~~SECRET~~ DORIAN

BIF-107-50013-69
Copy 1 of 3
Pages: 29
16 January 1969

MOL TECHNICAL STATUS SUMMARY

BRIEFING TO GEN FERGUSON

9 JANUARY 1969

HANDLE VIA BYEMAN
CONTROL SYSTEM ONLY

~~SECRET~~ DORIAN

MOL TECHNICAL STATUS

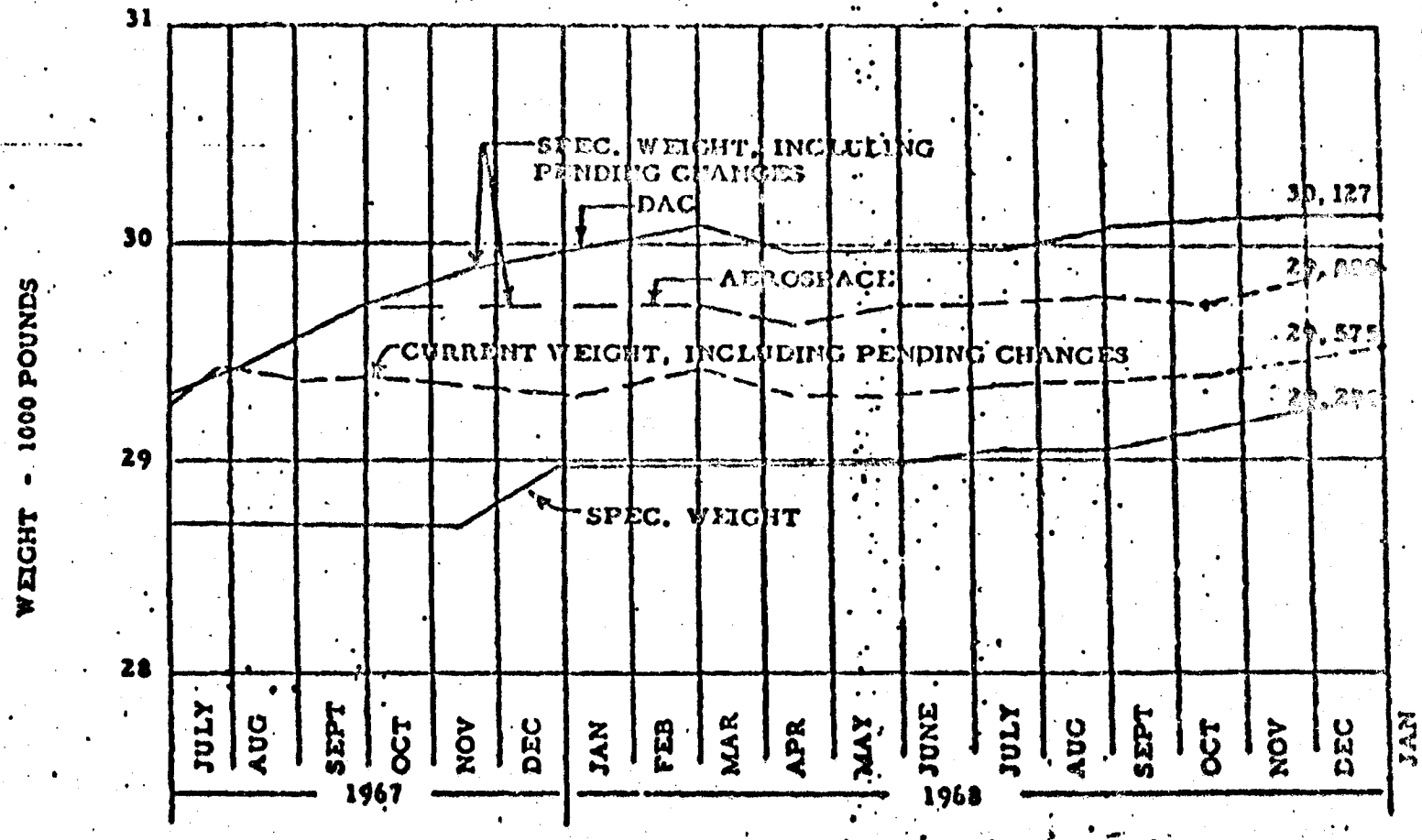
SUMMARY

THIM CURRENT PERFORMANCE STATUS*

PAYLOAD CAPABILITY (DATA BOOK, REV 19)	31,074
PENDING WEIGHT CHANGES	-98
	30,976
MOL REQUIREMENT	30,850
PREDICTED ADDITIONAL CAPABILITY	+126 LB

*REFERENCE ORBIT 80 N. MI. - 187 N. MI., 90° INCLINATION
45° N LATITUDE PERIGEE

ORBITING VEHICLE WEIGHT HISTORY



HANDLE VIA BYEMAN
CONTROL SYSTEM ONLY

~~SECRET~~/DORIAN

ORBITING VEHICLE SYSTEM SEGMENT WEIGHT SUMMARY

1 JANUARY 1969

SYSTEM SEGMENT AVE (INCLUDING GFE)	FLIGHT WEIGHT		% OF CURRENT WEIGHT		
	SPEC	ACTUAL(1)	ESTIMATED	CALCULATED	ACTUAL
MAC AVE & GFE	5944	5930	16	72	12
DAC AVE & GFE	14704	14376	42	45	13
GE AVE & GFE	2845	2851	45	54	1
EK AVE	5769	5800	6	26	68
HS PSA AVE	156	156	100	0	0
WHIRLPOOL - FOOD	102	102	0	100	0
FLIGHT CREW	360	360	100	0	0
ORBITING VEHICLE	29080	29575	31	47	22
UNALLOCATED GROWTH	-	+217			
OV PLUS UNALLOCATED GROWTH	29,880	29,792			
TIIM CAPABILITY: 90° INCL, 80/187 NM, LAT, 45° N	30,850	30,976			
PAYLOAD MARGIN	970	1,184			
RESERVE PAYLOAD DELTA					
1 MARK V DRV	475				
WIDEBAND SCAN SYSTEM	485				
	960				

(1) PREDICTED FLIGHT WEIGHT BASED ON CURRENT REQUIREMENTS INCLUDING PENDING DESIGN CHANGES AND UNALLOCATED GROWTH.

~~SECRET~~/DORIAN

EPS FUEL CELL STATUS

- APOLLO MODIFIED BACON TYPE (400°F) FUEL CELL CHANGED TO NASA AAP MATRIX TYPE (190°F) FUEL CELL.

- PROGRAM ADVANTAGES
  - POWER INCREASE
  - DOUBLE LIFE (2000 HOURS)
  - WEIGHT SAVINGS (200 LBS.)
  - ON-ORBIT START UP AND SHUT DOWN CAPABILITY
  - DELETE POWER SWITCHING CONTROL UNIT
  - ELIMINATE VOLTAGE CLIPPING
  - SIMPLIFY OPERATIONS AND MAINTENANCE

- PROGRAM STATUS
  - CEI CHANGES BEING INCORPORATED BY ECP
  - FUEL CELL TRS PRESENTLY UNDER REVIEW
  - FUEL CELL PDR SCHEDULED 3 FEBRUARY

OV PEAK AND AVERAGE POWER

	ALLOCATION	10-15 LAST REPORT	12-15 THIS REPORT	CHANGE FROM LAST REPORT	VARIANCE WITH ALLOCATION
AVERAGE POWER (WATTS)	1822	1609	1611	+ 2	- 211
PEAK POWER (WATTS)					
A) TRACKING MIRROR SLEW	4326	3954	3841	- 113	- 485
B) PHOTOGRAPHIC OPERATIONS	4426	4160	4019	- 141	- 407
C) MISSION PAYLOAD CHECKOUT	4370	4102	4056	- 46	- 314
D_1) MISSION PAYLOAD ACTIVATION/ PREPARATION	4301	4105	4014	- 91	- 287
D_2) OTHER MISSION PAYLOAD OPERATION	4209	3697	3669	- 28	- 540
E) SGLS STATION	3342	3129	3149	+ 20	- 193
F) WIDEBAND STATION	3851	3339	3359	+ 17	- 492
G) SGLS & WIDEBAND STATIONS	3937	3727	3748	+ 21	- 189
H) ALL OTHER ORBITAL	4196	3857	3850	- 7	- 346
I) EARLY OR LATE ORBIT	4439	4102	4126	+ 24	- 313
J) LAUNCH AND ASCENT	2791	2260	2289	+ 29	- 502
CAPABILITY (WATTS ESTIMATED)	2310 AVERAGE 5080 PEAK				

HANDLE VIA BYEMAN
CONTROL SYSTEM ONLY

LOADS CYCLE HISTORY

- LOADS CYCLE 1 (COMPLETED APRIL '66)
  - / STATIC ELASTIC
  - / 8 MASS OV MODEL
  - / ALL TRANSIENT CONDITIONS EXAMINED
- LOADS CYCLE 2 (COMPLETED NOV '66)
  - / STATIC ELASTIC - UP-DATED VEHICLE EXTERNAL CONFIGURATION
  - / 15 SPRUNG MASS OV MODEL
  - / ALL TRANSIENT CONDITIONS EXAMINED
- LOADS CYCLE 3 (COMPLETED MAY '67)
  - / STATIC ELASTIC - UP-DATED SHELL STIFFNESS/VEHICLE EXTERNAL CONFIGURATION
  - / 15 SPRUNG MASS OV MODEL - UP-DATED IN DEGREES OF FREEDOM
  - / SELECTED TRANSIENT CONDITIONS EXAMINED
    - o STAGE I SHUT-DOWN
    - o THRUST TERMINATION
- LOADS CYCLE 4 (COMPLETED JAN '69)
  - / STATIC ELASTIC - BASELINE EXTERNAL CONFIGURATION
  - / 110 SPRUNG MASS OV MODEL - 613 DEGREES OF FREEDOM
  - / ALL TRANSIENT CONDITIONS EXAMINED

STRUCTURES STATUS - MAJOR MILESTONES

- MDAC-WD
  - LAB MODULE

    FWD UNPRESS. COMPARTMENT - LIMIT LOAD STATIC TEST COMPLETED 30 NOV 68

    - ULT LOAD STATIC TEST SCHEDULED 30 APRIL 69

    PRESS. COMPARTMENT - ULT LOAD STATIC TEST COMPLETED 10 OCT 68

  - MISSION MODULE

    FWD SECTION DOOR SEPARATION - TEST SCHEDULED 11 JAN 69

  - AERODYNAMIC - WIND TUNNEL

    1/10 SCALE MODEL RIGID BODY FLUCTUATING PRESS TEST COMPLETED

    PROTUBERANCE HEATING (4 BASIC MODELS) TEST COMPLETED

    1/2 SCALE METEROID SHIELD - TRANSONIC (BUFFET) AND SUPERSONIC (FLUTTER) COMPLETED 11 DEC 68

- MDAC-ED

  ADAPTER - ULT LOAD/MAX TEMP STATIC TEST COMPLETED SEPT 68

STRUCTURES STATUS (MAJOR MILESTONES)

O GE

- o TRACKING MIRROR ASSEMBLY

  LIMIT LOAD STATIC TEST OF Be STRUCTURE (3RD LOADS CYCLE) COMPLETED DECEMBER 68

  - ULTIMATE LOAD STATIC TEST (4TH LOADS CYCLE) SCHEDULED NOVEMBER 69

- o DYNAMIC TEST (4TH LOADS CYCLE) 2.4" BEARINGS COMPLETED DEC 68
- o THERMAL COVER

  STATIC TEST OF STRUCTURE (OUTSIDE SHELL) SCHEDULED JAN 69

O EK

- o CAMERA OPTICAL ASSEMBLY

  LIMIT LOAD STATIC TEST OF BARREL (-5, ±2, ±2) COMPLETED 3 NOVEMBER 68

  MODAL SURVEY OF STRUCTURES DEV MODEL 1 (SDM-1) COMPLETED APRIL 68

  SDM-1 ACOUSTIC TEST CONFIGURATION INSTRUMENTATION AND DATA ANALYSIS COMPLETED OCTOBER 68

  - ACOUSTIC TEST SCHEDULED SEPTEMBER 69

MAIN OPTICAL SYSTEM POINTING ERROR

	LOS ERROR (0.95p) ARC MIN SPEC	PREDICTED
o AVE HARDWARE INCLUDING STRUCTURAL DEFLECTIONS	6	5.9
o TARGET LOCATION UNCERTAINTY	5	5
o EMPHEMERIS UNCERTAINTY	14	8.7
RSS TOTAL	16	11.6

SMEAR RATE BUDGET

μ-RAD/SEC 2σ

	ALLOCATION
AUTOMATIC	
TRACKING MIRROR CONTROL SYSTEM	[redacted]
VIBRATION	
IMAGE VELOCITY SENSOR (IVS)	
RSS TOTAL	
MANNED	
CREW	
RSS TOTAL	

~~SECRET~~ / DORIAN

TRACKING MIRROR DRIVE SMEAR RATE

μ RAD/SEC

	ALLOCATION (2σ)	PREDICTED (2σ)
ROLL	[redacted]	
PITCH		
2 AXIS TOTAL (LOS)		
SPECIFICATION REQUIREMENT		

~~SECRET~~ / DORIAN

TRACKING MIRROR SERVO ERROR

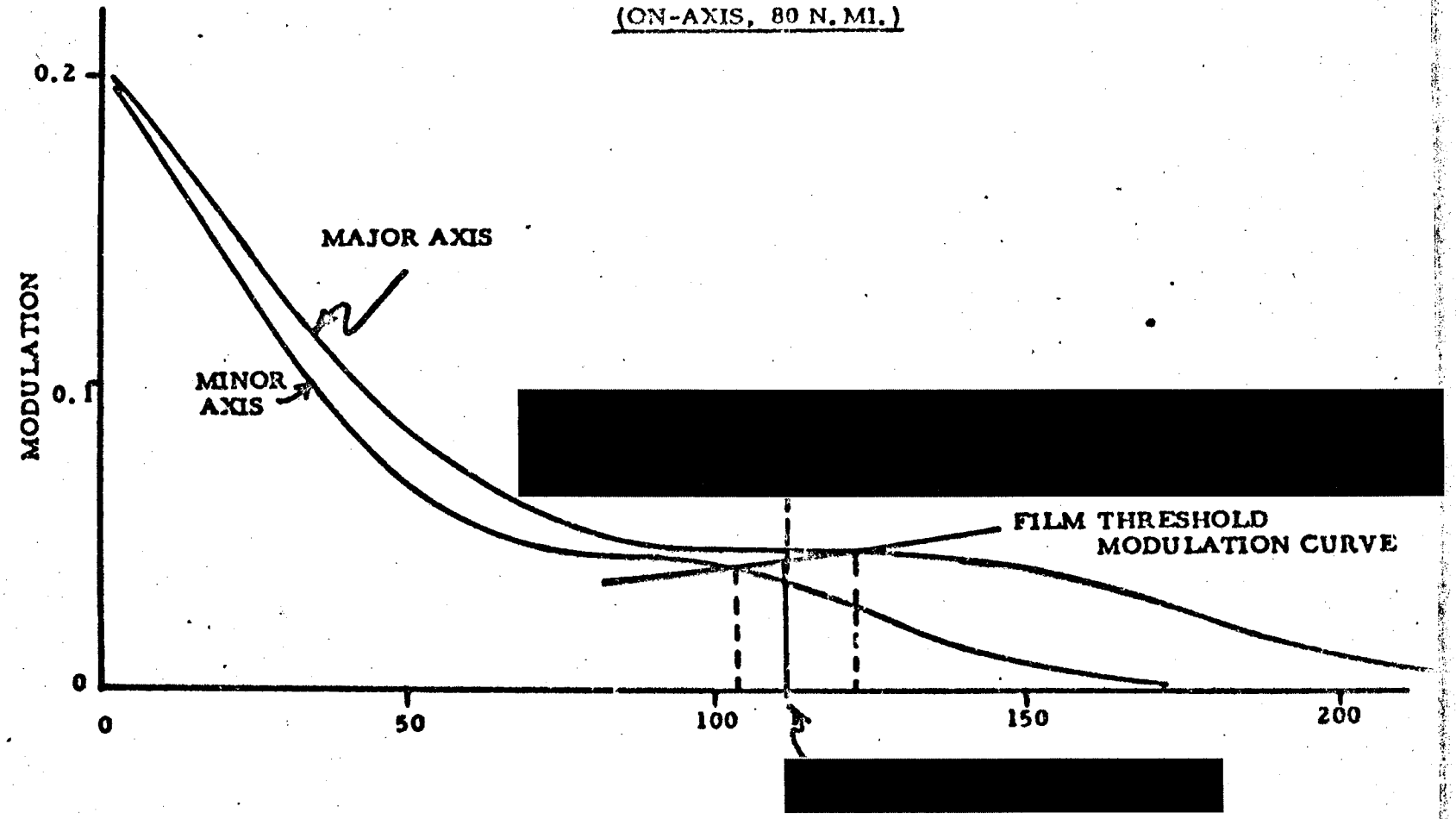
μ RAD/SEC

COMPONENT	GIMBAL ALLOCATION (2σ)	ACTUAL (2σ)	PREDICTED (2σ)
PITCH AXIS-18 RAD/SEC LOOP*			
BEARINGS	4.2	4.15	4.2
TORQUERS	2.5		7.5
POWER AMP & COMP AMP	4.2	0.8	1.2
D/A AND BUFFER	4.3		4.3
EMI	4.0		4.0
GYRO NOISE	2.5	1.95	2.70
ENCODER	0.3		0.3
HARNESS	2.0	1.5	1.5
SAMPLING	0.5		0.5
COMMAND	1.0		1.0
TOTAL PITCH	2(9.6) = 19.2		2(10.9) = 21.8

*BASED ON PITCH RATE OF 1.5 DEG/SEC

~~SECRET~~ / DORIAN

BASELINE DYNAMIC PERFORMANCE PREDICTION
(ON-AXIS, 80 N. MI.)



OPTICAL PERFORMANCE DIFFERENCES

MAJOR DIFFERENCES

- DIFFERENT CALCULATION TECHNIQUE - 7 SPECTRAL WAVE LENGTHS VERSUS MONOCHROMATIC
- CHANGE IN AERIAL IMAGE MODULATION (AIM) CURVE
- LARGER CENTRAL AND TOTAL OBSTRUCTION - 12.7% CENTRAL 17.2% TOTAL
- LOWER LIGHT TRANSMISSION (1/165 SEC VERSUS 1/200 SEC)

POTENTIAL IMPROVEMENT

- OPTICAL QUALITY FACTOR - [redacted] CONTRACT TO [redacted] GOAL

ATS PERFORMANCE (2σ)

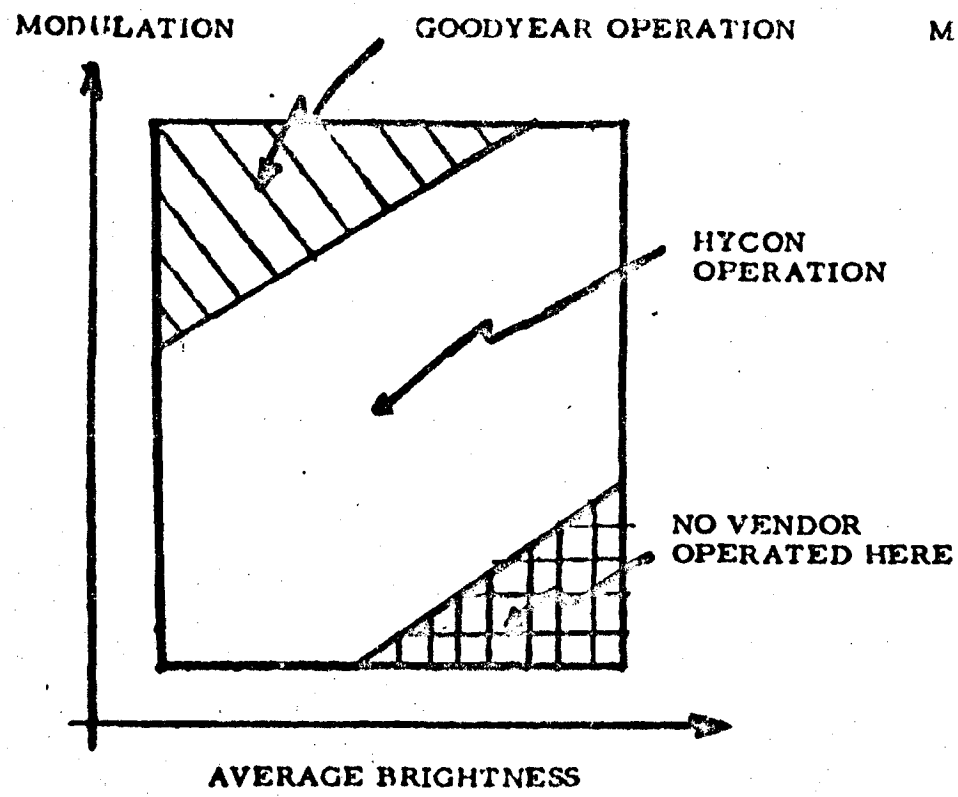
	SPEC	PREDICTED
o RESOLUTION (2:1 CONTRAST TARGET, 80 N.MI., SCHADE EYE DATA)	3.3 FT	2.7 FT
o JITTER (ABOVE 6 CPS)		
PRIMARY MODE	.25 $\widehat{\text{SEC}}$	.21 $\widehat{\text{SEC}}$
BACKUP MODE	1.25 $\widehat{\text{SEC}}$	.80 $\widehat{\text{SEC}}$
o POINTING ACCURACY (ASSUMING MDAC CONTRIBUTIONS OF 6 $\widehat{\text{MIN}}$, NO TARGET LOCATION AND EPHEMERIS UNCERTAINTIES)	10 $\widehat{\text{MIN}}$	7.8 $\widehat{\text{MIN}}$
o SLAVED MODE (MAIN OPTICS SMEAR WHEN SLAVED TO ATS)	100 μ RAD/SEC	81 μ RAD/SEC

~~SECRET~~/DORIAN

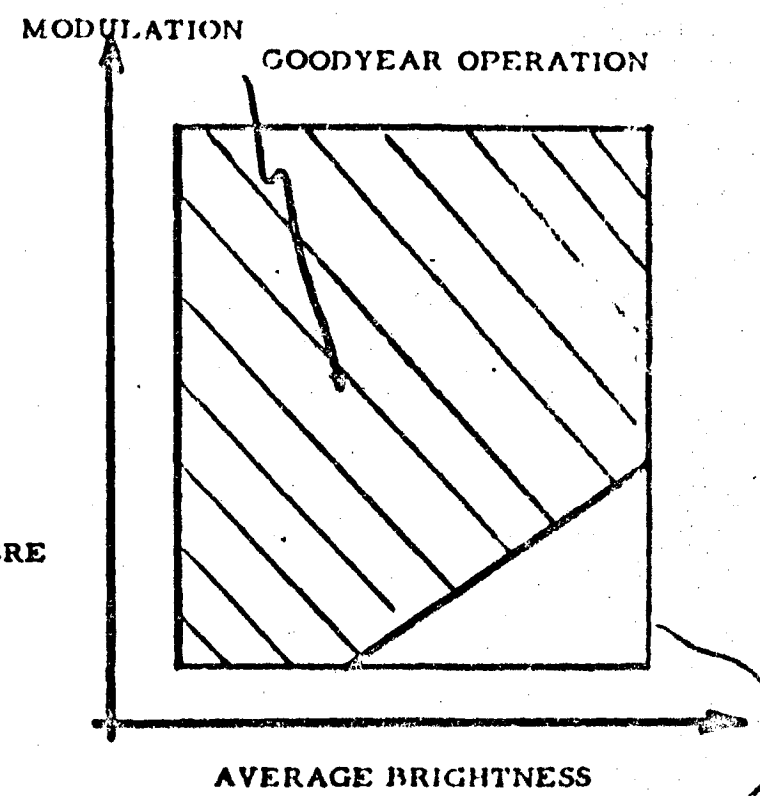
IMAGE VELOCITY SENSOR (IVS) PURPOSE

- IVS IS MANDATORY FOR AUTOMATIC MODE TO ACHIEVE [redacted] RESOLUTION
- MOL ON-BOARD DIGITAL COMPUTER COMMANDS TRACKING MIRROR RATES TO WITHIN 1% OF PERFECT TRACKING
- IMAGE VELOCITY SENSOR (IVS) REDUCES TRACKING MIRROR RATES TO WITHIN 0.08% OF PERFECT TRACKING

BREADBOARD TESTS



ENGINEERING MODEL TESTS



NOTE: HYCON OPERATES OVER ENTIRE SPEC.

IVS BRIGHTNESS SPECIFICATION AND ACTUAL PERFORMANCE

~~SECRET~~ / DORIAN

PRELIMINARY IVS ENGINEERING MODEL (EPEM) TEST RESULTS

- HYCON IVS
  - SPECIFICATION COMPLIANCE SATISFACTORY EXCEPT FOR CROSSCOUPLING
  - CROSSCOUPLING MAY VIOLATE SYSTEM REQUIREMENTS
    - TO BE ANALYZED
    - TO BE INVESTIGATED VIA CLOSED-LOOP TESTING
- GOODYEAR IVS
  - GOOD IMPROVEMENT FROM BREADBOARD TESTS OF PHASE I
  - TESTING NOT COMPLETE ENOUGH TO DETERMINE SPECIFICATION COMPLIANCE
- GOODYEAR AND HYCON UNITS WERE RETURNED TO VENDOR FACILITY FOR MODIFICATIONS DURING THIS TEST PROGRAM, CAUSING A TWO-WEEK DELAY

~~SECRET~~ / DORIAN

NEAR TERM SCHEDULE OF IVS EVENTS

o EVALUATION TESTS COMPLETE	31 JAN 69
o EVALUATION REPORT PRESENTATION	14 FEB 69
o RECOMMEND GOODYEAR OR HYCON AS WINNER	15 FEB 69
o START GOODYEAR OR HYCON CONTRACT	1 MAR 69
o DELIVERY TO GE OF GOODYEAR OR HYCON DEVELOPMENT IVS	1 NOV 69

SIMULATORS STATUS

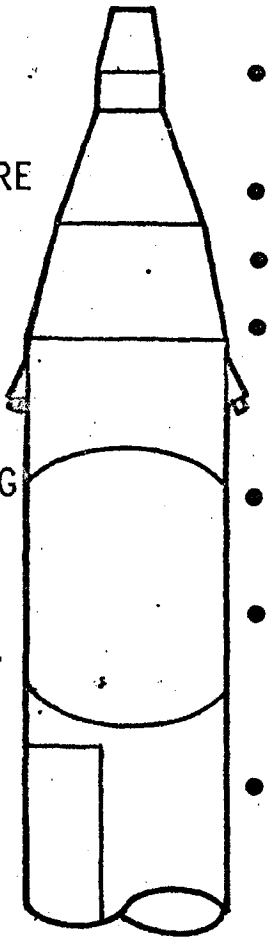
- **ELEMENTAL DEVELOPMENT SIMULATOR (EDS) AT GE**
  - / DEVELOPED LATE WITH POOR QUALITY SCENE VIEWING SYSTEM
  - / CONTRIBUTED TO DEFINITION OF AVE CONTROLS AND DISPLAYS
- **MISSION DEVELOPMENT SIMULATOR (MDS) AT GE**
  - / REQUIREMENTS DEFINED IN JUNE 1968; USES 9" X 9" SLIDES IN ITEK DEVELOPED SLIDE VIEWING SYSTEM
  - / PHASE 0 CONFIGURATION (SINGLE CREW STATION) TO BE OPERATIONAL IN APRIL 1969
  - / PHASE 3 CONFIGURATION (DUAL CREW STATIONS WITH AVE COMPUTER AND SOFTWARE) TO BE OPERATIONAL IN DECEMBER 1969
- **MISSION SIMULATOR AT VAFB**
  - / CONSISTS OF LABORATORY MODULE SIMULATOR (LMSE), MISSION MODULE SIMULATOR (MMSE), AND GEMINI B PROCEDURES SIMULATOR (GBPS) WITH VOICE AND DATA CONNECTIONS TO MISSION CONTROL CENTER (MCC) AT SUNNYVALE
  - / MMSE TO BE SIMILAR TO MDS; LMSE AND GBPS DESIGN AND DEVELOPMENTS PROCEEDING ESSENTIALLY ON SCHEDULE
  - / SCHEDULED FOR 9 MONTHS OPERATIONS PRIOR TO FIRST MANNED LAUNCH
  - / CURRENT PROBLEMS:
    - MMSE DEVELOPMENT DELAY DUE TO MDS DEVELOPMENT ACTIVITIES
    - LMSE/MMSE SOFTWARE INTERFACE UNDEFINED
    - LMSE/STC SOFTWARE (AND HARDWARE) INTERFACE UNDEFINED
    - GBPS/STC SOFTWARE INTERFACE UNDEFINED

~~SECRET~~/DORIAN

MAJOR DIFFERENCES

MANNED

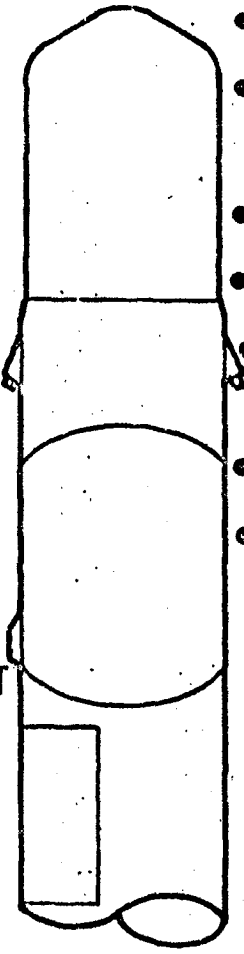
- GEMINI B
- 30 DAY MISSION
- 15,000 FRAMES
- 5 PSI ATMOSPHERE
- ONE-TIME DATA RETURN BY GEMINI B
- SHIP RECOVERY
- TARGET TRACKING AVAILABLE



COMMONALITIES

- HIGH RESOLUTION PHOTO RECONNAISSANCE
- ORBIT: 80 X 186 NMI
- INCLINATION: 90°
- GROUND EQUIPMENT AND FACILITIES COMPATIBLE WITH BOTH SYSTEMS
- ONE LAUNCH EVERY FOUR MONTHS
- FACTORY FACILITIES AND FIXED EQUIPMENT SUPPORT BOTH SYSTEMS
- LAUNCH WITH TIIIM

UNMANNED



- SUPPORT MODULE
- APPROXIMATELY 60 DAY MISSION
- 500 FRAMES PER DAY
- 2 PSI ATMOSPHERE
- SIX TIME DATA RETURN BY DRV
- AIR RECOVERY
- SPACE PRESERVED FOR 29,500 FRAMES OF TB FILM

HANDLE VIA BYEMAN
CONTROL SYSTEM ONLY

~~SECRET~~/DORIAN

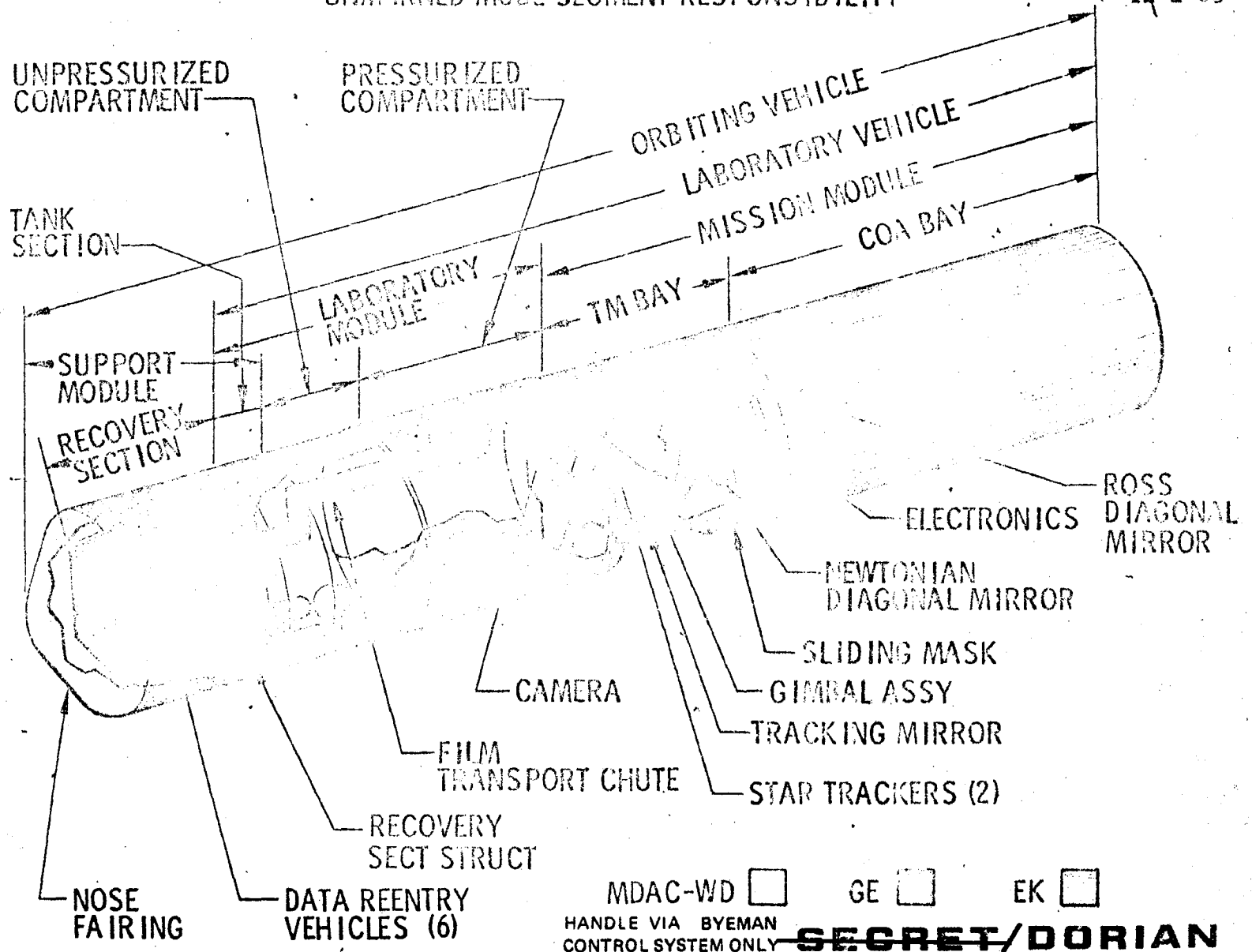
CURRENT STATUS

- **PHASE I TASKS COMPLETE:**
  - **BASIC REQUIREMENTS DEFINED.**
  - **PART I CEI/EXCHANGE HARDWARE REQUIREMENTS DEFINED.**
  - **BASIC CONTRACTOR TO CONTRACTOR INTERFACES DEFINED.**
  - **TEST PROGRAM DEFINED.**
  - **TEST AND ASSEMBLY FLOW COMPLETE.**
  - **LIFE-LIMITED, CRITICAL COMPONENTS IDENTIFIED (VS. 60 DAY ORBIT LIFE).**

~~SECRET/~~DORIAN

BIF-77 ZB07651
COPY 3
12-2-68

UNMANNED MODE SEGMENT RESPONSIBILITY



MDAC-WD ☐ GE ☐ EK ☐

HANDLE VIA BYEMAN CONTROL SYSTEM ONLY

~~SECRET/~~DORIAN

MOL

GEMINI B

TEST PROGRAM

o	ELECTRONIC SYSTEMS TEST IN PROGRESS	
	* SUBSYSTEM COMPATIBILITY	COMPLETE
	* PYRO EMI SUSCEPTIBILITY	CONTINUING
	* INSTRUMENTATION EVALUATION	CONTINUING
	* INTERFACE (LV & T-III) EVALUATION	IN PROGRESS
o	CREW TRANSFER AND DRG HANDLING	
	* ZERO G FLIGHTS - EV AND IV	CONTINUING
o	STRUCTURAL	
	* ADAPTER HIGH TEMPERATURE CONDITION	COMPLETE
	* EJECTION SEAT SYSTEM TESTS	START IN JANUARY
	* COLD LAUNCH CONDITIONS	COMPLETE IN LATE 1969
o	ABORT SIMULATIONS	COMPLETE
	* VERIFY CREW CONTROL CAPABILITY	
o	REENTRY HEATING	
	* AFTERBODY SHINGLE TEMPERATURES DURING ABORT	COMPLETE
	* HEAT SHIELD GAP QUALIFICATION	IN PROGRESS
o	DUAL GAS SYSTEM TEST	
	* UNMANNED	IN FEBRUARY
	* MANNED	IN MARCH AND APRIL
	* REENTRY CONTROL SYSTEM EVALUATION	STARTS IN APRIL

MDAC-WD TEST STATUS

- BREADBOARD/ PROTOTYPE TESTING COMPLETE

  ACTS/ SCE, ACTS 22 LB THRUSTOR & PROPELLANT TANKS CREW RESTRAINTS, ANTENNA, MONITOR & ALARM, PCM, FM, & CENTRAL TIMING, MOL SEIVE, WASTE COLLECTION, O_2 HEAT EXCHANGERS

- REMAINING SUBSYSTEM DEVELOPMENT TESTING IN PROCESS THRU NOV 1969
- SYSTEM DEVELOPMENT TESTING (EDCTU, DTS, ACTS/ CRYO) JUNE 1969 - SEPT 1971
- SUBSYSTEM QUALIFICATION TESTING JAN 1969 - DEC 1970
- SYSTEM QUALIFICATION TESTING (LMQTV) - SEPT 1971 - OCT 1971

GE IN-HOUSE TESTING ACTIVITIES

- COMPONENT AND BRASSBOARD DEVELOPMENT TESTS
  - GYROS, TRACKING MIRROR DRIVE BRASSBOARD, THERMAL DOOR DRIVE BRASSBOARD, BEARINGS, DRIVE ELECTRONICS, IMAGE VELOCITY SENSOR, MISSION DATA ADAPTER UNIT, EXPERIMENT CONTROLLER, CONSOLE CONTROLLER, AND TELEMETRY
- DSS-1 (SUBSYSTEM DEVELOPMENT) SEPT 68 TO MAR 70
- 113D (STRUCTURAL TEST VEHICLE) COMPLETE JULY 69
- 113T (THERMAL TEST VEHICLE) COMPLETE OCT 69
- 114 (DEVELOPMENT VEHICLE) NOV 69 TO JUN 70
- 1970 AND LATER TESTS INCLUDE GE LAB MODULE CONSOLES (QUALIFICATION), 114E (FOR EK), 115 (QUALIFICATION), 118 (FACI)

EK TEST STATUS

- PRELIMINARY STRUCTURAL VIBRATION MODAL SURVEY OF THE COA STRUCTURE HAS BEEN COMPLETED
- STATIC LOAD TEST OF THE OA STRUCTURE TO ORIGINAL LIMIT LOADS (5, 2, 2G) HAS BEEN COMPLETED
- ZERO-G/ONE-G (TURN-OVER) OA STRUCTURE DEFLECTION TEST IN PROGRESS
- COMPONENT DEVELOPMENT AND BREADBOARD TESTING IN PROGRESS
- HALF SCALE TRACKING MIRROR THERMAL DISTORTION TEST IN PROGRESS - RESULTS SHOULD BE AVAILABLE BY END OF JANUARY
- THERMAL MODEL (OA LEVEL) TESTING TO START THIS MONTH
- FORMULA SAMPLE TEST TO START IN MARCH
- ENGINEERING MODEL (OA LEVEL) TESTING TO START IN MARCH
- QUALIFICATION MODEL (OA LEVEL) TESTING TO START IN DECEMBER

HANDLE VIA BYEMAN
CONTROL SYSTEM ONLY