IEC’s test requirements for Ground Lead Disconnectors, not sufficient for Eskom applications

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Electrotechnical Standardisation

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Typical surge arrester
Ground lead disconnector (GLD)

Diagram showing:
- Arrester
- Spark gap
- Grading resistor

Images of a GLD component showing:
- Spark gap
- Grading resistor
Ground lead disconnector (GLD)

- Arrester
- Spark gap
- Grading resistor
- 2 Cartridge
- Ground lead disconnector (GLD)

• 2 Cartridge
IEC 60099-4: GLD test requirements

IEC 60099-4: Specification for metal-oxide surge arresters without gaps for a.c. systems

Type test requirements for GLDs according to IEC 60099-4 are:
• Disconnector withstand tests
• Disconnector operation test
IEC 60099-4: GLD test requirements

Disconnector withstand tests:
When an arrester is fitted with a GLD it shall withstand, without operating, each of the following tests:

• **Long-duration current impulse test**
The arrester and GLD are subjected to a series of 18 long-duration current impulses (2000 μs square wave).

• **Operating duty test**
The arrester and GLD is subjected to a series of 20 lightning current impulses (10 kA, 8/20 μs) and 2 high current impulses (100 kA, 4/10 μs).
IEC 60099-4: GLD test requirements

Disconnecter operation test:

The time delay for the operation of the disconnector is determined for three values of current, 20 A, 200 A and 800 A r.m.s.

GLD operation curve
Failures – Prior to 2003

Arresters failed
GLDs did not operate
Grading of Sensitive Earth Fault (SEF) with GLD

SEF setting philosophy
- Trip delay: 3 s to 15 s
- Pick-up: 3 A to 6 A

Typical GLD operation curves
Typical SEF setting:
5 s @ 5 A

Specified minimum GLD operating time:
3 s @ 5 A
Failures: 2004 - 2005

- Arrester not damaged
- GLD operated
GLD test points according to IEC 60099-4

Current [A] vs. Time [us]

- Effective duration of impulse (tail time - rise time)
- Typical lightning flash current duration

Test points according to IEC 60099-4:
- 4/10
- 8/20
- 0/2000
Arrester damage curve

- **Current [A]**
  - 1000000
  - 100000
  - 10000
  - 1000
  - 100

- **Time [us]**
  - 1
  - 10
  - 100
  - 1000
  - 10000

- **Effective duration of impulse (tail time - rise time)**

- **MOV failure level**

- **Typical lightning flash current duration**

- **Arrester damage curve**

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Arrester damage curve vs transient operation curve of GLD

Effective duration of impulse (tail time - rise time)
Arrester damage curve vs transient operation curve of GLD

Effective duration of impulse (tail time - rise time)

Current [A]

Time [us]

MOV failure level
Old GLD
New GLD
GLD operation for 30/80 us current impulse

<table>
<thead>
<tr>
<th>Product</th>
<th>Ipeak [kA]</th>
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<tbody>
<tr>
<td>Product A</td>
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<tr>
<td>Product B</td>
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<td>Product C</td>
<td>30</td>
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<tr>
<td>Product X (Old)</td>
<td>20</td>
</tr>
<tr>
<td>Product X (New)</td>
<td>30</td>
</tr>
</tbody>
</table>

- **Withstood**
- **Operated**
Eskom’s GLD test requirements

1. **Disconnector operation test**
   GLD operating time is determined at 20 A, 200 A and 800 A, as well as at 5 A

2. **Long duration current impulse withstand test**
   18 x 2000 μs square wave current impulses
   GLD resistance measurements and 5 A operation test

3. **Operating duty withstand test**
   20 x 8/20 μs, 10 kA and 2 x 4/10 μs, 100 kA current impulses
   GLD resistance measurements and 5 A operation test

4. **High lightning duty current impulse withstand test**
   2 x 30/80, 30 kA current impulses
   GLD resistance measurements and 5 A operation test

5. **Repetitive surge withstand ability test**
   1000 voltage impulses, sufficient to ensure spark-over of the GLD’s internal gap
   GLD resistance measurements and 5 A operation test

6. **Moisture ingress test**
   GLD is immersed in boiling water for 42 hours
QUESTIONS?