

N83 22295^{D6}

SUMMARY OF EMI/EMC AND VIBROACOUSTICS

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STS PAYLOAD BAY ENVIRONMENT

PRESENTER - R. A. COLONNA

PAYLOAD BAY ENVIRONMENTS

CONTENTS

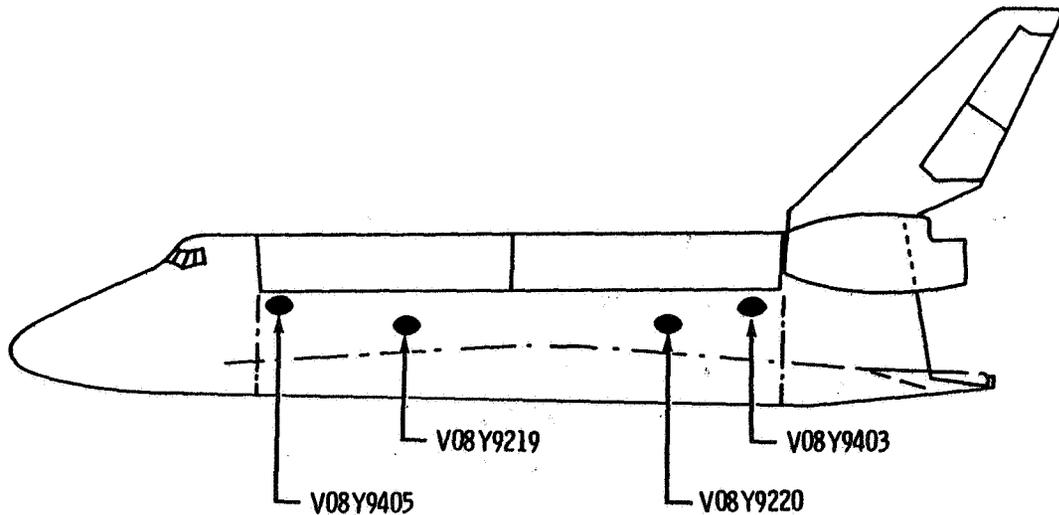
- ACOUSTIC
- VIBRATION
 - HIGH FREQUENCY
 - LOW FREQUENCY (LOADS) DATA
- ELECTROMAGNETIC EFFECTS

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STS PAYLOAD BAY ACOUSTICS

STS PAYLOAD BAY ACOUSTIC MEASUREMENTS

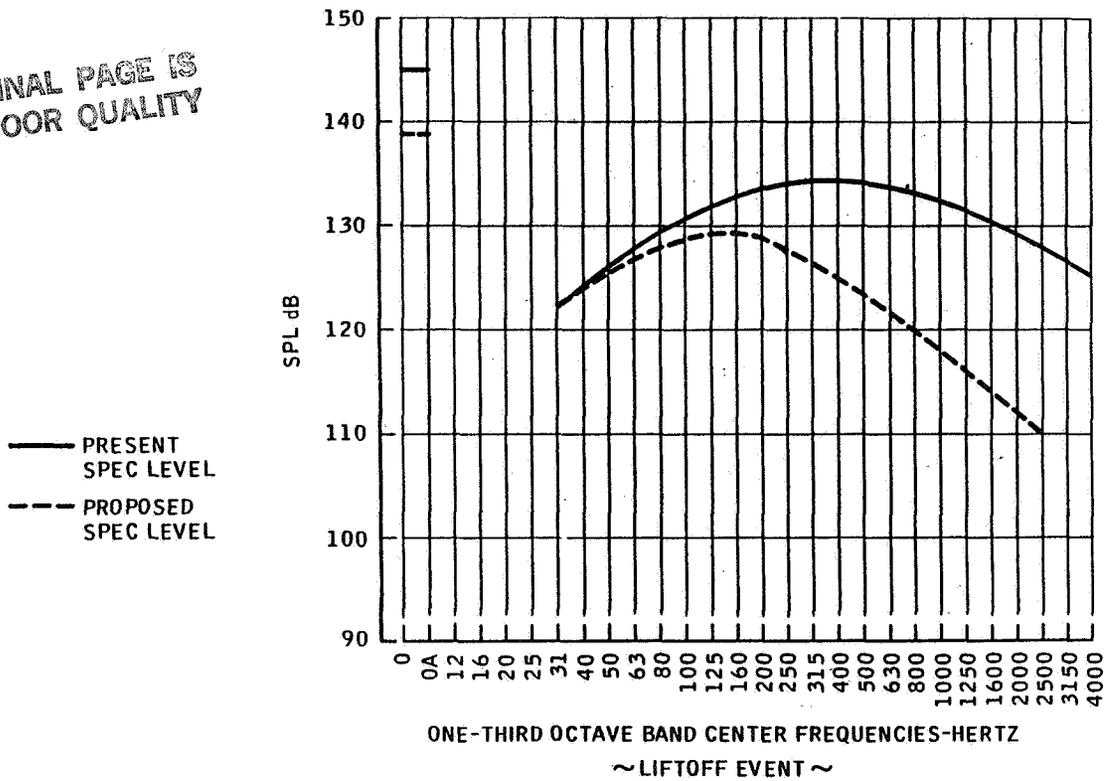


DATE MEASUREMENTS

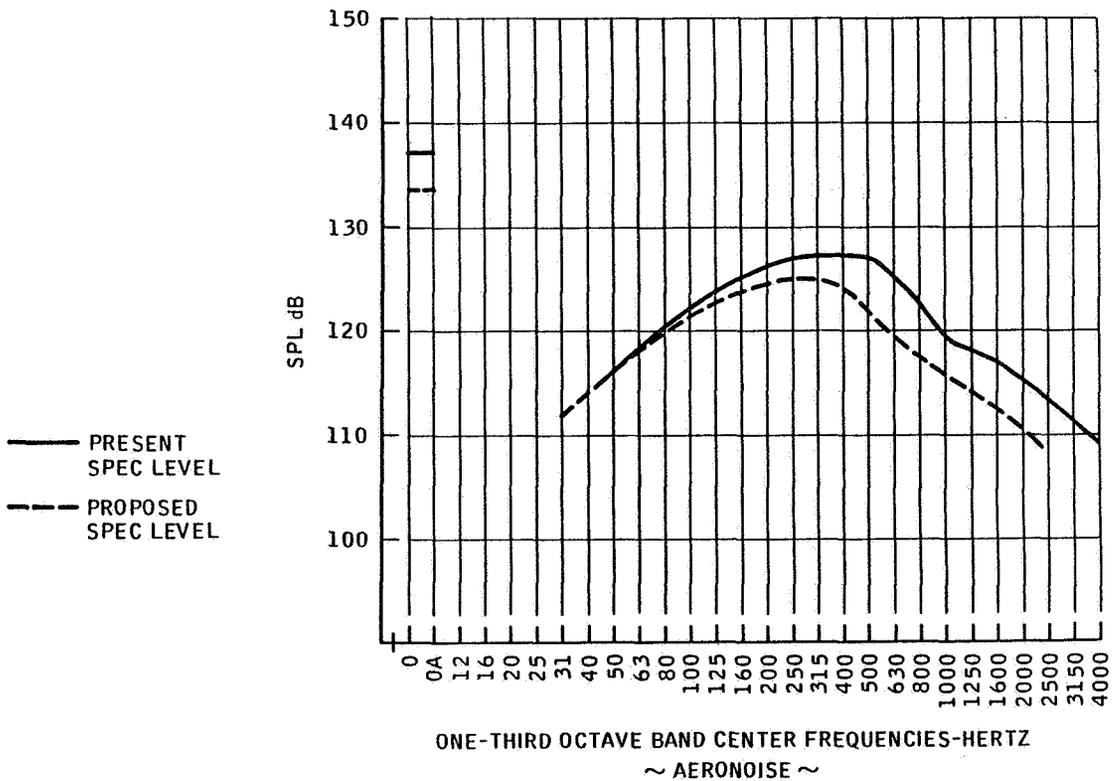
- STS- 2 14 MICROPHONES ON DFI PACKAGE AND OSTA-1
- STS-3 8 MICROPHONES ON DFI PACKAGE AND OSS -1
- STS- 4 8 MICROPHONES ON DFI PACKAGE AND PAYLOAD

ORBITER PAYLOAD BAY INTERNAL ACOUSTIC ENVIRONMENT

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ORBITER PAYLOAD BAY INTERNAL ACOUSTIC ENVIRONMENT



STS PAYLOAD BAY ENVIRONMENT

ACOUSTICS

- DERIVATION OF THE NEW PAYLOAD BAY CRITERIA
 - DATA WERE OBTAINED FROM 4 INTERNAL MICROPHONES (4 FLIGHTS)
 - DATA WERE ANALYZED FOR 6 FLIGHT EVENTS
 - MAIN ENGINE IGNITION
 - SRB IGNITION/LIFTOFF
 - TRANSONIC
 - MAX Q
 - SUPERSONIC
 - ENTRY
 - MAXIMUM NOISE LEVELS OCCUR DURING LIFTOFF AND TRANSONIC EVENTS
 - ACOUSTIC DATA WERE AVERAGED AND ENVELOPED FOR THE TWO EVENTS

STS PAYLOAD BAY ENVIRONMENT

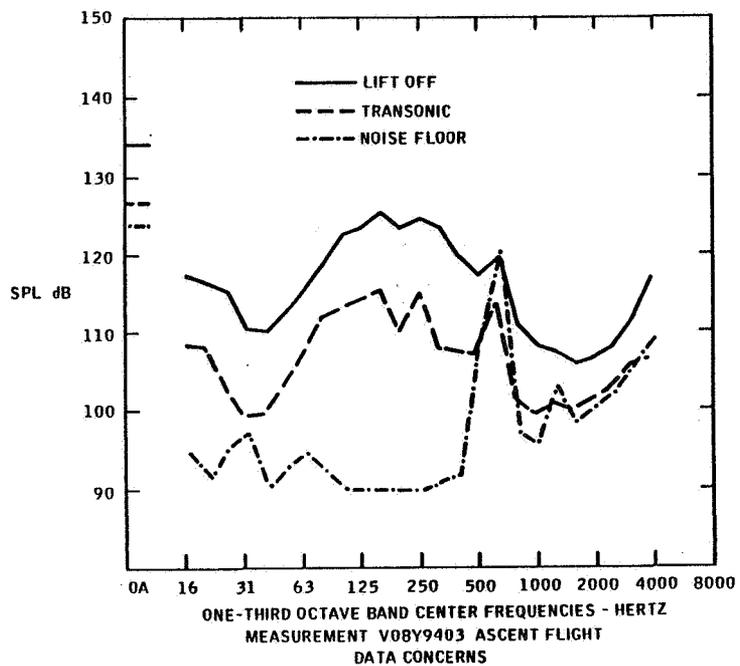
ACOUSTIC (CONT)

- EVALUATION CONSIDERED THE NOISE LEVELS MEASURED ON THE DIFFERENT PALLETS
- SPECTRUM CONSIDERED TO BE THE MINIMUM TO CERTIFY TO FOR FLIGHT
- CONTINUING ANALYSIS WILL QUANTIFY 300 Hz VENT TONE AND INCLUDE IN CRITERIA

DATA CONCERNS:

- 300 Hz TONE
- 4000 Hz NOISE ON FORWARD BULKHEAD MEASUREMENT
- 600 Hz NOISE ON AFT BULKHEAD MEASUREMENT
- HIGH FREQUENCY (ABOVE 1000 Hz) CONTENT OF MOST MEASUREMENTS

STS PAYLOAD BAY ENVIRONMENT



STS PAYLOAD BAY ENVIRONMENT

SUMMARY

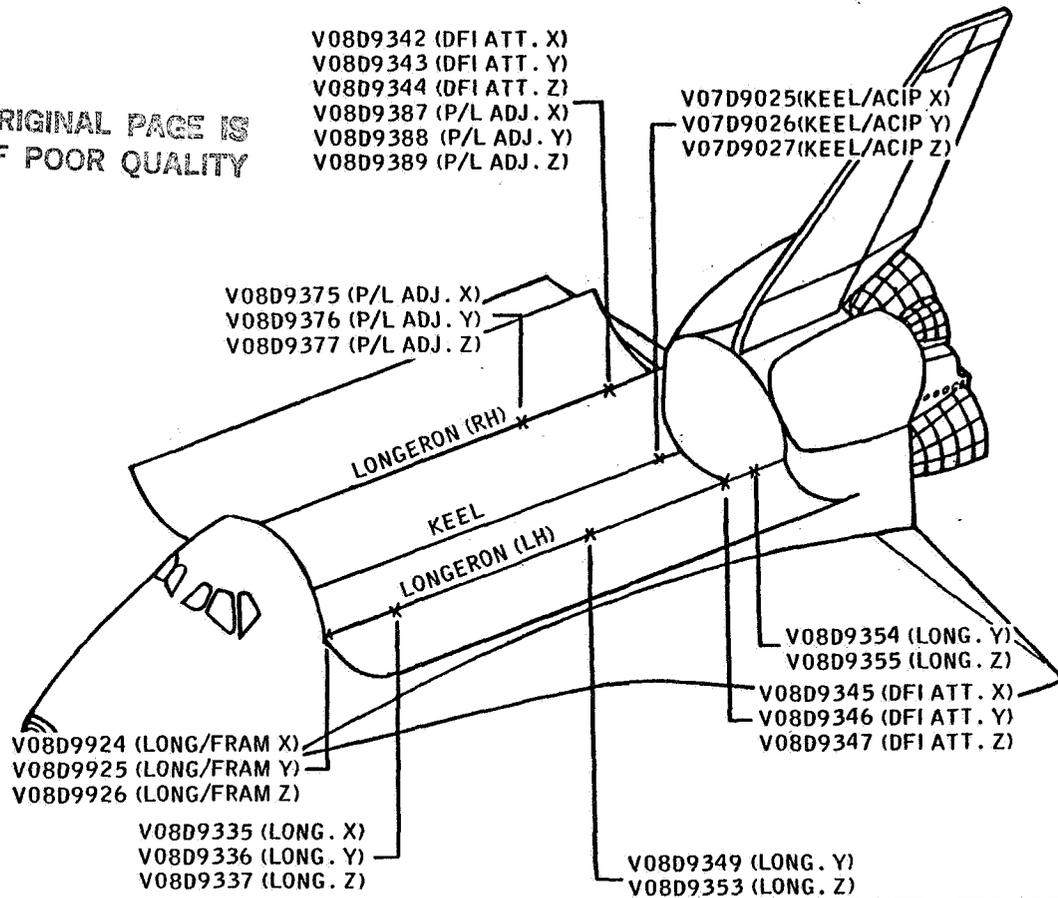
- PAYLOAD INTERNAL ACOUSTICS ABOUT 6 dB LESS THAN ORIGINAL CRITERIA

**STS PAYLOAD BAY
VIBRATION**

**STS PAYLOAD BAY
HIGH FREQUENCY VIBRATION**

ORBITER HIGH FREQUENCY ACCELEROMETERS

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STS PAYLOAD BAY ENVIRONMENT

- VIBRATION SOURCES FOR PAYLOADS
 - LIFTOFF AND AERODYNAMIC NOISE EXCITATION OF ORBITER STRUCTURE
 - ACOUSTIC NOISE TRANSMITTED INTO PAYLOAD BAY
- VIBRATION ENVIRONMENT VARIES THROUGHOUT STRUCTURE
- CRITERIA ORIGINALLY DEVELOPED FOR ORBITER PAYLOAD BAY ZONES
 - MAIN LONGERON
 - KEEL
 - UNLOADED STRUCTURE

STS PAYLOAD BAY ENVIRONMENT

● ACCELERATION DATA ASSESSED FOR

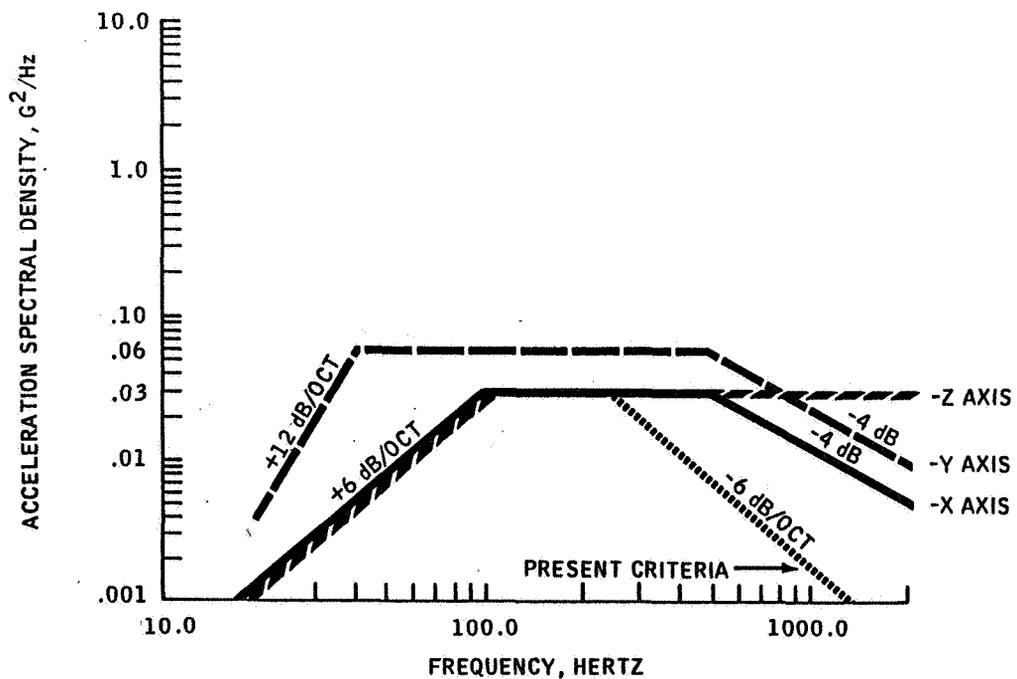
- MAIN ENGINE IGNITION
- SRB IGNITION/LIFTOFF
- AERODYNAMIC FLIGHT
- ENTRY/LANDING

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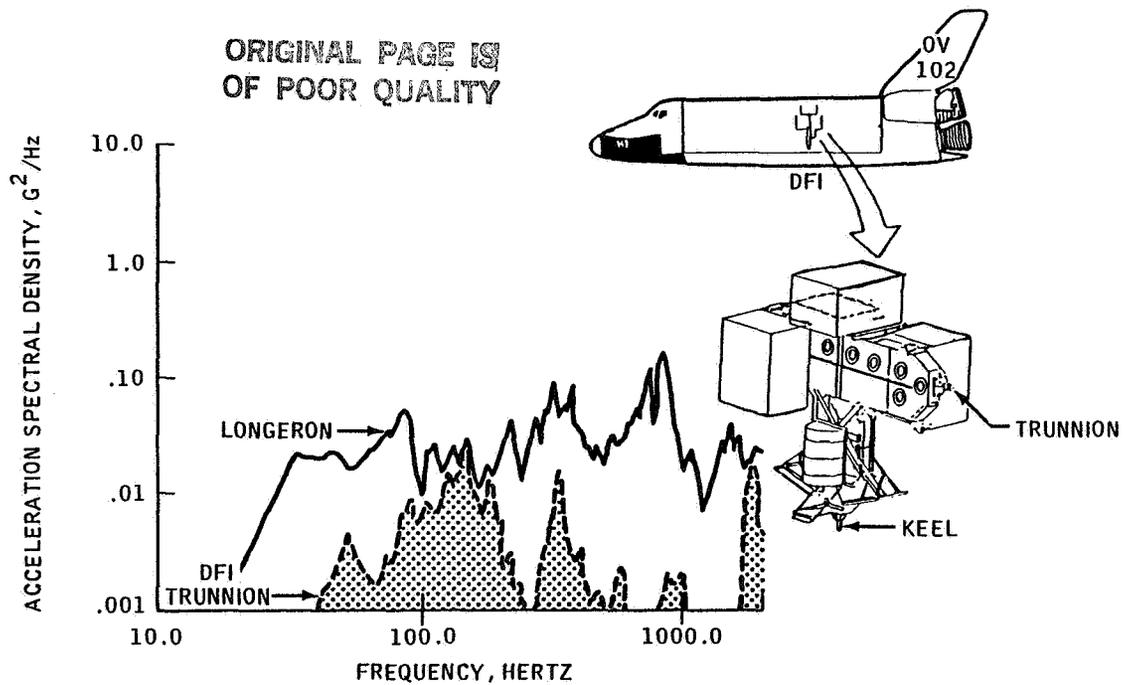
● ASSESSMENT

- AMPLITUDES AND FREQUENCY CONTENT WERE COMPARED TO ANALYTICAL PREDICTIONS
- PAYLOAD WEIGHT EFFECT APPEARS TO HAVE LITTLE INFLUENCE ON MEASURED LEVELS
- REVISION TO BE ISSUED TO UPDATE THE ORBITER LONGERON LEVELS BASED ON FLIGHT DATA

ORBITER MAIN LONGERON RANDOM VIBRATION CRITERIA DERIVED FROM FLIGHT DATA



STS PAYLOAD BAY VIBRATION



STS PAYLOAD BAY ENVIRONMENT

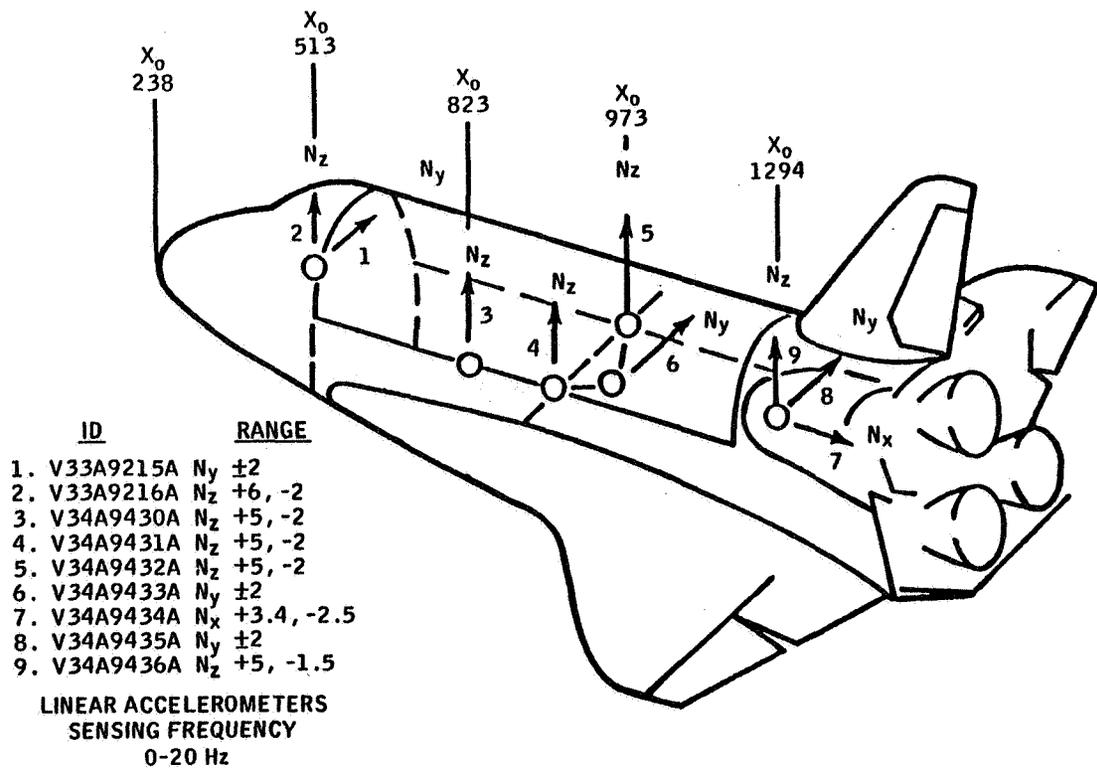
SUMMARY

- HIGH FREQUENCY RESPONSES OF LONGERON GREATER THAN PREDICTED (RANDOM VIBRATION)
- TRANSMISSION ACROSS TRUNNION LESS THAN EXPECTED WITH NET EFFECT ON PAYLOAD EXPECTED TO BE UNCHANGED

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STS PAYLOAD BAY LOW FREQUENCY VIBRATION

ORBITER LOW FREQUENCY ACCELEROMETERS



STS PAYLOAD BAY LOW FREQUENCY VIBRATION

- ACCELERATION DATA ASSESSED FOR
 - LIFTOFF, LANDING - DYNAMIC CONDITIONS
 - ASCENT, DESCENT - QUASI - STATIC CONDITIONS
- INSTRUMENTATION
 - LOW FREQUENCY ACCELEROMETERS - 0-20 Hz
 - "DATE" ACCELEROMETERS 0-50 Hz , 1 1/2-50 Hz , 5-2K Hz
- ASSESSMENT
 - AMPLITUDES, FREQUENCY CONTENT AND DAMPING OF MEASURED ACCELERATIONS ARE COMPARED TO ANALYTICAL PREDICTIONS
 - UPDATES TO ANALYTICAL DATA BASE USED IN PAYLOAD LOADS ANALYSES WILL BE DERIVED FROM FLIGHT DATA

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LIFTOFF COMPARISON

Xo LOCATION DESCRIPTION	DIRECTION	FLIGHT DATA				STS-3 PREFLIGHT DESIGN CASE*
		STS-1	STS-2	STS-3	STS-4	
1294, BULKHEAD	NX	2.10	1.79	1.91	1.82	2.18
979, KEEL	NY	0.4	0.16	0.16	0.14	0.55
1294, BULKHEAD	NY	0.25	0.13	0.19	0.08	0.39
823, LEFT LONGERON	NZ	2.8	0.74	0.72	0.84	1.51
973, LEFT LONGERON	NZ	2.9	0.60	0.66	0.70	1.65
973, RIGHT LONGERON	NZ	2.9	0.52	0.58	0.72	2.43
1294, BULKHEAD	NZ	1.25	0.25	0.25	0.35	1.08

* INCLUDES DISPERSION ON SRB THRUST, SSME THRUST, OVERPRESSURE, SRB MODEL, WINDS

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ASCENT & DESCENT COMPARISONS

<u>ASCENT</u>	<u>STS-1</u>	<u>STS-2</u>	<u>STS-3</u>	<u>STS-4</u>	<u>P/L REQUIREMENTS</u>
NX	-2.92	-2.99	-2.92	-2.93	-3.17
NY	0.1	0.2	0.1	0.2	0.4
NZ	-0.6	-0.6	-0.6	-0.6	-0.8
<u>DESCENT</u>					
NX	0.4	0.4	0.3	0.3	1.01
NY	0.2	0.2	0.1	0.2	0.85
NZ	1.6	1.9	1.6	1.8	2.5

LANDING TOUCHDOWN CONDITION COMPARISONS

CONDITION	<u>FLIGHT DATA</u>				<u>PAYLOAD VERIFICATION ANALYSIS</u>
	<u>STS-1</u>	<u>STS-2</u>	<u>STS-3</u>	<u>STS-4</u>	
HORIZONTAL VELOCITY AT MAIN IMPACT (KNOTS)	189	196	233	199	199
MAIN GEAR SINK RATE (FPS)	~1	<1	5.7	~1	6.0
NOSE GEAR SINK RATE (FPS)	5.7	5.1	8.8	5.4	11.0

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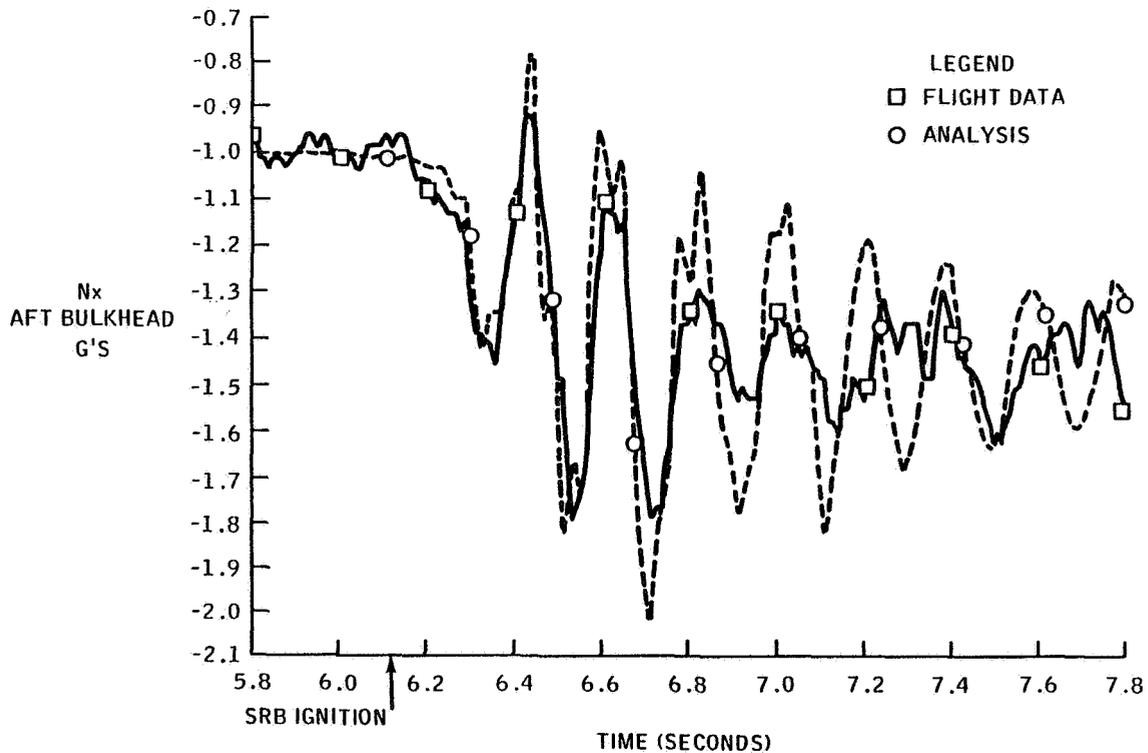
LANDING LOAD FACTOR COMPARISONS

Xo LOCATION DESCRIPTION	DIRECTION	FLIGHT DATA								REQUIREMENT	
		STS-1		STS-2		STS-3		STS-4			
		MG	NG	MG	NG	MG	NG	MG	NG	MG	NG
1294, BULKHEAD	NX	0.2	0.6	0.2	0.5	0.3	0.6	0.1	0.3	0.6	-
979, KEEL	NY	0.2	0.1	0.1	0.2	0.9	0.2	0.1	0.1	0.6	0.3
1294, BULKHEAD	NY	0.2	0.1	0.1	0.1	0.5	0.2	0.1	0.1	-	0.4
823, LEFT LONGERON	NZ	1.3	1.6	1.1	1.3	2.2	2.8	1.3	1.4	2.4	2.5
973, LEFT LONGERON	NZ	1.4	1.4	1.1	1.3	2.1	2.3	1.3	1.4	2.7	2.2
973, RIGHT LONGERON	NZ	1.4	1.4	1.1	1.2	2.0	2.3	1.3	1.4	2.4	2.3
1294, BULKHEAD	NZ	1.4	1.3	1.2	1.2	2.2	2.2	1.3	1.3	2.4	1.8

MG - MAIN GEAR IMPACT

NG - NOSE GEAR IMPACT

CORRELATION WITH AFT BULKHEAD Nx, FOR STS-2 LIFTOFF



SUMMARY

- **LOW FREQUENCY RESPONSES MEASURED IN ORBITAL FLIGHT TESTS ARE GENERALLY WELL BELOW STS REQUIREMENT**
- **STRUCTURAL DAMPING FOR PAYLOAD LOADS ANALYSES MAY BE INCREASED**

STS ELECTROMAGNETIC ENVIRONMENT

STS ELECTROMAGNETIC COMPATIBILITY

STS ELECTROMAGNETIC ENVIRONMENT DEFINED IN ICD2-19001

- ENVIRONMENT INCLUDES CONTRIBUTION OF STS ELEMENTS AND PAYLOADS
- ENVIRONMENT VALID WHEN PAYLOAD CONTRIBUTION IS LIMITED TO LEVELS OF CONDUCTED AND RADIATED EMISSIONS ALLOWED IN ICD2-19001
- STS CONTRIBUTION TO ENVIRONMENT VERIFIED
 - GROUND TEST ON OV101
 - SPECIAL EMI TESTING IN SAIL
 - LRU TESTING
 - ANALYSIS

STS ELECTROMAGNETIC PERFORMANCE

- FLIGHT RESULTS INDICATE NO INTERFERENCE IN STS FLIGHT CRITICAL SYSTEMS FROM ON BOARD OR GROUND BASED SOURCES
- MINOR PROBLEMS NOTED TO DATE
 - MINOR AUDIO SYSTEM NOISE WHEN CREW NEAR WINDSHIELD - SOURCE IS TACAN XMTR'S. (NOTED IN GROUND TEST ONLY)
 - AFT PAYLOAD CURRENT SENSORS (BUS B&C) READ LOW WHEN HYDRAULIC PUMP IS RUNNING ON SAME BUS
 - NRL EXPERIMENT MALFUNCTIONED EACH TIME HYDRAULIC PUMP STARTED ON SAME BUS

SUMMARY

- **ELECTROMAGNETIC EFFECTS ARE ABOUT AS EXPECTED**

STS PAYLOAD BAY ENVIRONMENT

CONCLUSION

- **IN GENERAL THE PAYLOAD BAY ENVIRONMENTS ARE LESS SEVERE THAN PREDICTED**