Iron-Core reactors used by NEPSI are tested by third party testing laboratories

150kV BIL Iron-Core Reactor Test Results

KEMA-Powertest, LLC

Test Report # 13051-D

Equipment Tested:

11162, Serial No. 27519, Iron Core Aluminum Wound Reactor

Tested For:

Withstand of Dielectric

February 14, 2013

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REPORT OF PERFORMANCE NUMBER: 13051-D

EQUIPMENT TESTED: **11162, Serial No. 27519**
IRON CORE ALUMINIUM WOUND REACTOR

MANUFACTURER'S RATINGS:

Voltage:	35	kV Class
BIL:	150	kV
Frequency:	60	Hz
Continuous Current:	75	A
Number of Phases:	1	

DATES OF TEST: February 14, 2013

TESTED FOR: Withstand of Dielectric

The tests have been carried out in accordance with the client's instructions.

This report consists of 44 pages, and contains the results of tests performed at the KEMA-Powertest Laboratory on the above noted equipment. Publication or reproduction of the contents of this report in any form other than a complete copy is not permitted without written approval of KEMA-Powertest.

Measurement uncertainty can be verified by reviewing the instrument calibration records. The instruments used are calibrated on a regular basis and are traceable to the National Institute of Standards and Technology.

The results apply only to the specific devices tested and are recorded on the enclosed tables, oscillograms, photographs, etc. A table of contents is included on Page 2.

Richard J. Cubbage
Manager, Test Operations

February 21, 2013
Date

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TEST SUMMARY

A. Discussion

The client submitted one PM 11162, Serial No. 27519, Iron Core Aluminium Wound Reactor, in good condition, to be subjected to withstand of dielectric tests in accordance with the client's instructions. The test sample is rated 35 kV Class, 150 kV BIL, 75 A I_{CONT}, 60 Hertz, and single phase.

B. Test Requirements

The client requested tests to verify the ability of the PM 11162, Serial No. 27519, Iron Core Aluminum Wound Reactor to withstand dielectric in accordance with the client's instructions. These test requirements are summarized in the following table:

High Voltage Test			
Impulse Test			
Full Wave		Chopped Wave	
Voltage (kV)	Waveform (µs)	Voltage (kV)	Chopping Time (µs)
150	1.2 / 50	165	> 3.0

The impulse test sequence shall consist of applying one (1) reduced level impulse, one (1) full level impulse, one (1) reduced level chopped impulse, two (2) full level chopped impulses, and two (2) full level impulses, without causing damage or a flashover.

The impulse shall consist of a high voltage 1.2 / 50 µs wave with a crest of 150 kV.

Reference standard: ANSI/IEEE C57.16-1996, IEEE C57.12.91-2011, C57.12.01-1998

C. Test Results

The withstand of dielectric tests for the PM 11162, Serial No. 27519, Iron Core Aluminum Wound Reactor were performed in accordance with the test standards mentioned above and the client's instructions.

Detailed results are reported in the Impulse Test Record on pages 5-6 of this report.

This report will be forwarded to the client for evaluation.

IMPULSE TEST RECORD

TEST DEVICE: Power Magnetics Inc. - PM 11162, Serial No. 27519, Iron Core Aluminium Wound Reactor **TEST NO.:** 13051-D

Atmospheric Conditions:

Date:	Time:	Bar. Pr. (mmHg):	T_D (°C):	Hum. (%):	RAD:	F_C: (Positive)	F_C: (Negative)
2/14/2013	9:15 AM	748	21	43	0.981	0.953	0.959
Date:	**Time:**	**Bar. Pr. (mmHg):**	**T_D (°C):**	**Hum. (%):**	**RAD:**	**F_C: (Positive)**	**F_C: (Negative)**

Initial Conditions: Tested as received. Elevated on insulators provided by customer.

TESTER: RP, DD

Trial #	Device Under Test	Grounded Parts		Charge Voltage (V)	Polarity	Test Voltage (kV)	Corrected Voltage (kV)	Time to Chop (ms)	Resulting Waveform	Remarks
1	C1	C0		24.8	Positive	72.1	75.7	-	Calibration	1
2	C1	C0		24.8	Positive	72.5	76.1	-	Reduced	2
3	C1	C0		49.2	Positive	143.2	150.3	-	Full	
4	Gap	Gap		27.2	Positive	79.7	83.6	2.22	Calibration	3
5	C1	C0		27.2	Positive	79.1	83.0	2.74	Reduced Chop	
6	Gap	Gap		54.0	Positive	158.3	166.1	3.72	Calibration	4
7	C1	C0		54.0	Positive	157.2	165.0	-	Full	5
8	C1	C0		54.0	Positive	157.2	165.0	-	Full	6
9	Gap	Gap		54.5	Positive	159.5	167.4	3.88	Calibration	
10	C1	C0		54.5	Positive	158.8	166.6	-	Full	5
11	C1	C0		55.0	Positive	160.0	167.9	-	Full	6
12	Gap	Gap		55.0	Positive	161.2	169.2	3.13	Calibration	
13	C1	C0		55.0	Positive	160.1	168.0	-	Full	5
14	C1	C0		55.0	Positive	161.3	169.3	5.07	Chop	
15	C1	C0		55.0	Positive	161.3	169.3	-	Full	5
16	Gap	Gap		55.0	Positive	160.1	168.0	3.41	Calibration	7
17	C1	C0		55.0	Positive	160.1	168.0	-	Full	5
18	C1	C0		55.5	Positive	161.2	169.2	-	Full	6
19	Gap	Gap		55.0	Positive	161.0	168.9	2.57	Calibration	
20	C1	C0		55.0	Positive	159.9	167.8	-	Full	5

Remarks: 1) Test circuit calibration with the test device in the circuit. Generator change to slow down tail time. 2) Client approved test circuit and setup. Resulting waveshape parameters: 1.15 µs front time, 45.5 µs tail time. 2) Configuration of Marx generator: 3 stages in series, R_F = 78 Ω, R_T = 67 Ω, R_G = 500 Ω. 3) Chopping gap set to distance of 85.5 mm. Chopping Gap does not allow sufficient control of chopping time. 4) Chopping gap set to distance of 200 mm. 5) Chopping gap did not flashover. Test will be repeated. 6) Chopping Gap did not flash over. Adjustment of settings. 7) Chopping gap set to distance of 195 mm.

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IMPULSE TEST RECORD

TEST DEVICE: Power Magnetics Inc. - PM 11162, Serial No. 27519, Iron Core Aluminium Wound Reactor **TEST NO.:** 13051-D

Atmospheric Conditions:

Date:	Time:	Bar. Pr. (mmHg):	T_D (°C):	Hum. (%):	RAD:	F_C: (Positive)	F_C: (Negative)
2/14/2013	9:15 AM	748	21	43	0.981	0.953	0.959
Date:	**Time:**	**Bar. Pr. (mmHg):**	**T_D (°C):**	**Hum. (%):**	**RAD:**	**F_C: (Positive)**	**F_C: (Negative)**

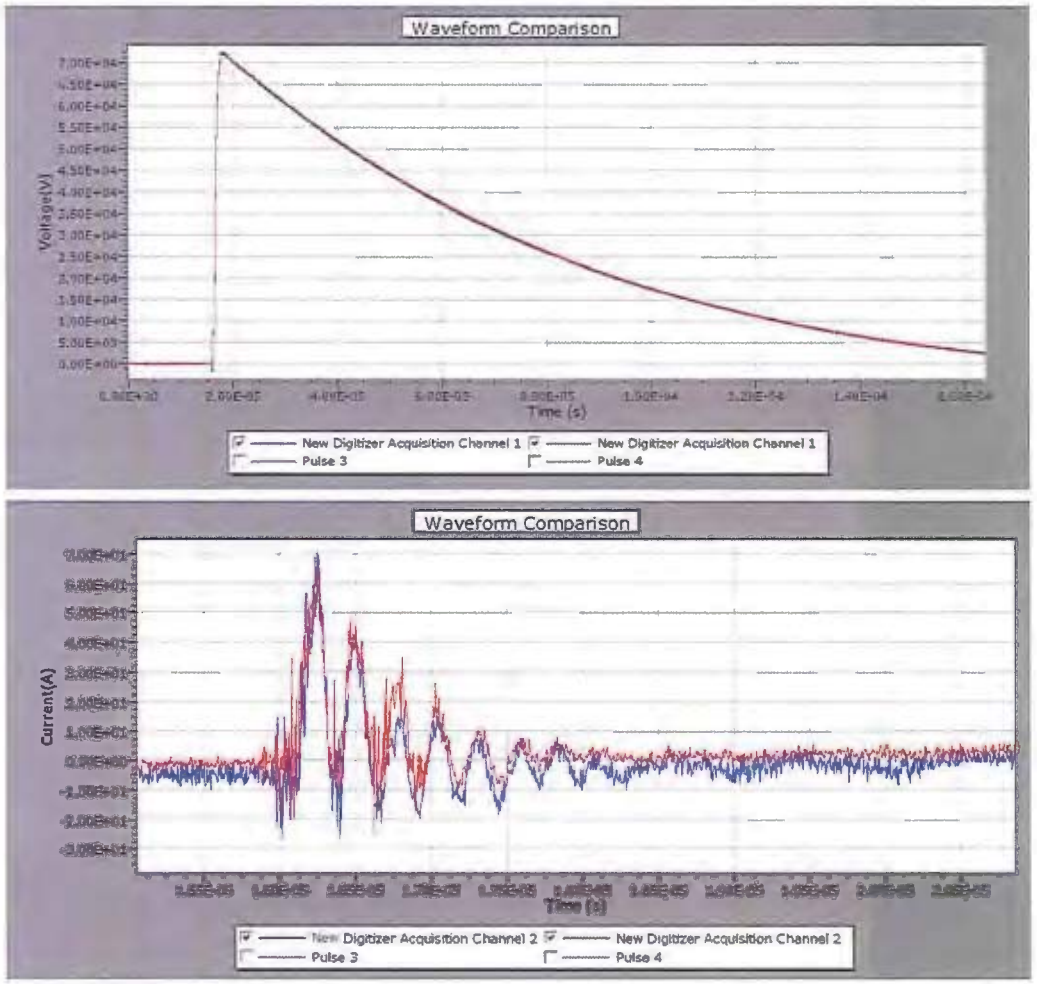
Initial Conditions: Tested as received. Elevated on insulators provided by customer.

TEST OBSERVERS: **TESTER:** RP, DD

Trial #	Device Under Test	Grounded Parts		Charge Voltage (V)	Polarity	Test Voltage (kV)	Corrected Voltage (kV)	Time to Chop (ms)	Resulting Waveform	Remarks
21	C1	C0		55.7	Positive	161.9	169.9	3.82	Chop	
22	C1	C0		49.2	Positive	143.0	150.1	-	Full	
23	C1	C0		49.2	Positive	143.0	150.1	-	Full	1
24	C0	C1		24.8	Positive	72.0	75.6	-	Reduced	2
25	C1	C0		49.2	Positive	142.7	149.7	-	Full	
26	Gap	Gap		27.2	Positive	79.7	83.6	2.35	Calibration	3
27	C1	C0		27.2	Positive	78.8	82.7	2.16	Reduced Chop	
28	Gap	Gap		55.5	Positive	162.4	170.4	2.72	Calibration	4
29	C1	C0		55.5	Positive	161.0	168.9	4.62	Chop	
30	C1	C0		55.5	Positive	160.9	168.8	2.65	Chop	
31	C1	C0		49.2	Positive	143.0	150.1	-	Full	
32	C1	C0		49.2	Positive	142.8	149.8	-	Full	

Remarks: 1) End of first test sequence. Configuration will be reversed. 2) Start of second test sequence. C0 energized, C1 earthed. 3) Chopping gap set to distance of 85.5 mm. Chopping Gap does not allow sufficient control of chopping time. 4) Chopping gap set to distance of 195 mm. Chopping Gap does not allow sufficient control of chopping time.

Desc:	Channel 1
File Name:	13382.jmx
Peak:	72.5 kV
Front Time:	1.152 us
Tail Time:	45.5 us
Desc:	Channel 1
File Name:	13411.jmx
Peak:	143.0 kV
Front Time:	1.202 us
Tail Time:	45.9 us
Desc:	
File Name:	
Peak:	
Front Time:	
Tail Time:	
Desc:	
File Name:	
Peak:	
Front Time:	
Tail Time:	
Desc:	Channel 2
File Name:	13382.jmx
Peak:	0.06 kA
Desc:	Channel 2
File Name:	13411.jmx
Peak:	0.12 kA
Desc:	
File Name:	
Peak:	
Desc:	
File Name:	
Peak:	



Corrected Voltage: 150.1kV

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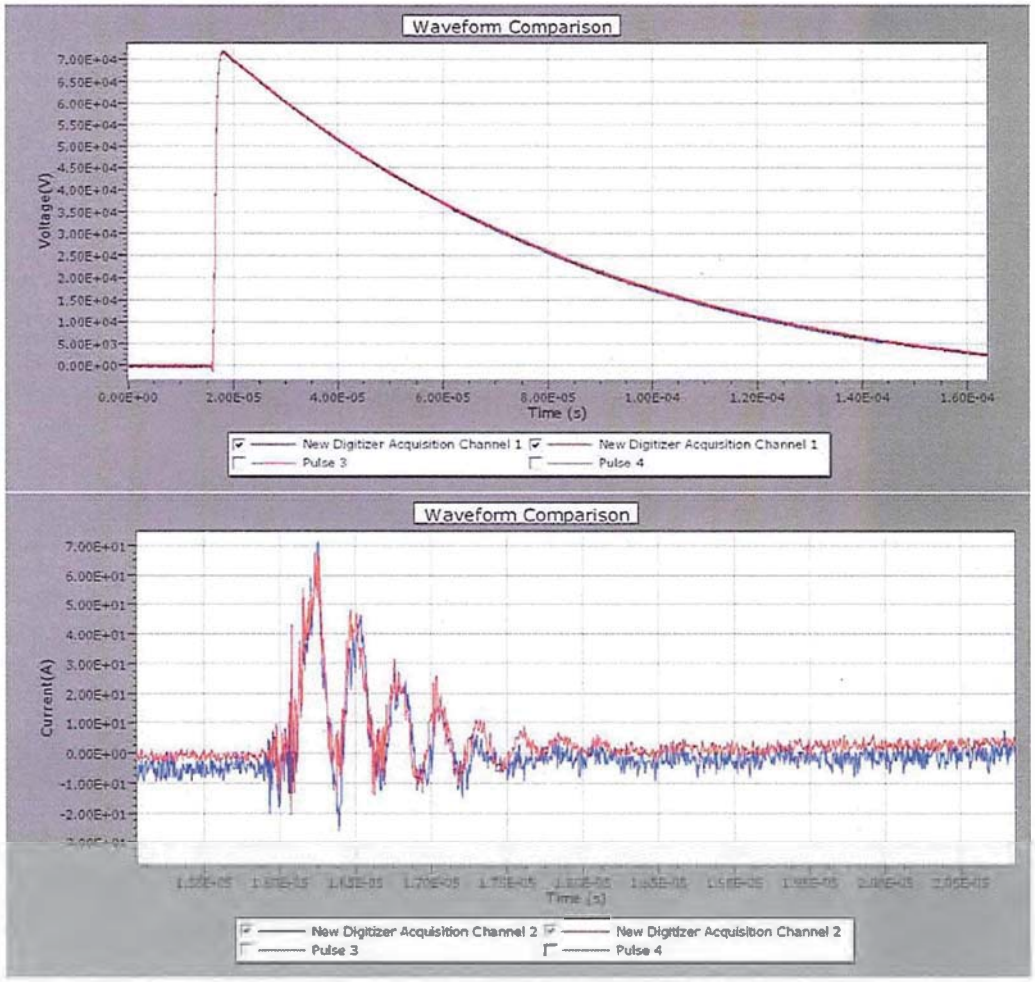
REPORT # 13051-D
WAVEFORM COMPARISON
TRIAL #22 vs. TRIAL #2

Type Wave:	Reduced
Description:	Channel 1
File Name:	13413.jmx
Peak:	72.0 kV
Front Time:	1.211 us
Tail Time:	45.6 us

Type Wave:	Full #1
Description:	Channel 1
File Name:	13420.jmx
Peak:	143.0 kV
Front Time:	1.202 us
Tail Time:	45.9 us

Type Wave:	Reduced
Description:	Channel 2
File Name:	13413.jmx
Peak:	0.07 kA
Front Time:	0.156 us
Tail Time:	55.6 us

Type Wave:	Full #1
Description:	Channel 2
File Name:	13420.jmx
Peak:	0.12 kA
Front Time:	0.206 us
Tail Time:	59.4 us



Corrected Voltage: 150.1kV

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REPORT # 13051-D
WAVEFORM COMPARISON
TRIAL 31 vs. TRIAL 24