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15 Feb '67

~~21 August 1967~~ 27 Pages

REVIEW OF MOL/DORIAN

GROUND TEST PLANNING

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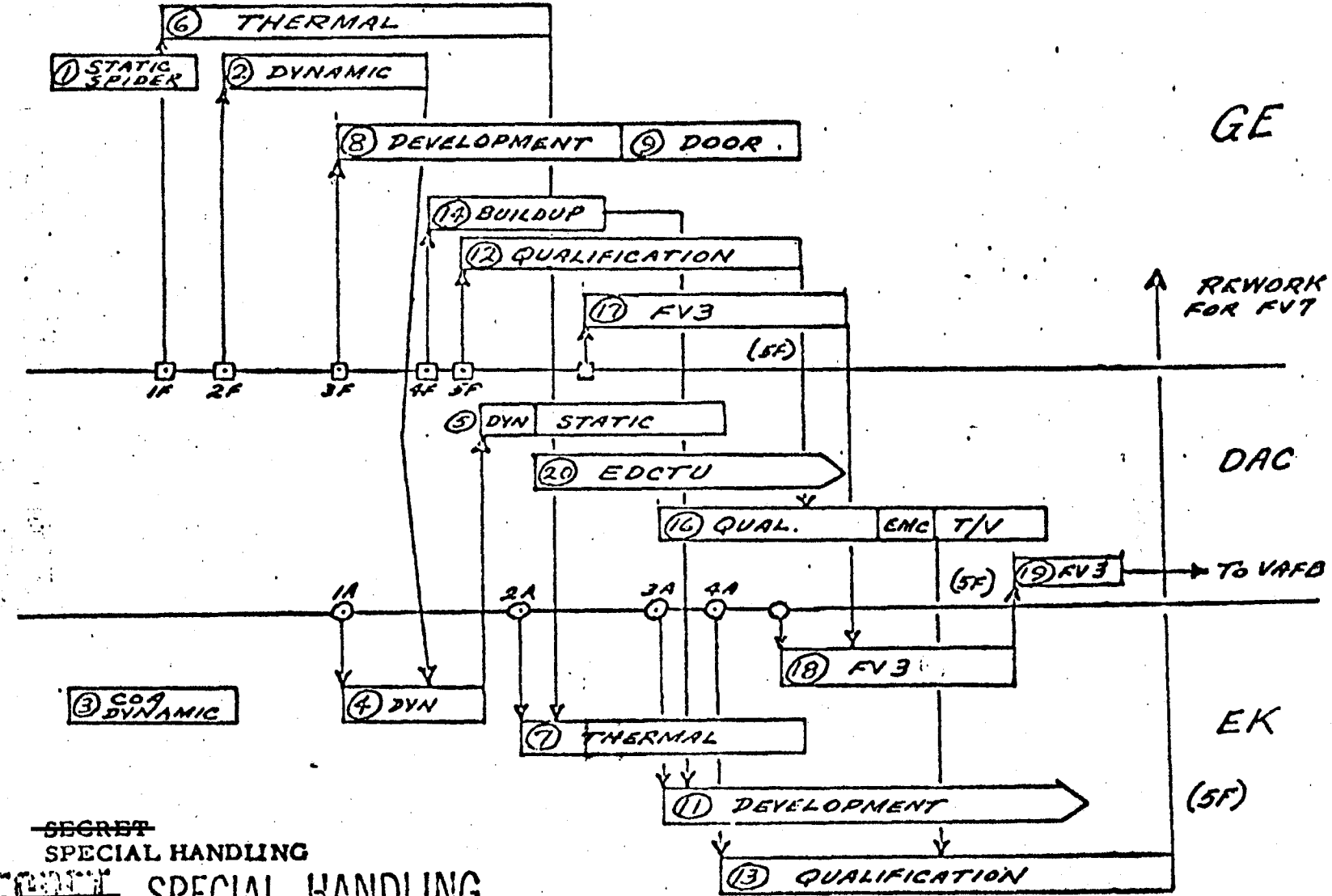
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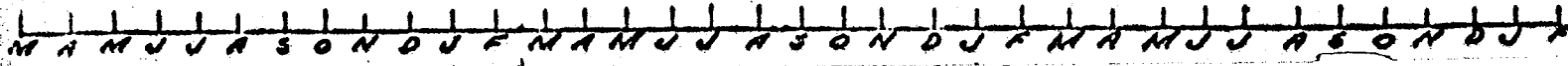
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INTEGRATED TEST FLOW PLAN



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OBJECTIVES

RE-EXAMINE MOL/DORIAN SYSTEM TEST PLANNING TO:

- O ENSURE WELL INTEGRATED CONSISTENT TEST PROGRAM
- O REDUCE NEED FOR NEW FACILITIES AND OTHER COSTS CONSISTENT WITH THE OBJECTIVES OF THE PROGRAM
- O RESULT IN LEAST IMPACT ON PRESENT ROLES

AREAS OF PARTICULAR CONCERN:

- O THERMAL VACUUM TESTING
- O ACOUSTIC TESTING
- O VIBRATION TESTING FOR MODES
- O OPERATIONAL DYNAMICS TESTING
- O TEST TIME PRIOR TO FLIGHT
- O IMPACT OF FLOW ON AGE/FACILITIES

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PARTICIPANTS AND RESPONSIBILITIES

TEAM CHAIRMAN - J. KENT

CO-CHAIRMAN - N. NIEDERMAN

CATEGORY CHAIRMEN

DEVELOPMENT TESTING -

(F. W. BELINA)

QUALIFICATION TESTING -

(F. P. KIEFER/R. J. KREJCI)

ACCEPTANCE TESTING -

(W. C. HAYDEN/F. W. MACNAB)

PARTICIPANTS

THERMAL -

(R. D. LONG)

ACOUSTIC -

(D. L. VANERT/S. D. ZINN)

DYNAMICS -

(J. E. ANDERSON/R. W. DEZELAN)

EMC -

(W. J. BALDAU)

FACILITIES/AGE - (D. E. WILKINS)

(R. E. FINNEY/E. F. SCHMIDT)

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IMPLEMENTATION

RECOMMENDATION

ACTION REQUIRED

DEVELOPMENT TESTING

- | | | |
|----|--|----------|
| 1 | DIRECT GE TO CONDUCT INDIVIDUAL COMPONENT ACOUSTIC DEVELOPMENT TESTING, ONLY ON A SELECTIVE BASIS, AND RETAIN COMPONENT VIBRATION TESTING. | ECP |
| 2. | DIRECT DAC TO CONDUCT THE MM DOOR JETTISON SHOCK TEST IN LV CONFIGURATION. | IN SCOPE |
| 3. | DIRECT DAC TO CONDUCT SUPERSONIC, AS WELL AS TRANSONIC, METEROID SHIELD FLUTTER TEST. | ECP |
| 4. | DIRECT DAC TO CONDUCT BOOST PHASE MODAL SURVEY WITH STV BASE SUPPORTED BY A STRUCTURE SIMULATING TITAN ADAPTOR. | IN SCOPE |
| 5. | DIRECT DAC TO CONDUCT ORBITAL PHASE MODAL SURVEY ON STV, SUSPENDED VERTICALLY IN FREE-FREE CONDITION, WITH MM DOOR REMOVED AND WITHOUT DOOR TRUSS. | IN SCOPE |

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IMPLEMENTATION

RECOMMENDATION

ACTION REQUIRED

DEVELOPMENT TESTING (CONT'D)

- | | | |
|----|---|-------------|
| 6. | REVIEW THE EK COMPONENT DEVELOPMENT TEST PROGRAM TO ENSURE THAT CRITICAL DEVELOPMENTAL COMPONENTS ARE SUBJECTED TO THERMAL, THERMAL-VACUUM AND DYNAMIC EXPOSURES TO PROVIDE A MINIMUM RISK COMPONENT QUALIFICATION PROGRAM. | NORMAL WORK |
| 7 | DIRECT EK TO LIMIT PLANNED GROUND CONDITIONING TESTS (TEMPERATURE, HUMIDITY, ETC.) OF MM THERMAL MODEL. | ECP |
| 8. | DIRECT EK TO PERFORM THE COA MODAL SURVEY WITH THE BARREL ATTACHED TO FIXED SUPPORTS AT THE THREE MOUNTING POINTS INSTEAD OF SUSPENDED IN A FREE-FREE CONDITION. | IN SCOPE |
| 9 | DIRECT EK TO PERFORM MM ACOUSTIC DEVELOPMENT TEST AT AN OFF SITE FACILITY. | ECP |

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IMPLEMENTATION

RECOMMENDATION

ACTION REQUIRED

QUALIFICATION TESTING

- | | | |
|----|--|----------|
| 1. | DIRECT GE TO CONDUCT INDIVIDUAL COMPONENT ACOUSTIC QUAL TESTING ONLY ON A SELECTIVE BASIS. (RETAIN COMPONENT VIBRATION QUAL TESTING.) | ECP |
| 2 | DIRECT GE TO DELETE THE PLANNED TM BAY VIBRATION QUAL TEST, BUT CONDUCT A PRE-QUAL VIBRATION TEST. | ECP |
| 3 | DIRECT EK AND GE TO PERFORM THE TM BAY DYNAMIC QUAL TEST USING 114E. | ECP |
| 4. | DIRECT DAC TO PERFORM THE MM SHELL STRENGTH QUAL TEST COMBINING DIFFERENTIAL PRESSURES WITH BENDING MOMENTS. | ECP |
| 5 | FOR UNIFORMITY THROUGHOUT THE PROGRAM, LIMIT ACOUSTIC QUAL TESTING TO FLIGHT LEVELS AND FLIGHT DURATION TO PERMIT QUAL VEHICLE USE FOR FLIGHT. | ECP |
| 6. | RETAIN COA 30-DAY T/V TESTS. REDUCE OR CONSIDER FOR DELETION 60 MM T/V TEST | APPROVAL |
| 7 | DIRECT DAC TO PERFORM A LIMITED LM ACOUSTIC QUALIFICATION TEST AT THE SAME FACILITY USED FOR THE ACOUSTIC DEVELOPMENT TEST. | ECP |

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IMPLEMENTATION

RECOMMENDATION

ACTION REQUIRED

ACCEPTANCE TESTING

- | | | |
|----|---|------------|
| 1 | DIRECT DAC TO PERFORM A T/V ACCEPTANCE TEST ON EACH LM; DELETE T/V ACCEPTANCE TEST OF LV. | ECP |
| 2 | DIRECT GE TO PERFORM AN MMFS MODE VERIFICATION ACCEPTANCE TEST ON EACH FLIGHT VEHICLE | ECP |
| 3 | DIRECT EK TO PERFORM A COA MODE VERIFICATION ACCEPTANCE TEST ON EACH FLIGHT ARTICLE. | ECP |
| 4. | DELETE ORBITAL PHASE SURVEY ON FV'S 3 AND 6. | (APPROVAL) |
| 5. | DIRECT EK AND GE TO CONDUCT JOINT MM EMC ACCEPTANCE TEST AT ROCHESTER. | ECP |
| 6. | LOW LEVEL VIBRATION ACCEPTANCE TEST FOR LV, LM, AND MM. | ECP |

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PROPOSED SYSTEM-SEGMENT ACOUSTIC TESTS

(STEERING COMMITTEE RECOMMENDATION)

TEST PHASE	System LV = LM + MM	System Segments	
		LM	MM*
			TM Bay
DEVELOPMENT		Acoustic	Acoustic
QUALIFICATION		Limited** Acoustic	Limited** Acoustic
ACCEPTANCE	Local Excitation at Interface Hard Points (Workmanship)	None Low Level Vibration	Low Level Vibration

*MM = TM Bay + COA Bay

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SYSTEM-SEGMENT ACOUSTIC TESTS
ALTERNATE PLAN

	SYSTEM LV = LM + MM	SYSTEM SEGMENTS	
		LM	MM
			TM BAY
DEVELOPMENT		ACOUSTIC*	ACOUSTIC**
QUALIFICATION		--	--
ACCEPTANCE	LOCAL EXCITATION AT INTERFACE HARD POINTS	ACOUSTIC	ACOUSTIC

* OFF SITE OR HUNTINGTON BEACH

** OFF SITE OR ROCHESTER

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COST COMPARISON - DELTAS

	<u>OFF SITE QUAL. & DEVELOP. (COLD)</u>	<u>ON SITE DEVELOP. & ACCEP. (HOT)</u>
ROCHESTER FACILITY		2.50 M
PERSONNEL SUPPORT OF FACILITY (2 YEARS)		.60 M
HUNTINGTON BEACH FACILITY		2.75 M
PERSONNEL SUPPORT OF FACILITY (2 YEARS)		.60 M
DAC ADDITIONAL TEST SUPPORT	.75 M	1.75 M
GE AND EK ACCEPTANCE TEST CREDIT	(.50 M)	
TRANSPORTATION (LM & MM)	.20 M	
SHROUDS AND STE (LM & MM)	.50 M	
GE TEST SUPPORT	1.00 M	
EK TEST SUPPORT	1.00 M	
AGE	.50 M	2.10 M
NASA SUPPORT COSTS	<u>?</u>	<u> </u>
	4.45 M	10.35 M

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MAJOR RECOMMENDATIONS AFFECTING DAC

<u>RECOMMENDATION</u>	<u>IMPACT</u>	<u>ROM COST</u>	
		<u>FUNDED</u>	<u>NEW FUNDS</u>
o CONDUCT LM ACOUSTIC QUAL TEST (IN SAME FACILITY USED FOR STV ACOUSTIC TEST)	TRANSPORT.		+\$50 K
	TEST INCREASE (PLANNING & SUPPORT)		+\$750 K
	ADD'L REFURB. LMQTV		+\$500 K
	FACILITY COST		+\$250 K
o T/V ACCEPTANCE OF LM INSTEAD OF LV	ELIM. CONTAM. TEST		-\$60 K
	ELIM. BUILD. MOD.		-\$150K
o DELETE ONE MMAS SHELL FOR FM 4.		-\$500 K	
		<hr/> -\$500 K	<hr/> +\$1.34 M

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MAJOR RECOMMENDATIONS AFFECTING GE

<u>RECOMMENDATION</u>	<u>IMPACT</u>	<u>FUNDED</u>	<u>ROM COST</u> <u>NEW FUNDS</u>
o MODIFY TEST FLOW			
SUBJECT QUAL VEHICLE #115 TO T/V ONLY, THEN FLY.	ELIMINATE ONE SET GE-AVE	-\$5 M	
TM BAY 114E TO BE USED BY EK FOR COA DRV AND QUAL TESTING.	REDUCE AGE	-\$4.5 M	
	REDUCE TEST SUPPORT	-\$500 K	
	REDUCE SPARES	-\$200 K	
DELETION OF QUAL TEST AT GE	ELIMINATE FACILITIES OPERATIONAL PERSONNEL	-\$200 K	
SUPPORT OF DEVELOP. & QUAL TEST AT HOUSTON	ADDITIONAL TIME, TRAVEL, ETC.		+\$300 K
o DIRECT GE TO DELETE MOST COMPONENT DEVELOP. & QUAL ACOUSTIC TESTS	ELIMINATE TESTS	-\$100K	
		<u>-\$10.5 M</u>	<u>+\$300 K</u>

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MAJOR RECOMMENDATIONS AFFECTING EK

<u>RECOMMENDATION</u>	<u>IMPACT</u>	<u>ROM COST</u>	
		<u>FUNDED</u>	<u>NEW FUNDS</u>
o NO MM ACOUSTIC FACILITY AT ROCHESTER	ELIMINATE FACILITY	-\$2.5 M	
	ELIMINATE TEST FACILITY OPERATIONAL PERSONNEL	-\$600 K	
o DELETE GROUND CONDITIONING TEST	ELIMINATE TEST & FACILITY	-\$182K	
o USE TM BAY 114E FOR DEVELOP. & QUAL.	TEST SUPPORT REDUCTION	-\$50 K	
o PERFORM MM ACOUSTIC DEVELOP. TEST AT AN OFF-SITE FACILITY	TEST SHROUD TRANSPORT.		+\$250 K
	TEST INCREASE		+\$50 K
			+\$150 K
o SUBJECT EK QUAL VEHICLE TO LIMITED ACOUSTIC QUAL TEST, THEN FLY	DELETE FM 4	-\$3.2 M	
	REFURB. QM		+\$1.0 M
	OFF-SITE TEST SUPPORT INCR.		+\$250 K
	TRANSPORT.		+\$50 K
		<u>-\$6.53 M</u>	<u>+1.75 M</u>

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IMPACT SUMMARY

	<u>PRESENTLY FUNDED</u>	<u>NEW FUNDS</u>
o MAJOR RECOMMENDATIONS AFFECTING DAC	-\$500 K	+\$1.34 M
o MAJOR RECOMMENDATIONS AFFECTING GE	-\$10.5 M	+\$300 K
o MAJOR RECOMMENDATIONS AFFECTING EK	-\$6.53 M	+\$1.75 M
	<u>-\$17.53 M</u>	<u>+\$3.39 M</u>
NET DIFFERENCE		-\$14.14 M

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CONCLUSIONS

- o THE RECOMMENDED PROGRAM IS LESS THAN DESIRABLE FROM A TECHNICAL STANDPOINT, BUT UNDER THE FUNDING RESTRICTION IS AN ACCEPTABLE RISK
- o IT PROVIDES INCREASED CONFIDENCE OF MISSION SUCCESS AND CREW SAFETY OVER THE BASELINE PROGRAM
- o IT REQUIRES NO NEW FUNDS AND SHOULD RESULT IN REDUCTIONS
- o THE ALTERNATE APPROACH PROVIDES INCREASED CONFIDENCE AND SHOULD BE ACHIEVABLE WITHIN PRESENT FUNDING

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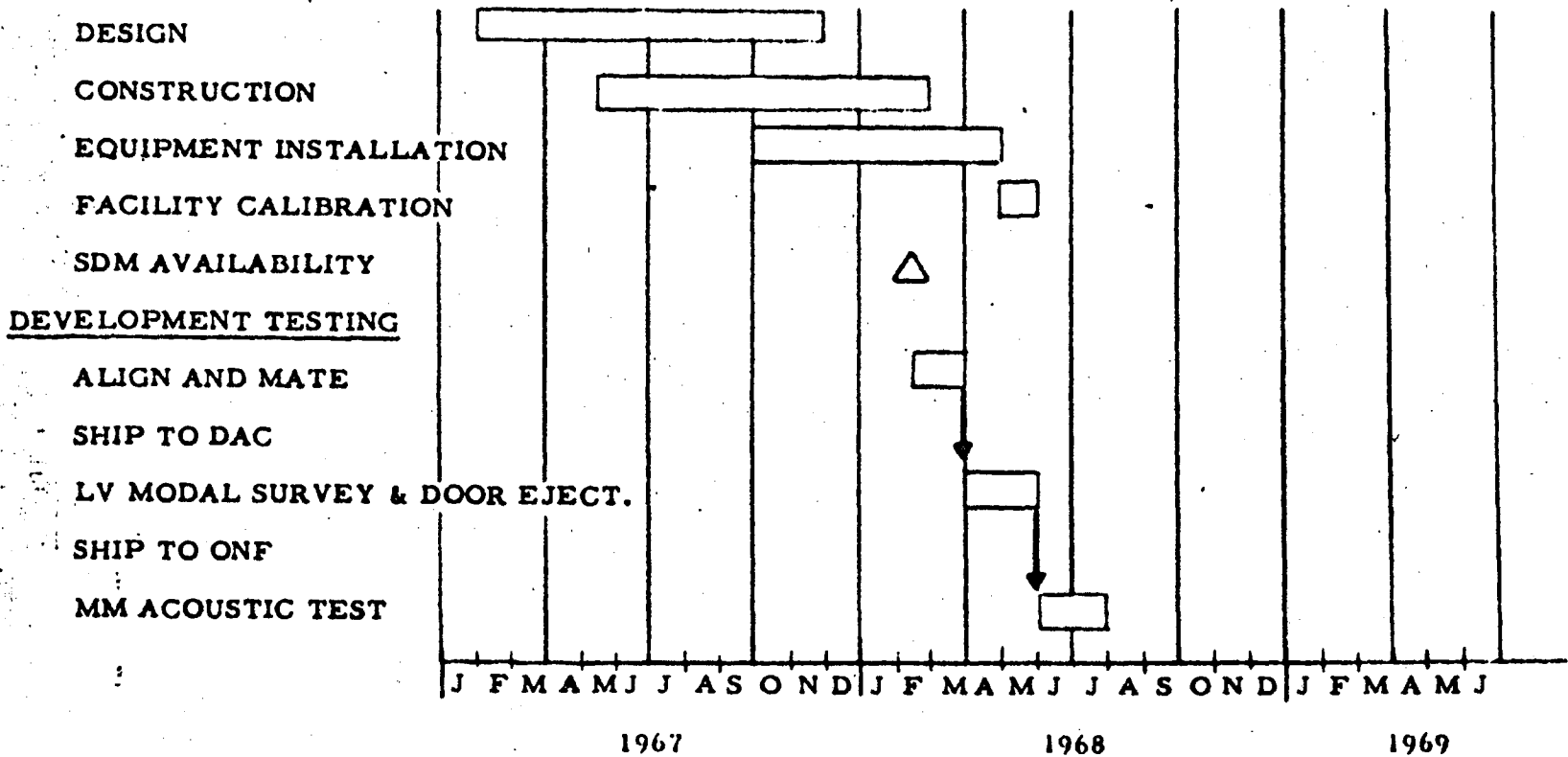
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PROPOSED MM ACOUSTIC TEST SCHEDULING

ACOUSTIC FACILITY AT ONF



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TM BAY VIBRATION QUALIFICATION TEST

BASELINE:

- SINUSOIDAL VIBRATION TEST ONLY.
- RANDOM VIBRATION MAY BE ADDED BASED ON DATA FROM MM ACOUSTIC DEVELOPMENT TEST.

RECOMMENDATION:

- DELETE TM BAY VIBRATION QUALIFICATION TEST.
- REPLACE WITH TM BAY ACOUSTIC QUALIFICATION TEST (114E)
- CONDUCT LOW LEVEL VIBRATION (PRE-QUAL) TEST.

STEERING COMMITTEE ACTION:

- APPROVED.

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ACOUSTIC QUALIFICATION TEST RECOMMENDATIONS

- o SUBJECT LM AND MM TO AN ACOUSTIC TEST AT QUAL LEVELS FOR A DURATION IN EXCESS OF THAT EXPECTED DURING FLIGHT.
- o PROVIDE ACOUSTIC FACILITY AT ROCHESTER FOR MM TESTING.
- o MODIFY SANTA MONICA FACILITY FOR LM TESTING.

STEERING COMMITTEE ACTION:

- o SUBJECT LM AND MM QUAL VEHICLES TO AN ACOUSTIC TEST AT FLIGHT LEVELS FOR FLIGHT DURATION.
- o PERFORM LIMITED QUAL ACOUSTIC TEST IN SAME FACILITY AS USED FOR DEVELOPMENT TEST (TEST CONDUCTED WITH POWER OFF -- CHECK AT H.B. AND ROCHESTER BEFORE AND AFTER).
- o FLY QUAL VEHICLES ON FLIGHT 7.

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LM QUALIFICATION COSTS

	<u>OFF SITE</u>	<u>HUNTINGTON BEACH</u>
LM HARDWARE (LIKE NO. 6)	\$19.44 M	\$19.44 M
ENGINEERING AND TEST SUPPORT	.69 M	.69 M
LMQTV REFURBISHMENT CREDIT	(2.81 M) <u>\$17.32 M</u>	(2.81 M) <u>\$17.32 M</u>
ADDITIONAL AGE STATION	4.37 M <u>\$21.69 M</u>	2.10 M <u>\$19.42 M</u>
THREE-MONTH PROGRAM EXTENSION	21.85 M <u>\$43.54 M</u>	21.85 M <u>\$41.27 M</u>

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LV THERMAL VACUUM TESTING AT DAC

ALTERNATIVES	CONSIDERATIONS
<u>BASELINE:</u> LAB VEHICLE THERMAL/VAC TEST	POSSIBLE HIGHER CONFIDENCE IN THERMAL INTERFACE POSSIBLE CONTAMINATION HANDLING PROBLEMS SCHEDULE DELAY DUE TO FINDING LM PROBLEMS IN LV CONFIGURATION
<u>ALTERNATE:</u> LM THERMAL/VAC TEST	SAVES 280 HOURS OF MM REDUNDANT TESTING AVOIDS POSSIBLE MM CONTAMINATION AVOIDS HANDLING PROBLEMS FINDS PROBLEMS IN SIMPLER CONFIGURATION FIVE-WEEK LAUNCH SLIP UNLESS DELETE PRE-QUAL EMC AND IMPROVE ECLS TEST SCHEDULE
<u>RECOMMENDATION:</u>	T/V TEST LM INSTEAD OF LV, REVISE TEST FLOW TO ALLEVIATE SCHEDULE PROBLEM.
<u>STEERING COMMITTEE ACTION:</u>	APPROVED PENDING SCHEDULE EVALUATION.

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MMFS MODE VERIFICATION TEST
ACCEPTANCE

ALTERNATIVES	CONSIDERATIONS
1. NO ACCEPTANCE MODAL VERIFICATION IS PRESENTLY PLANNED IN BASELINE	<ul style="list-style-type: none">o A STATIC DEFLECTION MEASUREMENT IS TO BE PERFORMED ON THE SPIDER STRUCTURE ONLY
2. PERFORM A MMFS MODE VERIFICATION MEASUREMENT ON EACH ASSEMBLY AS A PART OF ACCEPTANCE PROCEDURE	<ul style="list-style-type: none">o TM DYNAMIC CHARACTERISTICS ARE ONE OF MOST CRITICAL STRUCTURAL CONSIDERATIONSo MODE MEASUREMENTS OF MMFS ASSEMBLY IS BEST METHOD OF VERIFICATIONo FIXTURE REQUIRED FOR HARD SUPPORT AT MMFS/LM INTERFACE STATION

RECOMMENDATION:

A MODE VERIFICATION TEST OF THE MMFS BE INCORPORATED INTO THE GE ACCEPTANCE TEST PROGRAM.

STEERING COMMITTEE ACTION:

CONDUCT ON FV 3 THEN CONSIDER ELIMINATION.

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COA MODE SURVEY TEST
(ACCEPTANCE)

ALTERNATIVES	CONSIDERATIONS
BASELINE MODE SURVEY OF COA NOT PLANNED ON EACH ARTICLE	
ALTERNATIVE CONDUCT MODE SURVEY SIMILAR TO DM TEST	<ul style="list-style-type: none">o THE RESULTS WILL VERIFY THAT DYNAMIC PROPERTIES OF COA ARE AS PREDICTEDo WILL PROVIDE MINIMUM SHAKE-OUT OF WORKMANSHIP

RECOMMENDATION:

A MODE SURVEY TEST SHOULD BE CONDUCTED ON EACH FLIGHT ARTICLE. THIS TEST SHOULD UTILIZE HARD-POINT SUPPORT FIXTURE AS DESCRIBED FOR DM TEST

STEERING COMMITTEE ACTION:

CONDUCT ON FV 3 THEN CONSIDER ELIMINATION.

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ACOUSTIC ACCEPTANCE TEST RECOMMENDATIONS

- o SUBJECT LM AND MM TO AN ACOUSTIC ACCEPTANCE TEST.
- o SUBJECT LV TO LOCAL EXCITATION AT INTERFACE HARD POINTS TO CHECK INTERFACE CONNECTIONS.

STEERING COMMITTEE ACTION:

- o CONDUCT MM LOW LEVEL VIBRATION ACCEPTANCE TEST AT ROCHESTER.
- o CONDUCT LV AND LM ACCEPTANCE TEST AT HB (LOW LEVEL EXCITATION).

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DAC FACILITY COSTS

BUILDING	900 K
SOUND EQUIPMENT (HORN)	180 K
COMPRESSOR, MOTOR, ELECTRIC DISTRIBUTION SUBSTATION	650 K
TAPE TRANSPORT	225 K
ACCELEROMETERS	31 K
SIGNAL CONDITIONING	127 K
MISCELLANEOUS	15 K
ANE COSTS	<u>127 K</u>
TOTAL	2.255 M
ENGINEERING AND PLANNING	<u>.500 M</u>
	2.750 M

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AGE CONSIDERATIONS

