ENCLOSURE 2

Relevant pages from Nuclear Power Station Qualification Type Test Report "Limitorque Valve Actuators with Type LR Motor for Combustion Engineering PWR" (SDOC 13-N001-1.01-0829-1), March 17, 1986 (Report B0234).

NUCLEAR POWER STATION
QUALIFICATION TYPE TEST REPORT
LIMITORQUE VALVE ACTUATORS WITH TYPE LR MOTOR
FOR COMBUSTION ENGINEERING PWR

REPORT 80234

Tested per IEEE Standards 382-1980, 323-1974, and 344-1975

Test performed

Written by J. B. Drab Date 3-17-86
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Approved by [signature] Date 3/17/86
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LIST OF FIGURES AND APPENDICES

1.0 INTRODUCTION:

A Limitorque SMB-00 valve actuator with a 15 foot pound, Type LR motor was manufactured as specified by Limitorque Bill of Material 684014A and was submitted for qualification of valve actuators for MSLB/HELB condition inside containment of a Combustion Engineering PWR per IEEE Standards 382-1980, 323-1974, and 344-1975. The qualification test procedure aging parameters, environmental test profile, etc. were established per agreement with Combustion Engineering.

The SMB-00-15 valve actuator was subjected to active aging simulations of forty (40) year life prior to the DBE (Design Basis Event - MSLB/HELB) pressure-temperature transients.

2.0 IDENTIFICATION AND CONSTRUCTION OF ACTUATOR:

The following identification information was taken from the actuator and motor nameplates:

Unit Identification	Motor Identification
Type: SMB	I.D. No. 877Q0064M-UL-129A
Size: 00	Manufacturer: Reliance Elec. Co.
Order: 684014	Start: 15 foot pound
Serial #: L-369003	Run: 3 foot pound
Ratio: 55.8:1	Amps: 2.8
	Phase: 3
	Volts: 460 VAC
	Frame: P56

to the motor, the test terminal strip was mounted in the test actuator. During the pressure-temperature transients, at each operation of the test actuator, a motor located outside the test chamber was run in each direction for 30 seconds using power directed through the test terminal strip.

3.0 ACCEPTANCE CRITERIA:

The basic function of a valve actuator during a DBE is to provide the required torque and be capable of accepting the thrust to actuate a valve to either the open or closed position, as required. Also, it is required that limit switches and torque switch function properly to provide proper control logic. All qualifications conducted by Limitorque in this test program have been directed toward the candidate SMB-00 actuator delivering its rated torque of 250 foot pounds and capable of accepting rated thrust of 14,000 pounds while both the limit switch and torque switch are providing their proper control functions.

The electrical resistance to ground of all limit and torque switch connections and motor leads are taken for information and are not part of the acceptance criteria.

4.0 TYPE TEST PROCEDURE:

4.1 Initial Inspection:

Inspect actuator prior to conducting baseline measurements for damage from handling, etc.

Have damaged components replaced or repaired prior to starting test.

10 "set up" cycles and resulted in 2320 total mechanical cycles during the thermal and mechanical aging procedures.

6.4 Pressurization Aging:

The SMB-00-15 actuator was installed in the test chamber and pressurized to an average pressure of 66.1 psig holding each pressure plateau for 3 minutes. The actuator was exposed to 15 pressure cycles. The pressurization aging was initiated at 13:04 on July 24, 1985, and concluded at 14:53 on the same day.

6.5 Life Radiation Aging:

Life irradiation was initiated July 25, 1985, by Isomedix and concluded July 28, 1985. The actuator was exposed to 10.34 Megarads gamma radiation at a rate of 0.22 Megarads per hour during this period. The certification for the irradiation is included in Appendix C.

6.6 Plant Vibration and Seismic Aging:

6.6.1 Simulated Plant Vibration:

The simulated plant vibration aging consisted of exposing the actuator to an acceleration of .75 g (not exceeding a double amplitude of .025 inch) from 5 to 100 hz at a rate of two (2) octaves per minute for a total of 90 minutes in each of the three orthogonal axes. The actuator was successfully operated from position limit switch open position to torque switch seated closed position and back to the open limit switch position once every 15 minutes throughout this test.

6.6.2 OBE Seismic Aging:

The OBE sine sweep test was then conducted in each of the three axes from 2 to 35 to 2 hz at a rate of one octave per minute.

This test was conducted twice at a level of 3.0 g (from 2 to 4 hz, the acceleration was below 3.0 g and was at shaker table limits), which is equivalent to 5 OBE's.

6.6.3 SSE Seismic Aging:

The sine dwell test was performed in each of the three orthogonal axes. The test consisted of 15 second sinusoidal dwells at 1/3 octave intervals from 2 to 32 hz at an acceleration of 4.5 g (due to shaker table capacities, 4.5 g acceleration could not be achieved at 4 hz and lower frequencies). During each seismic dwell, the actuator was stroked from limit switch controlled open to torque switch seated close position back to the open limit switch position.

At the conclusion of testing, the actuator was electrically and manually cycled with the actuator operating normally in both cases. There was no evidence of physical damage.

6.6.4 Seismic Report:

A copy of Acton Report 20934-86N is included in Appendix D.

6.7 DBE Radiation Aging:

The DBE irradiation was initiated August 15, 1985, by Isomedix and concluded August 21, 1985. The actuator was exposed to 122.32 Megarads gamma radiation at a rate of 0.85 Megarads per hour during this period. The certification for the irradiation is included in Appendix E.

6.8 Baseline Test:

Between each of the above aging steps, a baseline test was conducted. Since the results showed no significant change in actuator performance, they were not included in this report. However, to provide verification of this statement, the results of

to Appendix I for results). Comparison with the initial baseline test shows the collected data to be equivalent and confirms the motor had retained its integrity.

It is concluded that the anomaly is a one-time occurrence caused by the unique conditioning of an unrelated actuator part. The actuator and motor are considered qualified for use in PWR containment chamber service where the environmental conditions stipulated in this report or lesser conditions are encountered.

The SMB-00 actuator and motor qualified in this report is an average, mid-size unit. All size actuators are constructed of the same materials with components designed to equivalent stress levels, same clearances and tolerances with the only difference being in physical size which varies corresponding to the differences in units' rating. It is concluded all other sizes (from smallest to largest) of the Type SMB, SB, SBD, and SMB/HBC actuators are also equally qualified.

APPENDIX D

SEISMIC AND PLANT VIBRATION AGING REPORT

National Technical Systems

Test Report No. 20934-86N No. of Pages 21

REPORT OF TEST

FOR

SEISMIC TESTING OF ONE (1)
SMB-00-15 ACTUATOR
S/N L369003

R & D PROJECT NO. 685024

LIMITORQUE CORPORATION
5114 WOODALL ROAD
P.O. BOX 11318
LYNCHBURG, VA 24506

Purchase Order No. 110073

Prepared by: Ernest R. Letterie Date 3 Sept 85
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Reviewed and
Approved by: William C. McGinnis Date 3 Sept 85
William C. McGinnis, Chief Dynamics Test Engineer
NTS/Acton

ERL/rla:328

National Technical Systems

2.0 TEST REQUIREMENTS

2.1 Vibration Aging

The purpose of the vibration aging was to subject the actuator to the required seismic vibration aging excitation to determine the actuator's functional integrity and ability to withstand such excitation without evidence of mechanical damage or deterioration.

2.2 Sine Dwell Test

The purpose of the sine dwell testing was to subject the actuator to the required seismic vibration aging excitation to determine the actuator's functional integrity and ability to withstand such excitation without evidence of mechanical damage or deterioration.

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3.0 TEST PROCEDURES

3.1 Test Mounting

For vibration testing, the actuator was mounted on a fixture plate with provisions for a stem thrust seating (torque switch trip) in the closed direction and position seating in the open direction. The fixture plate had a predrilled bolt pattern in order to adapt it to the head of an AETC A-249 electrodynamic shaker. The actuator/ fixture plate assembly was attached to the A-249 for vibration aging in the frequency range from 5 to 100 Hz. The actuator/ fixture plate assembly was rigidly clamped to the single axis hydraulic shaker for sine sweep and sine dwell testing in the frequency range from 2 to 35 Hz.

All wiring and monitoring of the actuator was performed by Limitorque personnel witnessing the test.

3.2 Test Monitoring

The actuator was visually monitored for any evidence of mechanical damage or deterioration.

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3.2 Test Monitoring (continued)

The actuator was instrumented with three (3) triaxial groups of accelerometers. The accelerometers were located as follows:

A-249 ACCELEROMETER LOCATIONS

ACCELEROMETER	SENSE	LOCATION
1	H_1	End of motor
2	H_2	
3	V	
4	H_1	Top of the Base
5	H_2	of SMB
6	V	
7	H_1	Controls
8	H_2	
9	V	

H_1 - Parallel to the Motor Axis

H_2 - Perpendicular to the Motor Axis

V - Vertical

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3.3 Vibration Aging

The vibration aging was performed in three (3) mutually orthogonal axes of excitation, two (2) horizontal and one (1) vertical. The vibration aging consisted of a sinusoidal input with peak accelerations of 0.75g and sweeps from 5 to 100 to 5 Hz at a rate of two (2) octaves per minute for a total of 90 minutes per axis. A double amplitude of .025 inch was not exceeded at low frequencies. The actuator was operated from position seated open to thrust seated closed position and back to the open position once every 15 minutes.

3.4 Sine Sweep (OBE)

The sine sweep was performed in the vertical, horizontal H_1 direction, and in the horizontal H_2 direction for the actuator. The actuator was exposed to two sinusoidal sweeps from 2 to 35 to 2 Hz, at a rate of one octave per minute. The level of input was 3.0 g except for the range from 2 to 4 Hz which was at the shaker table limits. The first sweep was conducted with the actuator in the closed position and the second sweep was conducted with the actuator in the open position.

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3.5 Sine Dwell Test

The sine dwell test was performed in the vertical, the horizontal H_1 direction, and in the horizontal H_2 direction. The dwell test consisted of 15-second sinusoidal dwells at frequencies of 2, 2.5, 3.15, 4.0, 5.0, 6.3, 8.0, 10, 12.5, 16, 20, 25, and 31.5 Hz. The acceleration during each dwell was 4.5g except where limited by shaker table capacity at the 4 Hz and lower frequencies. During each dwell the actuator was operated through one complete closed stroke - open stroke cycle.

At the completion of all tests, the SMB-00-15 was electrically operated from the open to the closed position and back to open, noting results.

The handwheel was clutched and manually operated to closed position and partially open position. The actuator was visually inspected for physical damage.

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4.0 TEST RESULTS

4.1 Pretest Operational Cycle

No anomalies in operation of the SMB-00-15 actuator were encountered during pretest operation checks.

4.2 Vibration Aging Results

No anomalies in operation were encountered during, or as a result of, the vibration aging of the SMB-00-15 actuator. There was no evidence of mechanical damage or deterioration of the actuator.

4.3 Sine Dwell and Sine Sweep Tests

No anomalies in operation were encountered during, or as a result of, the sine sweep and sine dwell testing of the SMB-00-15 actuator. There was no evidence of mechanical damage or deterioration of the actuator.

All testing was witnessed and approved by a representative of Limitorque Corporation.

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TEST SEQUENCE

TEST	DESCRIPTION	AXIS
1	Vibration Aging	H_2
2	Vibration Aging	H_1
3	Vibration Aging	Vertical
4	Sine Sweeps	Vertical
5	Sine Dwells	Vertical
6	Sine Sweeps	H_1
7	Sine Dwells	H_1
8	Sine Sweeps	H_2
9	Sine Dwells	H_2

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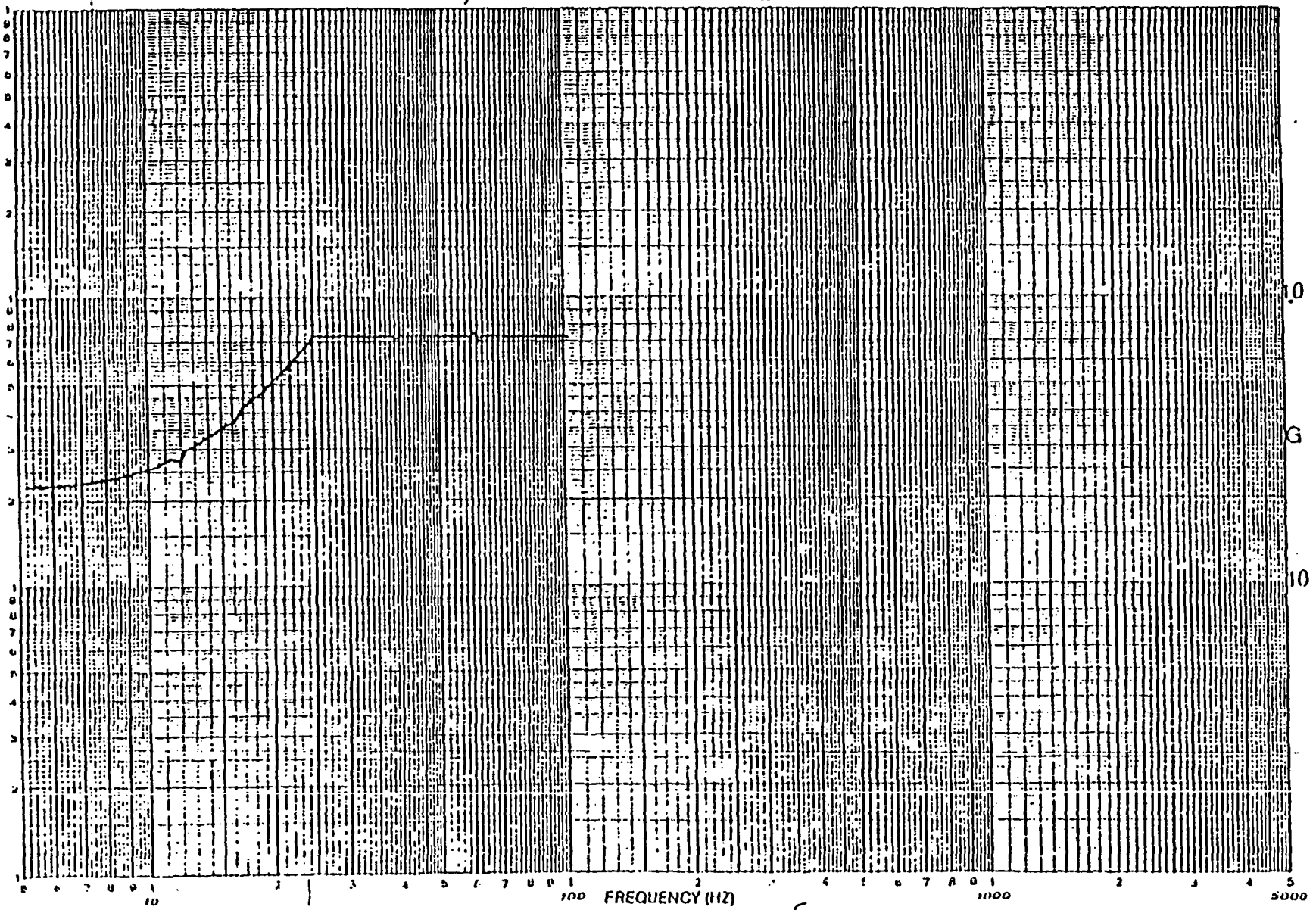
TEST NO. 1 CONTROL AXIS Na F.S. G LEVEL 10
TYPE OF TEST Sine Sgies ACCEL. NO. 8 F.S. FREQUENCY 5000
PERIOD OF TEST 2oct/min ACCEL. AXIS Na PERCENT DAMPING —



DATE 8-2-85 TEST ITEM P/N SMB-00-15 CONDITIONS AMBIENT
CUSTOMER [illegible] TEST ITEM S/N OPERATOR C. [illegible]

Graph Paper

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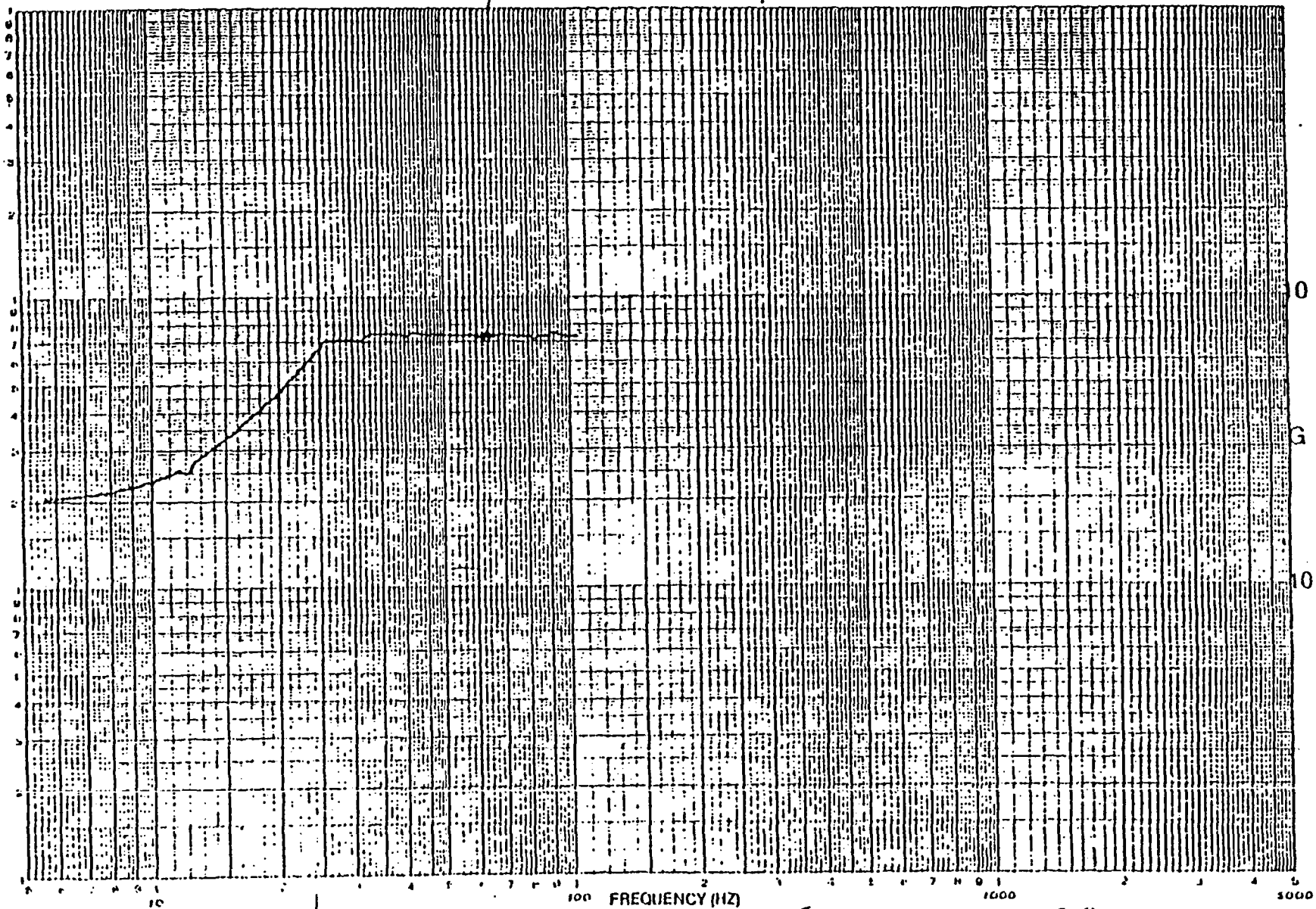
NTS

National
Technical
Systems

TEST NO. 2 CONTROL AXIS H1 F.S. G LEVEL 10

TYPE OF TEST Asine ACCEL. NO. 7 F.S. FREQUENCY 5000

PERIOD OF TEST 20cpf/min ACCEL. AXIS H1 PERCENT DAMPING —



DATE 8-3-85 TEST ITEM P/N SMB-00-15 CONDITIONS QTEE

TEST ITEM S/N OPERATOR

13-10407-N001-1.01-829-1 0150

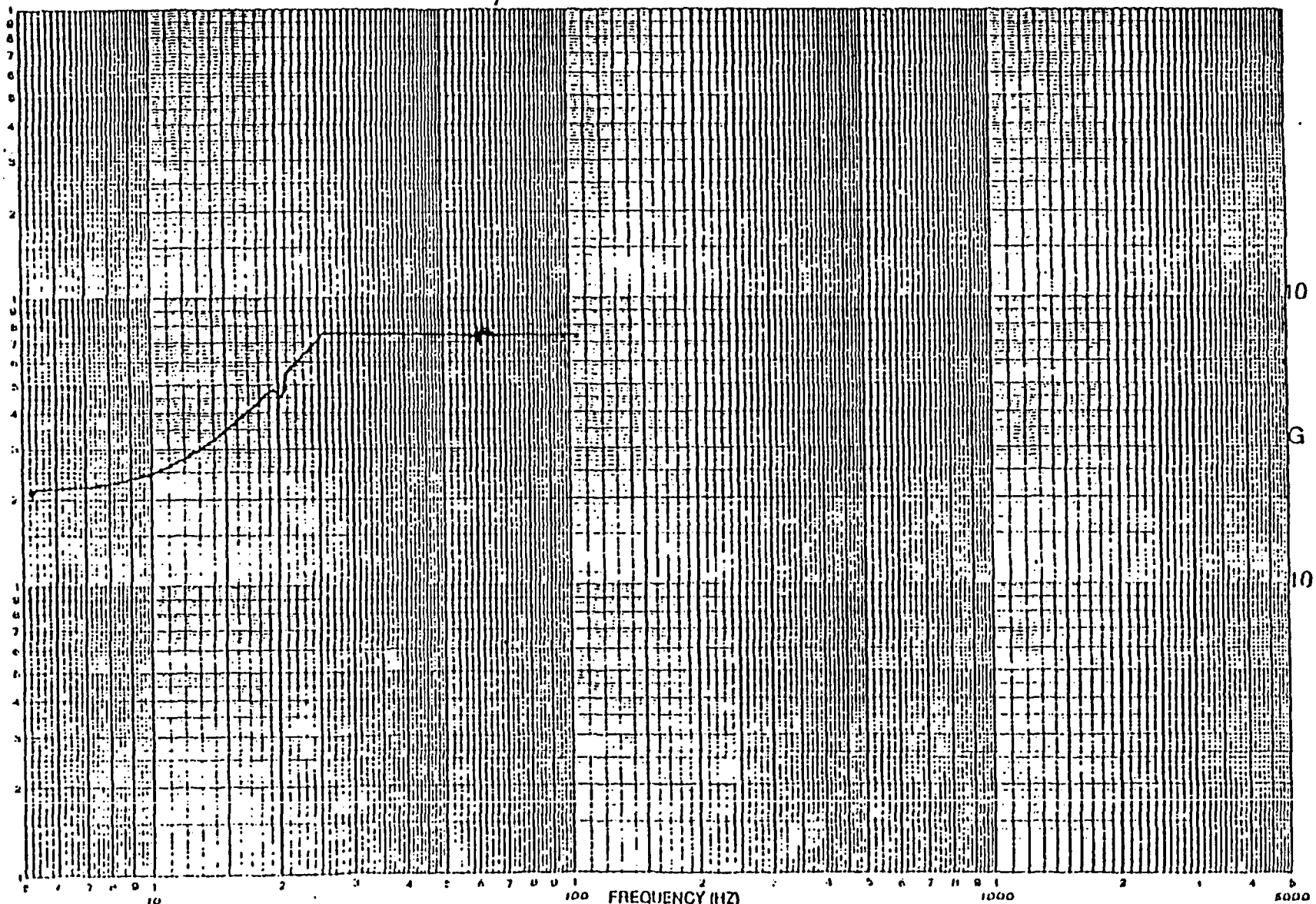
E14273 PE 5731 PAGE A145

D15

NTS

National Technical Systems

TEST NO. 3 CONTROL AXIS Vert F.S. G-LEVEL 20
TYPE OF TEST Aging ACCEL. NO. 9 F.S. FREQUENCY 5000
PERIOD OF TEST 20ct/min ACCEL. AXIS Vert PERCENT DAMPING —



DATE 8-3-85 TEST ITEM P/N SMB-OC-15 CONDITIONS OPEN
CUSTOMER Unisys TEST ITEM S/N OPERATOR C. Forbes