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BAH
Hohman

Distribution
Leonard
Williams
Wamsley
Moss
McGhee

MOL

TEST OBJECTIVES REVIEW BOARD

BRIEFING

2 FEBRUARY 1968

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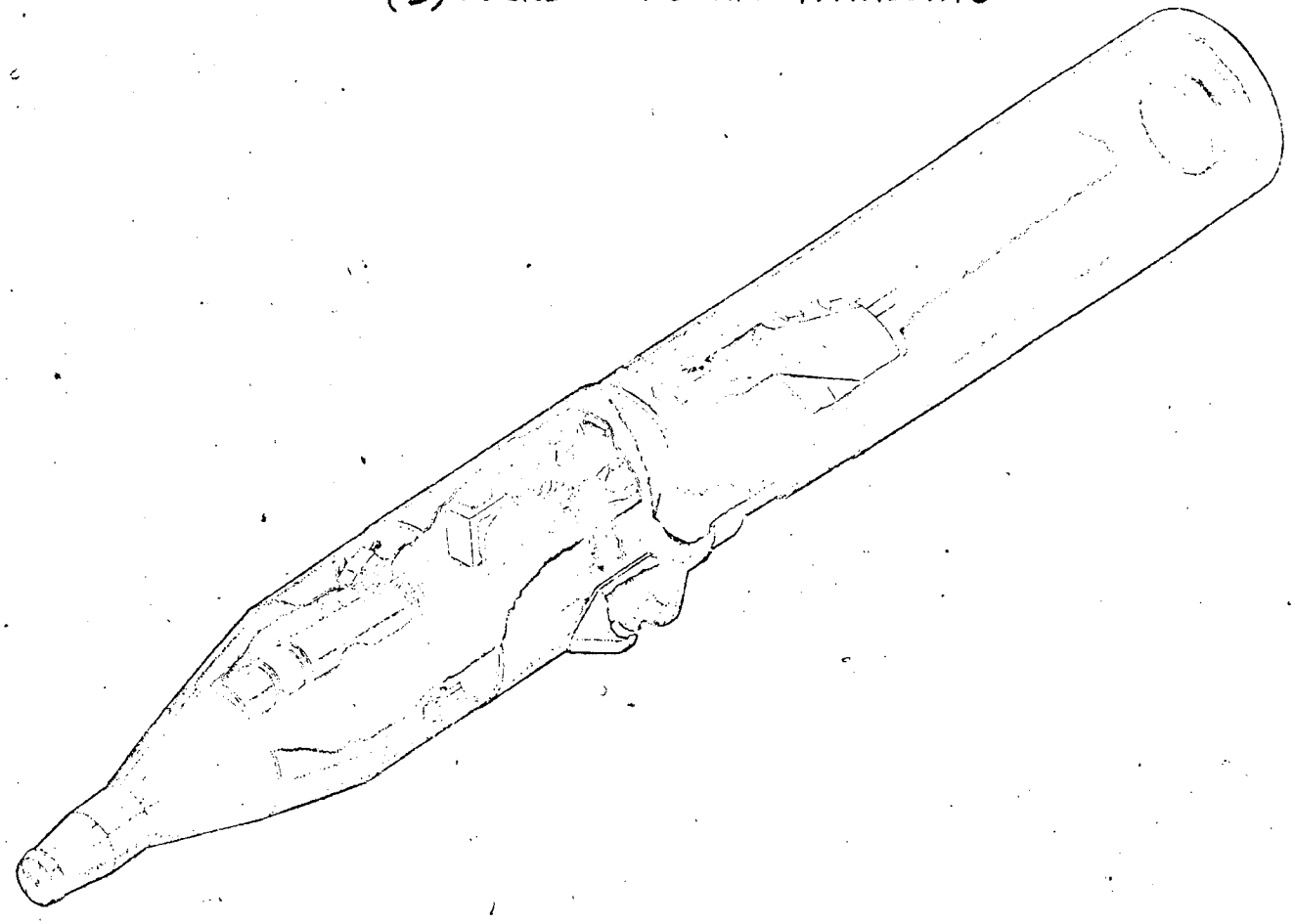

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TEST OBJECTIVES REVIEW BOARD

BOARD MEMBERS:	COLONEL R. R. HULL
	B. A. HOHMANN
	R. K. ARNOLD
	R. B. CHAMBERLIN
	R. A. GRAMMER
CONSULTANTS:	LT. COLONEL G. M. HREBEC
	D. R. COLLINS
	J. E. KENT
	M. C. SHRADER
	J. F. WAMBOLT
RECORDER:	MAJOR L. G. THOMPSON

NO TORB OBSERVATION, COMMENT OR RECOMMENDATION REPRESENTS AN OFFICIAL POSITION OF AGREEMENT OR DISAGREEMENT BY ANY CONTRACTOR REGARDLESS OF THE PARTICIPATION OF THE INDIVIDUAL CONTRACTOR BOARD MEMBER.

MOL TEST OBJECTIVES REVIEW BOARD

- SCOPE -

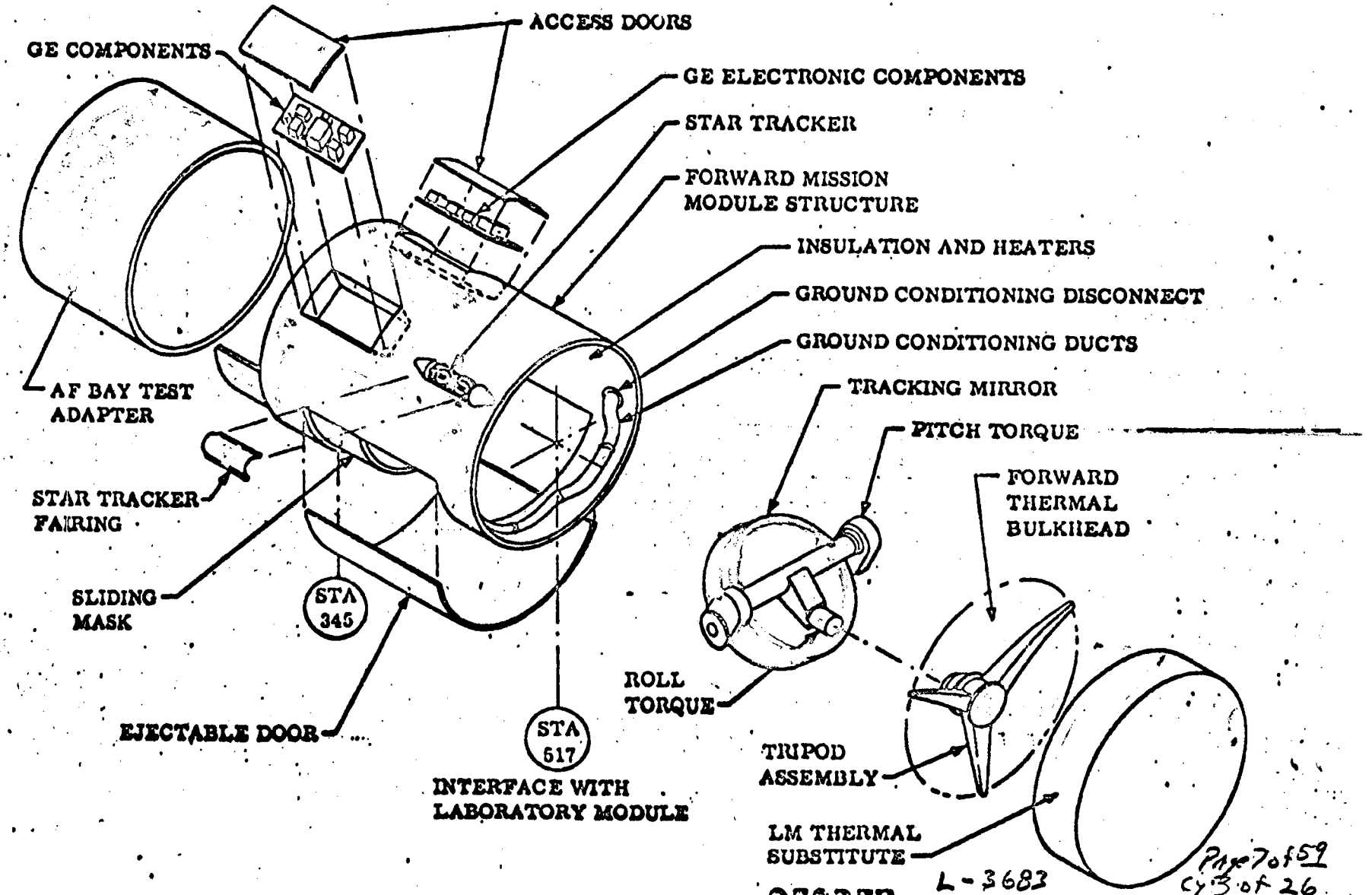
- BOARD APPROACH
  - OBJECTIVES
  - LEVEL OF DETAIL
- OUTLINE OF BRIEFING
  - TEST PROGRAM
    - DEVELOPMENT
    - QUALIFICATION
    - ACCEPTANCE
    - GENERAL
  - FACILITIES
  - CONTRACTUAL
- SUMMARY

MOL TEST OBJECTIVES REVIEW BOARD

- BOARD APPROACH
  - OBJECTIVES
    - EXAMINE COMPLETE TEST PROGRAM FOR LABORATORY VEHICLE
      - VALIDATE OBJECTIVES FOR TESTING
      - DEVELOP A LOGICAL TESTING SEQUENCE FOR LV
      - VALIDATE FACILITIES AND MANPOWER TO SUPPORT THIS SEQUENCE
  - LEVEL OF DETAIL
    - DEVELOPMENT TESTING - MAJOR COMPONENTS, SUBSYSTEMS, SYSTEMS
    - QUALIFICATION TESTING - SUBSYSTEMS, SYSTEMS
    - ACCEPTANCE TESTING - SUBSYSTEMS, SYSTEMS
  - DID NOT CONSIDER
    - FV 6 AND 7
    - VANDENBERG TEST SEQUENCE

Did not consider the flow in system reasoning why

~~SECRET~~ SPECIAL HANDLING MISSION MODULE FORWARD STRUCTURE ASSEMBLY



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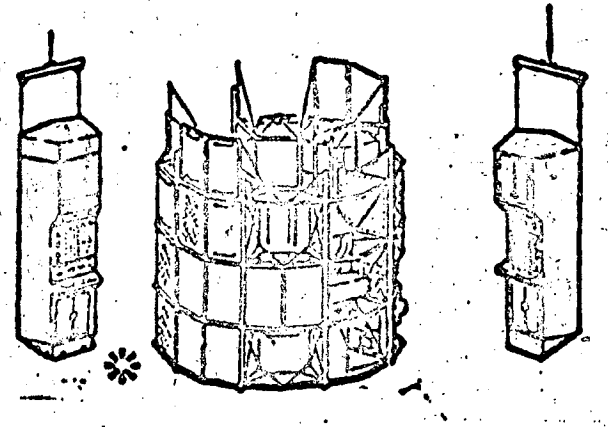
GE BAYS 2 AND 8 INSTALLATION



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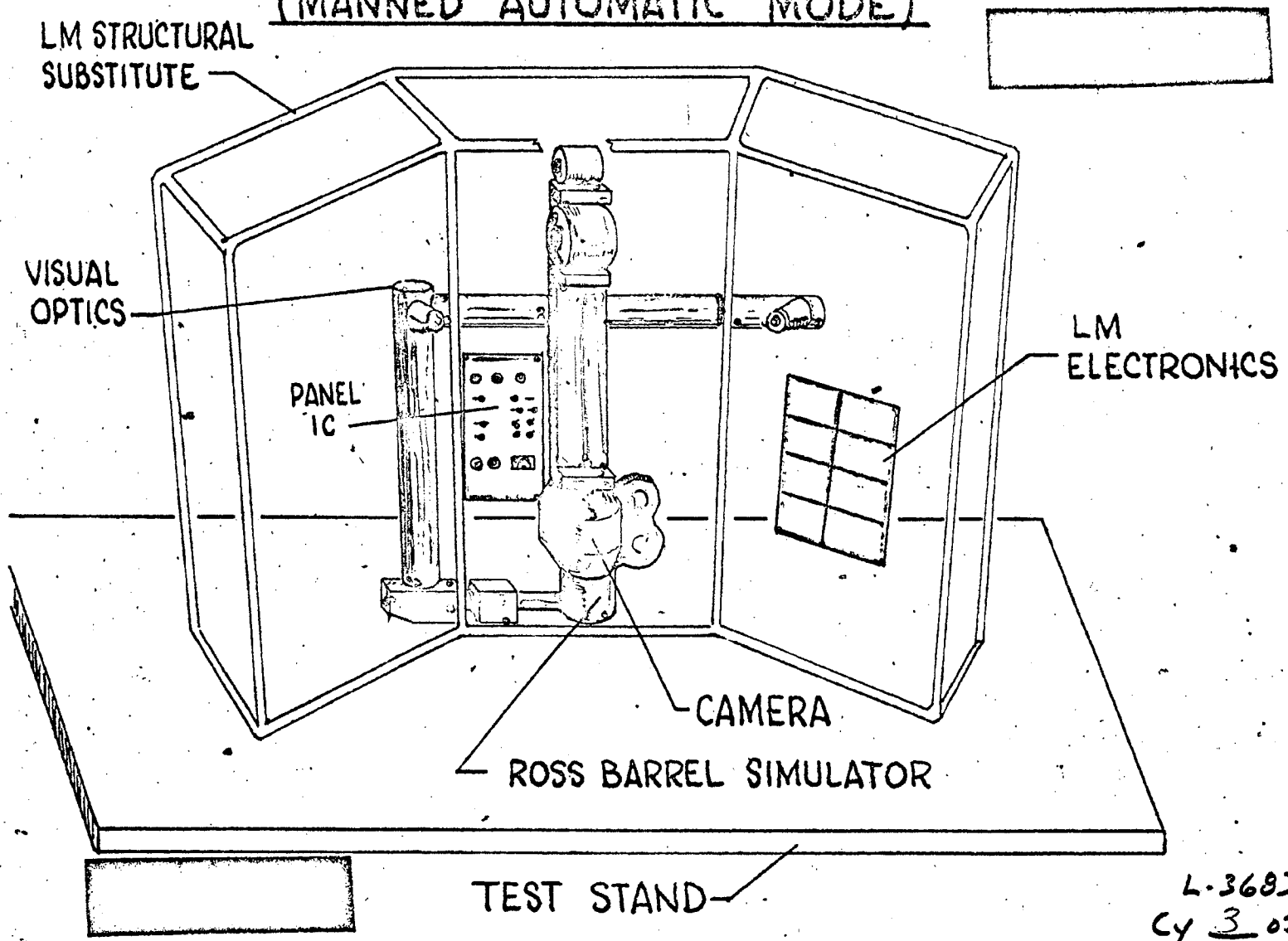
LAB MODULE SUBSYSTEM TEST CONFIGURATION
(MANNED AUTOMATIC MODE)



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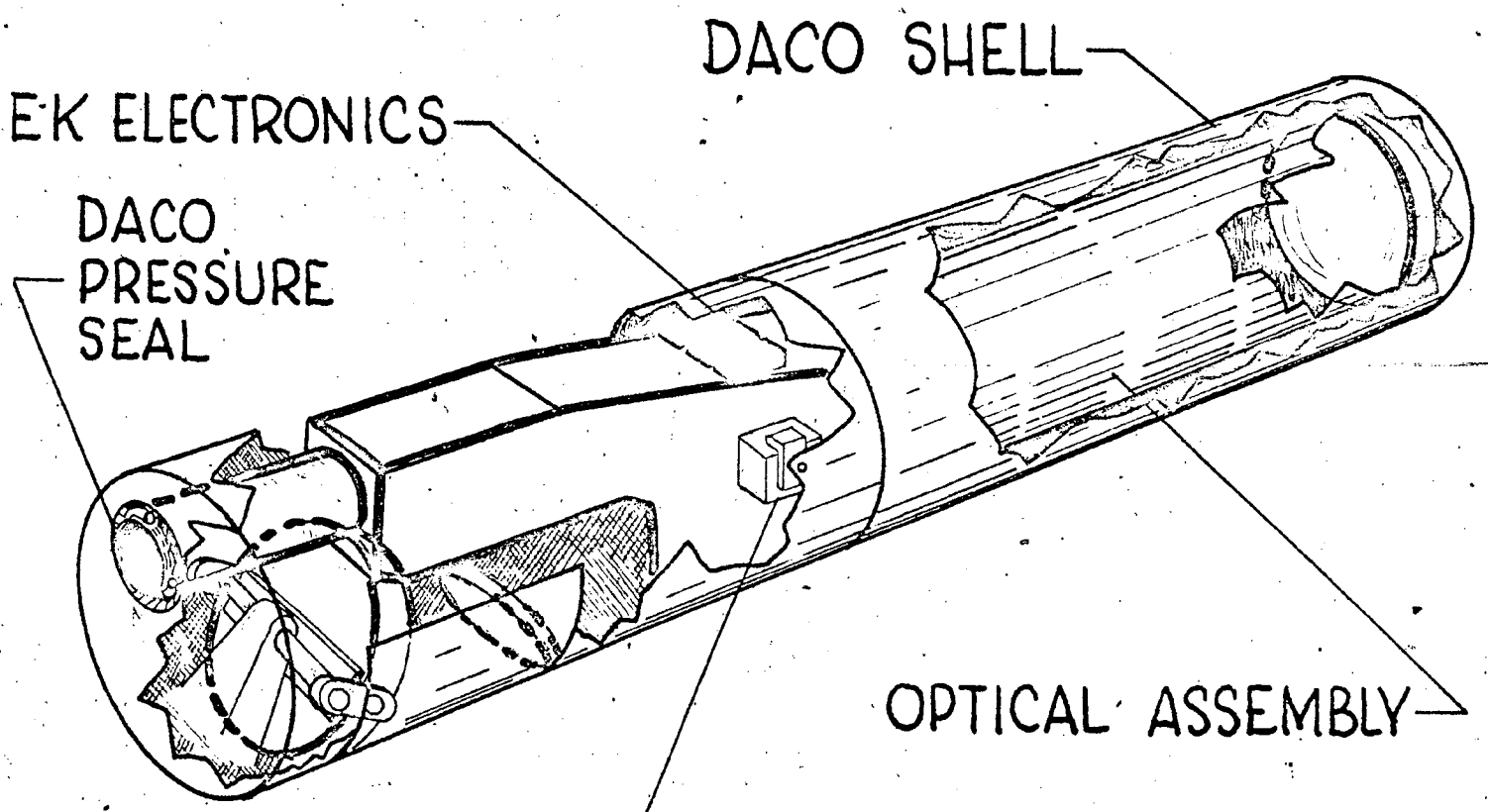
MISSION MODULE TEST CONFIGURATION



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DEFINITIONS

DEVELOPMENT TESTING

DEVELOPMENT TESTS ARE PERFORMED TO DETERMINE AND EVALUATE DESIGN FEASIBILITY, FUNCTIONAL AND ENVIRONMENTAL PARAMETERS, TESTING AND EVALUATION METHODS, MANUFACTURING, PACKAGING AND HANDLING TECHNIQUES.

QUALIFICATION TESTING

QUALIFICATION TESTS ARE PERFORMED ON PRODUCTION HARDWARE TO VERIFY THE CAPABILITY OF THE DESIGN TO OPERATE UNDER ITS SPECIFIED ENVIRONMENTAL DESIGN REQUIREMENTS.

EFFECTIVENESS TESTING

EFFECTIVENESS TESTS ARE PERFORMED TO DETERMINE MARGINS OF SAFETY OF THE SYSTEM WITH RESPECT TO STRESS AND/OR TIME BY OBTAINING DATA IN ADDITION TO THAT OBTAINED DURING DEVELOPMENT AND QUALIFICATION TESTING.

not in original Contract

ACCEPTANCE TESTING

ACCEPTANCE TESTS ARE PERFORMED ON PRODUCTION HARDWARE TO VERIFY CAPABILITY TO MEET SPECIFIED PERFORMANCE AND WORKMANSHIP REQUIREMENTS AND PROVIDE A BASELINE FOR REPEATABLE DATA.

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TEST PHILOSOPHY/OBJECTIVES

GENERAL

- MAXIMIZE COMPLETE TESTING OF SUBASSEMBLIES IN THE PROGRESSIVE ASSEMBLY OF THE SYSTEM.
- PLAN THE PHASES OF TESTING (DEVELOPMENT - QUALIFICATION - FLIGHT ACCEPTANCE) SO THAT EACH SUBASSEMBLY OR ASSEMBLY COMPLETES ITS PHASES SEQUENTIALLY.
- MAXIMIZE CONSTANCY OF TEST SEQUENCE AND EQUIPMENT FOR REPETITIVE TESTING.
- EQUIPMENT SHOULD BE OPERATED AND MONITORED TO MAXIMUM EXTENT POSSIBLE DURING TESTS IMPOSING ENVIRONMENTAL CHANGES (THERMAL, VIBRATION, VACUUM, ETC.).
- FORMAL REQUIREMENTS, PLANS, AND PROCEDURES FOR ALL TESTING.
- ESTABLISH AN ORGANIZED RETEST POLICY FOR TEST FAILURES, INTERRUPTIONS.
- INTRODUCE FLIGHT CREW INTO ALL TESTS OF THE MAN/EQUIPMENT INTEGRATED SYSTEM AS EARLY AS PRACTICAL.
- AVOID REDUNDANT AND EXCESSIVE TESTING RESULTING FROM GEOGRAPHICALLY SEPARATED BUILDUP AREAS.
- MINIMIZE VEHICLE HANDLING REQUIREMENTS AND SEPARATE TEST SETUPS TO GREATEST EXTENT POSSIBLE.

DEVELOPMENT

- MAINTAIN DEVELOPMENT TEST EQUIPMENT AS TEST BEDS FOR FLIGHT SUPPORT AND TROUBLE SHOOTING.

QUALIFICATION

- FUNCTIONS SHOULD BE TESTED SEQUENTIALLY AS IN-FLIGHT PROFILE.
- REDUNDANT CIRCUIT FEATURES SHOULD BE INDEPENDENTLY DESIGN VALIDATED.

ACCEPTANCE

- REDUNDANT CIRCUIT FEATURES SHOULD BE INDEPENDENTLY DEMONSTRATED.
- TEST CONDITIONS AIMED TO DETECT QUALITY FAULTS.
- TEST SHOULD BE CAPABLE TO ISOLATE FAILURES TO BLACK BOX LEVEL WITHOUT DISASSEMBLY.
- EQUIPMENT EXPERIENCING UNEXPLAINED INTERMITTENT OPERATION PROHIBITED FOR FLIGHT USE.
- DATA TREND ANALYSIS SHALL BE PERFORMED BETWEEN SUCCESSIVE STEPS OF ASSEMBLY AND TESTING.
- NO TESTING SHOULD BE PLANNED THAT INVALIDATES A PREVIOUS TEST.
- PROVIDE ADEQUATE TESTING AT ALL LEVELS TO CONSISTENTLY DECREASE FAULT RATE DURING VEHICLE BUILDUP AND PREPARATION FOR DELIVERY TO LAUNCH SITE.
- VERIFY INTERFACES AT LOWEST ASSEMBLY LEVEL POSSIBLE, AND CONDUCT SYSTEM AND SEGMENT LEVEL TESTS, WHERE MEANINGFUL AND PRACTICAL, ONLY TO VERIFY REMAINING UNVALIDATED INTERFACES.

I attached.

TEST PROGRAM DISCUSSION

- DEVELOPMENT
- QUALIFICATION
- ACCEPTANCE

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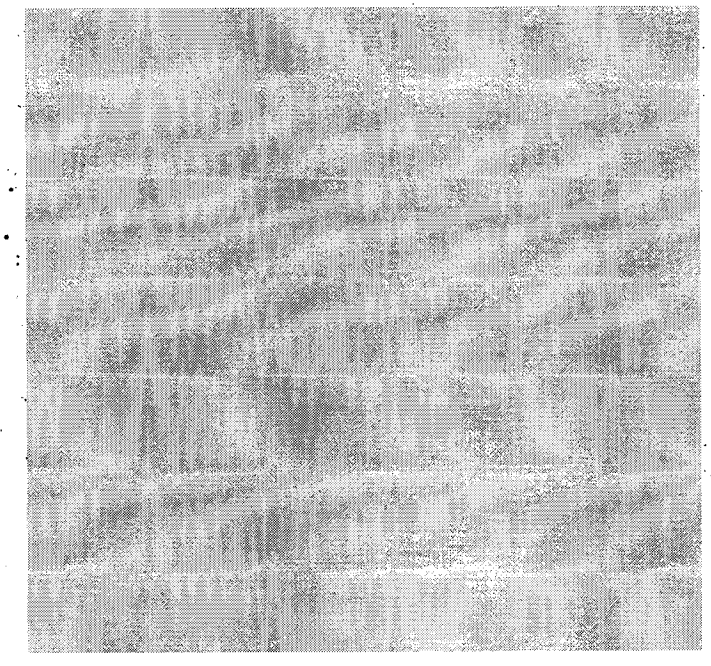

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DEVELOPMENT TESTING

		MOD	STAT	VIB	ACU	SHOCK	T/V	EMC	FUNC	REMARKS
GE	MMFS	✓	✓a	✓	*	✓	✓	*	*	
	CONSOLES (2&8)		✓ 2					*	*	a) TRACKING MIRROR SUPPORT STRUCTURE ONLY.
	AVE	*				*		✓	✓ 1	b) SHELL ONLY.
EK	COA	✓	✓b		*		✓	✓	✓	c) DOMES AND SHORT SECTION COMPONENTS.
	MMAS				*		✓	*	✓	
	MM				✓ 1	*	✓			
	LM MPE						✓	✓	✓	
DAC	MM STRUCTURE		✓						✓	
	BIRDCAGE	✓	✓ 2	*						
	PRESS SHELL		✓c	✓	*					
	UNPRESS. SHELL	✓	✓	✓	*					
	LM	*			✓ 1	*	✓	✓		
	LV	✓ 1				✓ 1				

* PERFORMED AT HIGHER LEVEL OF ASSEMBLY
✓ TEST PERFORMED
■ DEVELOPMENT TEST OBSERVATIONS
■ MOL TEST PROGRAM OBSERVATIONS

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DEVELOPMENT (O_1)

OBSERVATION

- DACO HAS NOT IDENTIFIED ANY DACO OBJECTIVES FOR THE MM ACOUSTIC TEST AT EK.
- EK AND GE HAVE OBJECTIVES FOR THE FOLLOWING TESTS AT DACO AND DACO IS NOT CONTRACTUALLY OBLIGATED TO TEST TO MEET THESE OBJECTIVES:
  - LM ACOUSTIC TEST
  - LV MODAL SURVEY
  - LV SHOCK TEST

PROBLEM

- MANY REQUIREMENTS DERIVING FROM OBJECTIVES OF OTHER ASSOCIATES HAVE NOT BEEN IDENTIFIED OR INCORPORATED INTO TEST PROGRAM PLANNING.

RECOMMENDATION

- ASSOCIATES SHOULD IDENTIFY AND SUBMIT THEIR REQUIREMENTS FOR TESTS TO COGNIZANT ASSOCIATE. BASED ON THE IDENTIFIED REQUIREMENTS, ALL ASSOCIATES SHOULD SCOPE THEIR CONTRACTS TO COVER ALL REQUIRED TASKS.

DEVELOPMENT (O_2)

OBSERVATION

- GE CONDUCTS STATIC LOAD TESTS ON BAYS 2 AND 8 INDIVIDUALLY.
- DACO CONDUCTS DEVEL/QUAL STATIC TESTS ON THE BIRDCAGE CONFIGURED WITH BAYS 2 AND 8 STRUCTURE BUILT BY DACO TO GE DRAWINGS.

PROBLEM

- GE TESTS DIFFICULT TO CONDUCT DUE TO INABILITY TO SIMULATE BIRDCAGE ATTACHMENT LOADS.
- DACO TEST DOES NOT INCLUDE INSTRUMENTATION OF BAYS 2 AND 8

RECOMMENDATION

- CONDUCT INTEGRATED DACO/GE BIRDCAGE STRUCTURE TEST PROGRAM AT DACO.
- DELETE BAYS 2 AND 8 STATIC STRUCTURE TEST AT GE.

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DEVELOPMENT (O_3)

OBSERVATION

- THE LM TEST CONFIGURATION AT DACO INCLUDES THE MISSION MODULE CONSOLE TEST ADAPTER (MISSION MODULE ELECTRICAL SUBSTITUTE).

PROBLEM

- THE MMCTA COMPATIBILITY WITH AVE/CITE IS NOT DEVELOPED AND VALIDATED DURING GE DEVELOPMENT TESTS ON VEHICLE 114 PRIOR TO SHIPMENT TO DACO.

RECOMMENDATION

- INCLUDE MMCTA IN THE DEVELOPMENT PROGRAM ON VEHICLE 114 AT GE TO INSURE COMPATIBILITY WITH CITE AND LM CONSOLES.

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DEVELOPMENT TESTING
GENERAL OBSERVATIONS

	COMMENT		RECOMMENDATION
1)	PROGRAM ASSOCIATE CONTRACTORS SHOULD ESTABLISH ZERO "G" TEST OBJECTIVES FOR THEIR HARDWARE.	1)	THE SPO SHOULD DEVELOP A COORDINATED TEST PROGRAM.
2)	UNDERWATER TESTING SHOULD BE A PRIMARY MODE OF CREW SYSTEMS DEVELOPMENT.	2)	THE SPO SHOULD INVESTIGATE THE REQUIREMENT FOR FURTHER UNDERWATER CREW SYSTEMS DEVELOPMENT.
3)	EK HAS AN OBJECTIVE TO VERIFY THE ADEQUACY OF OV MATH MODELING PROCEDURES FOR PREDICTING COA ELEMENT MOTIONS. PLANS HAVE NOT BEEN IDENTIFIED WHEREBY GE WILL PROVIDE NECESSARY NON-PHOTOGRAPHIC PAYLOAD EXCITATION DATA TO EK.	3)	THE OPR's SHOULD IDENTIFY WHAT DATA IS NECESSARY TO SUPPORT THE EK OBJECTIVE, AND HAVE GE DEVELOP PLANS TO OBTAIN THIS DATA.
4)	T/V TESTING PHILOSOPHY FOR EQUIPMENTS LOCATED WITHIN THE PRESSURIZED SHELL IS NOT CONSISTENT BETWEEN ASSOCIATE CONTRACTORS.	4)	A CONSISTENT T/V POLICY SHOULD BE ESTABLISHED BY THE SPO FOR THE EQUIPMENTS LOCATED WITHIN THE PRESSURIZED SHELL.
5)	THE EDCTU CONFIGURATION IS CONFIGURED FOR ACCESSIBILITY AND DOES NOT CORRECTLY REPRESENT THE FLIGHT EMC TEST CONFIGURATION. SOME EMI PROBLEMS WILL NOT BE SOLVED PRIOR TO TESTING OF THE LAB MODULE PRIME HARDWARE IN FLIGHT VEHICLE #3. EMC TESTING OBJECTIVES SHOULD BE EMPHASIZED IN LMQTV TEST.	5)	SEE OBSERVATION 3 OF MDL TEST PROGRAM OBSERVATIONS.
6)	GE AND EK APPEAR TO HAVE THE OPPORTUNITY (HARDWARE & FACILITY) TO SUBJECT NEAR PRIME SYSTEM LEVEL ASSEMBLIES 114 AND EM TO AN ACOUSTIC VIBRATION TEST. TEST WOULD SERVE AS A SYSTEM LEVEL (MM) DESIGN VERIFICATION AND PRE-QUAL TEST.	6)	IF SCHEDULE AND HARDWARE CAPABILITY (MATERIAL AND CONFIGURATION CAPABLE OF FLIGHT ENVIRONMENT) WILL SUPPORT SUCH A TEST, IT SHOULD BE ACCOMPLISHED.

QUALIFICATION TESTING

		ACOUSTIC	THERMAL VACUUM		FUNCTIONAL	REMARKS
GE	MMFS	*	✓	*	*	
	CONSOLES			*	*	
	AVE			✓	✓	
						* PERFORMED AT HIGHER LEVEL OF ASSY ✓ TEST PERFORMED ■ QUALIFICATION TEST OBSERVATIONS □ MOL TEST PROGRAM OBSERVATIONS
EK	MMAS	*	✓	*	✓	
	MM			✓	1 ✓	
	LMMPE	/	*			
DAC	LM		✓	*		
	LV			✓		

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QUALIFICATION (O_3)

OBSERVATION

DAC PERFORMS AN ACOUSTIC TEST ON THE LM STRUCTURE WITH MASS SUBSTITUTES INSTALLED. MEASURED LEVELS ARE COMPARED TO COMPONENT ACOUSTIC QUAL LEVELS AND THIS SERVES AS THE BASIS FOR "LM ACOUSTIC QUALIFICATION".

PROBLEM

- THIS APPROACH IS NOT CONSISTENT WITH GE AND EK, WHO RUN AN ACOUSTIC QUAL TEST ON THE FUNCTIONAL MM.
- AN ACOUSTIC OR VIBRATION TEST OF A CRITICAL PORTION OF A FUNCTIONAL LABORATORY MODULE (UNPRESSURIZED SECTION) HAS NOT BEEN PLANNED.

RECOMMENDATION

DACO SHOULD CONSIDER CONDUCTING AN ACOUSTIC OR VIBRATION QUAL TEST OF A FUNCTIONAL LM UNPRESSURIZED SECTION.

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VIBRATION/ACOUSTIC TEST PROGRAM

	DEVELOPMENT	QUALIFICATION	ACCEPTANCE
OE	113D (V)	115	118 (V)
EK	MM (A)	QM (A)	MM (A)
DAC	IM (A)	* UNPRESS (FUNCTIONAL)	LM (V)
	UNPRESS (V)		
	PRESS (V)		

* NEW RECOMMENDED TEST

QUALIFICATION (O_2)

OBSERVATION

THE EASTMAN MM QUAL TEST INCLUDES A TEST OF THE ASSEMBLED MM AND A TEST OF THE MMAS ALONE. THE MISSION MODULE IS QUALIFIED IN A THERMAL-VAC ENVIRONMENT FOR 15 DAYS. THE MMFS USED IN THIS TEST HAS BEEN PREVIOUSLY QUALIFIED FOR 30 DAYS. SUBSEQUENT TO THE 15 DAY COMPLETE MM TEST, THE MMAS IS QUAL TESTED FOR 30 DAYS.

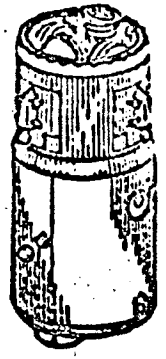
PROBLEM

- THE RATIONALE FOR THE ASSEMBLED MM BEING QUALIFIED FOR ONLY 15 DAYS IN THE SYSTEM IS NOT CONSISTENT WITH THE 30 DAY QUAL CRITERIA FOR THE PROGRAM.
- THE RATIONALE OF SUBJECTING THE MMFS AND MMAS TO 45 DAYS OF THERMAL VACUUM QUAL IS NOT CONSISTENT WITH LOWER LEVEL (COMPONENT) DESIGN AND TEST SPECIFICATIONS (30 DAYS).
- THE MMAS PORTION OF THE EASTMAN TEST IS CONDUCTED AFTER THE ASSEMBLED MM TEST.

RECOMMENDATION

- ITEM 1 IS NOT CONSIDERED A PROBLEM, PROVIDING SUFFICIENT TIME IS ALLOWED FOR THE ASSEMBLED MM THERMAL DYNAMICS, FUNCTIONAL AND OPTICS TESTING. IT IS RECOMMENDED THAT THE TIME REQUIRED FOR ASSEMBLED MM THERMAL DYNAMICS, OPTICS AND FUNCTIONAL TESTING BE RE-EXAMINED WITH THE OBJECTIVE OF REDUCING THE T/V EXPOSURE.
- CONSIDER LIMITING THE TOTAL T/V EXPOSURE OF THE MMFS AND MMAS EACH TO NOT MORE THAN 30 DAYS, WITH THE DURATIONS OF THE INDIVIDUAL MMFS AND MMAS T/V EXPOSURES NOT TO EXCEED 30 DAYS MINUS THE DURATION OF THE ASSEMBLED MM TEST.
- CONSIDER RE-ARRANGING TEST SEQUENCE SO THAT ALL OR PART OF MMAS TEST BE CONDUCTED PRIOR TO TEST OF ASSEMBLED MM, CONSISTENT WITH RECOMMENDATIONS (1) AND (2).
- IF RECOMMENDATION (2) CANNOT BE MET, CONSIDER REDUCTION IN OBJECTIVES OF MM TEST, RETAINING THERMAL/OPTICS OBJECTIVES.

MOL SYSTEM T/V QUALIFICATION PROGRAM

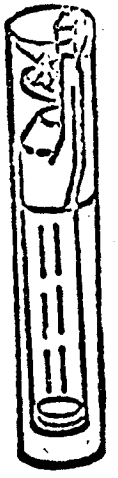


EK/GE/DACO
INTERFACE QUAL
(INTEGRATED QUAL)

MMFS ONLY
GE DESIGN QUAL

EK
DESIGN
QUAL

MM
ENVIRONMENT
QUAL



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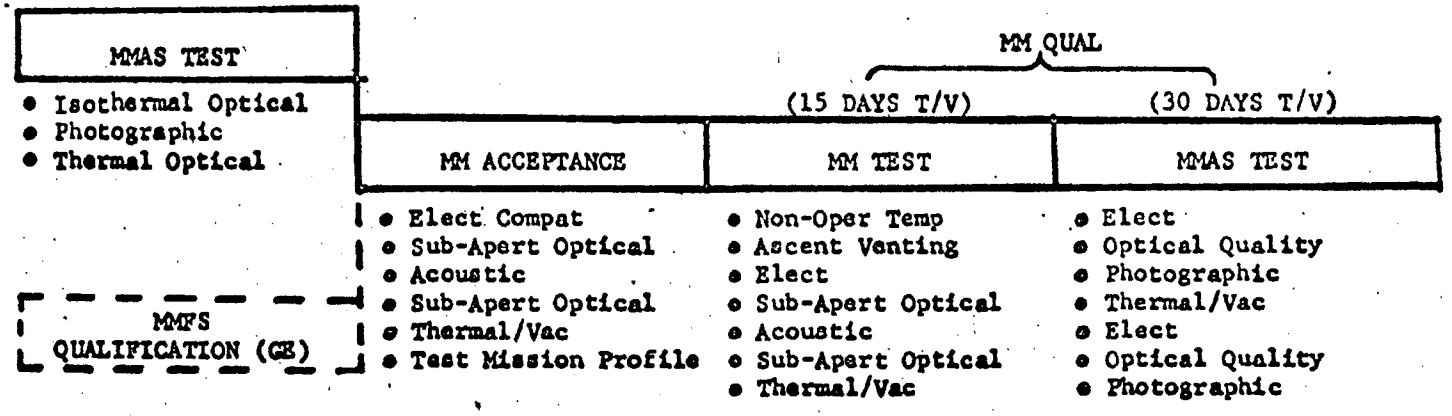
EK QUALIFICATION PROGRAM

PRESENT FLOW



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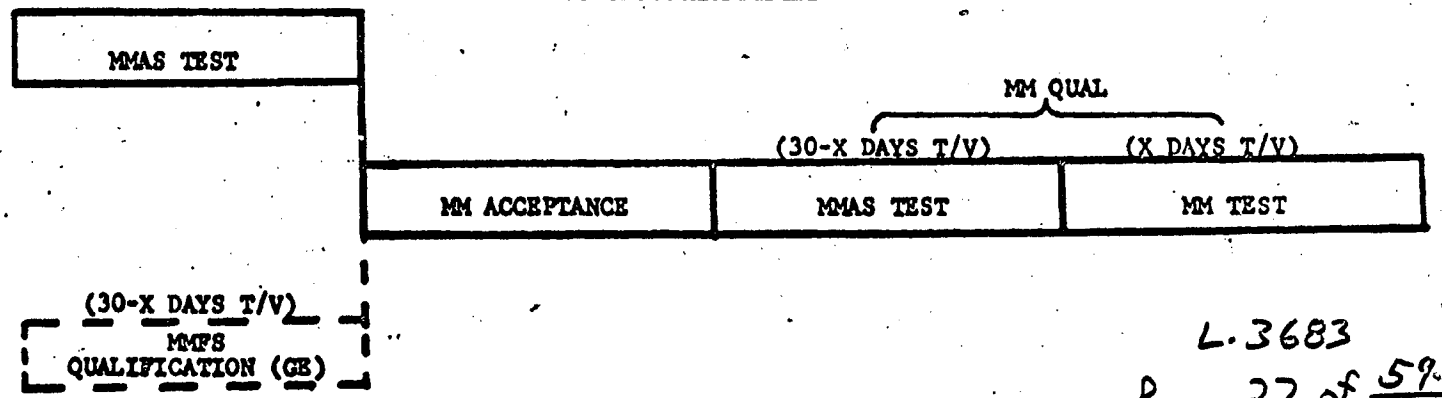

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ACCEPTANCE TESTING

		DYNAMICS			EMC	FUNCTIONAL	REMARKS
GE	MMFS	✓	*	✓	*	*	
	CONSOLES	✓		*	*		
	AVE			*	✓	✓	
EK	MMAS		*	✓	*	✓	
	MM		✓	✓	✓	✓	
	LM MPE	*		✓	✓	✓	
DAC	LM	✓		✓			
	LV				✓	✓	

* PERFORMED AT HIGHER LEVEL OF ASSEMBLY
✓ TEST PERFORMED

☐ ACCEPTANCE TEST OBSERVATION
☐ MOL TEST PROGRAM OBSERVATION

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ACCEPTANCE (O_1)

OBSERVATION

- THE VALIDITY OF LOW LEVEL VIBRATION AND ACOUSTIC TESTING HAS BEEN QUESTIONED; FURTHERMORE, ACOUSTIC/VIBRATION ACCEPTANCE TESTING PHILOSOPHY IS INCONSISTENT BETWEEN ASSOCIATE CONTRACTORS.

EXAMPLE:

COMPONENTS		SYSTEM	TYPE TEST
GE	ON	MMFS - ON	LOW LEVEL VIBRATION
EK	OFF	MM - ON (ASCENT ONLY)	FLIGHT LEVEL ACOUSTIC
DAC	ON	LM - OFF	LOW LEVEL VIBRATION

- OBJECTIVE OF THESE TESTS, AS PROPOSED BY SOME OF THE CONTRACTORS, ARE TO IDENTIFY QUALITY AND WORKMANSHIP DEFECTS.

PROBLEM

THE ENERGY LEVELS TRANSMITTED TO AND THE RESPONSE OF INTERNAL COMPONENTS IS QUESTIONABLE IN LARGE "SOFT" MOL TYPE STRUCTURES. THE RESPONSE LEVELS ON INTERNAL COMPONENTS ARE ANTICIPATED TO BE VERY LOW WHICH INVALIDATES THE BASIC INTENT OF THE TEST.

RECOMMENDATION

A STUDY BE CONDUCTED IN DEPTH TO DETERMINE THE VALIDITY OF CONDUCTING VIBRATION AND ACOUSTIC ACCEPTANCE TESTS, TO SATISFY THE ABOVE STATED OBJECTIVE, ON THE VARIOUS MOL SEGMENTS. THE STUDY MUST ALSO ADDRESS A CONSISTENT TEST APPROACH/CONFIGURATION, THAT WOULD APPLY TO ALL ASSOCIATE SEGMENTS.

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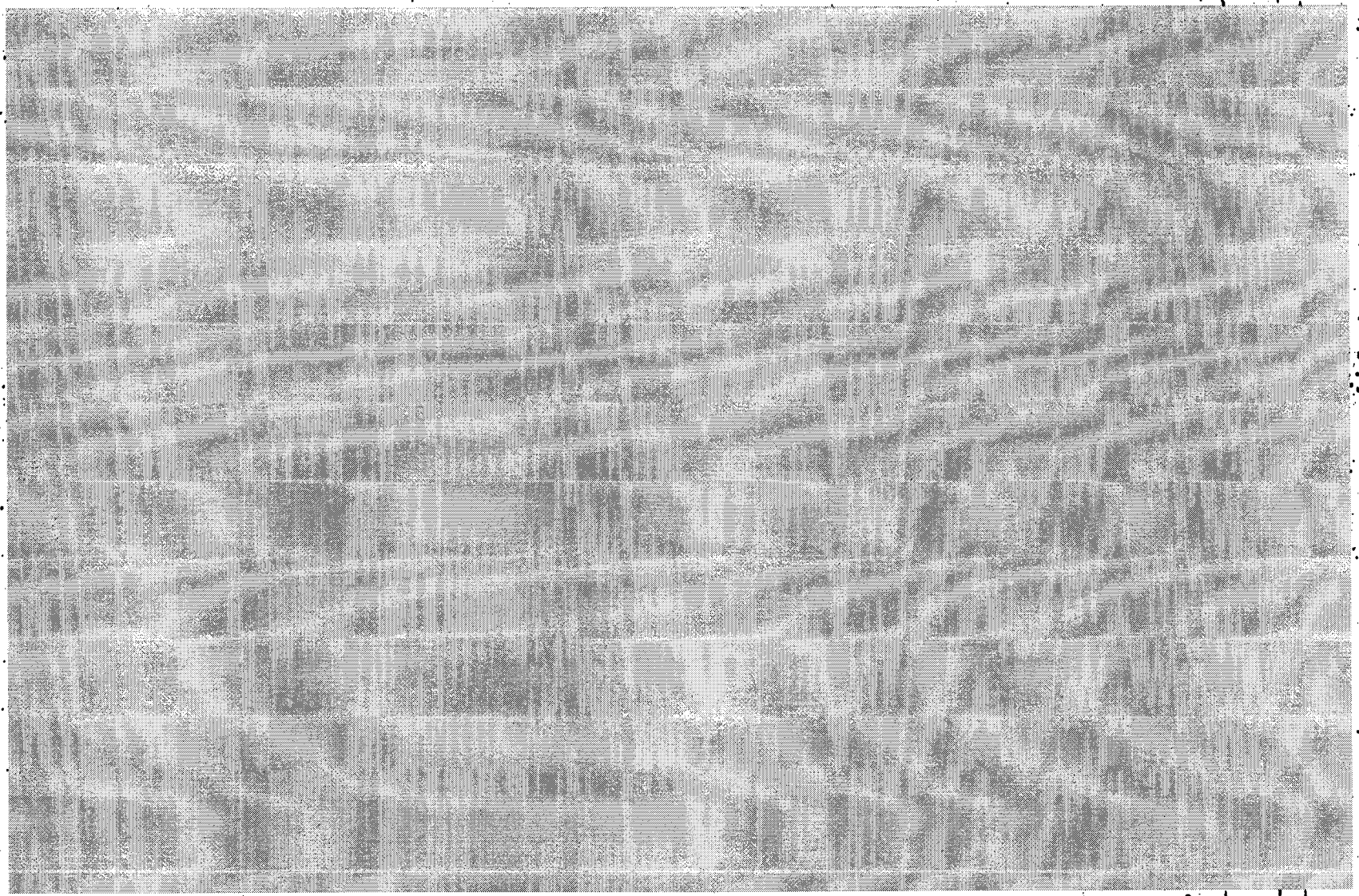

ACCEPTANCE (O_2)

OBSERVATION

- MANY COMMENTS WERE SUBMITTED BY BOARD MEMBERS RECOMMENDING REDUCTION AND/OR DELETION OF VARIOUS SYSTEM LEVEL THERMAL VAC TESTS. HOWEVER, THESE COMMENTS WERE ASSOCIATED WITH THE SINGLE T/V TEST OBJECTIVE OF "DETECTING QUALITY DEFECTS".

- IN REVIEWING TOTAL T/V ACCEPTANCE TEST OBJECTIVES, THE BOARD DETERMINED THAT THE QUALITY DEFECTS OBJECTIVE IS "SUBSERVIENT" TO OTHER "PRIMARY" OBJECTIVES SUCH AS:

  - VERIFICATION OF MM THERMAL CONTROL CAPABILITY (HIGH TECHNICAL REQUIREMENT IN THE DORIAN MISSION).
  - VERIFICATION OF IM SYSTEM CAPABILITY TO INTERFACE WITH AND SUPPORT MAN. (CRITICAL ELEMENT IN A CRITICAL ENVIRONMENT).

RECOMMENDATION

NO CHANGE IN THE T/V ACCEPTANCE TEST PROGRAM.

ACCEPTANCE (O_3)

OBSERVATION

- GE PLANS TO CONDUCT A FUNCTIONAL RECEIVING TEST ON CONSOLES 2 AND 8 AT DAC (BEFORE INSTALLATION INTO THE LM BIRDCAGE).
- THE TEST IS A RE-RUN OF A SIMILAR TEST AT GE BEFORE SHIPMENT. (SHIPPING DAMAGE TEST)

PROBLEM

- SPECIAL AGE NEEDED TO CONDUCT THE TEST IS NOT PROVIDED AT DAC IN THE PRESENT PROGRAM.
- THE TEST IS NOT A TOTAL FUNCTIONAL TEST OF THE CONSOLES (EK INSTALLED EQUIPMENT CANNOT BE OPERATED).

RECOMMENDATION

- THE BOARD RECOMMENDS THE FOLLOWING:
  - DELETING THE TEST, OR
  - ADDITION OF NECESSARY AGE FOR THE GE TEST AND INVESTIGATING THE POSSIBILITY OF OPERATING EK EQUIPMENT.

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MOL TEST PROGRAM

OBSERVATIONS/RECOMMENDATIONS

- MAJOR CONCERN ITEMS
  - MISSION MODULE TEST SET (MMTS) ☐ 1
  - ELECTRICAL SYSTEMS DEVELOPMENT ☐ 2
  - IMQTV/LV-3 TEST FLOW ☐ 3
- GENERAL ITEMS

M M T S

C A P A B I L T Y

□ 1

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MMTS CAPABILITY

DISCUSSION

- SUPPORTS MM TESTING AT EK
- MMTS CAPABILITY WILL IMPACT SCOPE OF TESTING
  - AVE PERFORMANCE IN OPERATIONAL MODES
  - DATA BASELINE
  - FAILURE DIAGNOSIS
  - EQUIPMENT REVALIDATION AFTER FAILURE AND FIX

PROBLEM

- PROGRAM DECISION TO REDEFINE MMTS HAS LED THE BOARD TO QUESTION THE VALIDITY OF MM LEVEL TESTING. TO INSURE THAT MM TESTING IS ADEQUATE, CERTAIN MMTS CAPABILITY MUST BE RETAINED.

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RANGE OF MMTS CAPABILITIES

MINIMUM	RECOMMENDED	MAXIMUM
POWER ON	OPERATE MM IN SEQUENCE OF FLIGHT TIMELINE WITH TIMING DELAYS, BUT SUCH THAT EACH OPERATING MODE CAN BE OBTAINED.	OPERATE MM AS LM/MPE WOULD a) REAL TIME SEUQENCING b) DATA FEEDBACK
MANUAL SEQUENCING		
DATA RECORDED VIA HARDWARE UNFORMATTED	DATA TAKEN EQUIVALENT TO COMPUTER INPUT, DISPLAYED FOR REAL TIME MONITORING, AND RECORDED FOR OFF LINE FORMATTING TO CITE OUTPUT FORM.	DATA TAKEN AS COMPUTER INPUT AND FORMATTED, DISPLAYED ON LINE, AND RECORDED LIKE CITE OUTPUT.
DATA REDUCTION OFF LINE		TEST SOFTWARE IS CITE MPSS SOFTWARE MODIFIED ONLY WHERE ESSENTIAL

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ELECTRICAL SYSTEMS

DEVELOPMENT

□2

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ELECTRICAL SYSTEMS DEVELOPMENT

OBSERVATION

- THE ASSOCIATES HAVE ATTEMPTED TO FOLLOW THE "BUILDING BLOCK" APPROACH IN ELECTRICAL SYSTEMS DEVELOPMENT TESTS. HOWEVER, SOME "BLOCKS" ARE MISSING IN THE PRESENT TEST PROGRAM, ESPECIALLY IN THE AREA OF INTEGRATED SEGMENT TESTING.
- ACTUAL TESTING OF MAJOR SEGMENT INTERFACES WILL OCCUR FOR THE FIRST TIME IN THE PROGRAM ON LV-3.
- A MAJOR "HOLE WAS FILLED" DURING THE PROGRAM MANAGERS MEETING WHEN GE AVE AND AGE WAS ADDED TO THE EDTCU.

PROBLEM

- EK HARDWARE IS NOT INCLUDED IN THE EDCTU.
- A PROPER TOOL IS STILL LACKING IN THE DEVELOPMENT TEST PROGRAM TO SATISFY THE FOLLOWING OBJECTIVES:
  - LM AVE SEGMENT-TO-SEGMENT INTERFACE COMPATIBILITY DEVELOPMENT
  - LV INTEGRATED AVE/AGE COMPATIBILITY DEVELOPMENT
  - SPECIAL ITEMS EMINATING FROM VEHICLE ACCEPTANCE AND FLIGHT PROGRAMS

RECOMMENDATION

- PROVIDE EK LM FLIGHT CONFIGURED ELECTRICAL COMPONENTS FOR THE EDCTU.
- UPGRADE THE OBJECTIVES OF THE EDCTU TEST PROGRAM TO INCLUDE THE LV, AS WELL AS LM, ELECTRICAL SYSTEM DEVELOPMENT OBJECTIVES.

THEN

- KEEP THE EDCTU IN AN UPDATED CONFIGURATION DURING THE MANNED FLIGHT PROGRAM FOR GROUND TROUBLE-SHOOTING PURPOSES DURING THE 30 DAY ON-ORBIT PERIODS. EDCTU WILL ALSO BE AVAILABLE FOR COMPONENT/SYSTEM FAILURE ANALYSIS DETERMINATION.

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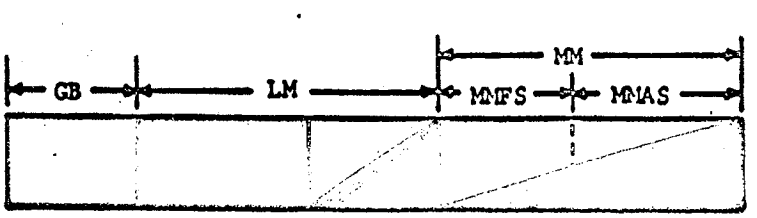
ELECTRICAL SYSTEMS DEVELOPMENT

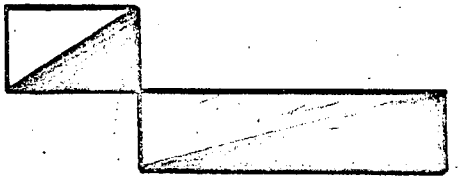


MAC
DAC
GE
EK
S SUBSTITUTE

A) GE (114)

NO EK FUNCTIONAL HARDWARE

B) EK (EM)



NO GE CONSOLES

LIMITED MMTS CAPABILITY

C) DAC (EDCTU)

NO EK FUNCTIONAL HARDWARE

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TEST FLOW CHANGE

L M Q T V

A N D

L V - 3

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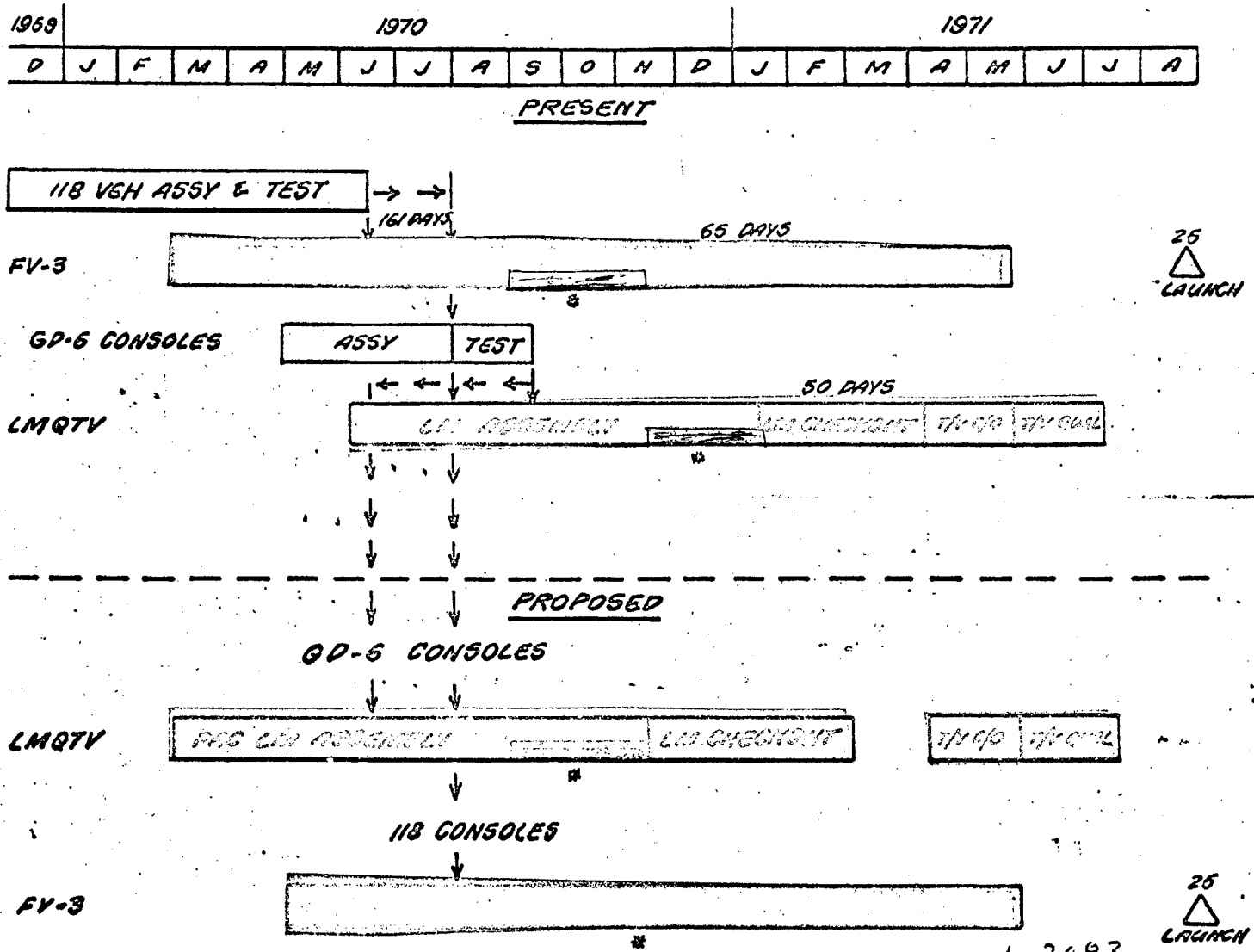
TEST FLOW STRAWMAN

LEARNING CURVE ON LMQTV FOR ASSEMBLY AND CHECKOUT ONLY



(D) ~~SECRET~~ SPECIAL HANDLING

FLOW REVISION GROUND RULES

- START LMQTV ASSEMBLY AND CHECKOUT ON PROPOSED FV-3 DATES
- LEARNING SPANS RETAINED IN FIRST PRODUCTION VEHICLE - LMQTV NOT FV-3
- THERMAL/VACUUM ACCEPTANCE ON FV-3 LM PRIOR TO T/V QUAL ON LMQTV

LMQTV/LV-3 TEST FLOW

- PRESENT BASELINE (LV-3 PRECEEDING LMQTV)
  - PHILOSOPHY BASED ON EARLY FISCAL FUNDING RELIEF.
  - ENABLED A 3 MONTH SHIFT-TO-RIGHT OF FIRST "ALL UP" VEHICLE AND AGE IN RESPECT TO LAUNCH OF FV-3.
  - SINCE MAJORITY OF DEVELOPMENT AND QUALIFICATION TEST PROGRAMS ARE HARDPOINTED TO THE FIRST "ALL-UP" VEHICLE, THE 3 MONTH SHIFT WAS ALSO REALIZED IN THESE MAJOR COST PROGRAMS.
- BOARD PROPOSAL (LMQTV PRECEEDING LV-3)
  - FIRST "ALL UP" VEHICLE RETAINS IDENTICAL DATES FOR START OF ASSEMBLY AND CHECKOUT PER PRESENT BASELINE.
  - IMPACTS FROM THE BOARD'S PROPOSAL ARE MAINLY ASSOCIATED WITH SECOND "ALL UP" VEHICLE AND AGE. THIS MINIMIZES THE COST IMPACT ON EARLY FISCAL FUNDING.

COMPARISON OF FLOWS

ADVANTAGES OF PRESENT FLOW

- RELIEVED THE FISCAL FUNDING PROBLEM, WHILE COMPLETING IM QUAL BEFORE FLIGHT OF FV-3

ADVANTAGES OF PROPOSED FLOW

- ASSEMBLY & TEST LEARNING ACCOMPLISHED ON LMQTV
- EK/GE LAB MODULE AVE COMPATIBILITY DEMONSTRATION WILL BE DONE ON LMQTV INSTEAD OF LV-3
- PROVIDES CAPABILITY FOR EMC TESTING ON QUAL LEVEL PRIOR TO ASSY OF FIRST FLIGHT VEHICLE
- PROVIDES CAPABILITY FOR ORDERLY DEVELOPMENT VALIDATION OF ACCEPTANCE TECHNIQUES PRIOR TO APPLICATION OF THESE TECHNIQUES ON THE FIRST MANNED FLIGHT VEHICLE
- START VEHICLE 118 TEST 6 WEEKS LATER

COMPARISON OF FLOWS

DISADVANTAGES OF PRESENT FLOW

- ASSEMBLY & TEST LEARNING ACCOMPLISHED ON FV-3
- THE FIRST PRIME VEHICLE (FV-3) AT DOUGLAS PROVIDES FIRST TEST BED FOR EK/GE LAB MODULE AVE COMPATIBILITY DEMONSTRATION

DISADVANTAGES OF PROPOSED FLOW

- WILL INCREASE FY70 FISCAL FUNDING REQUIREMENTS SLIGHTLY
- REQUIRES ADDITIONAL ASSEMBLY TOWER OR SLIP OF FLIGHT DATE OF FV-3 BY 5 WEEKS

IMPACT OF PROPOSED FLOW

DAC

- START OF ASS'Y ON 2ND PRODUCTION VEHICLE OCCURS 7½ WEEKS EARLIER
  - FIVE WEEK OVERLAP OF LMQTV/FV-3 IN FINAL ASSEMBLY TOWER
- START OF LM CHECKOUT ON 2ND PRODUCTION VEHICLE OCCURS 5 WEEKS EARLIER
  - REQUIRES EARLIER AVAILABILITY OF PSIA AGE SET #2
  - FV-2 MUST BE ASSEMBLED AND CHECKED OUT 5 WEEKS EARLIER BECAUSE OF PLANNED USE OF SET #2 OR PERFORM FV-2 CHECKOUT AT VAFB

GE

- SHIP SECOND MOL CITE 5 WEEKS EARLIER TO HUNTINGTON BEACH
- START CONSOLE ASSEMBLY FOR LMQTV 12 WEEKS EARLIER

EK

- NONE
  - EK PLANNED TO ASSY AND TEST LMQTV LM EQUIPMENT AS FIRST PRIME SET AND HOLD UNTIL NEEDED

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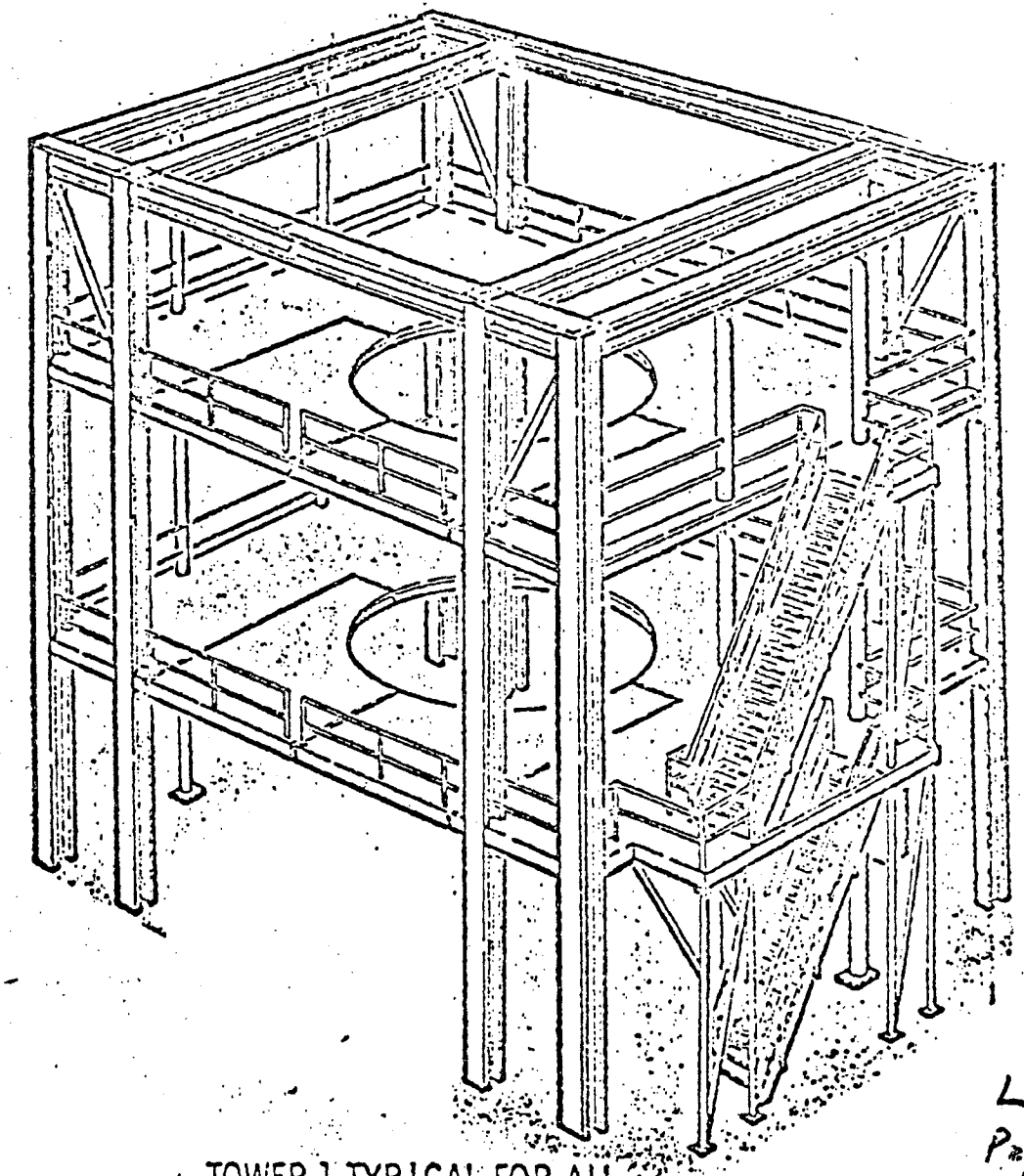
RECOMMENDATION

- MOVE LMQTV ASSEMBLY AND CHECKOUT AHEAD OF LV-3.
- PROVIDE ADDITIONAL ASSEMBLY TOWER.
- PERFORM LV-2 CHECKOUT AT VAFB.



TOWER 1 TYPICAL FOR ALL
INSTALLATION SEQUENCES

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MOL TEST PROGRAM

GENERAL ITEMS

1) REQUAL FACTOR IN SYSTEM LEVEL QUAL CYCLES -

DAC ALLOWS 50% REQUAL FACTOR

GE AND EK ALLOWS 0% REQUAL FACTOR(S).

THE IMPACT OF THE "NO REQUAL FACTOR" APPROACH SHOULD BE INVESTIGATED TO DETERMINE IMPACT ON MEETING LV-3 ACCEPTANCE SCHEDULE. (CONTRACTUAL DIFFERENCES)

2) GE CONSOLE ENVIRONMENTAL TEST REQUIREMENTS ARE NOT SPECIFIED. GE AVE IS TREATED ONLY AT THE SYSTEMS LEVEL WITH EMPHASIS ON MMFS ENVIRONMENTAL TESTING.

3) THERE IS LITTLE EVIDENCE OF SYSTEM LEVEL TESTING OF THE COMBINED LM TUNNEL AND TUNNEL HATCH. THE ADDITION OF SYSTEMS TESTING TO DAC'S TEST PROGRAM SHOULD BE INVESTIGATED.

4) IN THE PRESENT LM CHECKOUT CONFIGURATION A MULTITUDE OF TEST CABLES RUN THROUGH THE EVA HATCH. ROUTING OF CABLES INTO LM BY OTHER MEANS SHOULD BE INVESTIGATED TO REDUCE PANEL AND CONNECTOR WEAR DUE TO CABLE FLEXURE AND HANDLING.

5) THE BOARD RECEIVED NO EVIDENCE OF EMPHASIS ON SINGLE POINT FAILURE TESTING ANYWHERE IN THE TEST PROGRAM.

DAC will provide protection

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MOL TEST FACILITIES

MODIFIED EK
NEW DAC

FACILITY	STATUS	OBJECTIVES			REMARKS
		DEVELOPMENT	QUALIFICATION	ACCEPTANCE	
GENERAL ELECTRIC					
STATIC					
T/V					
VIBRATION					
ASSY AND C/O					
EASTMAN KODAK					
ACOUSTIC					(MM)
CHAMBER I, Is		COMPONENT TEST FACILITY			ASPHERE TESTING
CHAMBER II, IIs		COMPONENT TEST FACILITY			PLANO TESTING
CHAMBER III					OA TESTING (2)
CHAMBER A					T/V TESTING (MM)
CHAMBER B					RAPID PUMP DOWN
CHAMBER C					
CHAMBER F					
CHAMBER Iem					(2)
CHAMBER IIem					
ASSY AND C/O					
DOUGLAS					
STATIC					
VIBRATION					
ACOUSTIC					
EDCTU AREA					
SPACE CHAMBER					(LM)
ASSY AND C/O					

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(D) ~~SECRET~~ SPECIAL HANDLING

MOL TEST FACILITIES

EXISTING
MODIFIED
NEW

GE
EK
DAC

FACILITY	STATUS	OBJECTIVES			REMARKS
		DEVELOPMENT	QUALIFICATION	ACCEPTANCE	
GENERAL ELECTRIC					
STATIC					
T/V					
VIBRATION					
ASSY AND C/O					
EASTMAN KODAK					
ACOUSTIC					(MM)
CHAMBER I, Is		COMPONENT TEST FACILITY			ASPHERE TESTING
CHAMBER II, IIs		COMPONENT TEST FACILITY			PLANO TESTING
CHAMBER III					OA TESTING (2)
CHAMBER A					T/V TESTING (MM)
CHAMBER B					RAPID PUMP DOWN
CHAMBER C					
CHAMBER F					
CHAMBER Iom					(2)
CHAMBER IIom					
ASSY AND C/O					
DOUGLAS					
STATIC					
VIBRATION					
ACOUSTIC					
EDCTU AREA					
SPACE CHAMBER					(LM)
ASSY AND C/O					

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(D) ~~SECRET~~ SPECIAL HANDLING

NDL TEST FACILITIES

EXISTING
MODIFIED
NEW

GE
EK
DAC

FACILITY	STATUS	OBJECTIVES: DEVELOPMENT	OBJECTIVES: QUALIFICATION	OBJECTIVES: ACCEPTANCE	REMARKS
GENERAL ELECTRIC					
STATIC					
T/V					
VIBRATION					
ASSY AND C/O					
EASTMAN KODAK					
ACOUSTIC					(MM)
CHAMBER I, Is		COMPONENT TEST FACILITY			ASPHERE TESTING
CHAMBER II, IIs		COMPONENT TEST FACILITY			PLANO TESTING
CHAMBER III					OA TESTING (2)
CHAMBER A					T/V TESTING (MM)
CHAMBER B					RAPID PUMP DOWN
CHAMBER C					
CHAMBER F					
CHAMBER Iem					(2)
CHAMBER IIem					
ASSY AND C/O					
DOUGLAS					
STATIC					
VIBRATION					
ACOUSTIC					
EDCTU AREA					
SPACE CHAMBER					(LM)
ASSY AND C/O					

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MSC TEST FACILITIES

EXISTING — GE
MODIFIED — EK
NEW — DAC

FACILITY	STATUS	OBJECTIVES: DEVELOPMENT	OBJECTIVES: QUALIFICATION	OBJECTIVES: ACCEPTANCE	REMARKS
GENERAL ELECTRIC					
STATIC					
T/V					
VIBRATION					
ASSY AND C/O					
EASTMAN KODAK					
ACOUSTIC					(MM)
CHAMBER I, Is		COMPONENT TEST FACILITY			ASPHERE TESTING
CHAMBER II, IIs		COMPONENT TEST FACILITY			PLANO TESTING
CHAMBER III					OA TESTING (2)
CHAMBER A					T/V TESTING (MM)
CHAMBER B					RAPID PUMP DOWN
CHAMBER C					
CHAMBER F					
CHAMBER Iem					(2)
CHAMBER IIem					
ASSY AND C/O					
DOUGLAS					
STATIC					
VIBRATION					
ACOUSTIC					
EDCTU AREA					
SPACE CHAMBER					(LM)
ASSY AND C/O					

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FACILITIES RECOMMENDATIONS

- SINCE THE LM-DTS ACOUSTIC TEST IS A ONE-TIME-ONLY TEST AND REQUIRES ACOUSTIC CHAMBER MODIFICATION AT DACO, THE FEASIBILITY OF USING AN EXISTING ACOUSTIC FACILITY SHOULD BE STUDIED.

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- CONTRACTUAL

  - HARDWARE ACCEPTANCE POLICY ON EXISTING CONTRACTS IS INCONSISTENT. WILL EFFECT ROLES & RESPONSIBILITIES AGREEMENTS BETWEEN ASSOCIATE CONTRACTORS.

  - DAC IS NOT COVERED TO TEST TO ACHIEVE ASSOCIATE TEST OBJECTIVES ON SOME INTEGRATED TESTING.

    EXAMPLE:

    - ASSOCIATES HAVE TEST OBJECTIVES DURING LMQTV TESTING. LMQTV TEST COMPLETION IS INCENTIVIZED FOR DAC ONLY.

  - DUMMY ROSS BARRELL FOR LM CHECKOUT.

(OK)

SUMMARY

- OPTIMIZE MMTS CHECKOUT CAPABILITY. 1(1)
- UPGRADE EDCTU TO A LV ELECTRICAL SYSTEMS DEVELOPMENT TOOL AND MAINTAIN, IN UPDATED CONFIGURATION, FOR TROUBLESHOOTING PURPOSES. 4.7M
- REVERSE ORDER OF LMQTV/LV-3 ASSEMBLY AND CHECKOUT FLOW. (A) says ~~=~~; costs too high ~ 15 M
- ASSOCIATES IDENTIFY TEST OBJECTIVES FOR INTEGRATED TESTING.
- CONDUCT INTEGRATED DAC/GE BIRDCAGE STRUCTURE TEST AT DAC. yes (A)
- INCLUDE MMCTA IN DEVELOPMENT PROGRAM ON 114 AT GE. Concur but on 115
- DAC CONDUCT A VIBRATION/ACOUSTIC QUALIFICATION TEST OF A FUNCTIONAL LM UNPRESSURIZED SECTION. cost (3M) O.K. (A)
- LIMIT TOTAL THERMAL/VACUUM EXPOSURE IN QUALIFICATION TESTS OF MM SUBSYSTEMS TO 30 DAYS. (A) says no to TORB
- INVESTIGATE VALIDITY OF VIBRATION/ACOUSTIC TESTS TO MEET ACCEPTANCE OBJECTIVES.
- DETERMINE VALIDITY OF GE CONSOLE RECEIVING FUNCTIONAL TEST AT DAC. (A) There will be additional AGE Cost should be done by DAC
- PROVIDE CONTRACTUAL COVERAGE TO ALL ASSOCIATES FOR ACCOMODATING OTHER ASSOCIATE INTEGRATED ~~TEST~~ Test OBJECTIVES.

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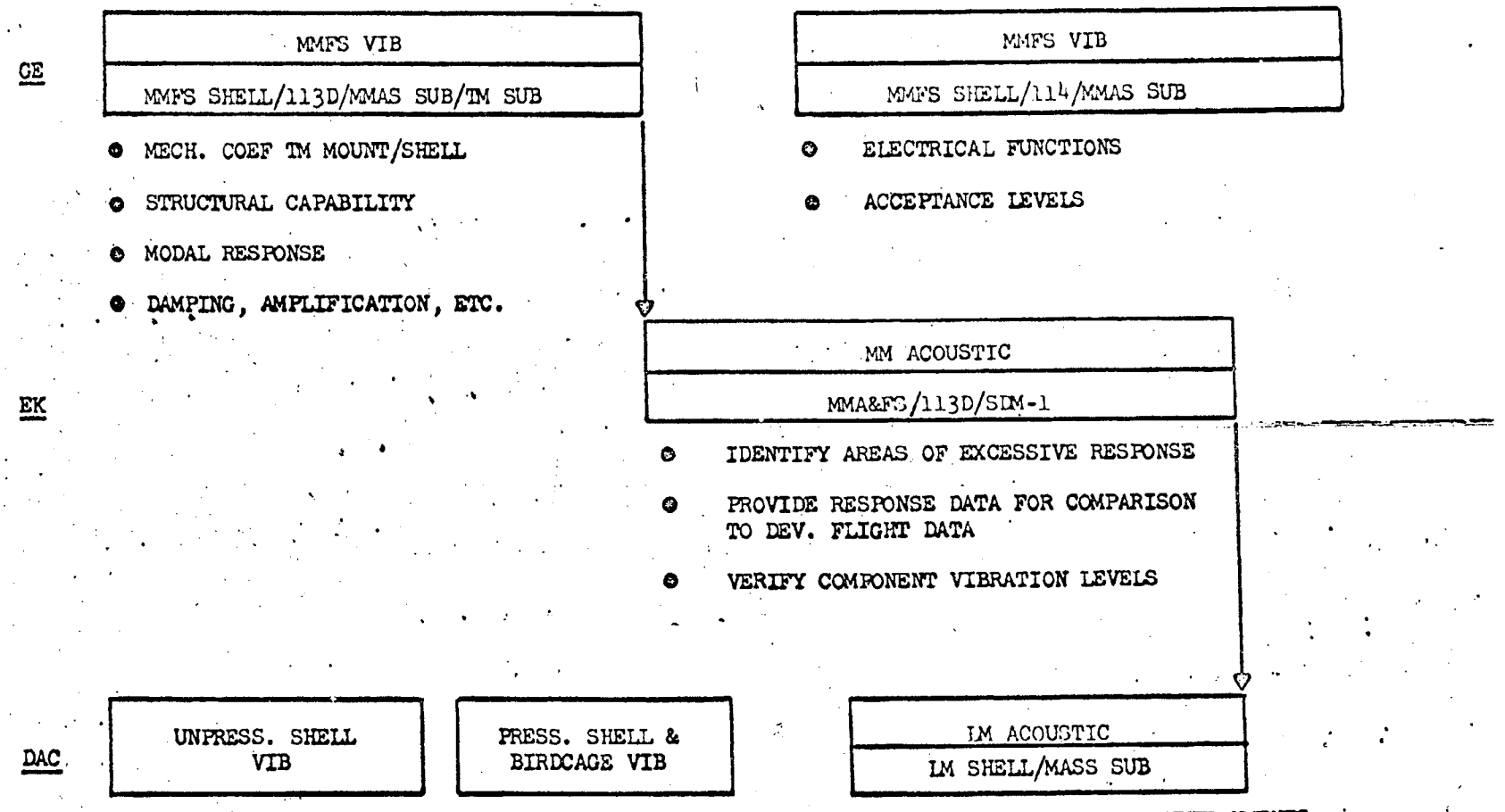
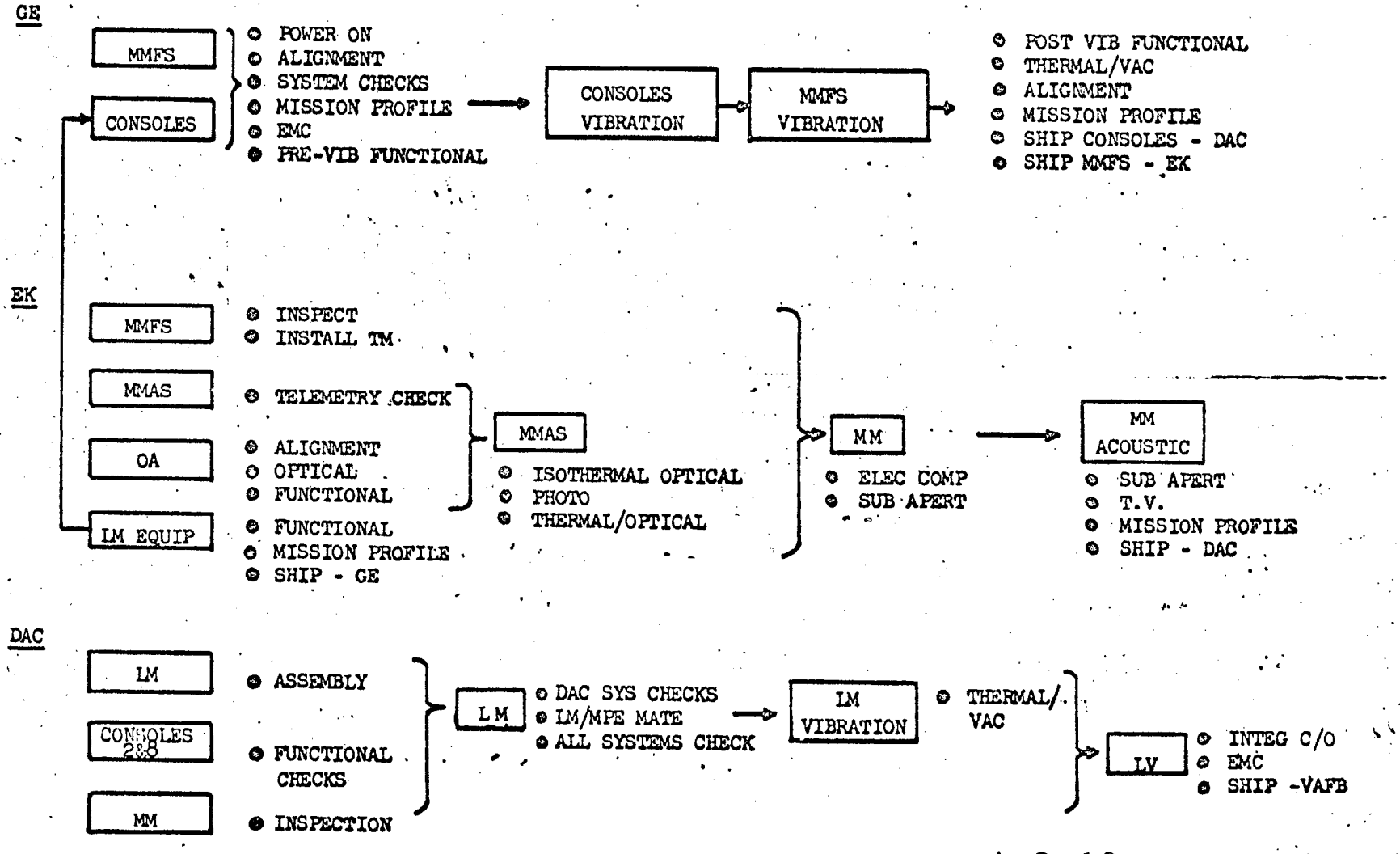
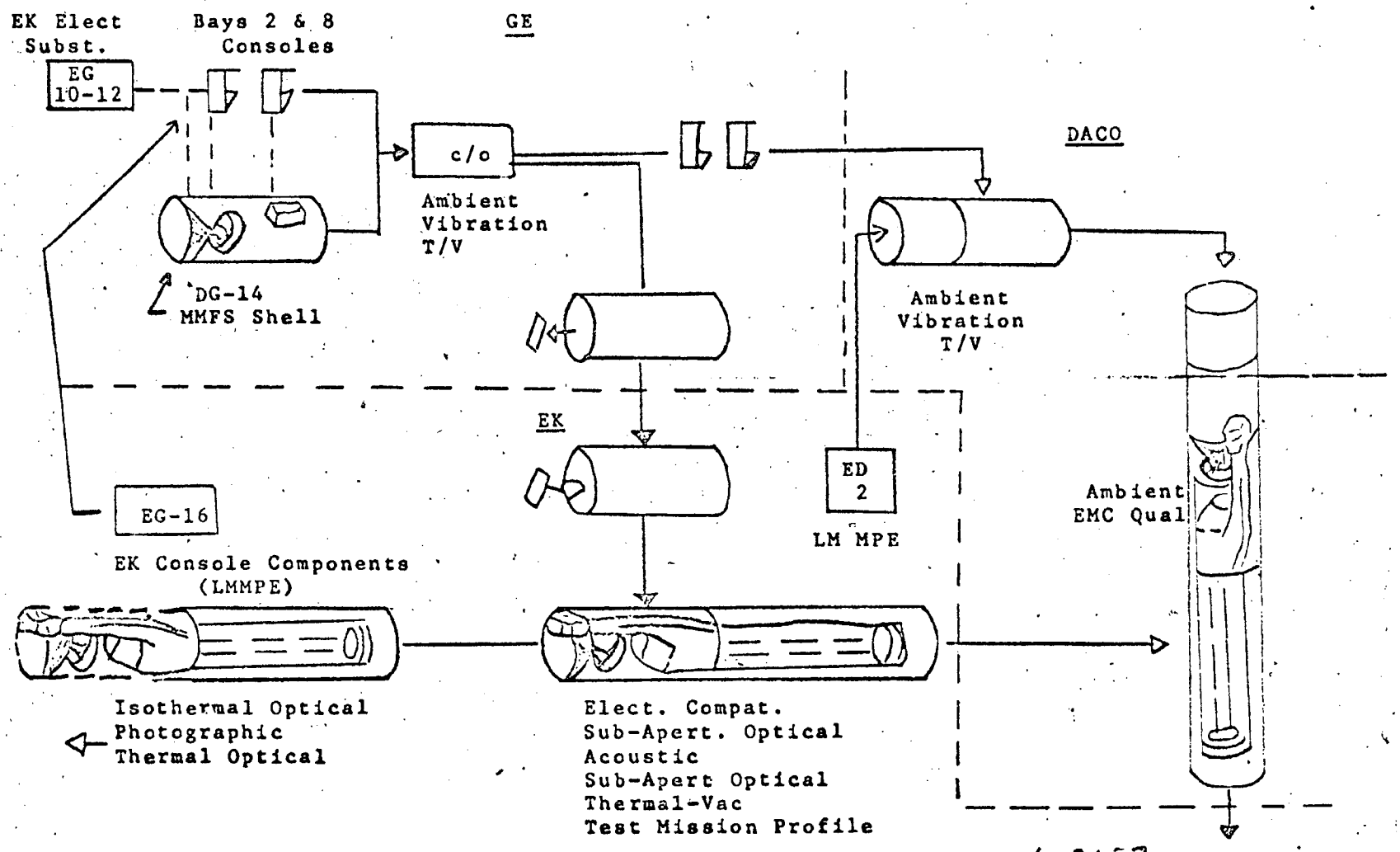
DEVELOPMENT - VIBRATION/ACOUSTIC



ACCEPTANCE VIBRATION (MECHANICAL/ACOUSTIC)



FY #3 ASSEMBLY AND TEST FLOW



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