

GENERAL ELECTRIC COMPANY
RELAYS AND ACCESSORIES
SEISMIC CAPABILITY

GEZ-6675

3/25/77

Revised 5/20/77

General - This "SEISMIC CAPABILITY" data is based on tests conducted in accordance with IEEE "Proposed Standard for Seismic Testing of Relays—P501/9", dated January 1977 unless otherwise specified. Relays (and other devices) have been placed on a shaker table and subjected to prescribed input motions to determine their seismic capability. Except where noted, all relays contain Hi-G high seismic instantaneous and/or target/seal-in units. The following comments partially explain the test methods used, and are extracted in part from the "Proposed Standard".

- (a) The FRAGILITY LEVEL shown is based on tests conducted with biaxial multi-frequency broad-band frequencies applied to the shaker table per attached Page 3. The following is quoted from Proposed Standard P501 (9th draft):

- "Broad-band Multi-frequency Fragility Testing

Repeatable multi-frequency input motions shall be used in the fragility testing. It is the test's objective to produce a Fragility Response Spectrum (FRS) which envelopes the Standard Response Spectrum shape using a biaxial input motion.

Point A = 1.0 Hz and an acceleration equal to 25% of the ZPA. ZPA means Zero Period Acceleration.

Point D = 4.0 Hz and 250% of the ZPA.

Point E = 16.0 Hz and 250% of the ZPA.

Point G = 33.0 Hz and a level equal to the ZPA.

The range of maximum amplification of acceleration, 4.0 to 16.0 Hz has been designed to most realistically match the range of peak acceleration input to the relays by the equipments and panels on which they are mounted. Below 4.0 Hz, it is possible to encounter building frequencies to as low as 1.5 Hz. The resulting panel motions would probably be enveloped by the line AD since the amplification of panels at these low frequencies is small. Above 16 Hz, there are equipment and panel resonances, however, the seismic energy input in this range is generally reduced and, therefore, the motions would probably be enveloped by the line EG."

Where the fragility level is shown as 6G ZPA, it should be noted that this represents the table limit of the test facility used. This corresponds to 15G at the peak (Points D and E) of attached Page 3.

Where an asterisk (*) appears opposite the ZPA values, this signifies that the testing was done to an earlier draft of

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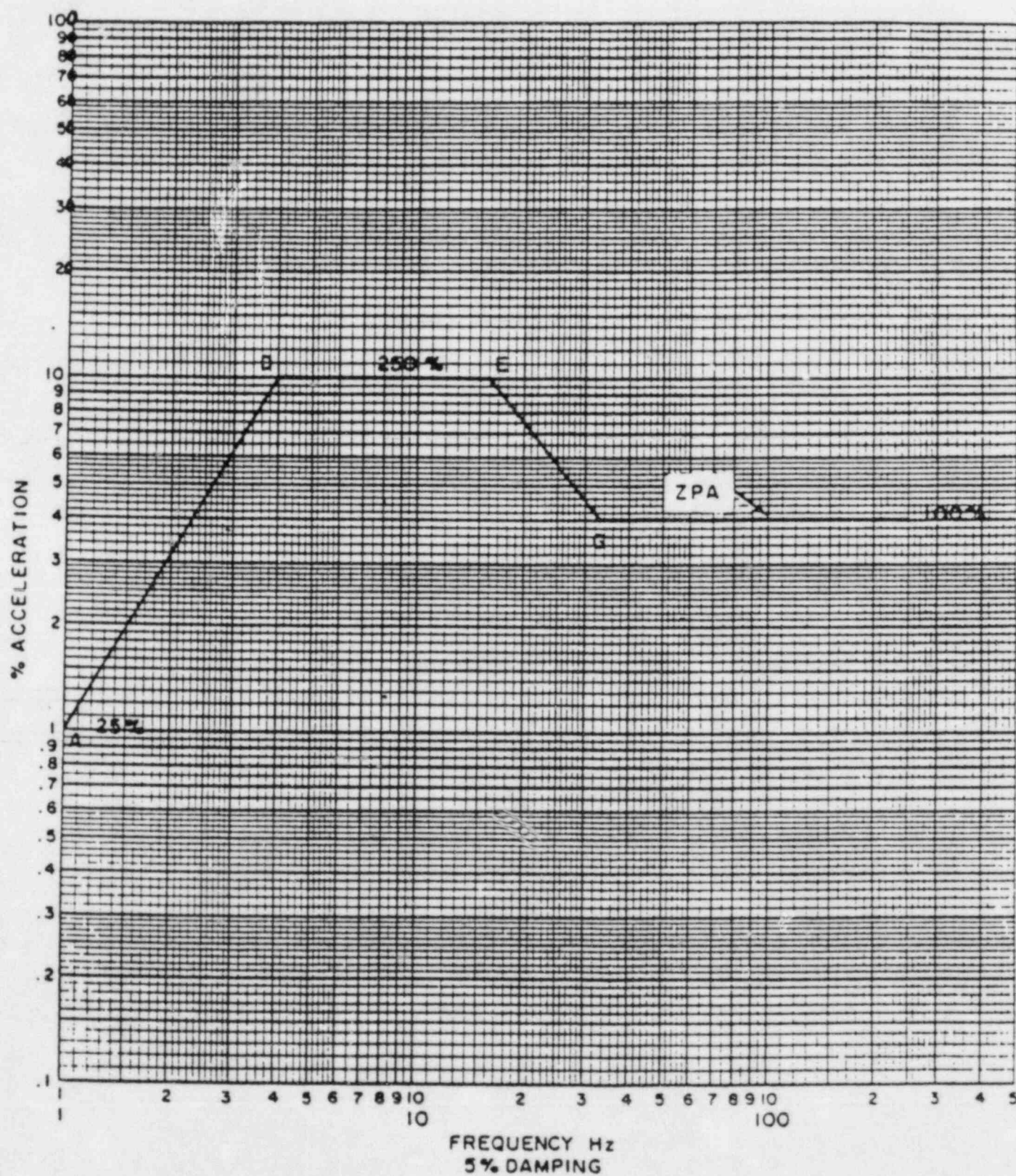
P501 in which the peak (line D-E) spanned from 2.5 to 10 Hz. In those tests, the table limit was 4G ZPA, corresponding to 10G at the peak.

Where the complete relay model number is shown (for example STD15B3A), that relay model was subjected to fragility testing. Following such tests, other models of that relay family were reviewed for electrical and mechanical commonality to the tested model. Such additional models are also listed with the note "by review" in those cases in which the fragility level was conservatively judged to be equal or higher than the tested model.

- (b) Relays in the "Non-operating" condition have tap settings, time dials, currents and/or voltages applied per P501, Table 1. These currents/voltages are intended to simulate maximum load conditions or conservative settings.
- (c) Relays in the "Operating" condition have currents and/or voltages applied as specified in P501, Table 1. These are generally 200% of pickup.
- (d) Relays have been tested using as failure criteria: a) a two-millisecond contact discontinuity, i.e., a normally open (N.O.) contact closes for 2 ms or a normally closed (N.C.) contact opens for 2 ms or b) an HEA relay connected to an N.O. contact operates or c) an HFA hand reset relay connected to an N.O. contact operates.
- (e) Transition tests are conducted (per P501) to determine if the operating time of the relay changes when subjected to a seismic test. Operating times are shown in seconds.
- (f) With "operating conditions" applied and the relay at rest, the relay operating time is measured. The average value is shown in the "Normal" column.
- (g) The relay is subjected to a biaxial multi-frequency motion at the level shown in column (b) and the "operating conditions" are again applied. The relay operating time is measured. The range of values found during these tests is shown in the "Seismic" column. The difference (if any) in the operating time may or may not be significant, depending on the relay application.

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MULTI-FREQUENCY BROAD-BAND STANDARD RESPONSE SPECTRUM SHAPE



(THIS CURVE APPEARS AS FIGURE 1 IN P501, DRAFT 9.)

CURRENT RELAYS
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CEL-0075
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Fragility Level is Stated in g's ZPA (a)

Position/Condition - Failure Criteria (d)	Non-operating (b)			Operating (c)			Transition Test(e) Time in Seconds	
	TOC	IOC	HFA	TOC	IOC	HFA		
	2 ms or HEA	2 ms	TOC/IOC	2 ms or HEA	2 ms	TOC/IOC	Normal(f)	Seismic(g)
HFC11 (by review)	-	4	-/6	-	6	-/6		
IAC51B & IAC51A (by review)	3	4	6/6	6	3	4	0.82	0.71-0.88
IAC53B & IAC53A (by review)	3	4	6/6	6		-	1.1	0.67-1.22
IAC66K8A & all IAC66A,B&K (by review)	3.5*	4*	4/4*	4*	4*	4/4*	6.18	6.02-6.34
IAC77B & IAC77A (by review)	3*	3.5*	4/4*	4*	4*	4/4*	1.41	1.31-1.42
IFC51B & IFC51A (by review)	3.5	4	6/6	6	3	1.5/6	0.80	0.65-1.0
IFC53B & IAC53A (by review)	3.5	4	6/6	6	3.5	1/6	1.04	0.93-1.20
IFC66A,B&K (by review)	3.5	4	6/6	5	3	1/6		
IFC77B & IFC77A (by review)	3.5	4	6/6	5	3	1/6	0.97	0.64-1.18
IJCV51A & all IJCV51A (by review)	3*	-	4*	4*	-	-	0.691	.673-.825
PJC11AV1A & all PJC11AV (by review)	-	1.4*	1.7	-	1.7	-/2.1	0.020	.013-.024
SBC21F1D & all SBC21 (by review)								
SFC177B1A & all SFC (by review)	6	3.5	6/6	6	5	6/6	0.75	.67-.75

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AUXILIARY AND TIMING RELAYS ##
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Fragility Level is Stated in g's ZPA (a)

Position/Condition - Failure Criteria (d)	Non-operating (b)			Operating (c)			Transition Test(e) Time in Seconds	
	N.O.	N.C. - 2 ms	HFA	N.O.	N.C. - 2 ms	HFA	Normal(f)	Seismic(g)
	2 ms or HEA			2 ms or HEA				
HEA61C & all HEA61A&B (by review)	4/5*	4/5*	-	4/5*	4/5*	-	N/A	
HFA51A42 Code 60) 51A42&42F Code 33) D.C.	2.5 2.5*	- 0.5	4 2.8	4 2.8	- 2.8	- 2.8	0.080 PU 0.070 DO	0.065-0.090 0.066-0.080
& all D.C. HFA51A (by review)								
HFA51A49F Code 33) A.C. & all A.C. HFA51A (by review)	3	3.5	4	4	4	4	0.020 PU 0.050 DO	0.16-.033 .030-.066
HFA54B187F & all D.C. HFA54B (by review)	3	2.5	4	1.75	1.75	1.75	0.60 PU 0.62 DO	.049-.069 .052-.088
HGA11J52) D.C. & all D.C. HGA11 (by review)	3.5	1.5	4	1.75	4	4	.075 PU .033 DO	.060-.080 .033-.048
HGA11J70) A.C. & all A.C. HGA11 (by review)	2.5	1	4	4	4	4	.040 PU .033 DO	.037-.074 .021-.051
HGA14A52) Low Pickup & all D.C. HGA14 (by review)	2	.5	4	0.5	4	3	0.040 PU 0.110 DO	0.035-.069
HGA17A52) Time Delay & all D.C. HGA17 (by review)	1	0.5	2	4	2.5	-	.050 PU .246 DO	.033-.098 .175-.280
SAM17A12A & all SAM without targets (by review)	4/5	-	4	4/5	-	4	0.058	.053-.058

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None of these relays include H1-G units

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DIFFERENTIAL RELAYS
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Fragility Level is Stated in g's ZPA (a)

Position/Condition - Failure Criteria (d) -	Non-operating (b)			Operating (c)			Transition Test (e)	
	N.O.			N.O.			Time in Seconds	
	2 ms or HEA	N.C. - 2 ms	HFA	2 ms or HEA	N.C. - 2 ms	HFA	Normal (f)	Seismic (g)
BDD16B11A & all ## BDD15&16B (by review) ##	1.75*	-	4*	3.5*	-	4*	.048	.018-.053
CFD22B1A & all CFD22B (by review)	0.75*	-	1.75*	3.5*	-	-	.085	.070-.144
IJD52A IJD53C11A & all IJD52A&53C (by review)	3.5	-	6	6	-	-	1.12	0.93-1.25
PVD11C11 & all PVD11C (by review)	1	-	2.5	6	-	-	0.016	.015-.019
PVD21D1A & all PVD21 (by review)	3	-	6	6	-	6	0.055	0.037-0.0
SBD11A1A & all SBD11 (by review)								
STD15B3A & all STD15&16 B&C (by review)	3.5	-	6	6	-	6	.038	.032-.040

* See Page 1

BDD relays do not include HI-G units

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VOLTAGE PHASE SEQUENCE & SYNCH CHECK RELAYS
SEISMIC CAPABILITY

Fragility Level is Stated in g's ZPA (a)

Position/Condition -

Failure Criteria (d)

IAV53L1A

ICR53A8A & all
ICR53A&B (by review)

IJS51A1A & all
IJS51A&52A (by review)

NGV13A11A & all NGV13A,
18A & 23A (by review)

NGV15A21 & all
NGV15A & 17A (by review)

RAV11B1A & all
RAV11 (by review)

STV11A1A
volts per Hz/TU
& all STV11 (by review)

	Non-operating (b)			Operating (c)			Transition Test(e)	
	N.O.	N.C. - 2 ms	HFA	N.O.	N.C. - 2 ms	HFA	Time in Seconds	
	2 ms or HEA			2 ms or HEA			Normal(f)	Seismic(g)
				6	0.5	1.0	2.83	2.62-3.10
	3*	3.5*	4*	4*	4*	4*	4.1	4.38-4.51
	3*	-	4*	4*	-	4*	2.45	1.01-3.1
	4*	4*	4*	4*	4*	4*	0.018	0.011-.020
	6	6	6	6	6	6	.018	.011-.020
	0.5	0.5	2	0.5	0.5	0.5	.100	.084-.403
	3.5/3.5	-	6/6	4/6	-	6/6	1.30	1.25-1.40

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DIRECTIONAL RELAYS

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Fragility Level is Stated in g's ZPA (a)

Position/Condition - Failure Criteria (d) -	Non-operating (b)			Operating (c)			Transition Test (e) Time in Seconds	
	<u>N.O.</u> <u>2 ms or HEA</u>	<u>N.C. - 2 ms</u>	<u>HFA</u>	<u>N.O.</u> <u>2 ms or HEA</u>	<u>N.C. - 2 ms</u>	<u>HFA</u>	<u>Normal (f)</u>	<u>Seismic (g)</u>
CJC15E2A Trip Direction/Non- trip direction & all CJC15E (by review)	0.5/3.5	-	5/6	4/3	-	0.5/-	0.060	0.080-0.225
IBC51E2A Trip Direction/Non- trip direction & all IBC51E (by review)	3/2.5	-	5/5	6/-	-	6/-	0.90	0.76-0.85
ICW52A2A & all ICW51A&B, 52A (by review)	6	0.5	6	1	6	4	3.56	4.2-5.3
GGP53B1A Trip Direction/Non- trip direction & all GGP53B (by review)	2.0/2.5	-	6	6/2	-	-		No Operation
CEH51A1A & all CEH51A (by review)	2	-	6	5	-	1.5	0.045	0.020-0.065

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SWITCHES, LIGHTS, TERMINAL BOARDS SEISMIC CAPABILITY

Fragility Level is Stated in g's ZPA (a)

Position/Condition -

Failure Criteria (d) -

Switches

SB1B1X2
& all SB1 switches of 8
stages or less (by review)

SBM10AA101
& all SBM (by review)

Lamps

ET-5 }
ET-6 }
ET-16 }
ET-17 }

Terminal Boards

EB-2 }
EB-4 }
EB-5 }
EB-25 }
EB-26 }
EB-27 }

Closed		Tripped	
<u>N.O.</u>		<u>N.O.</u>	
<u>2 ms or HEA</u>	<u>N.C. - 2 ms</u>	<u>2 ms or HEA</u>	<u>N.C. - 2 ms</u>

4*

4*

4*

4*

4*

4*

4*

4*

Good for 4* ZPA & 5 ZPA modified

Good for 4* ZPA & 5 ZPA modified

*See Page 1

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