



### TYPE TEST REPORT

**Test Object:** High-voltage insulator  
**Designation:** Dielectric tests on 400 kV composite insulator  
**Manufacturer:** Insulator: **DOROOD Kelid Bargh Co.**  
Karaj Ghazvin Road after Nazer Abad Sq. IRAN  
**Tested for:** **DOROOD Kelid Bargh Co.**  
Karaj Ghazvin Road after Nazer Abad Sq. IRAN  
**Date of tests:** 21<sup>st</sup> -23<sup>rd</sup> August 2012  
**Tested by:** VEIKI-VNL Ltd. – Budapest – HUNGARY  
**Project ID:** NFL-32/2012  
**Order/Contract:** NFL-32/2012, 26<sup>th</sup> April 2012  
**Test Specification:** IEC 61109:2008, IEC 60383:1993,  
**Tests Performed:** The test object, constructed in accordance with the description, drawings and photographs incorporated in this report has been subjected to dry lightning impulse voltage test, wet switching impulse voltage test and wet power-frequency voltage test.  
**Test Results:** **The test object passed the test.**

This Type Tests Report has been issued by VEIKI-VNL Ltd. in accordance with above mentioned Specifications.

The Report applies only to the test object tested. The responsibility for conformity of any test object having the same designations with that tested rests with the Manufacturer.

This Report comprises 12 sheets in total (7 numbered pages, 1 drawing and 4 oscillograms).

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VEIKI-VNL Ltd. is an independent testing laboratory accredited by the Hungarian Accreditation Board (NAT) under registration no. NAT-1-1251/2011.



Budapest,  
30 August, 2012

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## TEST CERTIFICATES OR REPORTS ISSUED BY VEIKI-VNL LTD.

### **Type Test Certificate of Complete Type Test**

This certificate provides the verification of all the rated characteristics of the equipment as assigned by the manufacturer, by means of the performance of all type tests specified by the standards.

### **Type Test Certificate of Dielectric Performance**

This certificate provides the verification of all dielectric ratings, by means of the performance of the appropriate type tests specified by the standards.

### **Type Test Certificate of Temperature-Rise Performance**

This certificate provides the verification of temperature-rise limits together with measurement of the main circuit resistance, by means of the performance of the appropriate type tests specified by the standards.

### **Type Test Certificate of Short-Circuit / Making and Breaking Performance**

This certificate provides the verification of rated characteristics with respect short-circuit and/or making and breaking performance, by means of the performance of the appropriate type tests specified by the standards.

### **Type Test Certificate of Switching Performance**

This certificate provides the verification of the switching ratings (e.g. capacitive current), by means of the performance of the appropriate type tests specified by the standards.

### **Type Test Report**

This report provides the verification of the rated characteristics of the equipment as assigned by the manufacturer, by means of the performance of the appropriate type tests specified by the standards, for type tests not indicated above.

### **Development Test Report**

This report is issued when the test is intended only to provide the Client with information about the performance of the equipment. The tests are performed in accordance with relevant standards, but are not intended to verify compliance of the equipment.

### **Control Test Report**

This report is issued for tests performed on equipment in service, or removed from service. Tests are performed, and compliance is evaluated in accordance with relevant standards.

### **Test Report**

Test report is issued in all cases not listed above.





**Ratings/characteristics assigned by the manufacturer:**

Test Object:	High voltage insulator
Designation:	Dielectric tests on 400 kV composite insulator
Manufacturer:	DOROOD Kelid Bargh Co. Karaj Ghazvin Road after Nazer Abad Sq. IRAN
Rated voltage:	400 kV
Pos. dry lightning impulse withstand voltage:	1850 kV
Wet power withstand frequency voltage test:	790 kV
Creepage distance:	13733 mm
Arcing distance	3970 mm
Specified Mechanical load (SML):	210 kN

**The tests were carried out in accordance with the following standards:**

IEC 61109:2008	Composite insulators for a.c. overhead lines with a nominal voltage greater than 1000 V- Definitions, test methods and acceptance criteria
IEC 60383:1993	Tests on insulators of ceramic material or glass for overhead lines with a nominal voltage greater than 1000 V

**Requirements of manufacturer or purchaser:**

**List of manufacturer's drawings for identification of the test object:**

DKHV-230-1                      400 kV Insulator

**Present at the test in charge of manufacturer or purchaser:**

Mr. Ali Khordetchi	DOROOD Kelid Bargh Co.
Mr. Matz László	SAI International Inspection Co

**TESTS PERFORMED ON THE TEST OBJECT**

No.	Description	Relevant clauses of the standard
1	Dry lightning impulse withstand voltage test	Sub Clause 11.1 of IEC 61109:2008
2	Wet power-frequency withstand voltage test	Sub Clause 11.1 of IEC 61109:2008
3	Wet switching impulse withstand voltage test	Sub Clause 11.1 of IEC 61109:2008



## DESCRIPTION OF THE TESTS

### 1. Dry lightning impulse voltage test

#### 1.1 Test methods and parameters

The 50% flashover voltage values were determined with up and down test method. During the test impulses of 1.40-1.48/46.3-47.9  $\mu$ s were applied (is shown in the attached oscillograms No. 3238, 3258). The test layout is shown on Photo 1.

The lightning impulse voltage test was carried out on suspension insulator set with corona rings at the test voltage of 2002 kV<sub>peak</sub> with application of the correction factor, 15 positive and 15 negative impulses.

Ambient parameters in outside laboratory:

- Dry/wet temperature: 32.0/20.5°C
- Air pressure: 100.4 kPa

During the tests the correction factor was  $K=0.9742$

#### 1.2. Test results

During the withstand lightning impulse voltage tests on the insulator set installed with corona rings neither flashover nor breakdown occurred at the test voltage of  $U=2002$  kV<sub>peak</sub>, therefore the single suspension set met the requirements of lightning impulse test in dry condition.

The determined 50% flashover voltage values are:

50% flashover voltage:	+2137/-2361 kV <sub>peak</sub>
calculated withstand voltage	2002 kV <sub>peak</sub>

The typical oscillograms from each polarity are attached to the test report.

### 2. Wet power-frequency voltage test

#### 2.1 Test methods and parameters

The average flashover voltages of the insulator set were determined in wet condition. The average value was calculated from five measured flashover voltages.

The specimen was pre-wetted for 15 minutes before the wet test. The form of the artificial rain was drop. During the test the set was continuously wetted.

Characterisation of the artificial rain:

- Vertical and horizontal component of the rain 1-1,2 mm/min
- Specific resistance of water 9800  $\Omega$ cm
- Direction of the rain to the insulator set 45°

Ambient parameters in outside laboratory:

- Dry/wet temperature: 26.0/20.0°C
- Air pressure: 100.0 kPa

During the tests the correction factor was  $K=0.9906$



## 2.2. Test results

During the withstand power frequency voltage tests on suspension insulator set neither flashover nor breakdown occurred, therefore the insulator set met the requirements of power frequency test in wet condition.

In wet condition, 1 minute without flashover:	790.0 kV <sub>rms</sub>
In wet condition, average flashover voltage:	834.0 kV <sub>rms</sub>

## 3. Switching impulse voltage tests in wet condition

### 3.1 Test methods and parameters

The specimen was pre-wetted for 15 minutes before the wet test. The form of the artificial rain was drop. During the test the set was continuously wetted.

The switching impulse voltage test was carried out on suspension insulator set with corona rings of a test voltage of 1200 kV<sub>peak</sub> with application of the correction factor 15 positive and 15 negative impulses. During the test impulses of 230-261/2720-2740  $\mu$ s were applied (is shown in the attached oscillograms No. 3611, 3631).

Characterisation of the artificial rain:

- Vertical and horizontal component of the rain 1-1.2 mm/min
- Specific resistance of water 9800  $\Omega$ cm
- Direction of the rain to the insulator set 45°

Ambient parameters in outside laboratory:

- Dry/wet temperature: 33.5/22.0°C
- Air pressure: 100.4 kPa

During the tests the correction factor was K=0.9829

### 3.2 Test results

During the withstand switching impulse voltage tests on the insulator set installed with corona rings neither flashover nor breakdown occurred at test voltage of U=1200 kV<sub>peak</sub>, therefore the suspension insulator set met the requirements of switching impulse test in wet condition.

The determined 50% flashover voltage values are:

50% flashover voltage:	+1320/-1361 kV <sub>peak</sub>
calculated withstand voltage	1200 kV <sub>peak</sub>

The typical oscillograms from each polarity are attached to the test report.



**Uncertainty of measurements**

During the tests the uncertainties of the measurements were the following:

- power frequency voltage:  $\pm 1\%$
- lightning impulse voltage measurement:  $\pm 0.64\%$

The uncertainty values given in this report are the standard deviation values multiplied by  $k=2$ . Measurement uncertainty was estimated according to the method described in the EA-4/02 document.

**Measuring devices used for the tests:**

Designation	Manufacturer	Type	S/N
Impulse generator	Haefely	SGV4000/320	-
Divider	Haefely	WO 553633	138127 ÷ 138133
Termination	Haefely	WO 553633 Ca/2	117147
Impulse voltage measuring system	DR STRAUSS	TR-AS 100-10	350
Transformer (1500 kV)	TUR	PEO 500/500 AB I	860115
		PEO 1000/500 AB II	861876
Divider	ISO-FARAD	-	3109-04
			3111-04
			3107-04
			3113-04
			3112-04
Termination	TUR	H91	852509
Meter	SIEMENS	MU-15	880019



PHOTO



Photo 1

Dielectric tests on 400 kV suspension insulator set



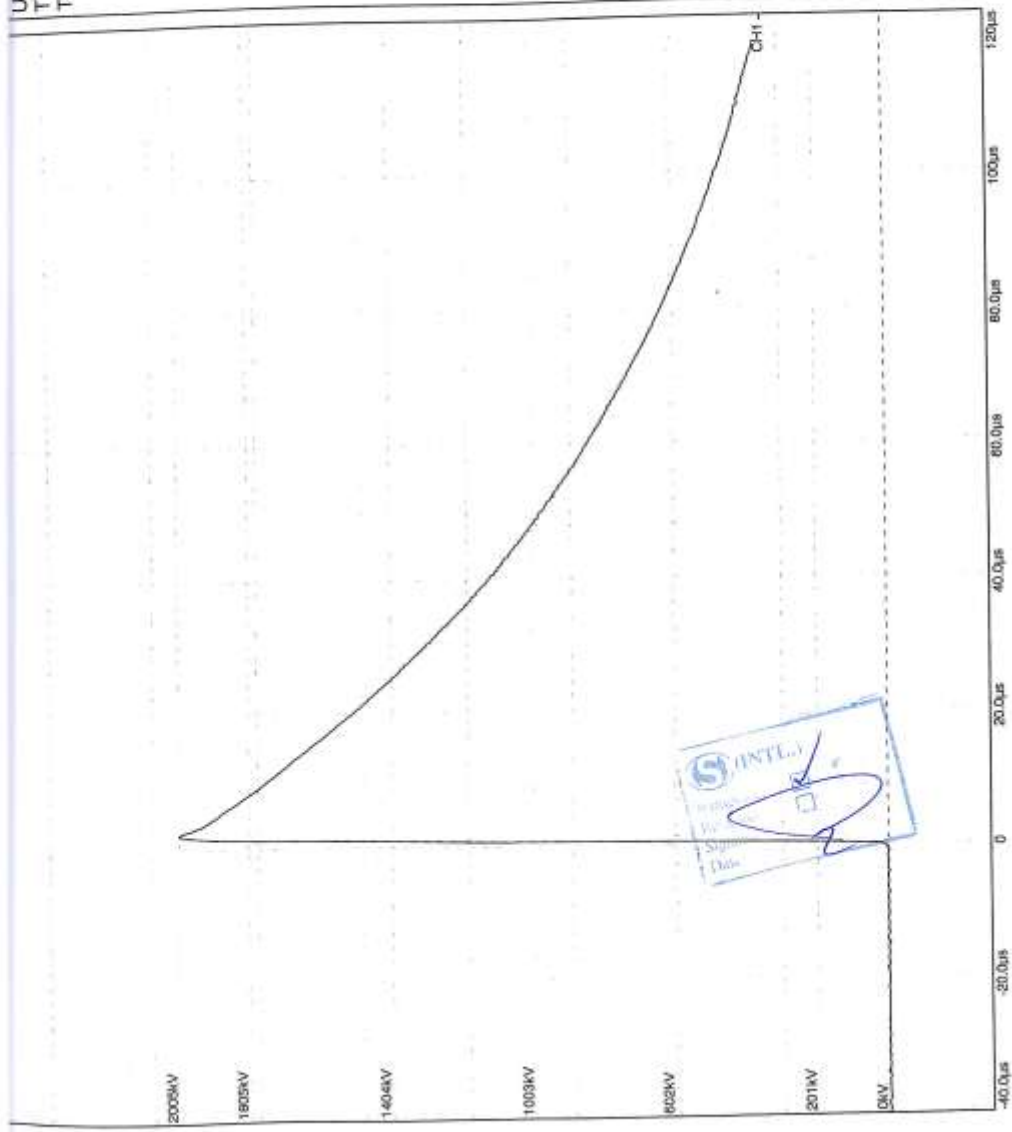
VNL-6869

*Signature*



2005kV  
1.48µs  
47.9µs

Up=  
T1=  
T2=



INTEL  
By: [Signature]  
Sig: [Signature]  
Date: [Signature]



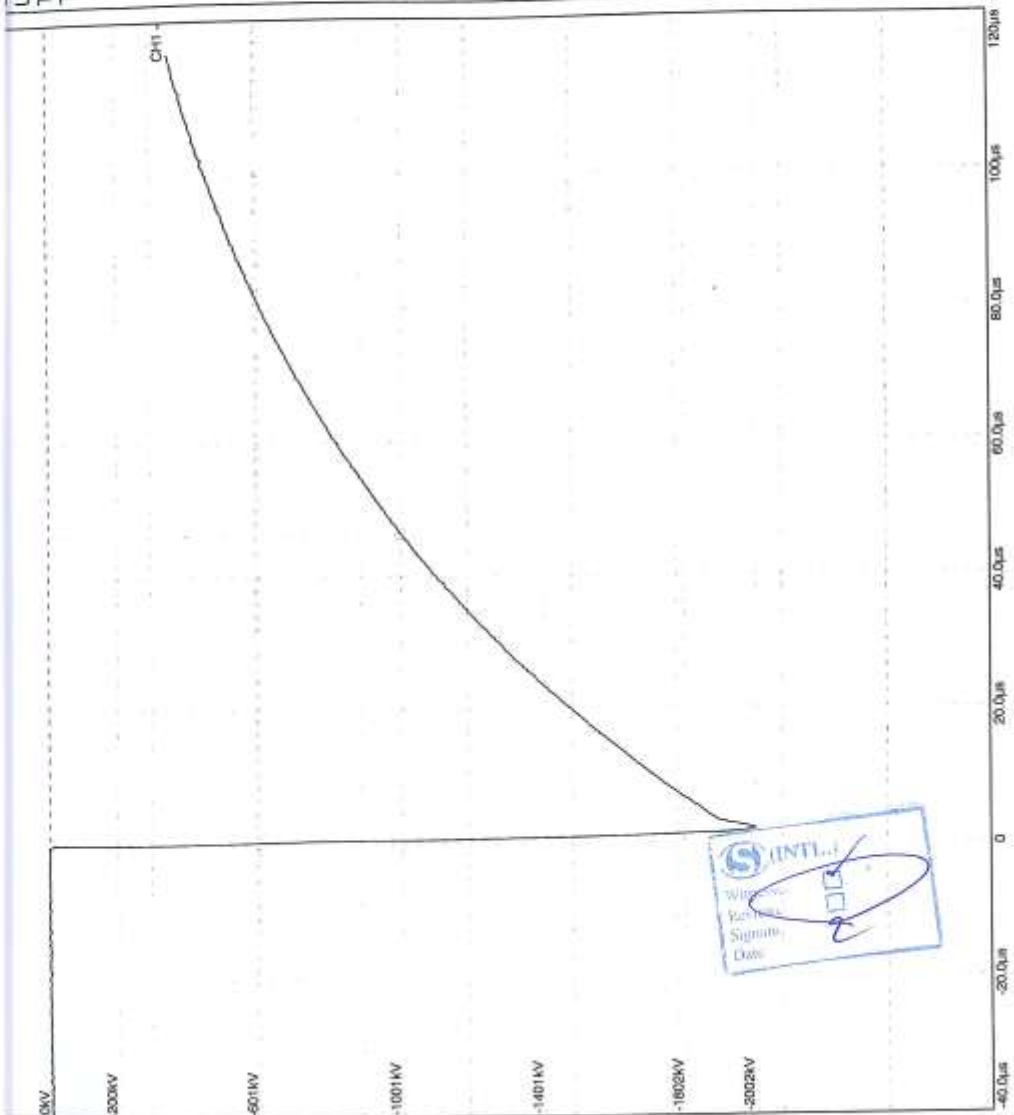
VNL-6869

Sm Jau



-2002kV  
1.40µs  
46.3µs

Up=  
T1=  
T2=



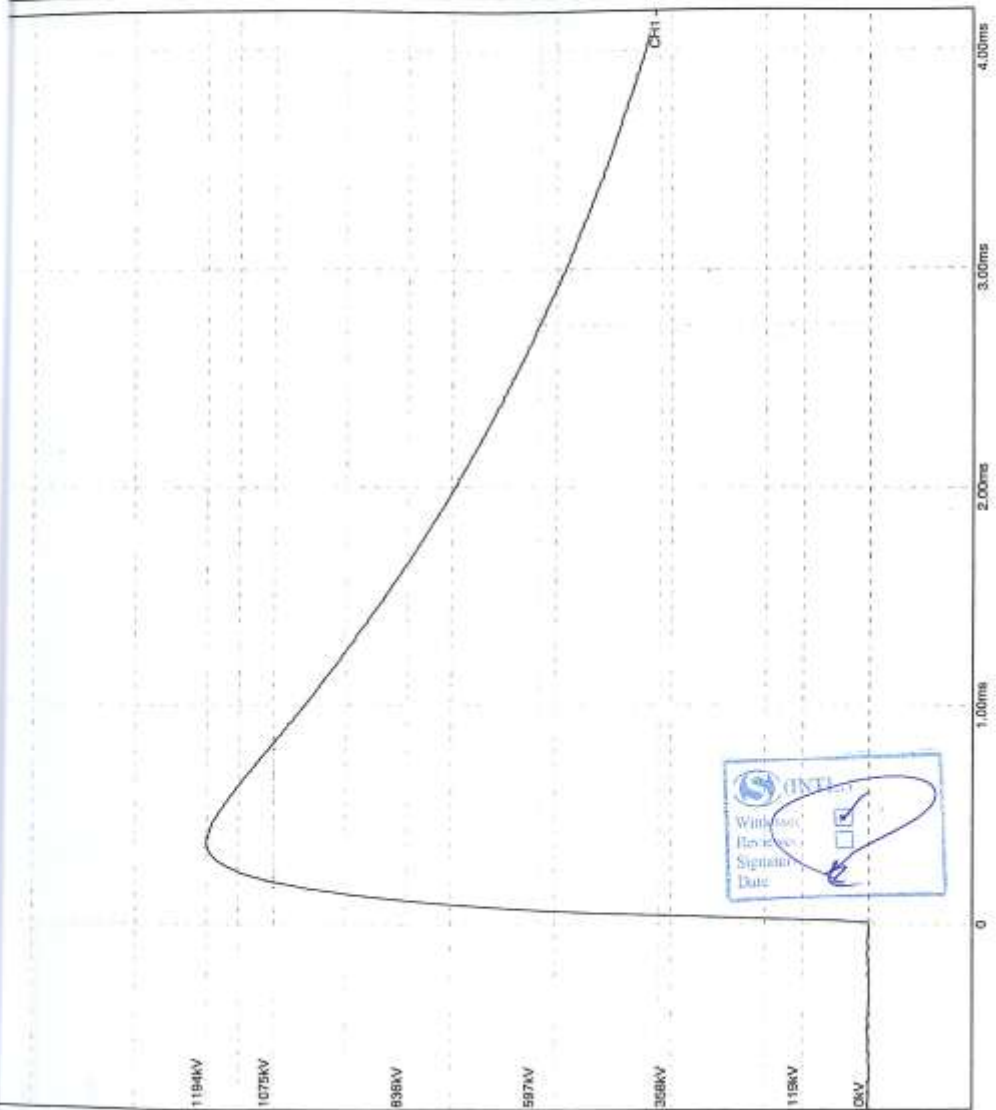
VNL-6869

*Sam Yean*



UP= 1194KV  
T1= 261µs  
Tp= 376µs  
Td= 628µs  
T2= 2.74E3µs

UP= 1194KV  
T1= 261µs  
Tp= 376µs  
Td= 628µs  
T2= 2.74E3µs

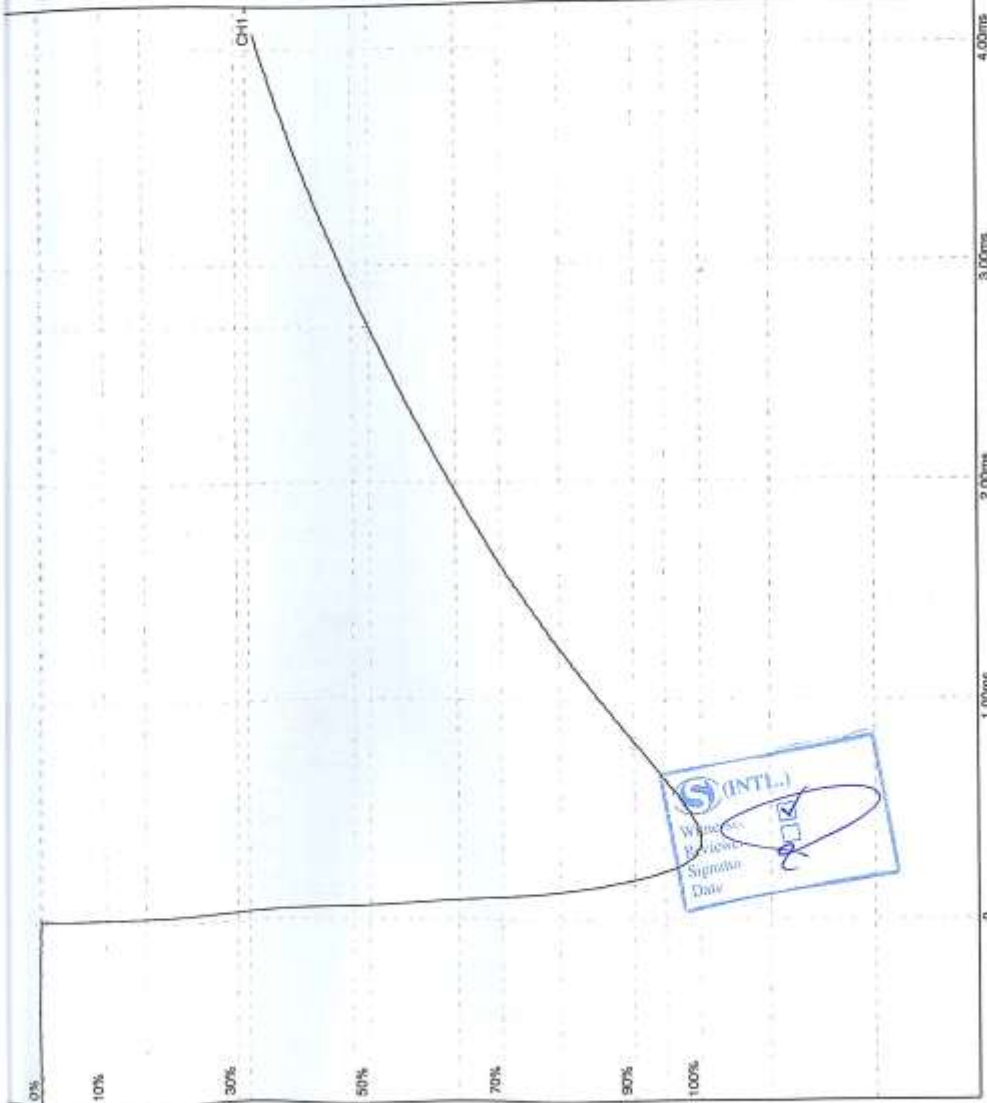


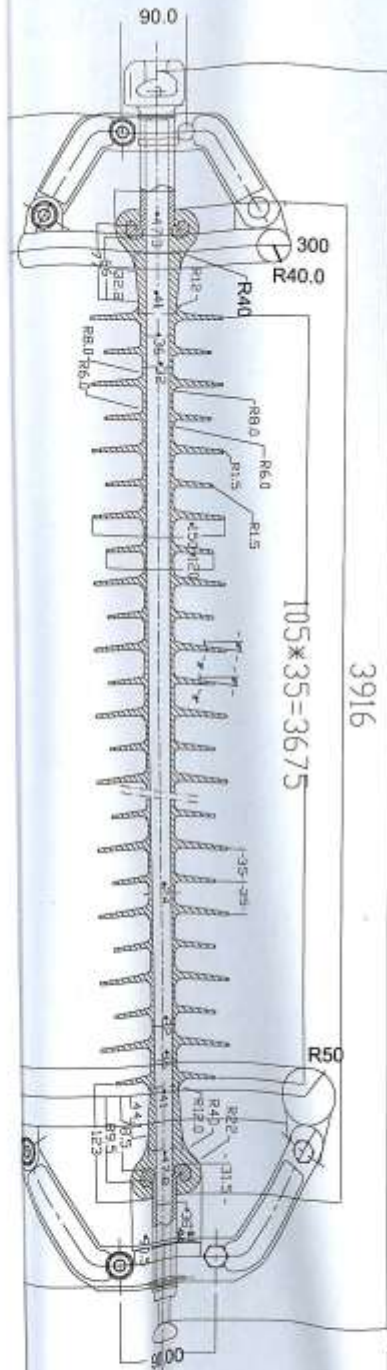
VNL-6869



Up= -1207KV  
T1= 230µs  
Tp= 352µs  
Td= 624µs  
T2= 2.72E3µs

Up=  
T1=  
Tp=  
Td=  
T2=





Technical data:

$U_m=420$  Kv

$U_n=400$  Kv

Power Frequency Withstand Voltage, 50 Hz, Wet=790 Kv

Lightning Impulse Withstand Voltage,  $P_{0.5}=1850$  Kv

Creepage distance=13733 mm

Arcing distance=3970 mm

Specified Mechanical Load tension=210 KN

Routine test Load tension=105 KN

Number of Sheds=106

Weight= 21.23 Kg

Coupling= 4200 mm

32.7 mm/kv

Material:

Insulator = ECR Fiberglass Rod With HTV Silicone rubber Housing

End Fittings = Drop Forged Steel-hot

Split Pins = Stainless Steel

Tolerances Of insulator acc. To IEC6 1109

VNL-6869



Doroud Kelid Bargh Co		
400 Kv Insulator		
Unit: mm	DWG No: DKHV-230-1	Number of pages :1