITS OF EQUIPMENTS WHICH HAVE A HIGH NUMBER OF ELECTRICAL INTERCONNECTIONS INTO A SINGLE REPLACEMENT ASSEMBLY AND TO REDUCE THE INTERFACE REQUIREMENT TO MECHANICAL ALIGNMENT WHEREVER POSSIBLE.

A SECOND CRITERION IS TO GROUP EQUIPMENT OF ABOUT EQUAL EXPECTED LIFE TOGETHER SO THAT MAXIMUM UTILIZATION IS ACHIEVED. THE P-66 RELIABILITY REQUIREMENTS INCLUDED THE STIPULATION THAT NO SINGLE EQUIPMENT FAILURE WOULD RESULT IN LOSS OF A PRODUCTIVE MISSION. AS A RESULT, STANDBY REDUNDANCY WAS REQUIRED IN THE SGLS, ATTITUDE CONTROL ELECTRONICS, COMPUTER, DATA ADAPTERS, AND SIMILAR UNITS.

EQUIPMENT RESUPPLY CONSIDERATIONS

RESUPPLY ITEM	REASON FOR RESUPPLY	ITEMS RESUPPLIED TO SIMPLIFY INTERFACES	REMAINING INTERFACES	REQUIRED TECHNOLOGY
CAMERA MECHANISM (INCLUDING PRESSURIZATION)	FAILURE OR LIFE EXPECTANCY INTERFACE SIMPLICITY	FILM SUPPLY FILM TRANSPORT	SIGNALS, POWER, MECHANICAL ALIGNMENT, ENVIRONMENT RADIATION	COMMAND/DATA INTERFACE UNITS DOCKING ADAPTER TECHNIQUES SHIELDING USABLE FILM
MISSION COMPUTERS, BULK STORAGE UNIT AND DAU's	FAILURE OR LIFE EXPECTANCY	SGLS, ATTITUDE CONTROL MODULE, V/h SENSOR, STAR ACQ, & TRACKING	SIGNALS, POWER	USE GEMINI MULTIPLEXING, SINGLE DUAL WIRE PLUG FOR TM/COMMANDS
SGLS	FAILURE OR LIFE EXPECTANCY	MISSION COMPUTERS, ATTITUDE CONTROL MODULE, DATA ADAPTER UNIT	SIGNALS, POWER	SAME AS ABOVE
ATTITUDE CONTROL ELECTRONICS	FAILURE OR LIFE EXPECTANCY	MISSION COMPUTERS, DATA ADAPTER UNITS, SGLS,	SIGNALS, POWER, ALIGNMENT	PRECISE ALIGNMENT DOCKING
STAR ACQUISITION AND TRACKING	FAILURE OR LIFE EXPECTANCY	MISSION COMPUTERS, SGLS, DATA ADAPTER, V/h SENSOR	PRECISE ALIGNMENT TO OPTICS POINTING REFERENCE POWER, SIGNALS	ALIGNMENT WITH TRACKING MIRROR ASSEMBLY
FILM TRANSPORT	FAILURE, INTERFACE SIMPLICITY	CAMERA, RV's, FILM SUPPLY, PRESSURIZATION	MECHANICAL LINKAGE ENVIRONMENT	LIGHT TIGHT MECHANISMS, CUT AND SPLICE ALIGNMENT TECHNIQUES
TRACKING MIRROR SERVO AND LOGIC	FAILURE OR LIFE EXPECTANCY	COMPUTER AND DAU SGLS	TRACKING MIRROR	INTERFACE WITH TRACKING MIRROR ASSEMBLY

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THE COST COMPARISONS PRESENTED ARE BASED ON THE FOLLOWING ASSUMPTIONS

		MOL	P-66	P-66 W/RESUPPLY	
				Initial	Resupply
BOOSTER	$M	17.0	15.0	15.0	15.0
MISSION MODULE		35.0	35.0	35.0	
MISSION SUPPORT & CONTROL MODULES		50.0	12.0	12.0	14.3
TOTAL		102.0	62.0	62.0	29.3

FOR MOL AND P-66, SIX LAUNCHES PER YEAR OF 30-DAY LIFE VEHICLES WERE ASSUMED. FOR P-66 WITH RESUPPLY, AN INITIAL LAUNCH FOLLOWED BY THREE 130-140 DAY RESUPPLY VEHICLES WAS USED. THE REST OF THE STUDY PRESENTS THE DETAILS OF THE P-66 RESUPPLY CONCEPT.

ROM ANNUAL RECURRING HARDWARE COST

SYSTEM	ANNUAL COST	SAVINGS VS. MOL
MOL	$612,000,000	-
P-66	$378,000,000	$234,000,000
P-66 RESUPPLY	$149,000,000	$463,000,000

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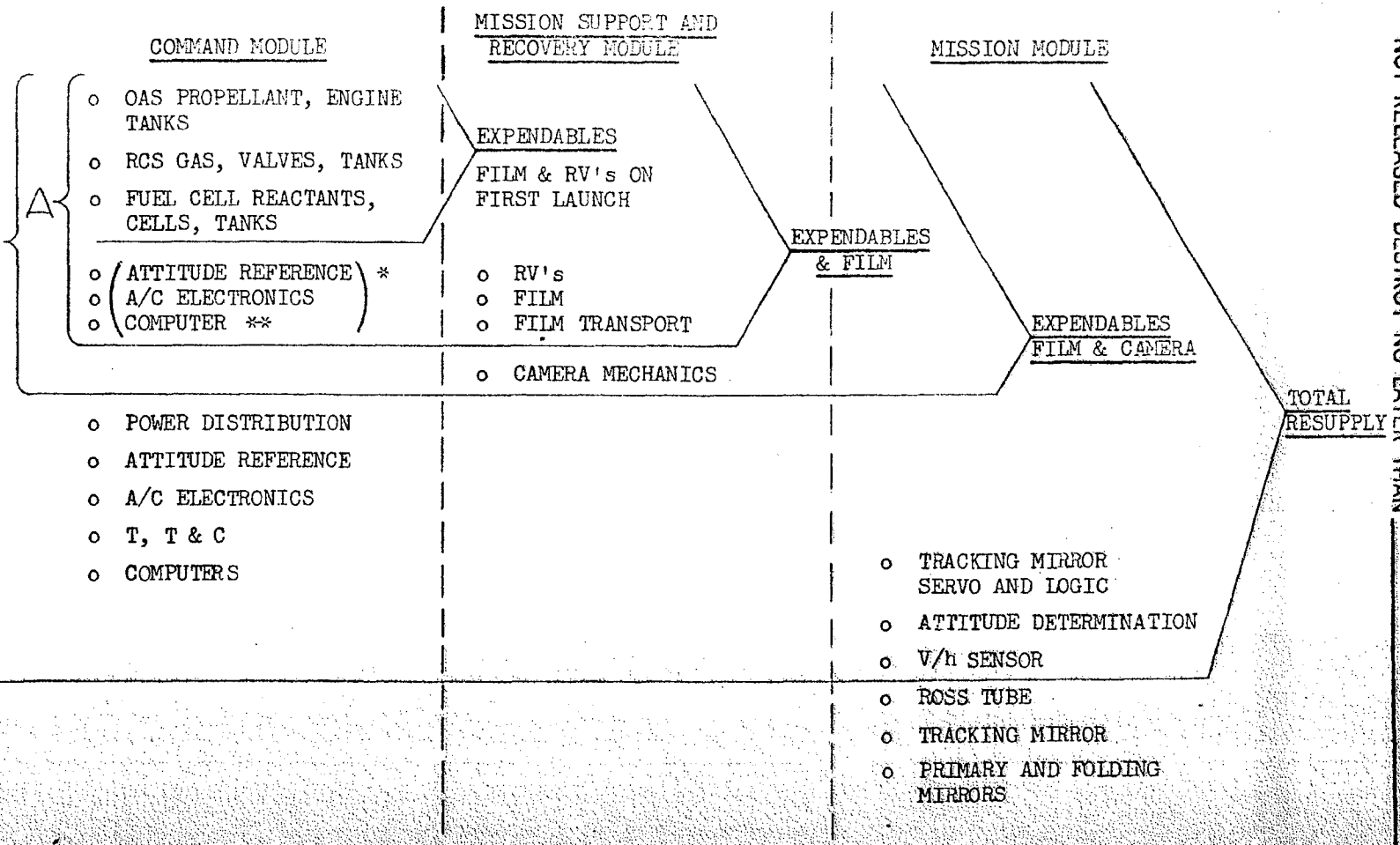
THE DEPLETION, EQUIPMENT FAILURE, AND RESUPPLY INTERFACE CONSIDERATIONS PRESENTED IN THE PREVIOUS CHARTS LEAD TO THE RESUPPLY MODES SHOWN HERE. FROM EXPENDABLES, FILM AND RV's, THE RESUPPLY LIST CAN BE EXPANDED TO INCLUDE ALL EQUIPMENT SUBJECT TO FAILURE IN OPERATION. IN A MAXIMUM RESUPPLY MODE, MISSION SUPPORT MODULE AND CONTROL MODULE MIGHT BE REPLACED COMPLETELY, AND THE ELECTRO-MECHANICAL ELEMENTS OF THE MISSION MODULE AS WELL. A, B AND C AT THE LEFT IDENTIFY RESUPPLY MODES FOR WHICH VEHICLE CONFIGURATIONS ARE DEVELOPED IN THE FOLLOWING PAGES.

THE GUIDANCE AND TT&C EQUIPMENT OF THE RESUPPLY VEHICLE CAN BE USED ON ORBIT AS MISSION EQUIPMENT AND THEREFORE OFFERS ADDITIONAL BACKUP IN THESE FUNCTIONS.

RESUPPLY MODES



*USED FOR ASCENT, RENDEZVOUS DOCKING, AVAILABLE AS ON-ORBIT BACKUP

**THE MISSION COMPUTER OF THE PARENT VEHICLE CAN ALSO BE USED FOR RENDEZVOUS.

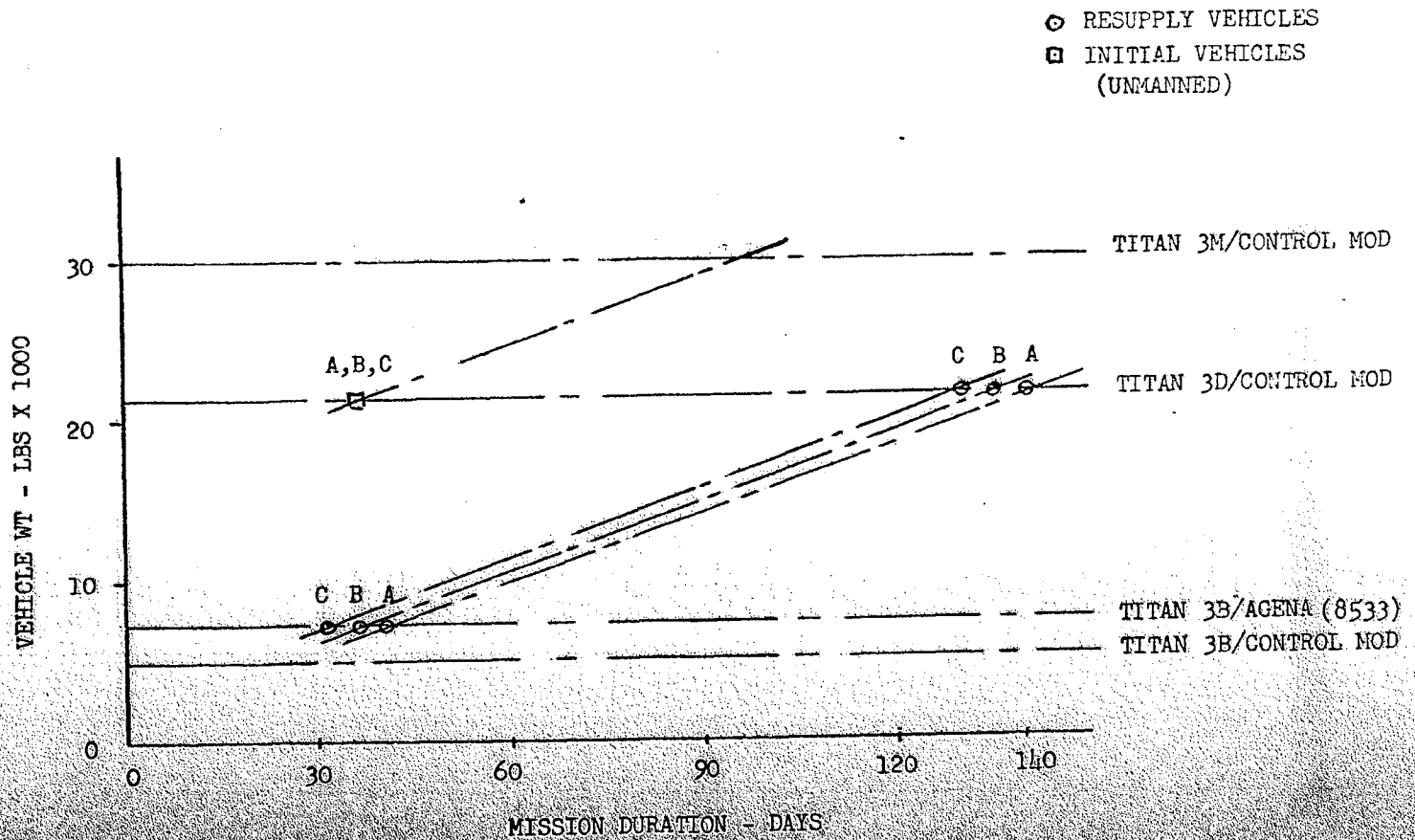
THE INDICATED LIFETIMES ARE ACHIEVED BY PROVISIONING THE VEHICLES WITH EXPENDABLE ITEMS TO THE LIMIT OF BOOSTER WEIGHT CAPABILITY. THE BREAKDOWN OF THESE ITEMS IS SHOWN BELOW FOR EACH OF THE CONFIGURATIONS. THE LARGE ORBIT ADJUST AND REACTION CONTROL PROPELLANT REQUIREMENTS REFLECT THE HEAVY DRAG ENVIRONMENT OF THE 70 NM/170 NM ORBIT IN WHICH THE VEHICLES ARE MAINTAINED. BOOSTERS WITH LESS CAPABILITY THAN TIIIB/AGENA (e.g., TIIIB/CONTROL MODULE) DO NOT PROVIDE RESUPPLY LIFETIMES LONG ENOUGH TO BE OPERATIONALLY OR ECONOMICALLY ATTRACTIVE.

		CONFIGURATION A		CONFIGURATION B		CONFIGURATION C	
INITIAL LAUNCH	RV's	4 MK 5		4 MK 5		4 MK 5	
	FILM	280 LB		280 LB		280 LB	
	ORBIT ADJUST PROP	2650		2650		2650	
	REACTION CONT. PROP	590		590		590	
	ELECT POWER	560		560		560	
		TIIID	TIIIB/AGENA	TIIID	TIIIB/AGENA	TIIID	TIIIB/AGENA
RESUPPLY LAUNCH	RV's	8 MK5	2 MK5	8 MK5	2 MK5	8 MK5	2 MK5
	FILM	560 LB	140 LB	560 LB	140 LB	520 LB	140 LB
	ORBIT ADJUST PROP	11200	2870	10850	2620	10400	2270
	REACTION CONT.PROP	1250	200	1200	200	1170	200
	ELECT POWER	SOLAR ARRAY	560 F.C. REACTANT	SOLAR ARRAY	560 F.C. REACTANT	SOLAR ARRAY	560 F.C. REACTANT

MISSION LIFE CAPABILITIES

70 NM/170 NM ORBIT

97° INCLINATION



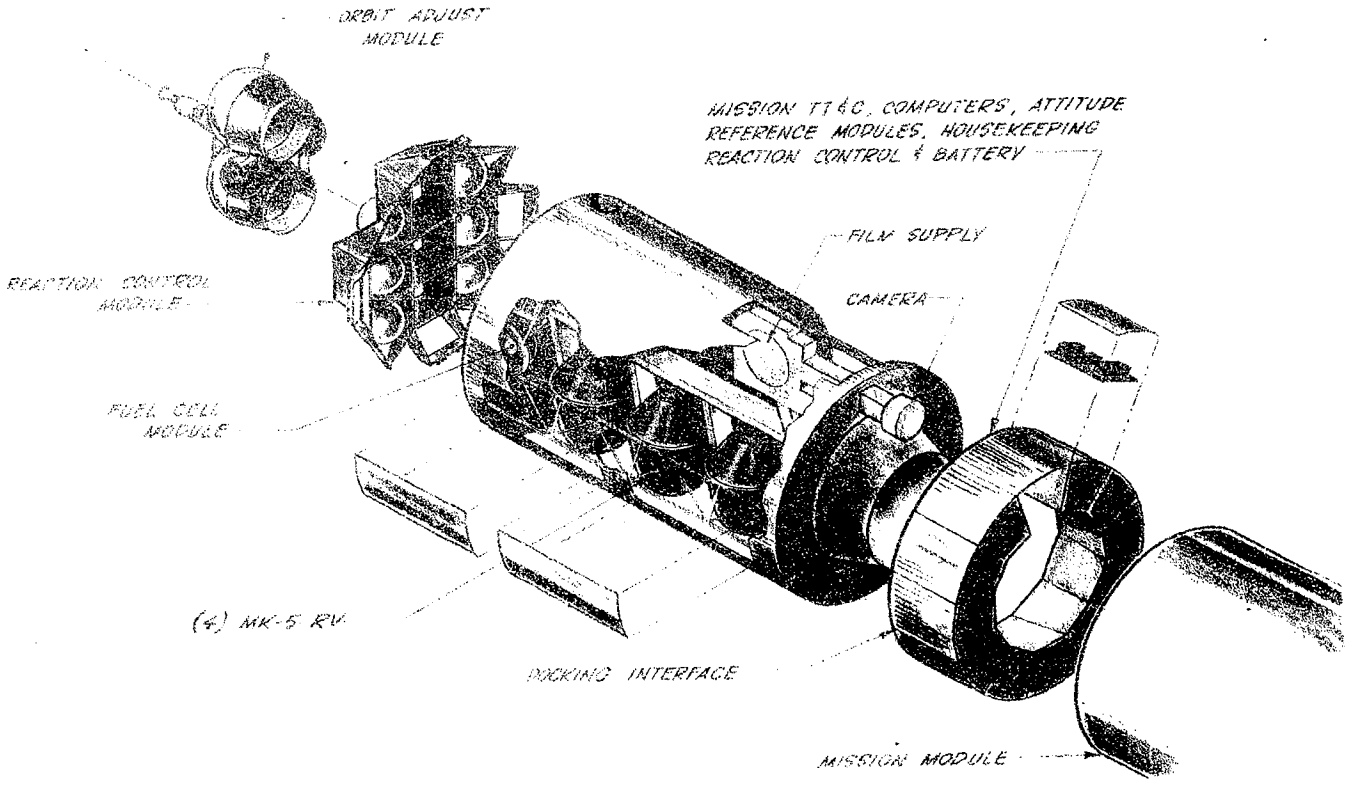
THE CHARACTERISTICS OF THE CONFIGURATIONS DEVELOPED FOR UNMANNED RESUPPLY ARE DETAILED IN THIS CHART. SUBSYSTEM EQUIPMENT AND LIFETIME ARE THE SAME FOR ALL THREE CONFIGURATIONS AT INITIAL LAUNCH. RESUPPLY DIFFERENCES ARE NOTED IN THE ATTITUDE CONTROL TT&C AND MISSION EQUIPMENT AREAS. THE SMALL EFFECT OF THESE RESUPPLY DIFFERENCES ON LIFETIME IS INDICATED

CONFIGURATION SUMMARY

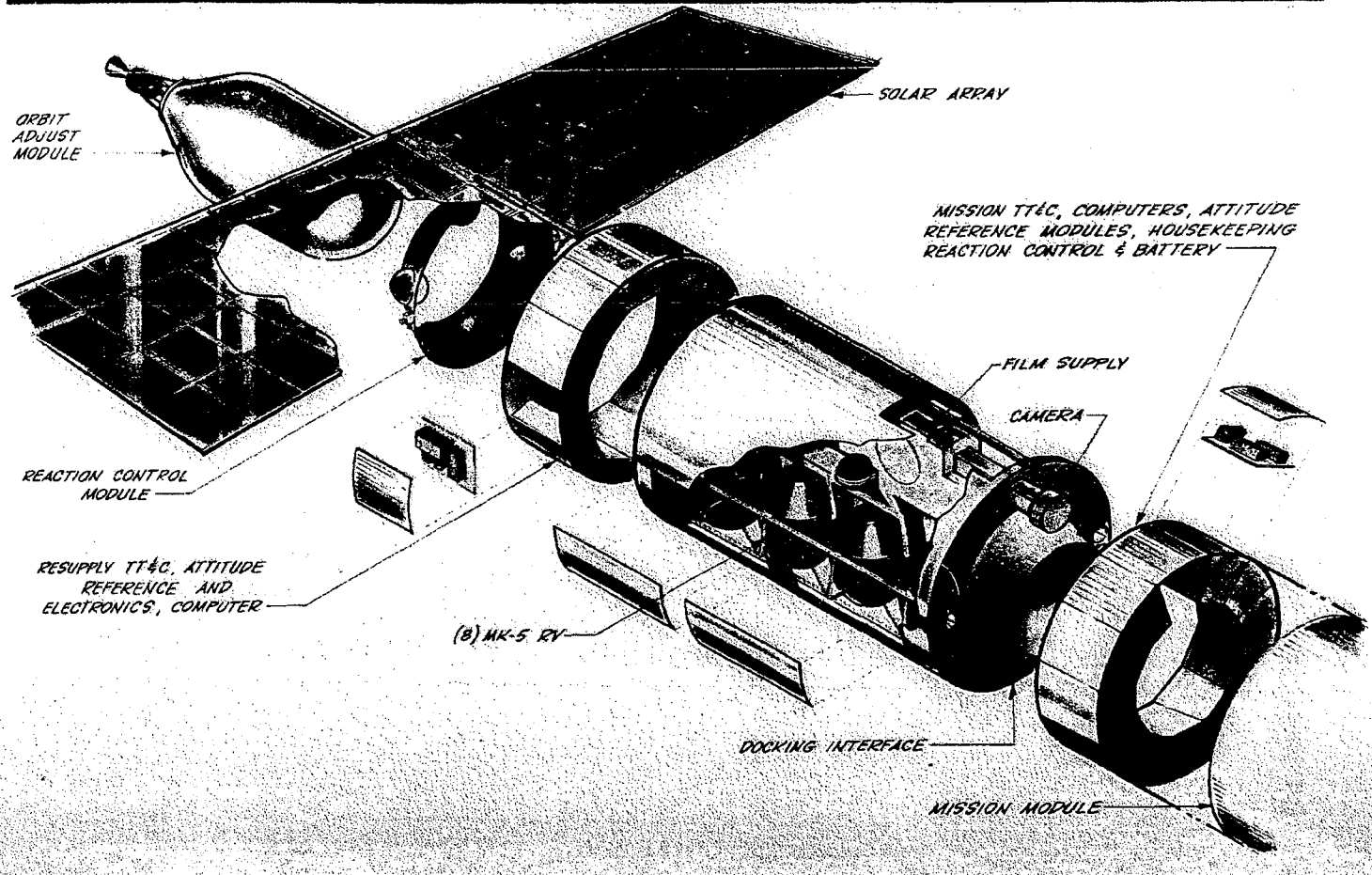
	A		B		C	
○ INITIAL LAUNCH						
BOOSTER	TIID		TIIID		TIIID	
MISSION LIFE	35 DAYS		35 DAYS		35 DAYS	
ORBIT ADJUST	BIPROPELLANT		BIPROPELLANT		BIPROPELLANT	
ELECTRICAL	FUEL CELL		FUEL CELL		FUEL CELL	
ATTITUDE CONTROL	H/S, STRAP DOWN GYRO, HOT GAS		H/S, STRAP DOWN GYRO, HOT GAS		H/S STRAP DOWN GYRO, HOT GAS	
TT&C	SGLS, COMPUTER		SGLS, COMPUTER		SGLS, COMPUTER	
FILM LOAD	280 LB		280 LB		280 LB	
RV's	4 MK 5		4 MK 5		4 MK 5	
PAYLOAD	MISSION MODULE		MISSION MODULE		MISSION MODULE	
○ RESUPPLY LAUNCH						
BOOSTER	TIIID	TIIIB/AGENA	TIIID	TIIIB/AGENA	TIIID	TIIIB/AGENA
MISSION LIFE	140 DAYS	40 DAYS	135 DAYS	36 DAYS	130 DAYS	32 DAYS
ORBIT ADJUST	PROPULSION SYSTEM AND PROPELLANT		PROPULSION SYSTEM AND PROPELLANT		PROPULSION SYSTEM AND PROPELLANT	
ELECTRICAL	SOLAR ARRAY	FUEL CELL SYST & REACTANTS	SOLAR ARRAY	FUEL CELL SYST & REACTANTS	SOLAR ARRAY	FUEL CELL SYST & REACTANTS
ATTITUDE CONTROL	THRUSTERS & PROPELLANT 1/		THRUSTERS & PROPELLANT 1/		THRUSTERS & PROPELLANT, ATTITUDE REF. & ELECTRONICS 1/	
TT&C	2/		2/		SGLS AND COMPUTER 2/	
MISSION EQUIPMENT	FILM TRANSPORT		FILM TRANSPORT & CAMERA		FILM TRANSPORT, CAMERA, ATT. DETERMINATION, TRACKING MIRROR SERVO & LOGIC, V/h SENSOR	
FILM	560 LB	140 LB	560 LB	140 LB	560 LB	140 LB
RV's	4 MK 5	2 MK 5	8 MK 5	2 MK 5	8 MK 5	2 MK 5

1/ RESUPPLY VEHICLE ATTITUDE REFERENCE AND ELECTRONICS AVAILABLE AS BACK-UP.
2/ RESUPPLY VEHICLE SGLS AND (RENDEZVOUS) COMPUTER AVAILABLE AS BACK-UP.

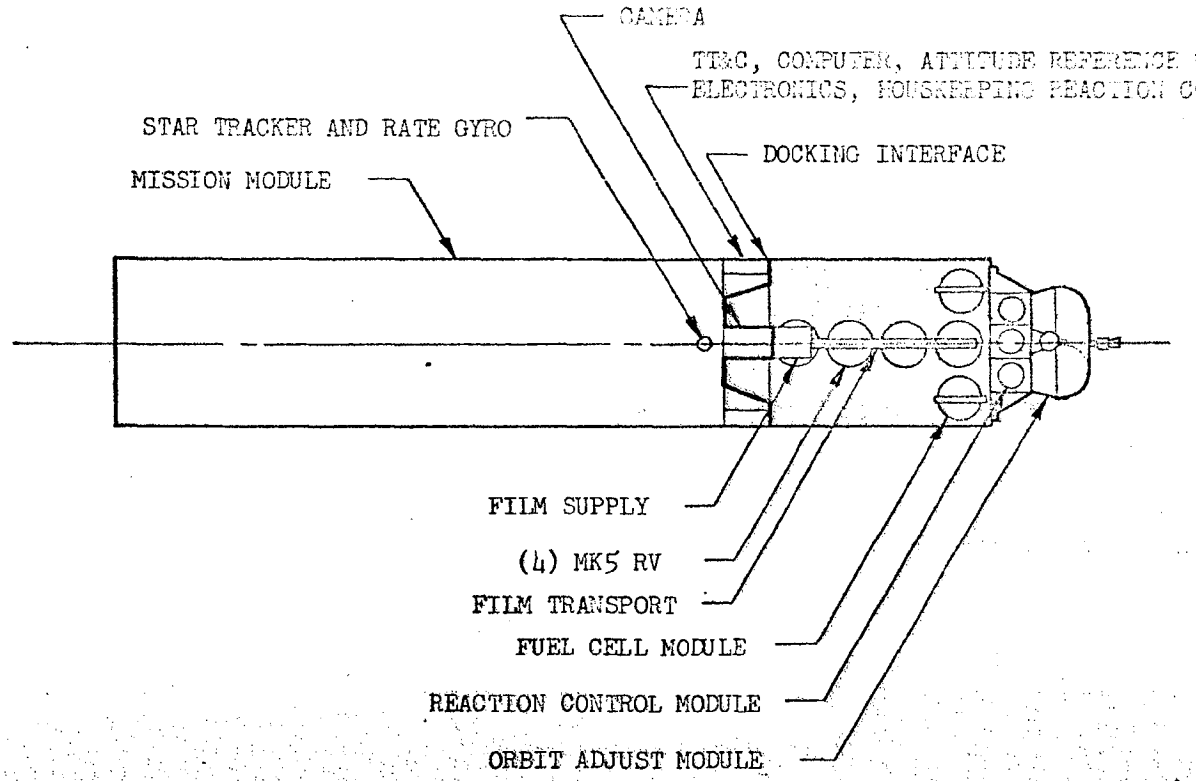
INITIAL SATELLITE VEHICLE



RESUPPLY SATELLITE VEHICLE



THIS CONFIGURATION IS DESIGNED FOR EXPENDABLE RESUPPLY. THE SATELLITE VEHICLE IS LAUNCHED ON A TITAN IIID BOOSTER AND PROVIDES EXPENDABLES FOR 35 DAYS IN ORBIT. AT THE END OF THAT TIME THE EXPENDABLE MODULES (SHADED) ARE SEPARATED FROM THE MISSION MODULE ON THE LEFT, TO BE REPLACED BY A RESUPPLY VEHICLE. A SEGMENTED CYLINDRICAL SECTION ATTACHED AFT OF THE MISSION MODULE CONTAINS MISSION EQUIPMENT AND A DOCKING ADAPTER AS WELL AS A BATTERY AND REACTION CONTROL EXPENDABLES FOR MAINTENANCE IN ORBIT BETWEEN SEPARATION AND RESUPPLY. CONFIGURATION A VEHICLES ARE NOT RESUPPLIED WITH CAMERAS BUT ONLY WITH FILM AND THE TRANSPORT SYSTEM. THEREFORE, CUT AND SPLICE DEVICES OR A FILM PACK FOR A REDESIGNED CAMERA ARE REQUIRED AT THE INTERFACE.



CONFIGURATION A - INITIAL SATELLITE VEHICLE

(TITAN IIID)

THE SHADED PORTION OF THE RESUPPLY VEHICLE IS LAUNCHED, LIKE THE INITIAL SATELLITE VEHICLE, ON THE TITAN IIID VEHICLE. IT IS ALSO A MODULARIZED SYSTEM AND CONTAINS EXPENDABLES FOR UP TO 140 DAYS. IT CONTAINS AN ACQUISITION AND TRACKING SYSTEM CONSISTING OF RADAR AND OPTICS UTILIZED DURING THE RENDEZVOUS AND DOCKING SEQUENCE. BECAUSE OF THE LONG ORBIT LIFETIME, A SINGLE-AXIS PROGRAMMABLE SOLAR ARRAY MODULE REPLACES THE FUEL CELL MODULE FOR PRIMARY POWER. THIS CONCEPT MAINTAINS THE MAXIMUM NUMBER OF MISSION SUPPORT FUNCTIONS IN ORBIT AT ALL TIMES AND RESUPPLIES ONLY EXPENDABLES AND THE MINIMUM MISSION EQUIPMENT.

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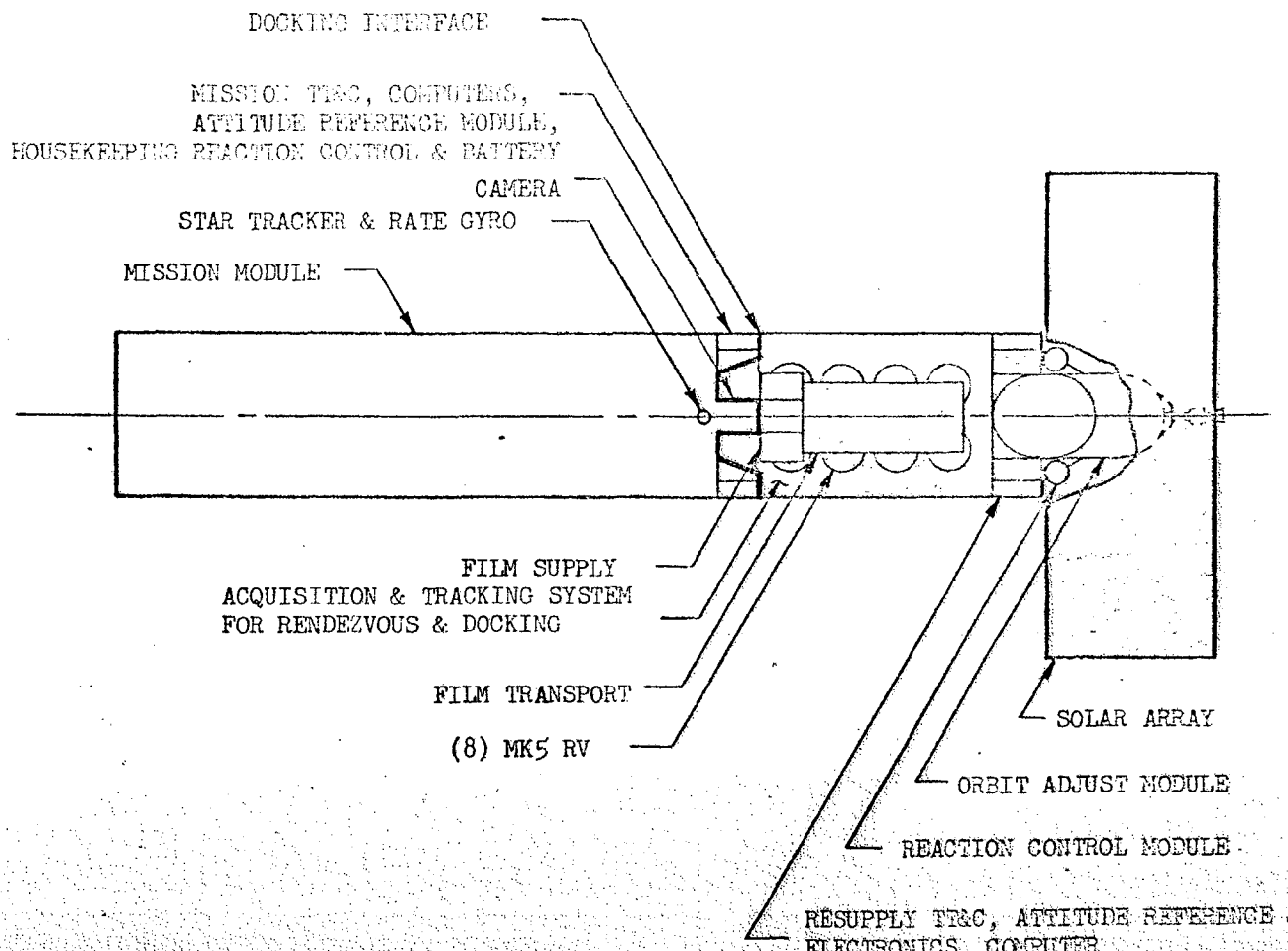
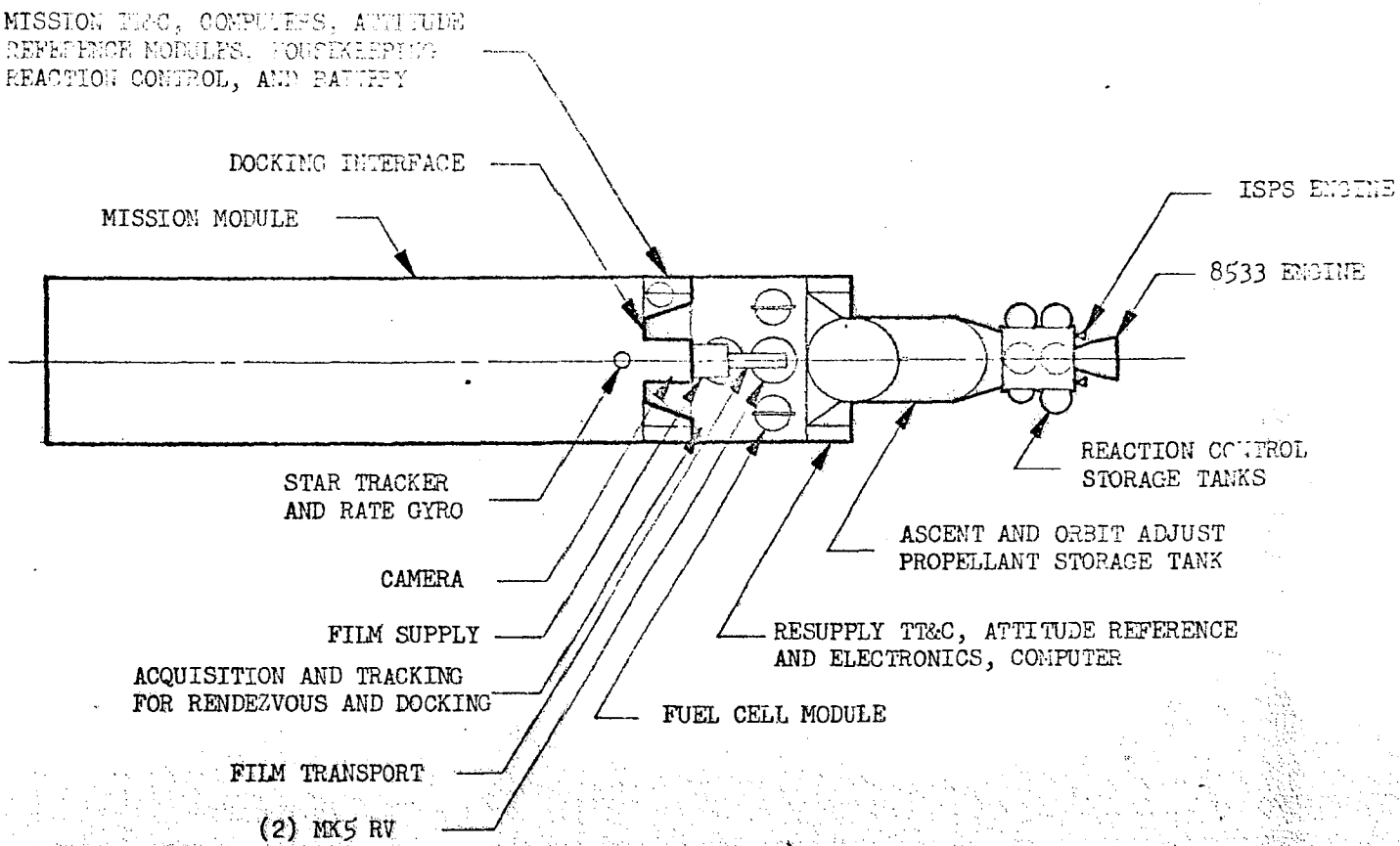


CONFIGURATION A - RESUPPLY SATELLITE VEHICLE

(TITAN IIID)

THIS ALTERNATE RESUPPLY VEHICLE, REPRESENTED BY THE RIGHT-HAND SHADED PORTION OF THE SATELLITE, IS LAUNCHED BY THE TITAN IIIB/ AGENA. AFTER MATING WITH THE QUIESCENT MISSION MODULE, THE PROPELLANTS RESERVED IN THE AGENA TANK ARE UTILIZED FOR ORBIT ADJUST IMPULSE BY MEANS OF THE ISPS ENGINES. A FUEL CELL MODULE AND TWO RV's ARE PROVIDED WITH THIS RESUPPLY VEHICLE BECAUSE OF THE LIMITED ORBITAL LIFETIME (40 DAYS). OTHERWISE THE ELECTRICAL AND ELECTRONIC COMPONENTS ARE THE SAME AS THOSE INCORPORATED IN THE TIIID-LAUNCHED RESUPPLY VEHICLE.



CONFIGURATION A - ALTERNATE RESUPPLY SATELLITE VEHICLE

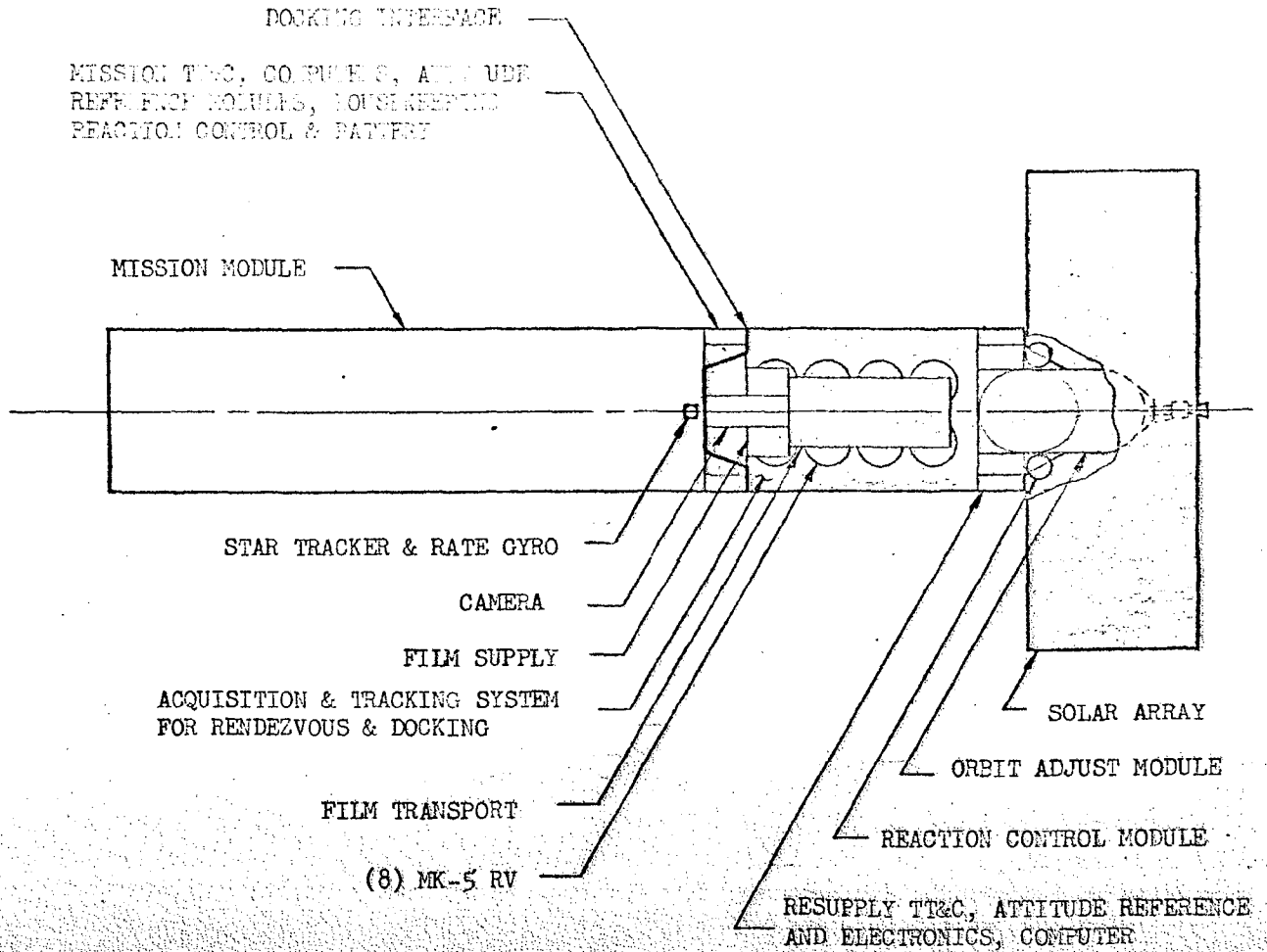
(TITAN IIIB/AGENA)

IN ADDITION TO THE EXPENDABLES, THIS CONFIGURATION ALSO RESUPPLIES THE CAMERA MECHANICS. THE VEHICLE IS LAUNCHED ON THE TITAN IIID BOOSTER AND PROVIDES EXPENDABLES FOR 35 DAYS IN ORBIT. AT THE END OF THAT TIME THE EXPENDABLE MODULES (REPRESENTED BY THE SHADED AREA) ARE SEPARATED FROM THE MISSION MODULE TO BE REPLACED BY A RESUPPLY VEHICLE. A SEGMENTED CYLINDRICAL SECTION ATTACHED AFT OF THE MISSION MODULE CONTAINS MISSION EQUIPMENT AND A DOCKING ADAPTER AS WELL AS A BATTERY AND REACTION CONTROL EXPENDABLES FOR MAINTENANCE IN PERIODS BETWEEN SEPARATION AND SUBSEQUENT RESUPPLY. CONFIGURATION B VEHICLES ARE RESUPPLIED WITH CAMERAS AS WELL AS FILM AND A TRANSPORT SYSTEM. THE DOCKING INTERFACE THEREFORE REQUIRES ONLY A LOCATING AND LOCKING MECHANISM FOR THE CAMERA SYSTEM TO ASSURE ACCURATE ALIGNMENT.

CONFIGURATION B - INITIAL SATELLITE VEHICLE

(TITAN IIID)

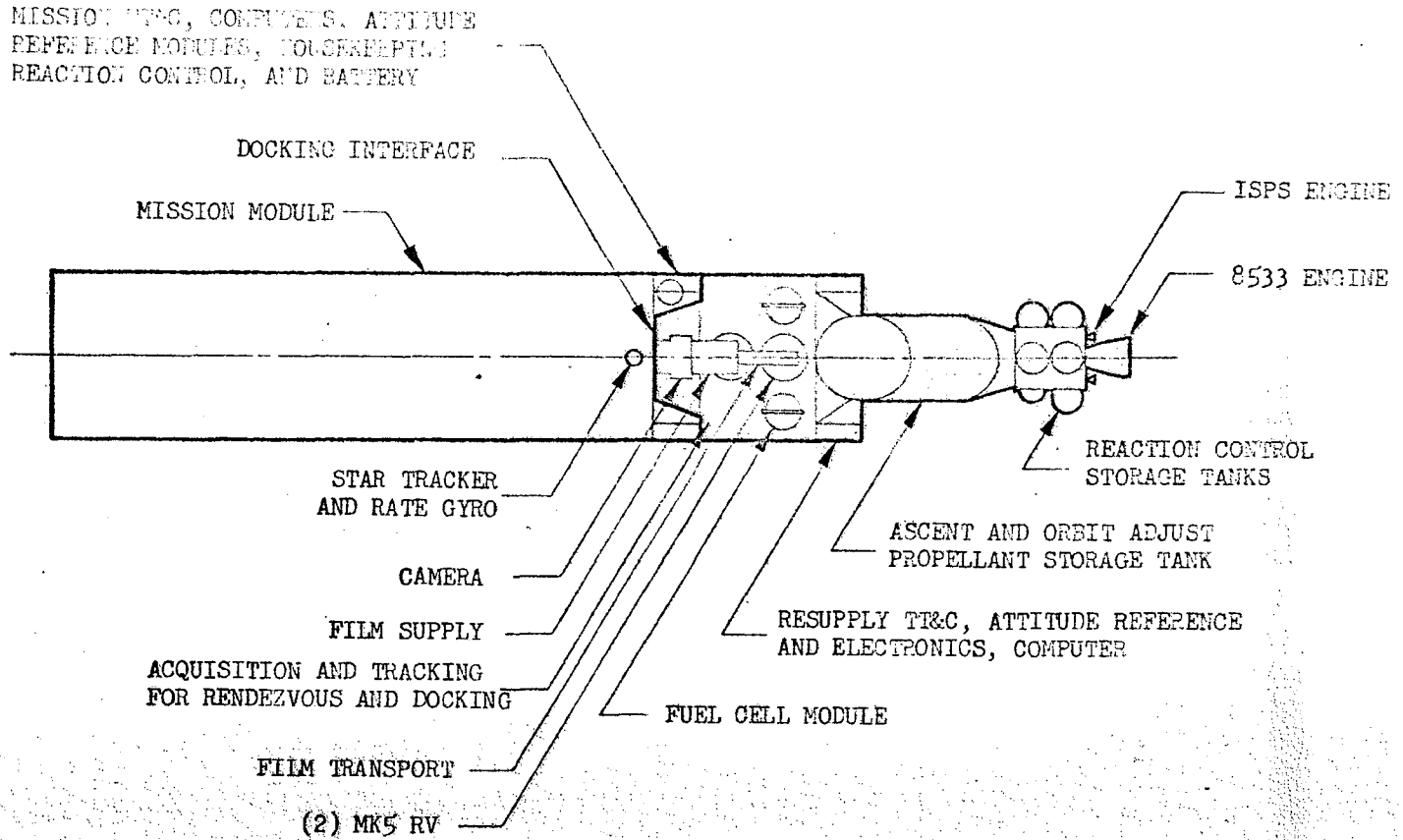
THE SHADED RESUPPLY VEHICLE ON THE RIGHT IS LAUNCHED, LIKE THE INITIAL SATELLITE VEHICLE, BY THE TITAN IIID. IT IS ALSO A MODULARIZED SYSTEM BUT CONTAINS EXPENDABLES FOR UP TO 135 DAYS. IT CONTAINS AN ACQUISITION AND TRACKING SYSTEM CONSISTING OF RADAR AND OPTICS FOR RENDEZVOUS AND DOCKING. A SINGLE-AXIS TRACKING SOLAR ARRAY MODULE REPLACES THE FUEL CELL MODULE IN THE INITIAL VEHICLE BECAUSE OF THE LONG ORBIT LIFETIME. THIS CONCEPT MAINTAINS THE MAXIMUM NUMBER OF MISSION SUPPORT FUNCTIONS IN ORBIT AT ALL TIMES AND RESUPPLIES ONLY NECESSARY EXPENDABLES AND THE MINIMUM MISSION EQUIPMENT.



CONFIGURATION B - RESUPPLY SATELLITE VEHICLE

(TITAN IIID)

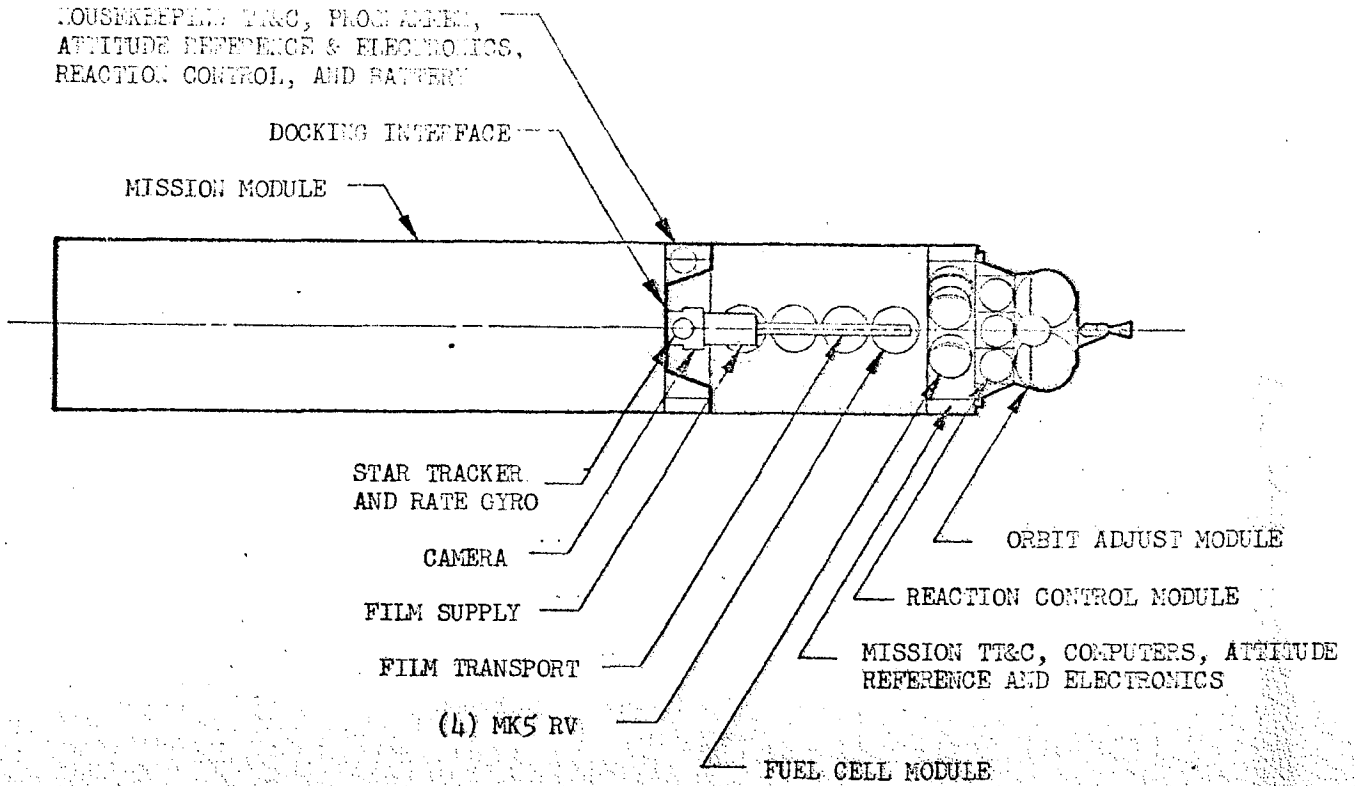
THE ALTERNATE RESUPPLY VEHICLE, REPRESENTED BY THE RIGHT-HAND SHADED PORTION OF THE SATELLITE, IS LAUNCHED BY THE TITAN IIIB WITH THE AGENA UPPER STAGE. AFTER MATING WITH THE MISSION MODULE THE PROPELLANTS REMAINING IN THE AGENA TANK ARE UTILIZED FOR ORBIT ADJUST BY USE OF THE ISPS ENGINES. A FUEL CELL MODULE AND ONLY TWO RVs ARE PROVIDED WITH THIS RESUPPLY VEHICLE BECAUSE OF THE LIMITED (36 DAYS) ORBITAL LIFETIME AND BOOSTER SYSTEM WEIGHT CAPABILITY LIMITATIONS. OTHERWISE THE ELECTRICAL AND ELECTRONIC COMPONENTS ARE THE SAME AS THOSE INCORPORATED IN THE TIIID-LAUNCHED RESUPPLY VEHICLE.



CONFIGURATION B - ALTERNATE RESUPPLY SATELLITE VEHICLE

(TITAN IIIB/AGENA)

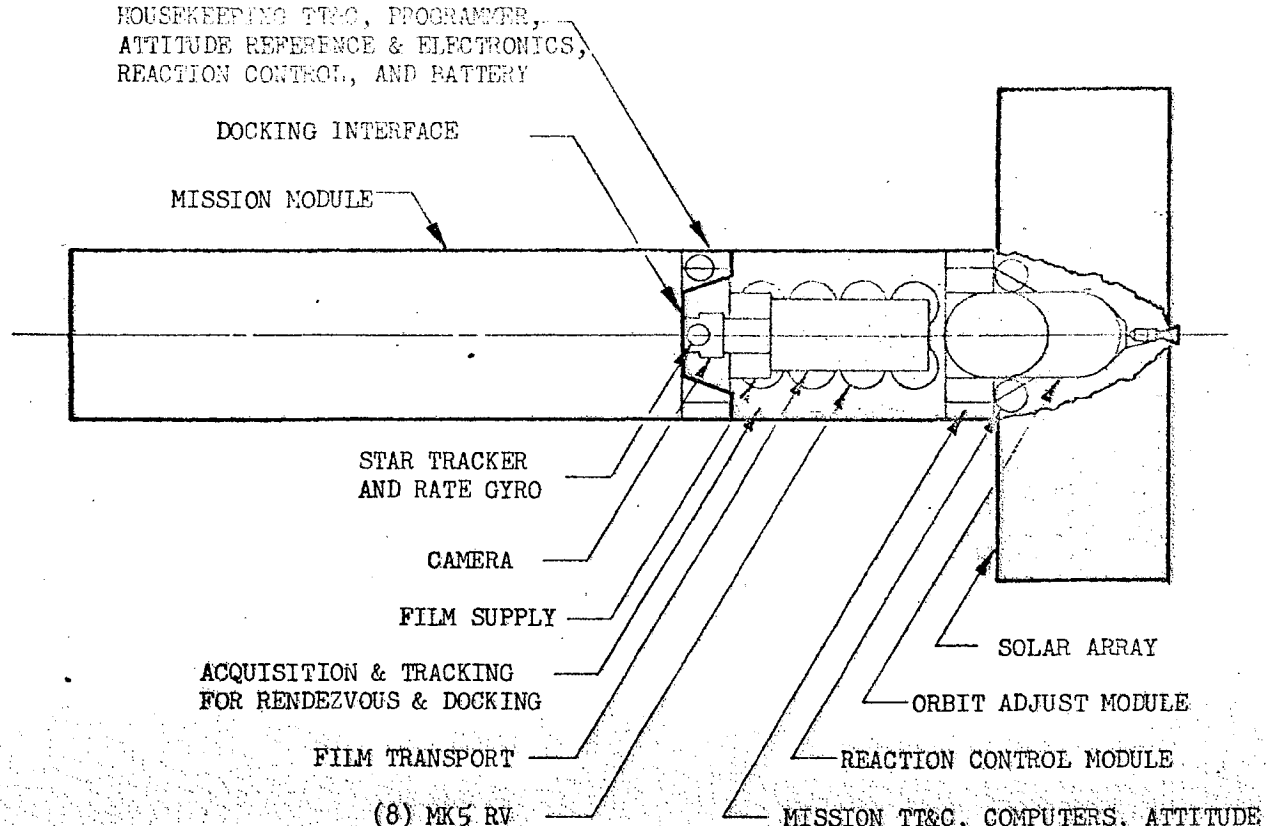
THIS SATELLITE VEHICLE IS LAUNCHED BY THE TIIID AND CONTAINS EXPENDABLES FOR 35 DAYS IN ORBIT. AFTER THAT THE INTEGRATED SCS AND MSM (SHADED) ARE SEPARATED AT THE DOCKING INTERFACE TO BE SUBSEQUENTLY REPLACED BY A RESUPPLY VEHICLE. THE SEGMENTED CYLINDRICAL SECTION AFT OF THE MISSION MODULE CONTAINS ONLY EQIUIPMENT AND EXPENDABLES NECESSARY FOR MAINTENANCE (HOUSEKEEPING) FUNCTIONS AND A DOCKING ADAPTER. CONFIGURATION C RESUPPLY VEHICLES REPLACE THE COMPLETE CAMERA/FILM/TRANSPORT SYSTEM, THE STAR TRACKER AND RATE GYRO PREVIOUSLY CONTAINED IN THE MISSION MODULE, AND ALL THE NECESSARY EXPENDABLES. THE DOCKING INTERFACE REQUIRES A LOCATING AND LOCKING MECHANISM FOR ACCURATE ALIGNMENT OF THE CAMERA SYSTEM WITH THE ROSS TUBE.



CONFIGURATION C - INITIAL SATELLITE VEHICLE

(TITAN IIID)

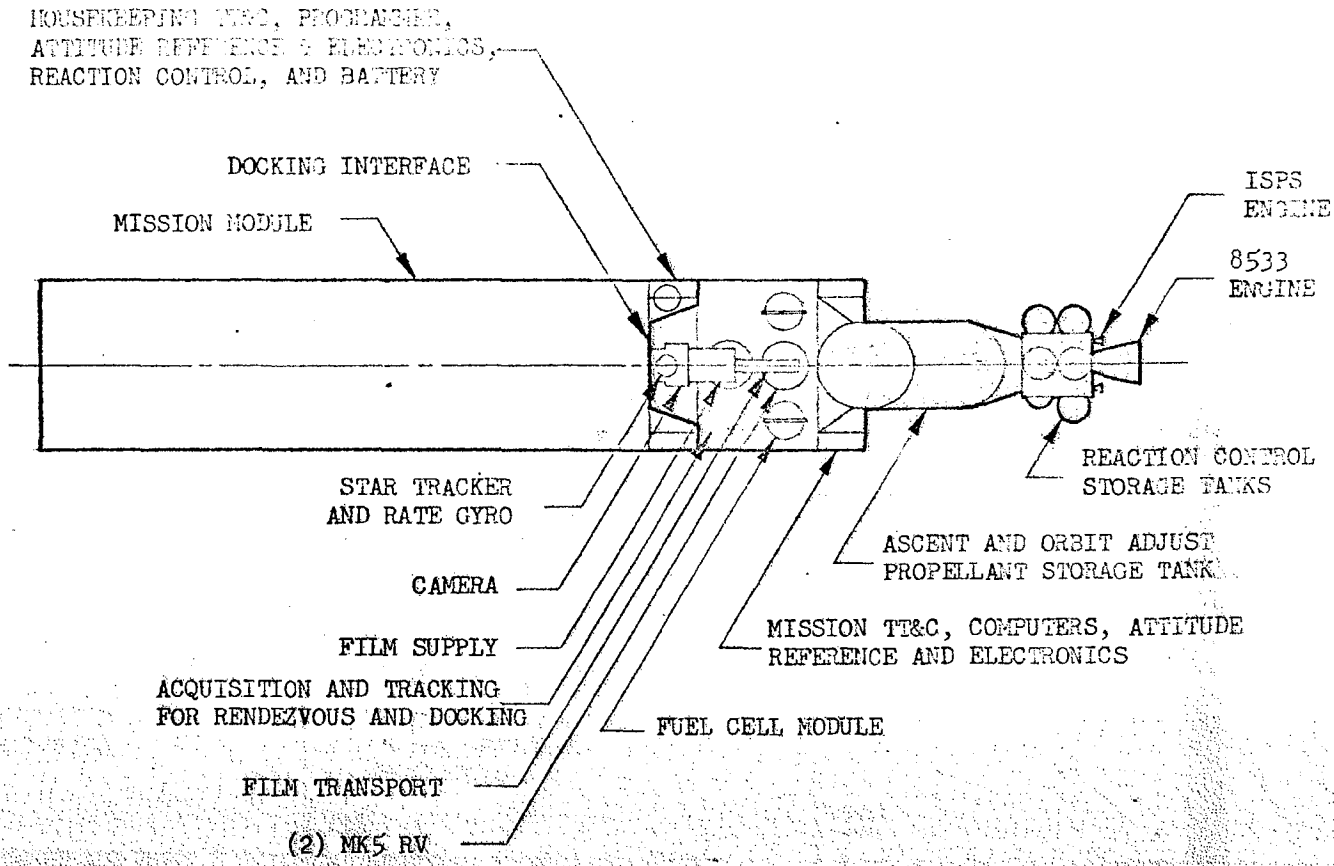
THIS MODULARIZED RESUPPLY VEHICLE (SHADED), CONTAINING ASCENT EQUIPMENT AND EXPENDABLES FOR UP TO 130 DAYS, IS LAUNCHED BY THE TIIID VEHICLE. A SINGLE-AXIS TRACKING SOLAR ARRAY MODULE REPLACES THE FUEL CELL MODULE IN THE INITIAL VEHICLE BECAUSE OF THE LONG ORBIT LIFETIME. THIS VEHICLE ALSO CONTAINS AN ACQUISITION AND TRACKING SYSTEM, CONSISTING OF RADAR AND OPTICS, UTILIZED DURING THE RENDEZVOUS AND DOCKING SEQUENCE. THIS CONFIGURATION MAINTAINS ONLY THE MINIMUM NUMBER OF HOUSEKEEPING FUNCTIONS IN ORBIT, ATTACHED TO THE MISSION MODULE BETWEEN SEPARATION AND RESUPPLY. MOST OF THE MISSION EQUIPMENT, THE COMPLETE CAMERA SYSTEM, AND THE STAR TRACKER AND RATE GYRO ARE RESUPPLIED WITH EACH SUBSEQUENT LAUNCH.



CONFIGURATION C - RESUPPLY SATELLITE VEHICLE

(TITAN IIID)

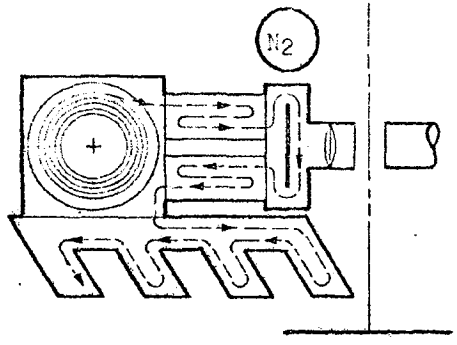
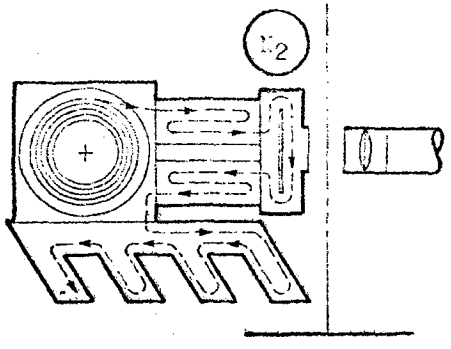
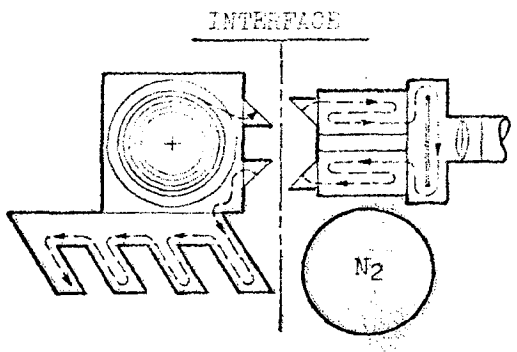
THE TITAN IIIB IS UTILIZED TO LAUNCH THE RIGHT-HAND (SHADED) PORTION OF THIS SATELLITE VEHICLE AND IT ACHIEVES ITS FINAL ORBIT WITH THE AGENA UPPER STAGE. PROPELLANTS REMAINING IN THE AGENA TANK PROVIDE THE IMPULSE FOR ORBIT ADJUSTMENT AFTER MATING WITH THE MISSION MODULE. A FUEL CELL MODULE AND ONLY TWO RVs ARE PROVIDED WITH THIS RESUPPLY VEHICLE BECAUSE OF THE LIMITED (32 DAYS) ORBITAL LIFETIME AND BOOSTER SYSTEM WEIGHT CAPABILITY LIMITATIONS. OTHERWISE THE ELECTRICAL AND ELECTRONIC COMPONENTS ARE THE SAME AS THOSE INCORPORATED IN THE TTIID-LAUNCHED RESUPPLY VEHICLE.



CONFIGURATION C - ALTERNATE RESUPPLY SATELLITE VEHICLE

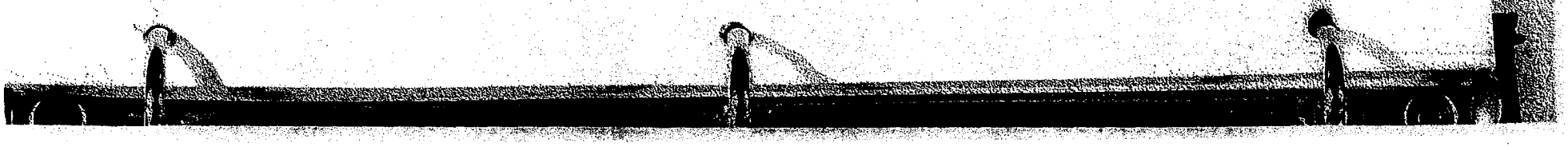
(TITAN IIIB/AGENA)

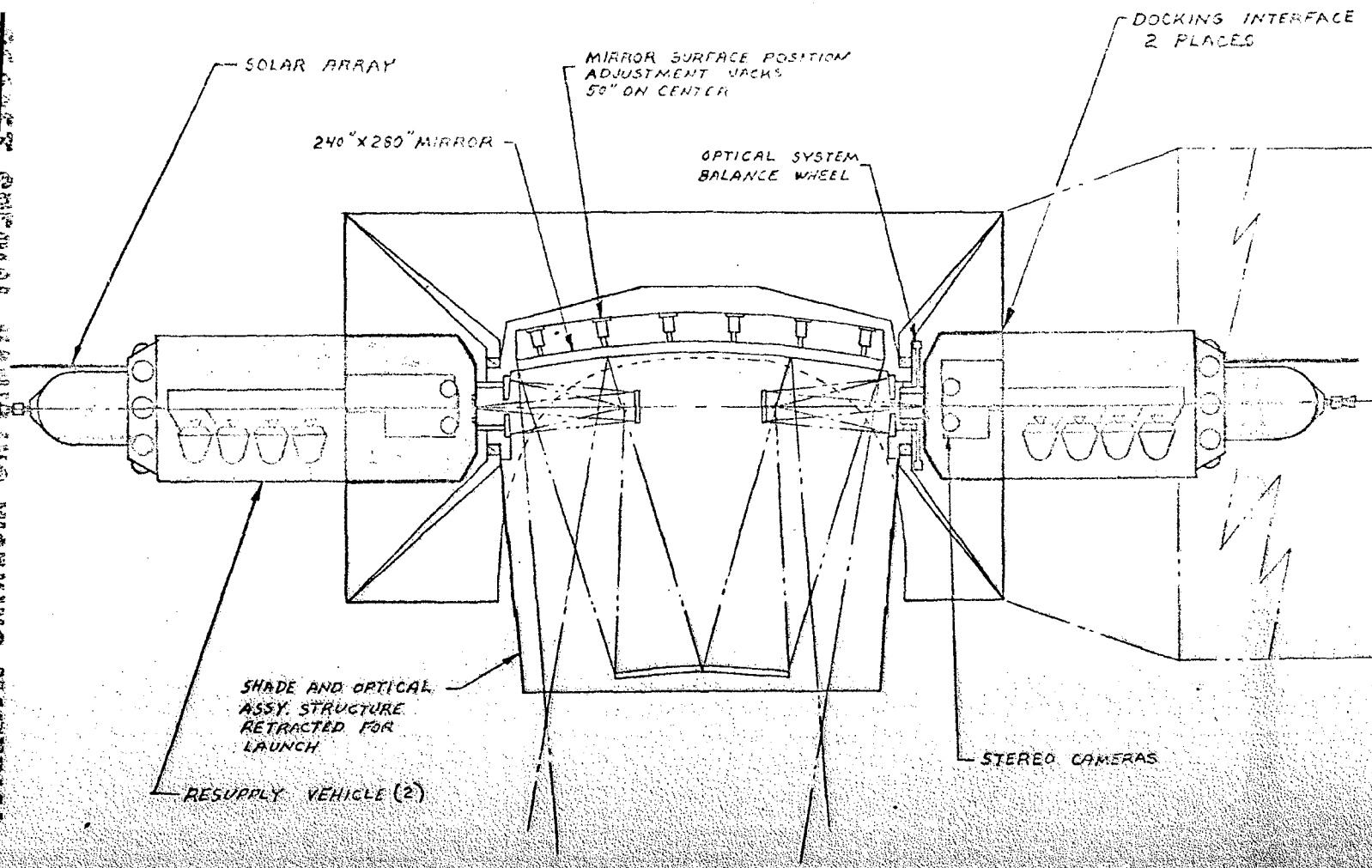
COMPARISON OF FILM AND CAMERA RESUPPLY CONCEPTS

COMPLETE REPLACEMENT	FILM PACK CONCEPT	PARTIAL REPLACEMENT
		
PRO: • FILM INSTALLED, SEALED, AND CHECKED OUT BEFORE LAUNCH • SIMPLE INTERFACE • FAILED CAMERA REPLACED WITH NEXT RESUPPLY LAUNCH • SIMPLE TRANSPORT SYSTEM • NO CAMERA REDESIGN CON: • REQUIRES CAMERA AND ROSS TUBE ALIGNMENT ON ORBIT	PRO: • FILM INSTALLED, SEALED, AND CHECKED OUT BEFORE LAUNCH • SIMPLE INTERFACE • FAILED CAMERA PARTIALLY REPLACED WITH NEXT RESUPPLY • SIMPLE TRANSPORT SYSTEM • CAMERA OPTICS AND ROSS TUBE PREALIGNED CON: • REQUIRES CAMERA REDESIGN	PRO: • ELIMINATES CAMERA REPLACEMENT - MINOR COST ITEM • CAMERA AND ROSS TUBE PRE-ALIGNED BEFORE LAUNCH • NO CAMERA REDESIGN CON: • REQUIRES SELF-THREADING OR 2 CUT/SPLICE DEVICES • REQUIRES LARGE N_2 SUPPLY OR GAS TRANSFER AT MATE • REPLACEMENT OF FAILED CAMERA REQUIRES NEW MM

THIS CHART PRESENTS A POST-DORIAN CONCEPT REPRESENTED BY A CONCENTRIC CASSEGRAIN STEREO SYSTEM (F/6). THE INITIAL LAUNCH VEHICLE IS CONSIDERED TO BE A TITAN OR SATURN BOOSTER.

THE P-66 RESUPPLY CONCEPT CAN BE APPLIED WITH VERY LITTLE MODIFICATION TO THE POST-DORIAN SYSTEM AS SHOWN IN THE SHADED AREAS. THE RESUPPLY VEHICLE WILL BE LAUNCHED FROM THE TITAN IIID BOOSTER





POST DORIAN SYSTEM

THE COST COMPARISONS PRESENTED ARE BASED ON THE FOLLOWING ASSUMPTIONS: (MILLIONS OF DOLLARS)

			RESUPPLY CONFIGURATIONS					
			A		B		C	
	P-66	MOL	L(1)	R(2)	L	R	L	R
BOOSTER	$15.0	$ 17.0	$15.0	$15.0	$15.0	$15.0	$15.0	$15.0
MISSION MODULE	35.0	35.0	35.0		35.0		35.0	
MISSION SUPPORT/ CONTROL MODULES	12.0	50.0	12.0	13.4	12.0	14.3	12.3	18.3
	$62.0	$102.0	$62.0	$28.4	$62.0	$29.3	$62.3	$33.3

FOR P-66 AND MOL, SIX LAUNCHES PER YEAR OF 30 DAY LIFE VEHICLE WERE ASSUMED. FOR P-66 RESUPPLY, AN INITIAL LAUNCH FOLLOWED BY THREE 130-140 DAY RESUPPLY VEHICLES WAS USED.

THE PRESENT STUDY INDICATES THAT THE COST VARIATIONS BETWEEN THREE TECHNICALLY FEASIBLE RESUPPLY CONCEPTS ARE RELATIVELY MINOR. THE CHOICE BETWEEN THESE APPROACHES WOULD BE BASED ON SIMPLICITY OF INTERFACES AND RELIABILITY OVER THE REQUIRED OPERATING LIFE.

NOTE (1) INITIAL LAUNCH

(2) RESUPPLY LAUNCH

ROM ANNUAL RECURRING HARDWARE COST

SYSTEM	ANNUAL COST	SAVINGS VS. MOL
MOL	$612,000,000	-
P-66	$378,000,000	$234,000,000
P-66 RESUPPLY		
CONFIGURATION A	$146,000,000	$466,000,000
CONFIGURATION B	$149,000,000	$463,000,000
CONFIGURATION C	$162,000,000	$450,000,000

~~SECRET~~ SPECIAL HANDLING WORKING MATERIAL

NOT RELEASED DESTROY NO LATER THAN

ROM ANNUAL RECURRING HARDWARE COST

(WITH EXPECTED RELIABILITY)

THE EXPECTED LIFE OF SYSTEMS INFLUENCES ANNUAL HARDWARE COST. BASED ON THE MISSION MODULE RELIABILITY ASSIGNMENT FURNISHED TO LOCKHEED IN CONNECTION WITH THE P-66 STUDY, IT APPEARS THAT TWO MISSION MODULE LAUNCHES PER YEAR WOULD BE REQUIRED. THIS FACTOR INCREASES THE COST OF RESUPPLY ABOUT $30,000,000 PER YEAR.

ROM ANNUAL RECURRING HARDWARE COST

(WITH EXPECTED RELIABILITY)

SYSTEM	ANNUAL COST	SAVINGS VS. MOL
MOL	$673,000,000	-
P-66	$426,000,000	$247,000,000
P-66 RESUPPLY (CONFIGURATION C)	$191,000,000	$482,000,000

SECRET SPECIAL HANDLING REQUIRED MATERIAL
NOT RELEASED DESTROY NO LATER THAN

- THE CHART ILLUSTRATES THE COST OF DEVELOPING P-66 AND P-66 RESUPPLY CONCURRENTLY WITH THE MOL/DORIAN PROGRAM. IT ALSO COMPARES THE OPERATIONAL COST OF MOL/DORIAN VS. THE P-66 AND P-66 RESUPPLY SYSTEMS.

- PARALLEL DEVELOPMENT OF P-66 CAN BE ACCOMPLISHED WITH COMPARATIVELY SMALL INCREASE IN PROGRAM COST.

- IF THE P-66 OR P-66R SYSTEMS ARE THEN EMPLOYED FOR DORIAN OPERATIONS, SAVINGS OF $1.2 BILLION (P-66) AND $2.3 BILLION (P-66R) CAN BE ACHIEVED AFTER 5 YEARS OF OPERATION

OPERATIONAL COSTS FOR PARALLEL DEVELOPMENT

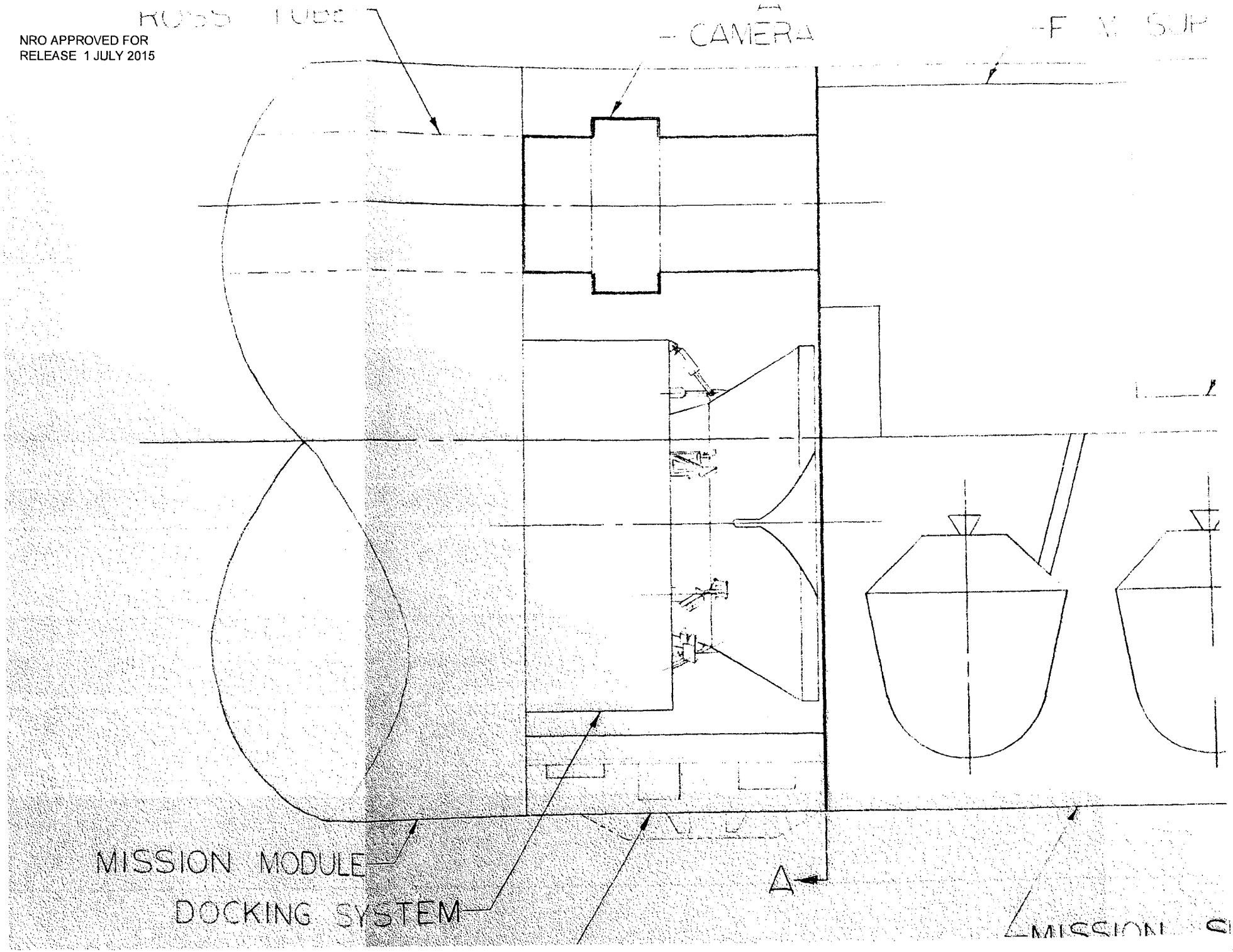
- THIS CHART ILLUSTRATES THE COST SAVINGS ACHIEVABLE WITH AN EARLIER UNMANNED DORIAN DECISION. A TYPICAL DECISION POINT IS ILLUSTRATED.

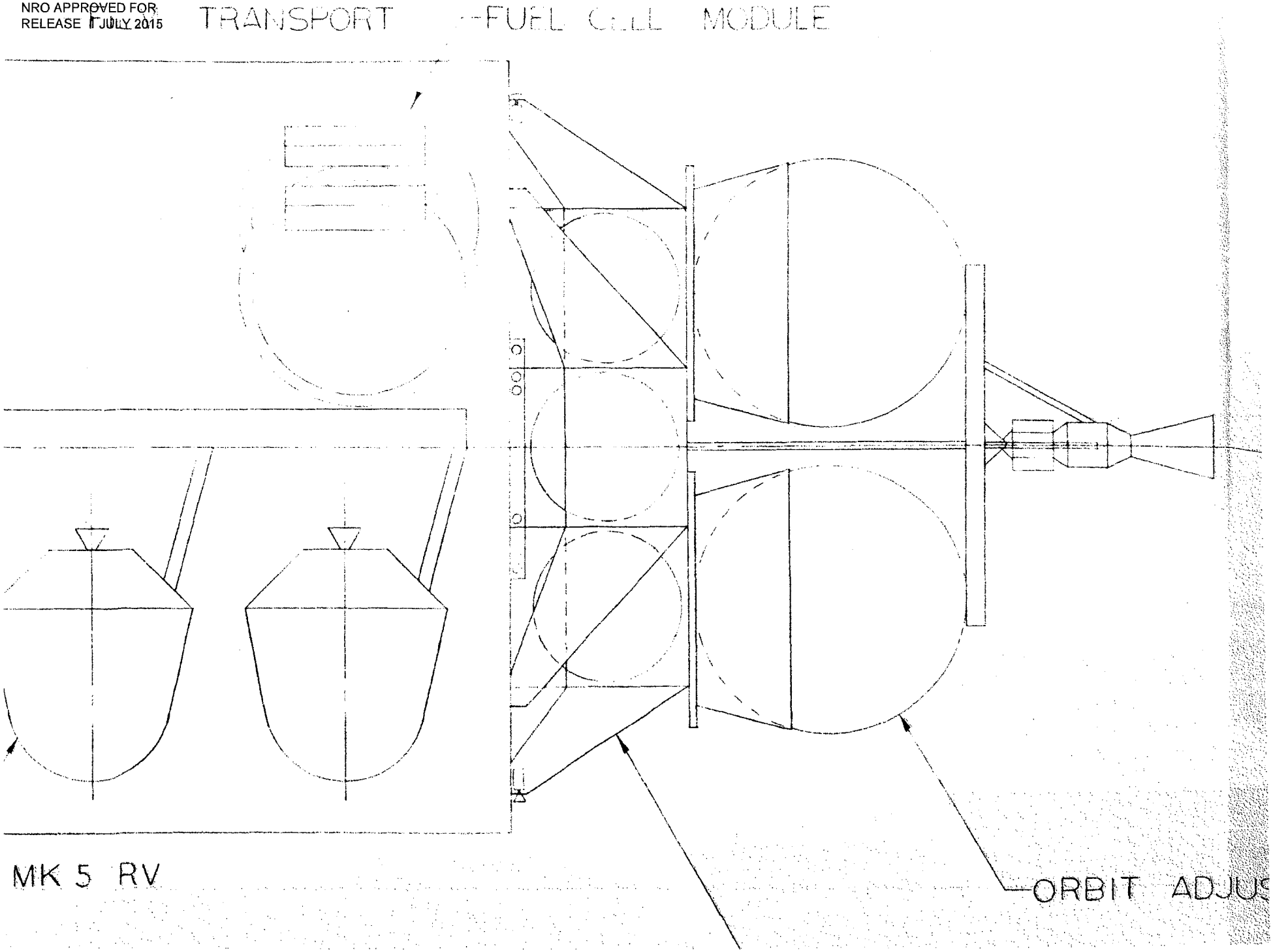
- BY MOVING THE DECISION POINT FROM THE FIRST LAUNCH DATE TO 1969 THE SAVINGS CAN BE INCREASED TO 2 MILLION (P-66) OR 3 MILLION (P-66R) AFTER 5 YEARS OF OPERATION.

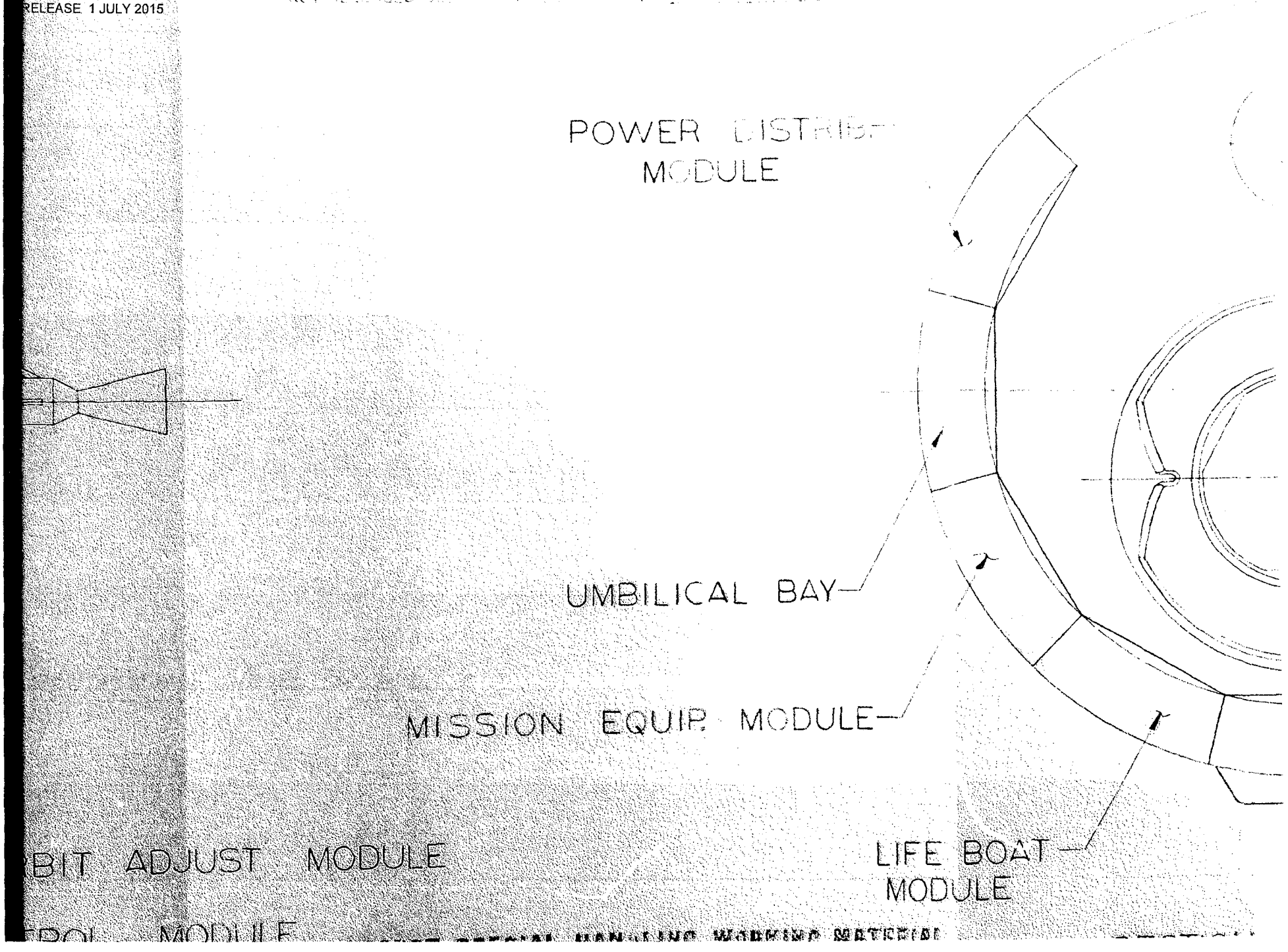
COMPARISON OF DEVELOPMENT AND OPERATIONAL COSTS

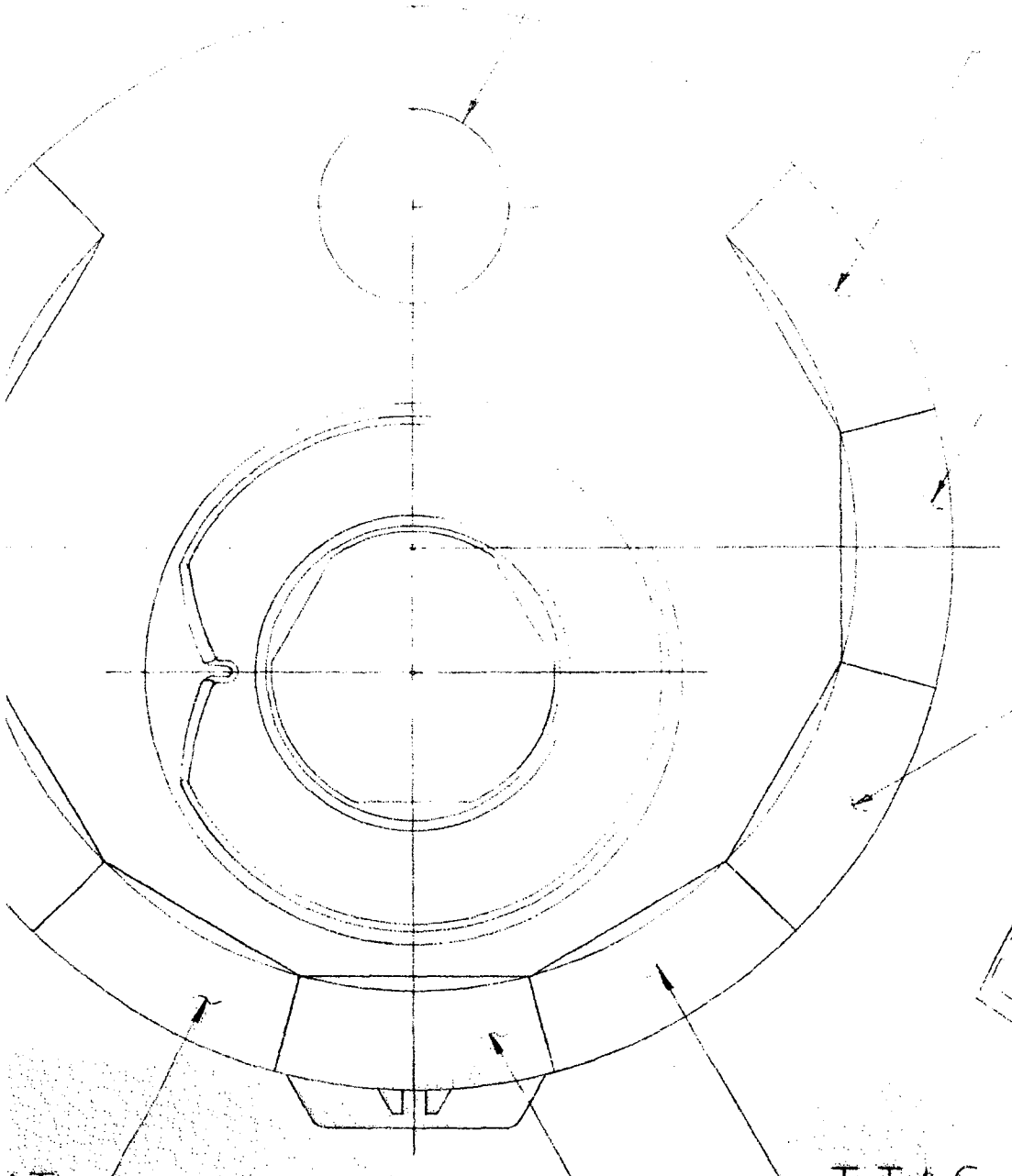
SUMMARY

- PRELIMINARY STUDIES HAVE SHOWN THREE TECHNICALLY FEASIBLE CONCEPTS FOR UNMANNED DORIAN RESUPPLY.
- BOTH THE LMSC P-66/P-66 RESUPPLY CONCEPTS CAN PROVIDE DORIAN OPERATIONAL CAPABILITY EARLIER THAN MOL.
- DEVELOPMENT SAVINGS WOULD EXCEED $1,000,000,000 AND ANNUAL OPERATIONAL SAVINGS WOULD RUN $200,000,000 - $500,000,000 LESS THAN MOL.
- NO NEW TITAN BOOSTERS ARE REQUIRED FOR THE UNMANNED APPROACHES.
- DEVELOPMENT OF P-66/P-66 RESUPPLY WOULD MAKE LARGE AMOUNT OF DEVELOPMENT FUNDS AVAILABLE FOR POST DORIAN SYSTEMS.
- P-66 RESUPPLY DEVELOPMENT LAYS FOUNDATION FOR POST-DORIAN SYSTEMS DESIGN/OPERATION.

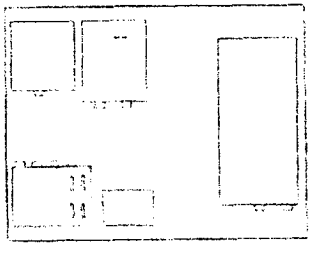




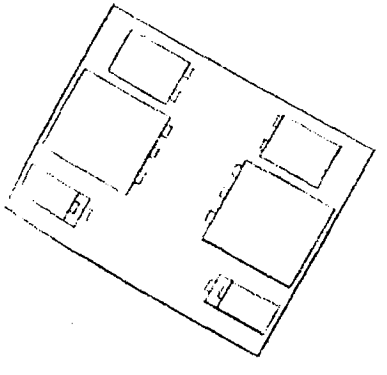




-BACK UP TELEMETRY MODULE



-COMPUTER SYSTEM MODULE



-T. T. & C. MODULE

SAT

JIF M LULE

TELEMETRY
ULE

SYSTEM MODULE

SATELLITE VEHICLE EQUIPMENT ARRANGEMENT

CONFIGURATION B - INITIAL LAUNCH