Application note	**Solving guide for wind applications with Riso (E025) and Ileak (E018) alarms**	Revision: **000**	Date: 06-jul-2009

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1. Introduction

The Aurora wind inverters have a detection system that relives, on the DC side, leakage currents and low insulation resistance to grounding earth.
The insulation resistance (Riso) measurement is performed before connecting to the grid. This kind of measurement, together with the relay test, will produce some clickes.
The leakage current (Ileak) measurement is performed continuously when the inverter is connected to the grid.
The user can check these values on the display while the inverter is on and connected (see the inverter manual).

Riso and Ileak are actually safety parameters, so each measurement is accurate and values out of local safety range will cause disconnections from the grid. If the inverter measures a value out of the mentioned range, it disconnects from grid and shows on the display the relative error message:

E018 → Ileak Fail
E025 → Riso Low

The appearance of one of the errors above usually indicates some kind of leakage or bad insulation on the DC side of the inverter. It means that it is necessary to check every connection up to the turbine generator.

This document will provide a simple guide on how to correctly measure leakage or insulation to ground, what are the instruments and what is normally expected in wind plants.

2. Physical aspects on leakage

Fist of all, letôs see what a leakage is and where it comes from.
From an electrical point of view the leakage current derives from a loss of insulation between some point of the plant and grounding earth. We can represent it as an impedance to ground as showed in Figure 1. This

impedance is not a simple resistor but a more complex impedance (with some capacitive behaviour). In addition we can't consider this impedance as a constant value, as it depends from many electrical and environmental parameters as voltage, current, umidity, temperature etc. This aspect is very important as the inverter can, sometimes, measure an high value of Riso at the connection, meaning there's no insulation problems on the DC side, and detect a Ileak during the normal operation, meaning there's a leakage.

As Figure 1 shows, the neutral on AC side is somewhere connected to grounding earth (except if a floating insulation transformer is installed on AC side), closing the loop and causing a circulating Ileak. There's nothing you can do but try finding and removing the low impedance to grounding earth.

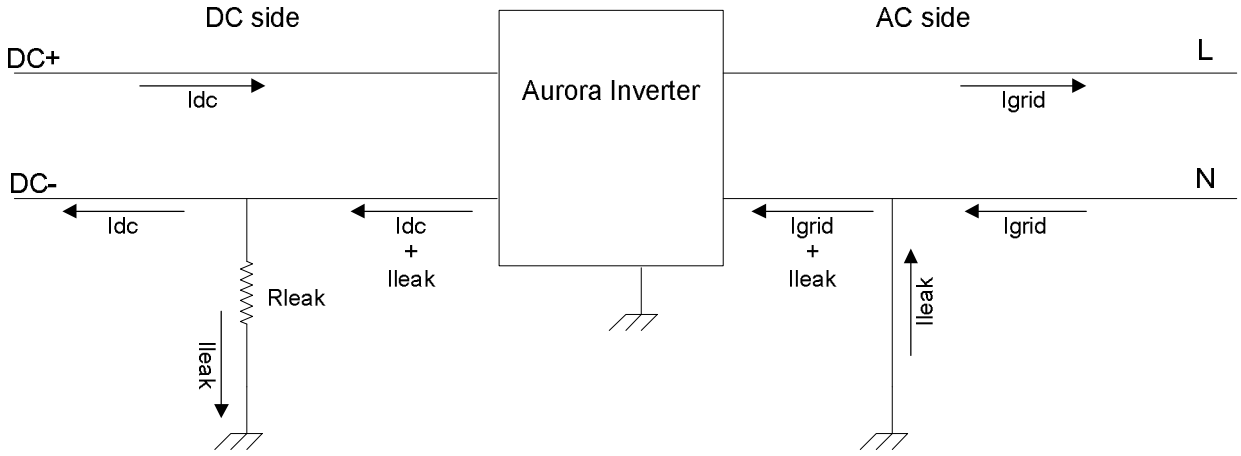

Figure 1 - Leakage current physical meaning

3. How to measure insulation and leakage on the plant

3.1 Instruments setting

In order to perform measurement of the plants insulation to ground it is necessary the usage of these instruments:

- MegaOhmeter
- Digital tester
- N°1 resistor 1 kOhm 15 W
- Screwdrivers and other standard tools

3.2 Note on measurement performing

WARNING!!!
This document is a guide that explains some physical aspects of the eolic plants and gives some information on how to measure it. These measurements have to be performed by trained operators because involving high voltages. If not well performed there is a risk of electric shock. Use precautions in order to prevent electric shock hazard. Power-one is not responsible for unproper operator actions.

For the following indications refer to the simplified plant diagram on Figure 2.

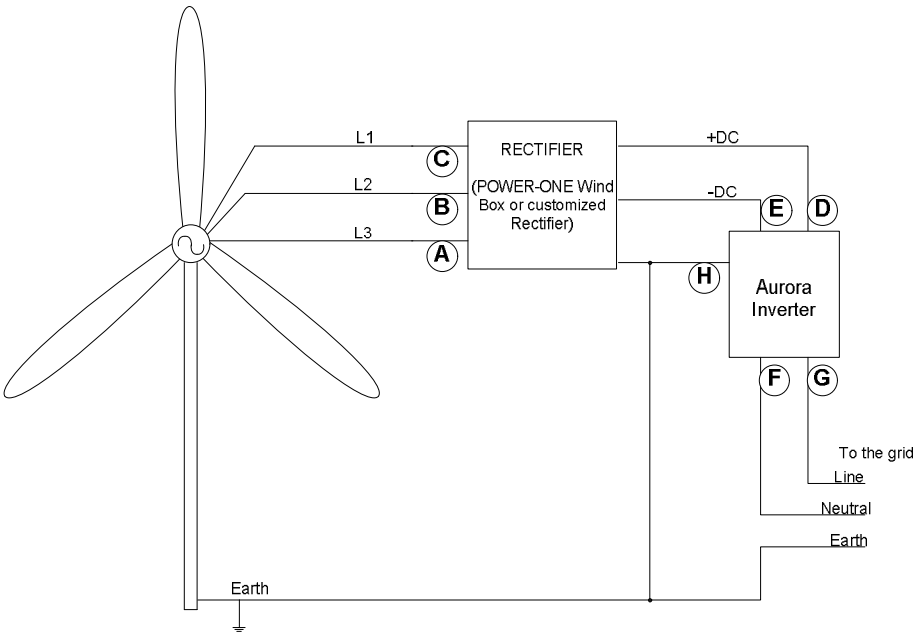

Figure 2 - Simplified plant diagram

3.3 Insulation resistance to grounding earth

1) Be sure the generator is not rotating by blocking mechanically the turbine.
2) Disconnect the inverter from the grid.
3) Measure the DC voltage between D and E point and verify it is in the range of 10V. If it is not check again the generator (it has to be absolutely stopped), or wait 10 minutes to be sure the DC link discharging.
4) Disconnect point D and E from the inverter.
5) Set the MegaOhmeter to 500V and measure from D to H. Values below 20MOhms have to be considered low insulation.
6) Set the MegaOhmeter to 500V and measure from E to H. Values below 20MOhms have to be considered low insulation.
7) If you find a low insulation following points 5) or 6), disconnect point A, B and C and measure, using the MegaOhmeter at 500V, from each point to H. Values below 20MOhms (*) have to be considered low insulation. If A, B and C points shows values above 20MOhms the low insulation is located on the rectifier box.

This procedure will give an indication of where the low insulation is located. Once detected check the components in order to solve it.

3.4 Leakage current

1) Disconnect Aurora inverter from the grid by disconnecting F and G points. Be sure the grid is not present before removing the cables.
2) Be sure there's enough wind to let the turbine rotate and the generator produce voltage. For safety reason do not remove braking resistor or mechanical braking.
3) Connect the 1 kOhm 15 W resistor between point E and H and note the voltage across it. Every volt on the resistor is equivalent to 1mA of leakage current.

4) Connect the 1 kOhm 15 W resistor between point D and H and note the voltage across it. Every volt on the resistor is equivalent to 1mA of leakage current.

Leakage currents in the order of 15mA are quite common in eolic systems, typical is 5mA. If the measured value is above 15-20mA (*) we suggest to take actions, like check the eolic generator, in order to reduce this value.

3.5 Parallel of many inverters

Sometimes it is necessary to build a plant using a turbine and more than one Aurora inverter connected in parallel. Care must be taken when realizing a system like that in order to avoid false alarms of Riso.

To correctly realize the plant and to maximize the efficiency we suggest to connect one of the inverter directly to the grid and to insulate the others using a single phase transformer. This is mandatory to avoid looping when the inverter are connected. In fact no common points on the AC side are allowed for paralleled inverters.

As shown in Figure 3, inverters from 2 to N are insulated by a transformer and there arenôt common points on the AC side of the inverters.

In this cases it is necessary to remove via software the Riso measurement in the inverter from 2 to N (the insulated inverters) in order to avoid false alams of Riso low. This is possible by the use of the ñAurora Installerò software.

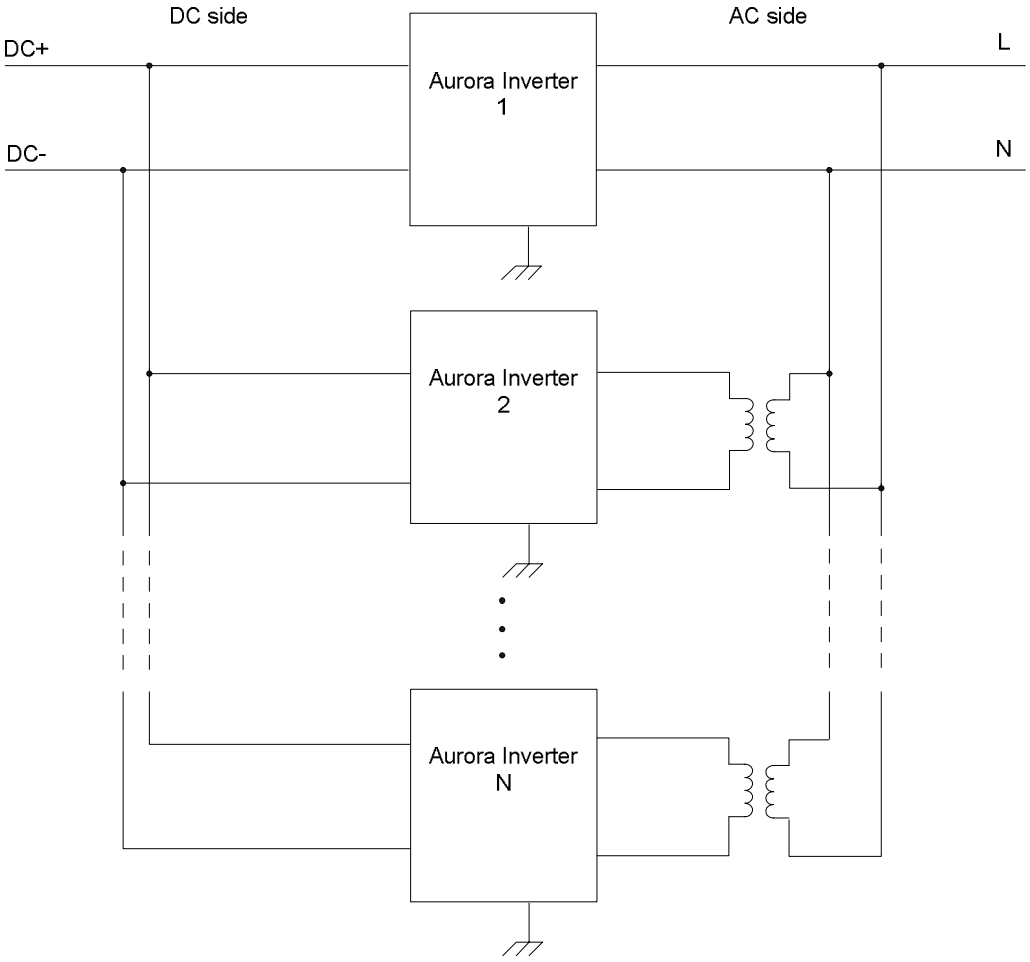

Figure 3 - Insulation of paralleled inverters

(*) the values are indicative and may be subjected to review