AGL Earth Fault Detection And Monitoring system

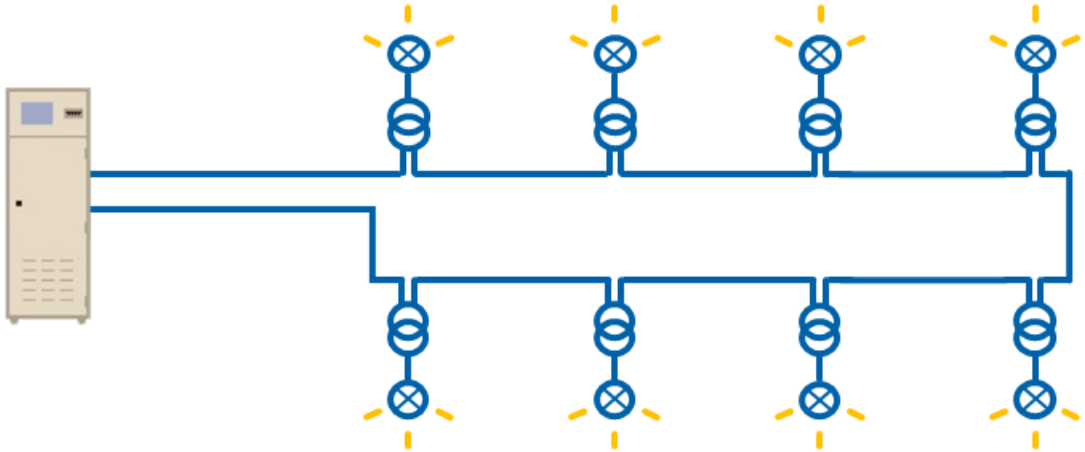
Field Experience

IESALC ILLUMINATING ENGINEERING SOCIETY AVIATION LIGHTING COMMITTEE

2023 IES Aviation Lighting Committee Technology Meeting
November 5-9, 2023 – Scottsdale, AZ

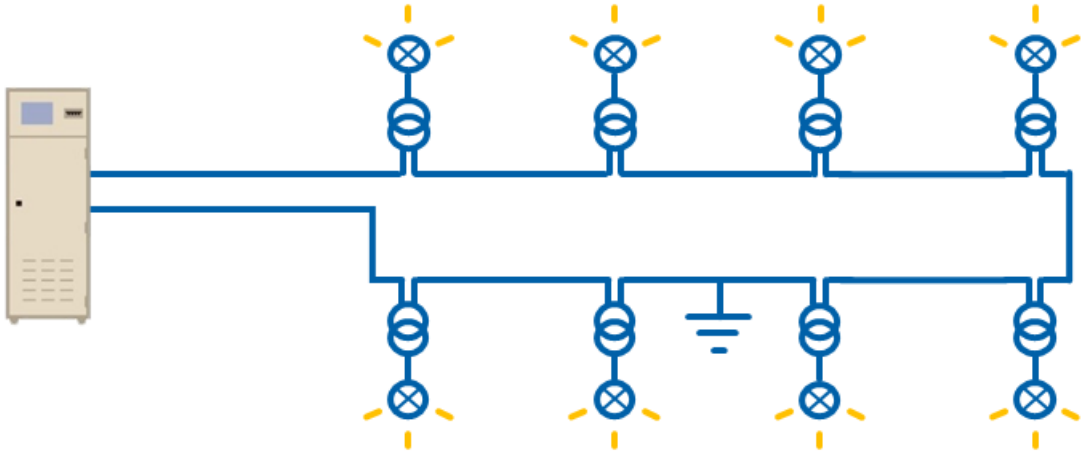
- AGL circuits and earth faults
- Detection and field problematic
- System architecture
- Field feedback

AGL Circuit Architecture



AGL circuit

AGL Circuit Architecture: Earth Fault

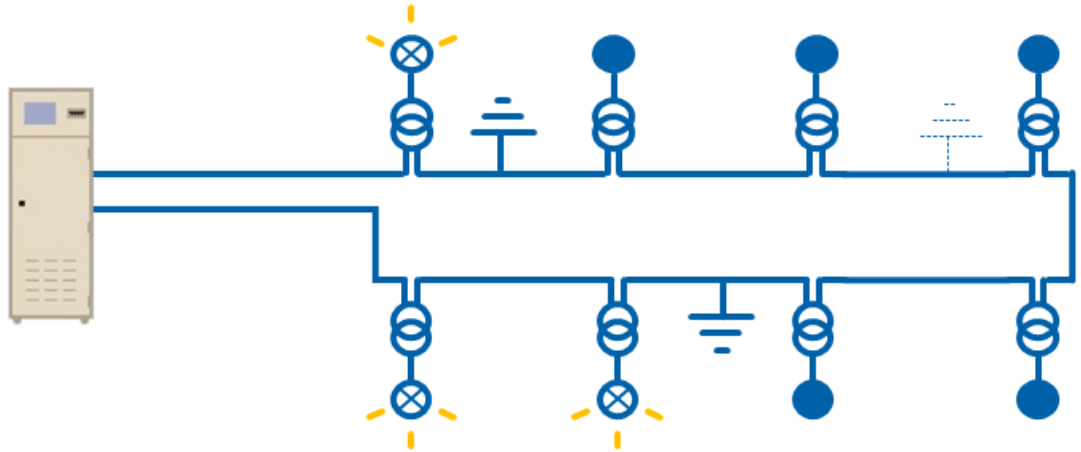


AGL circuit

Earth Fault

AGL Circuit Architecture: Earth Fault

Operation problem

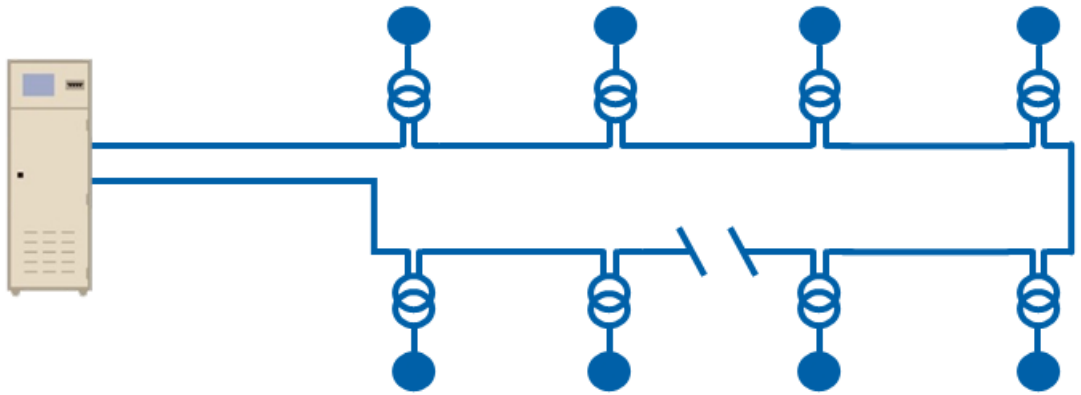


AGL circuit

- **Can be multiple**
- **No warning**

AGL Circuit Architecture: Earth Fault

Open circuit prevention



- **Primary cable**
- **Transformer**
- **Primary connectors**

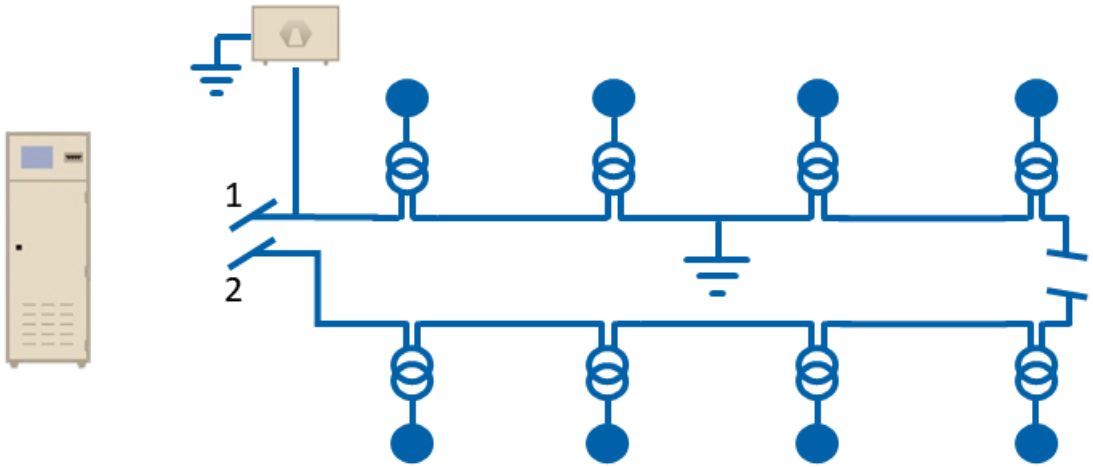
AGL Circuit Architecture: Earth Fault

What you see

What you want to see

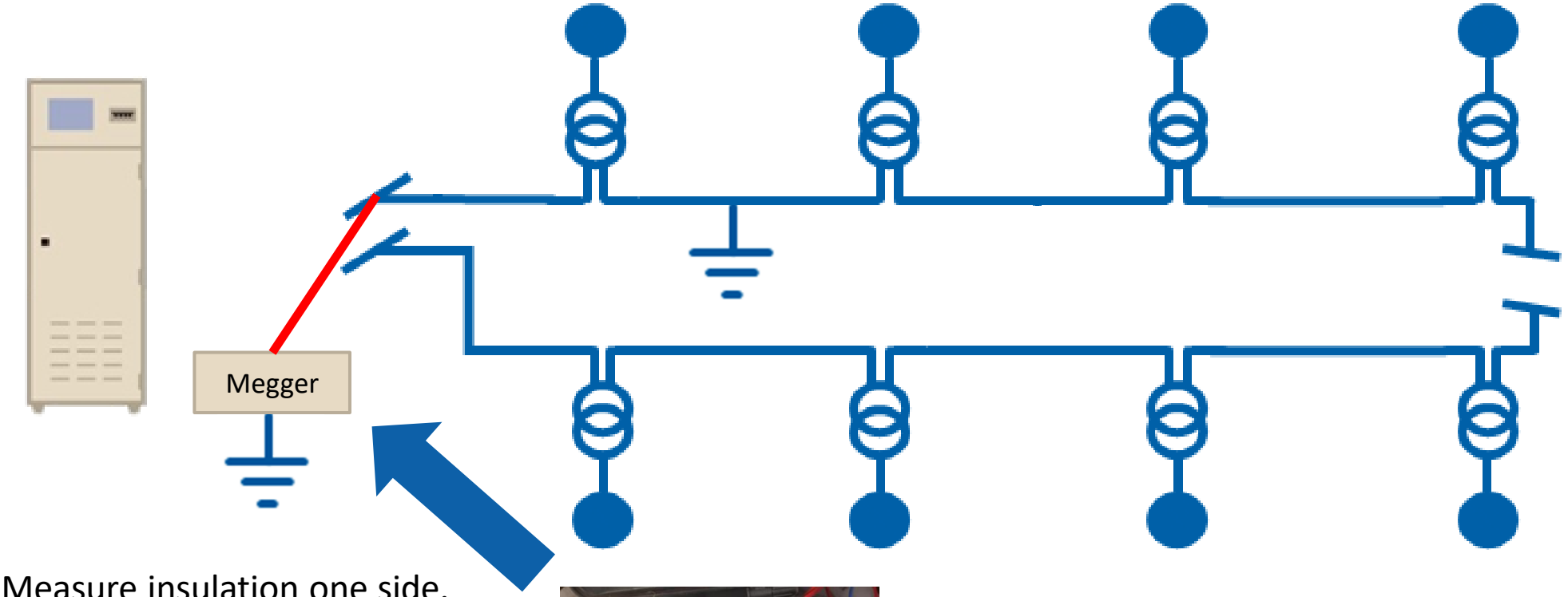
AGL Earth Fault Challenge

Locate the fault



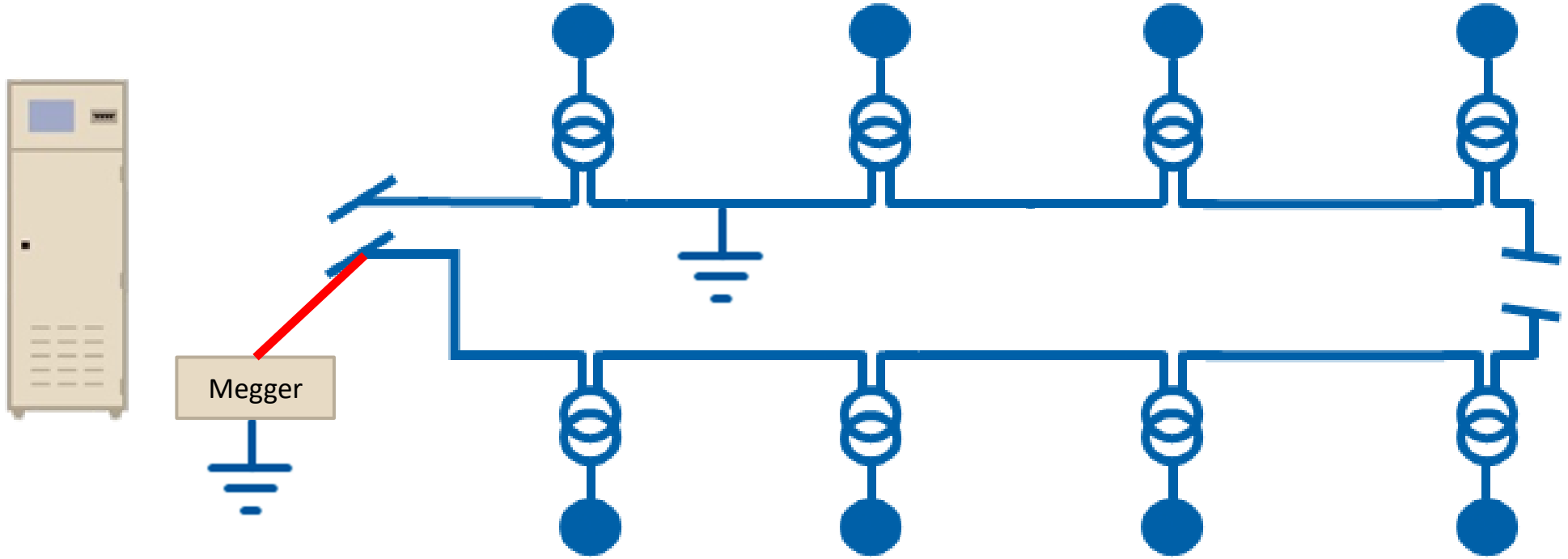
Field dichotomic search

Fault Finding



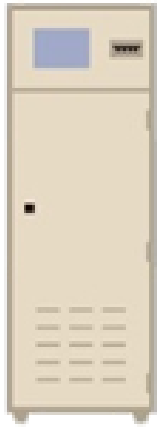
4. Measure insulation one side.

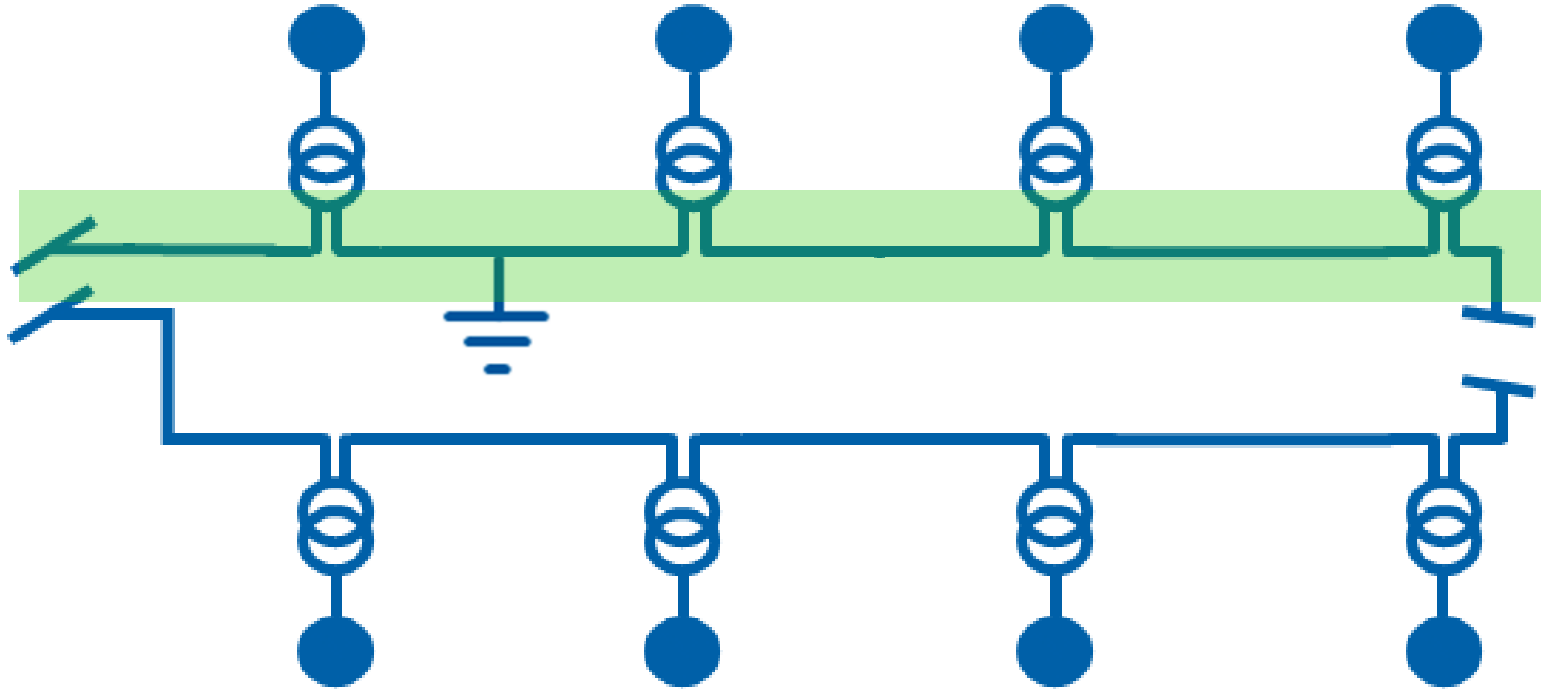
Fault Finding



5. Measure insulation the other side.

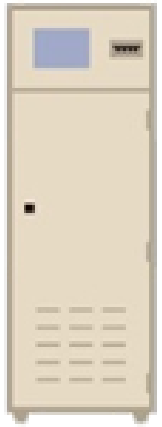
Fault Finding

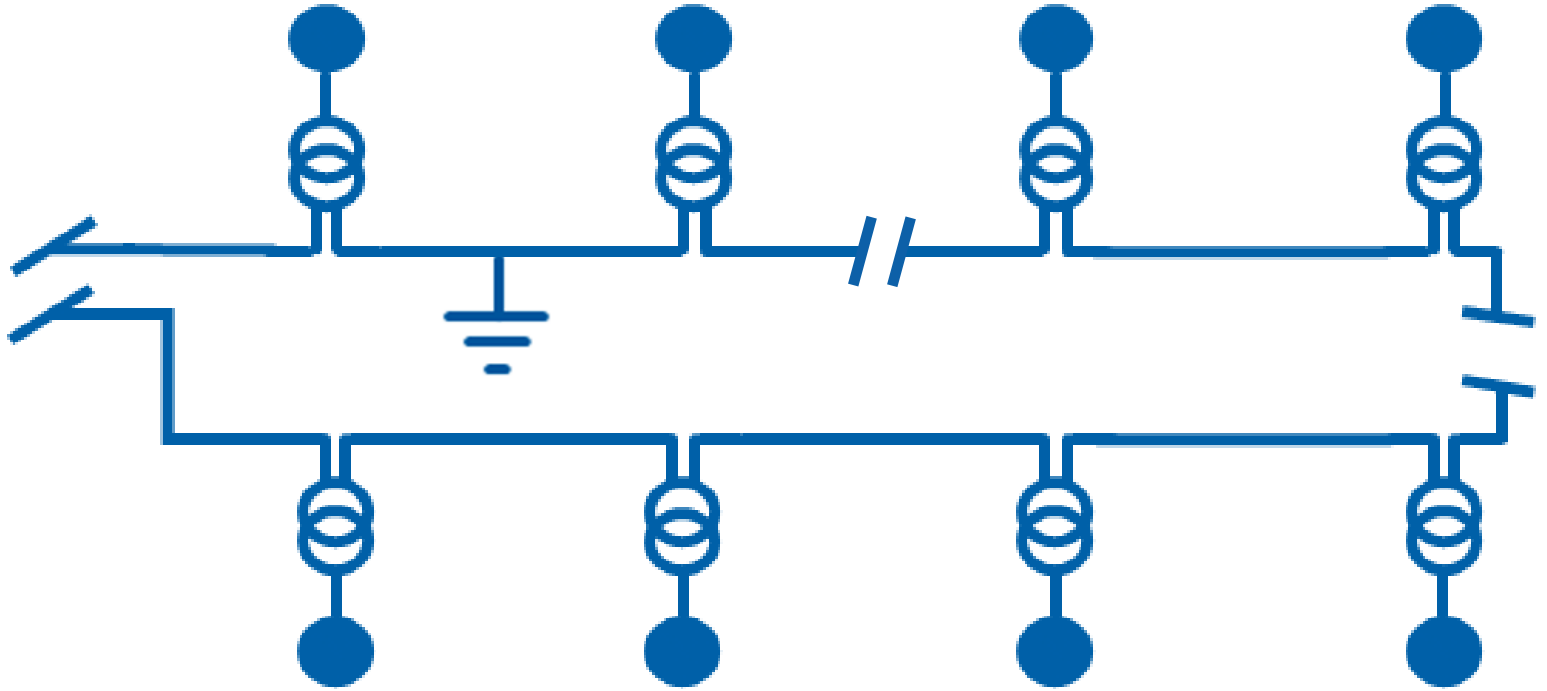




6. Continue with the side with lower insulation.

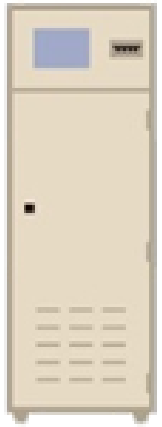
Fault Finding

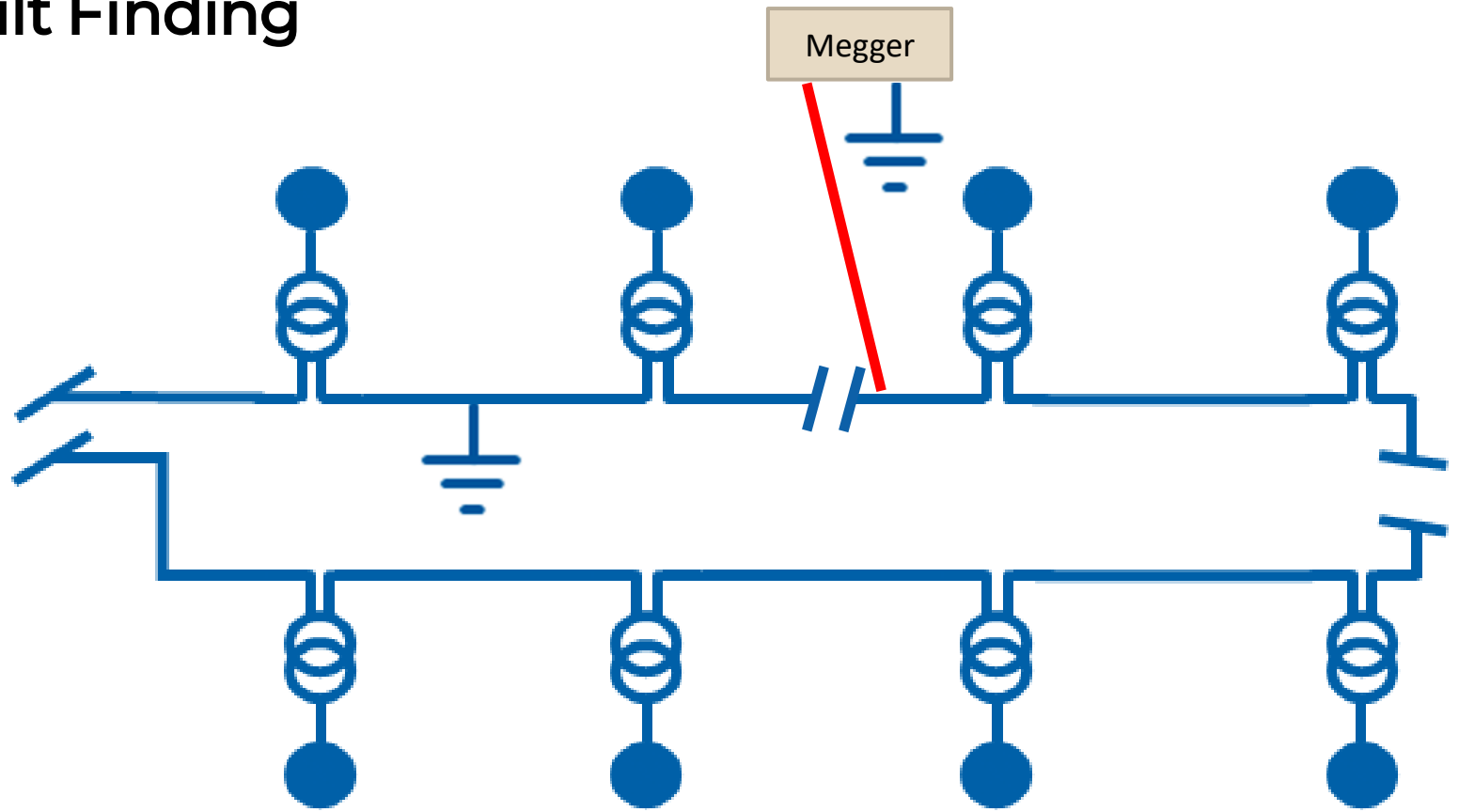




7. Locate center of section with lower insulation and disconnect.

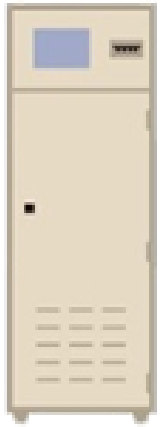
Fault Finding

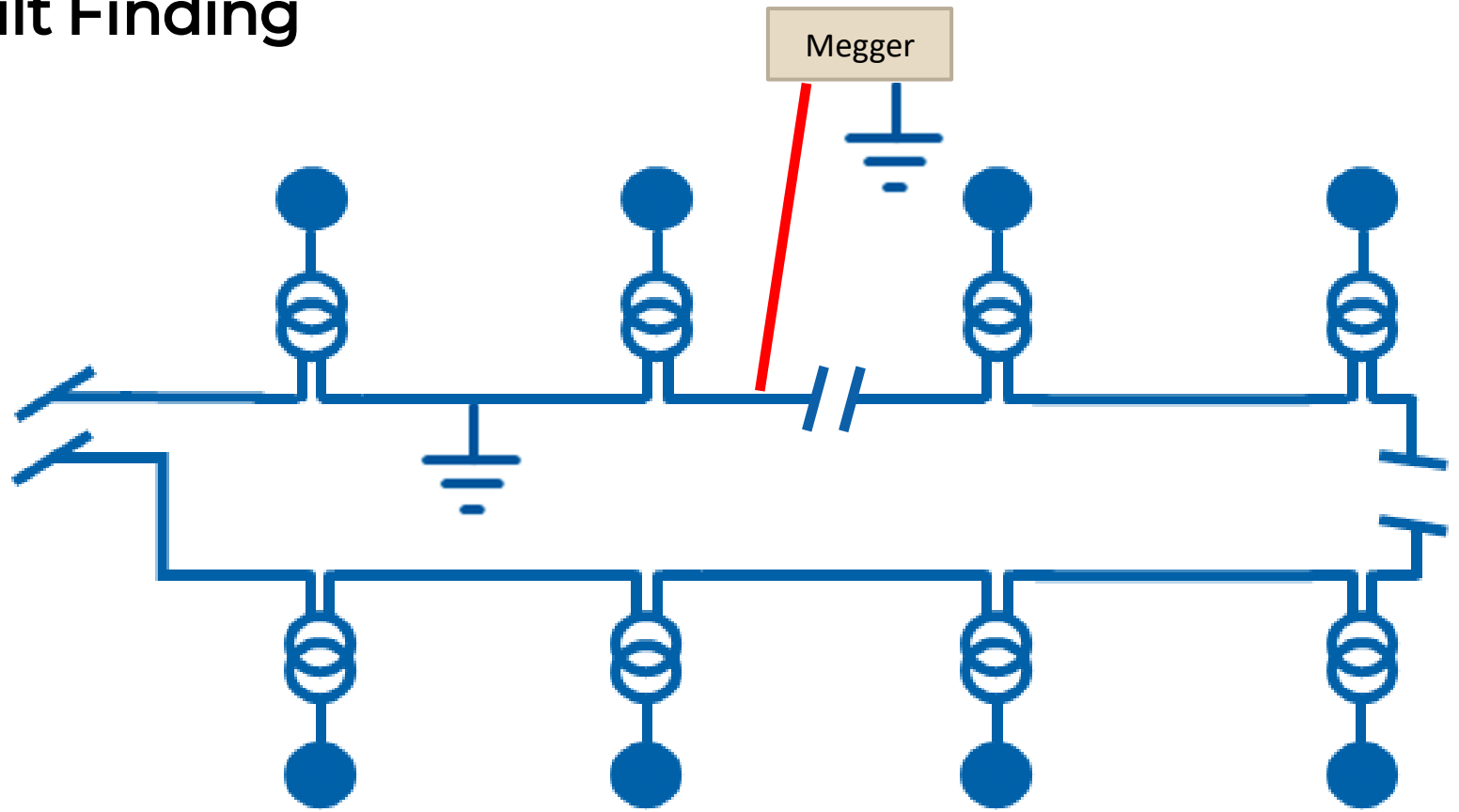




8. Measure insulation one side.

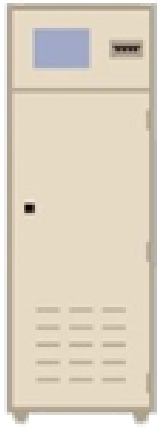
Fault Finding

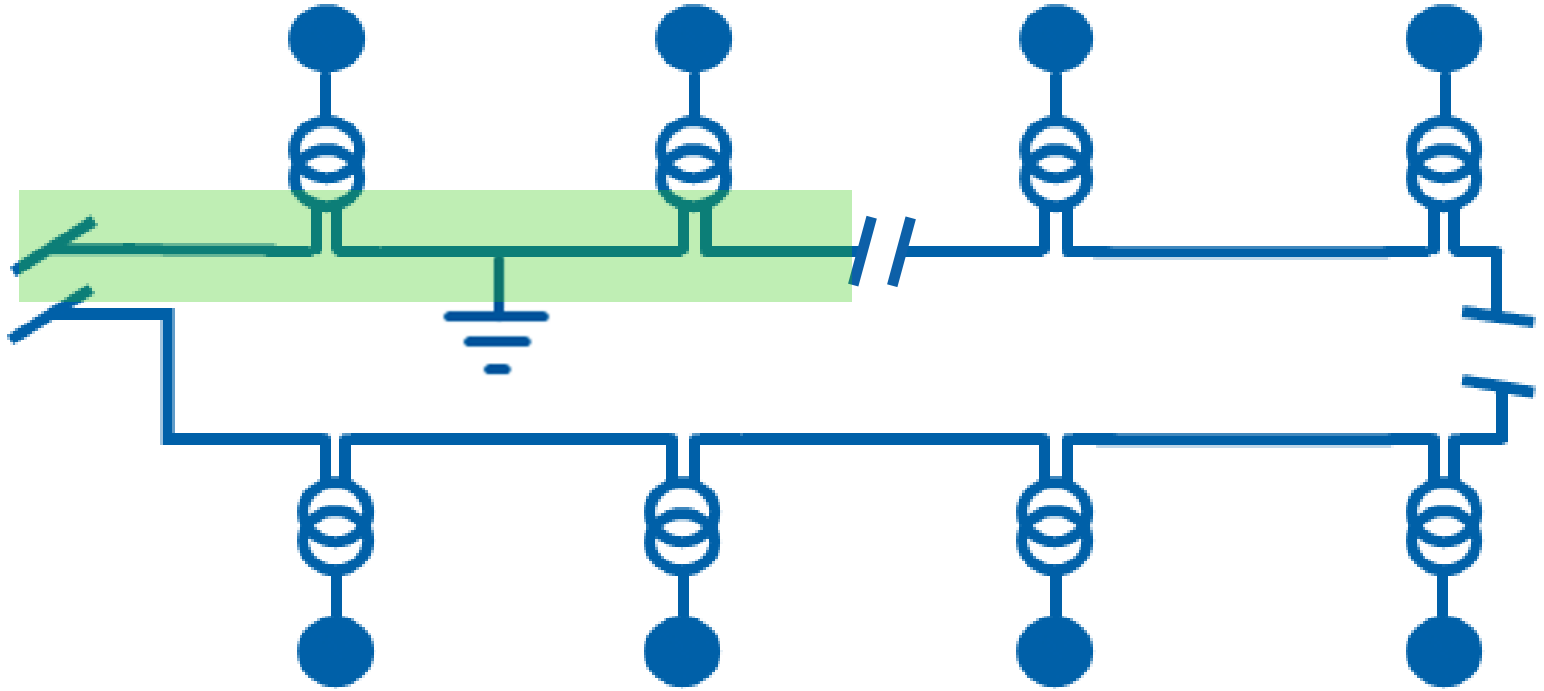




9. Measure insulation the other side.

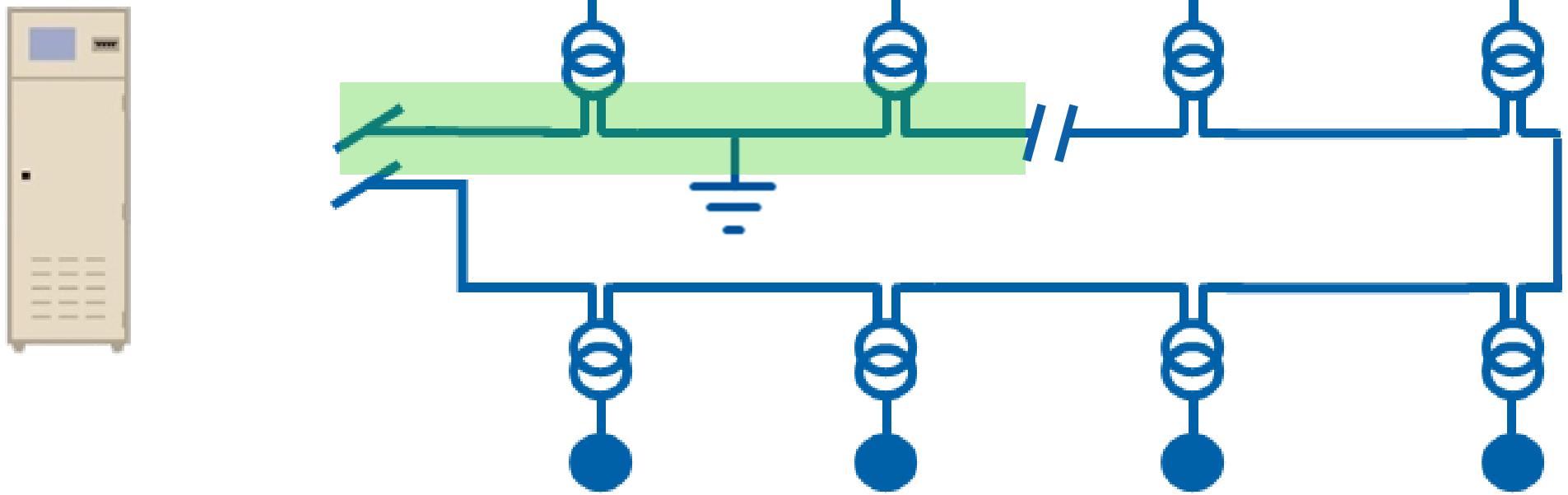
Fault Finding





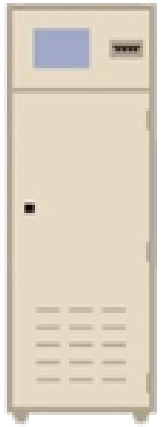
10. Continue with the side with lower insulation.

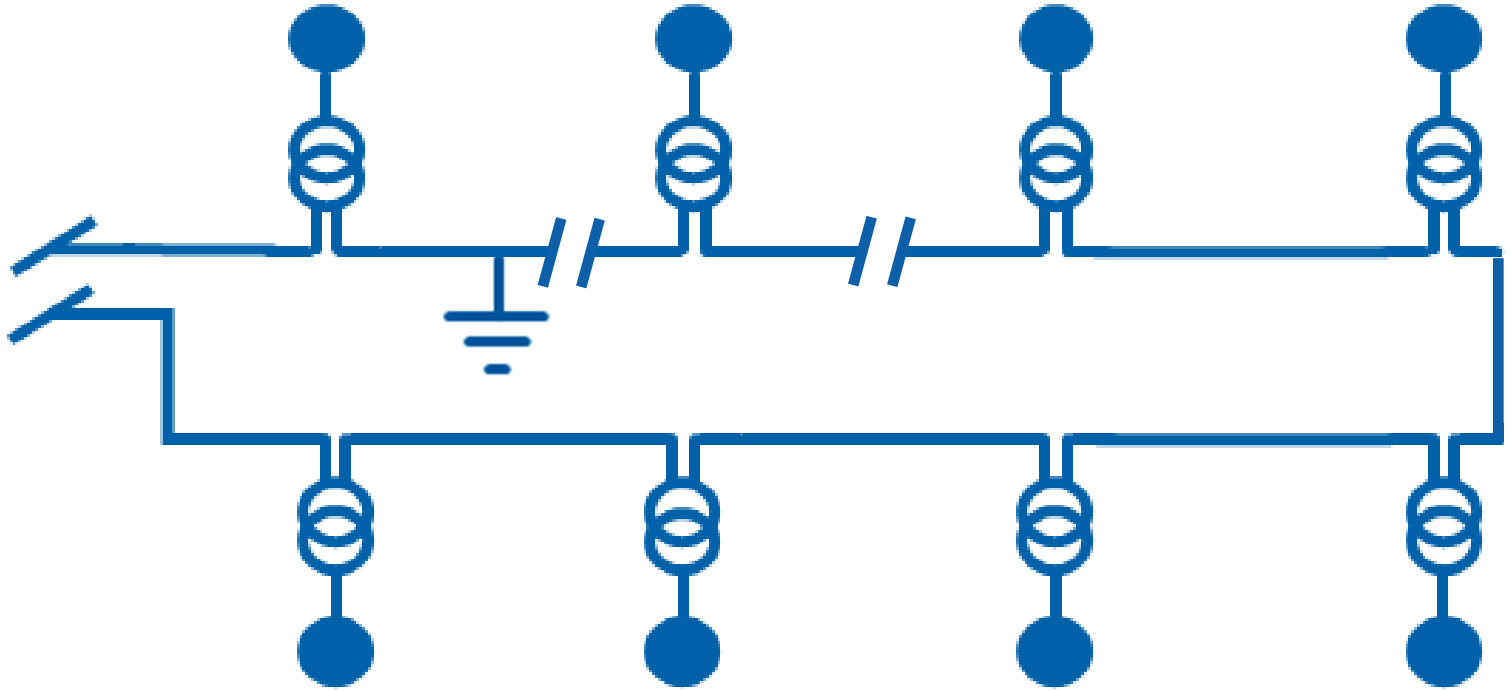
Fault Finding



11. Connect previous disconnection not needed anymore.

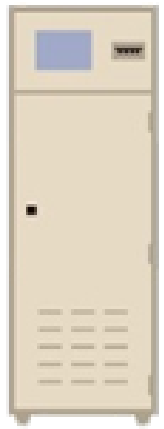
Fault Finding

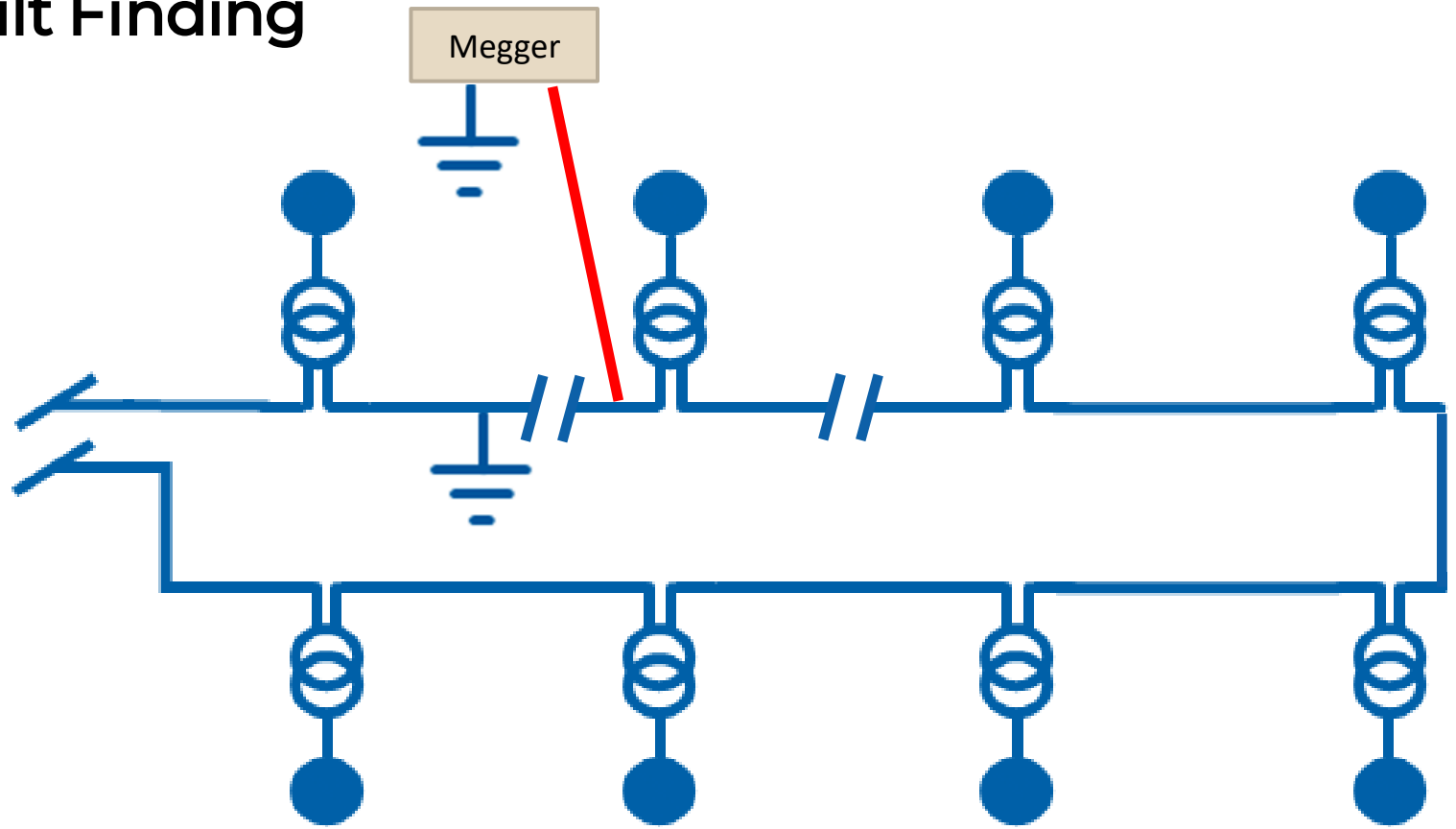




12. Locate center of section with lower insulation and disconnect.

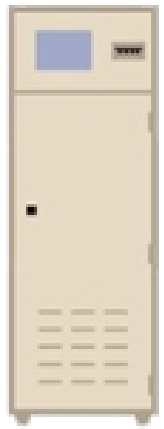
Fault Finding

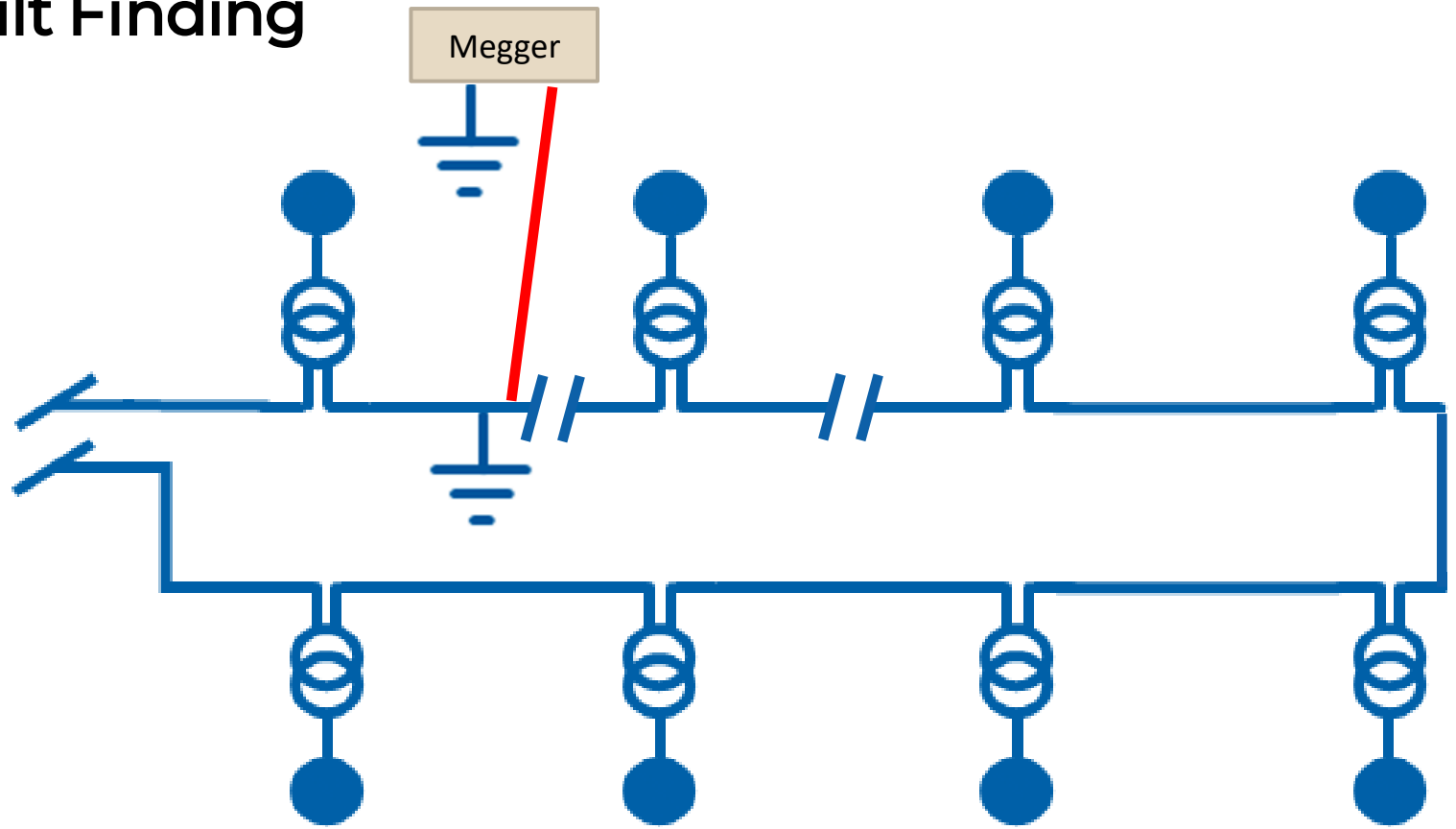




13. Measure insulation one side.

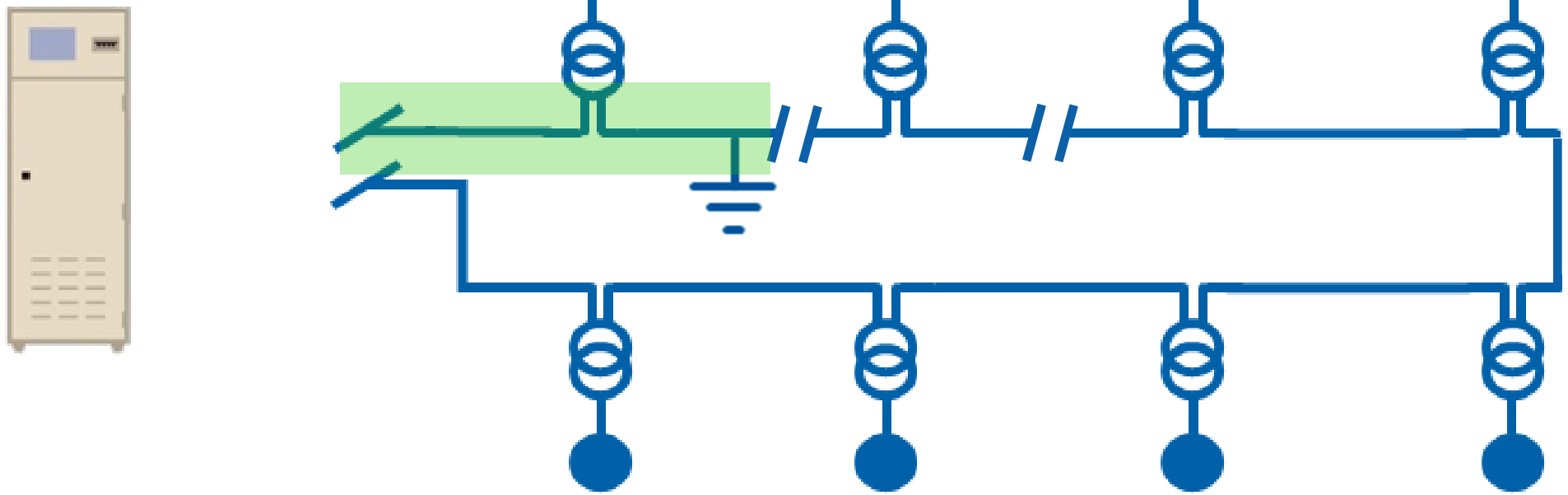
Fault Finding





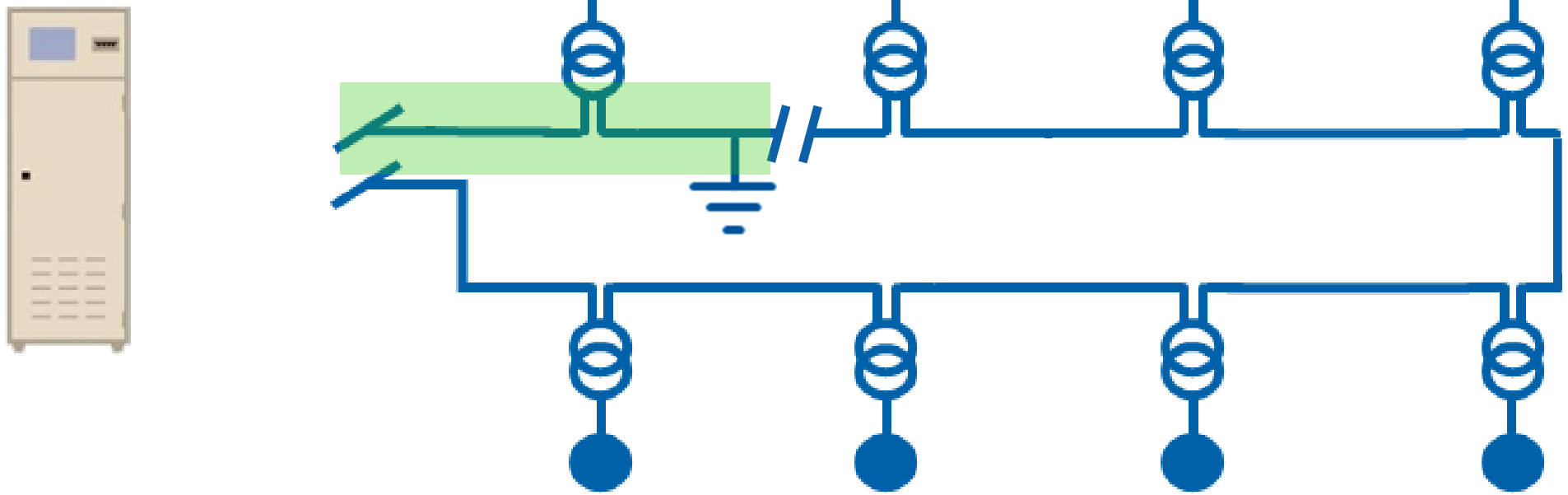
14. Measure insulation the other side.

Fault Finding



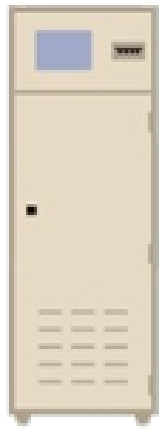
15. The side with lower insulation is the one with the earth fault.

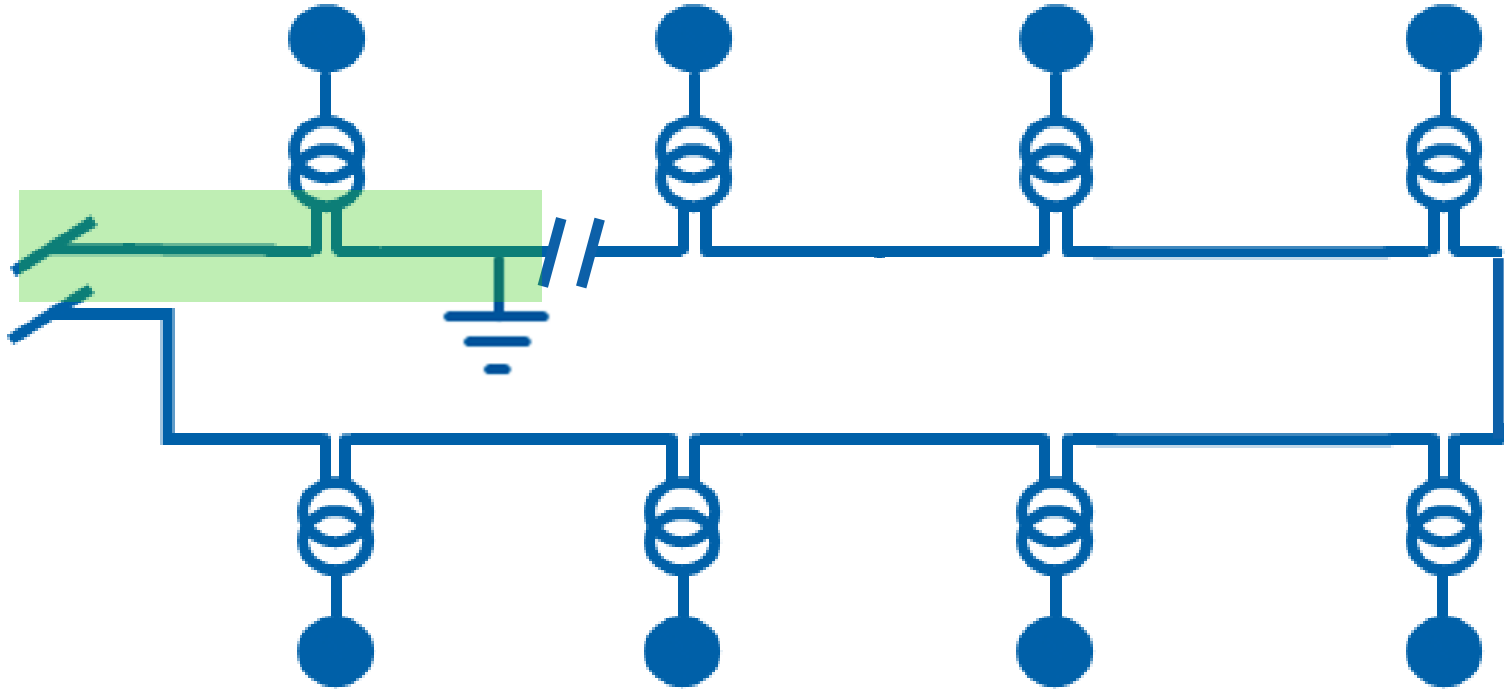
Fault Finding



16. Connect previous disconnection not needed anymore.

Fault Finding

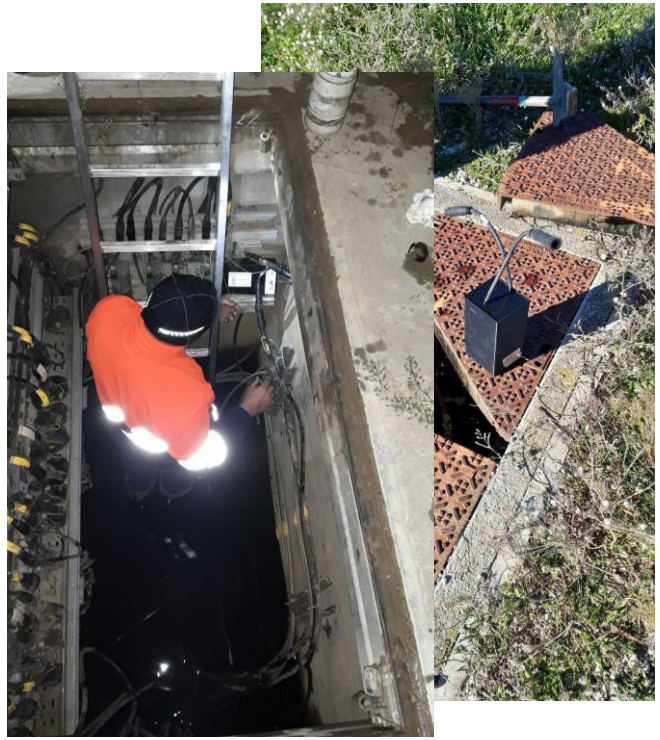




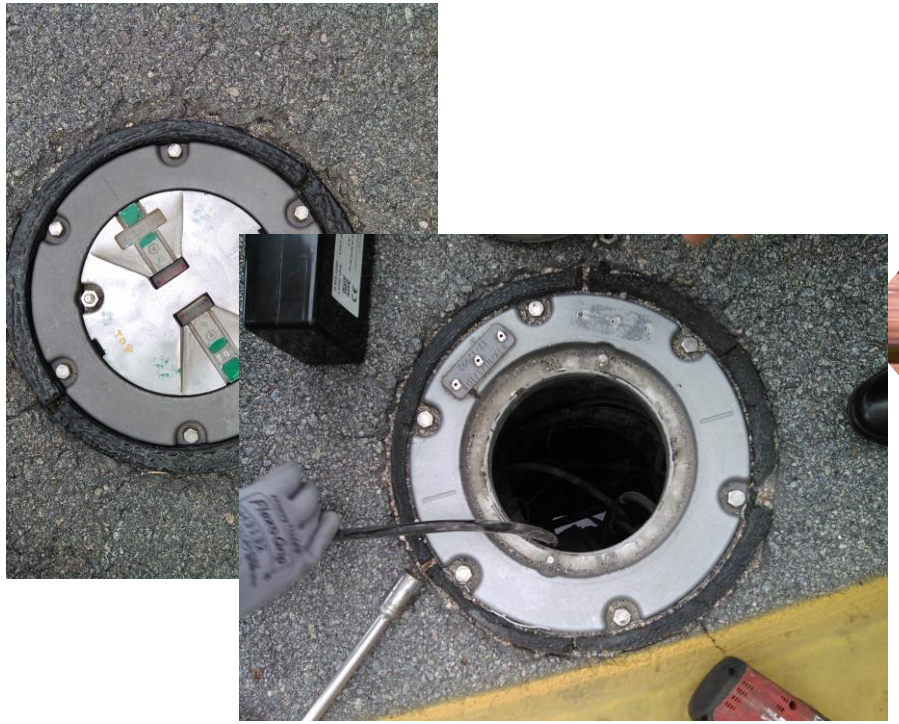
17. Repair the earth fault.

AGL Earth Fault Challenge

Accessibility – technical access



Side pits



Deep cans

AGL Earth Fault Challenge

Accessibility – Traffic

AGL Earth Fault Challenge

Accessibility – LVP operation

AGL Earth Fault Challenge

Challenge and Consequences

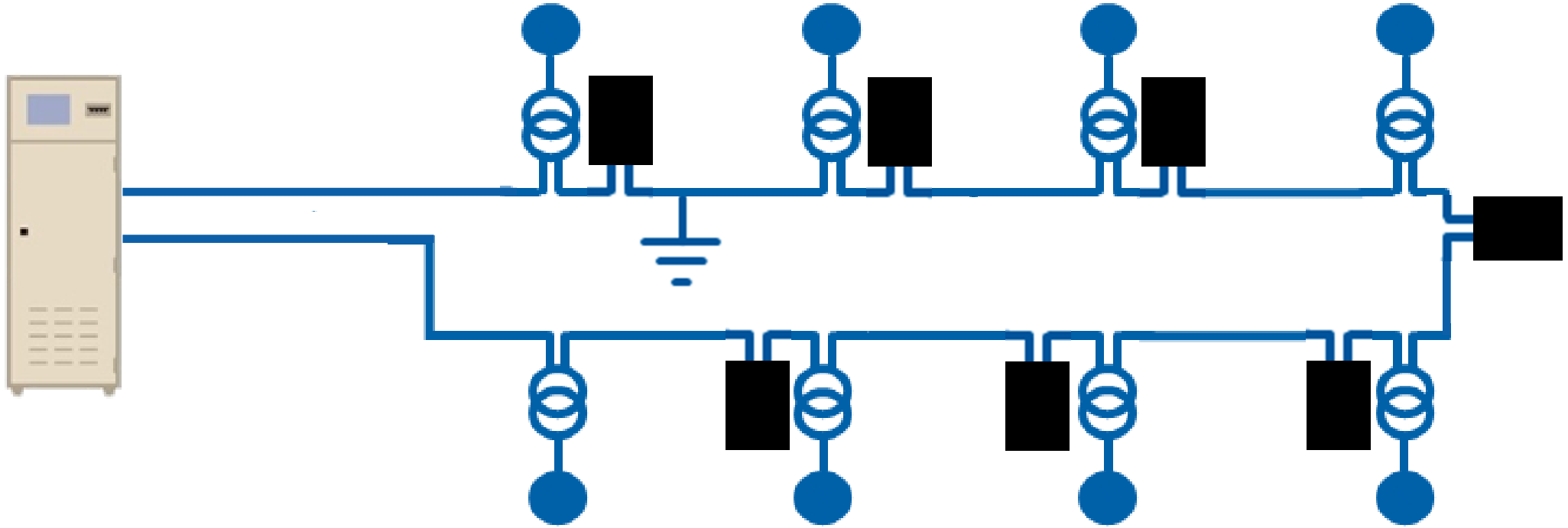
- Perform a test “when you can” vs “when you should”
- Periodicity depends on local conditions
  may range from once a year to once a month
- Corrective budget overestimation
- Use your manpower efficiently
- Set the right maintenance criteria

EFS-GRP

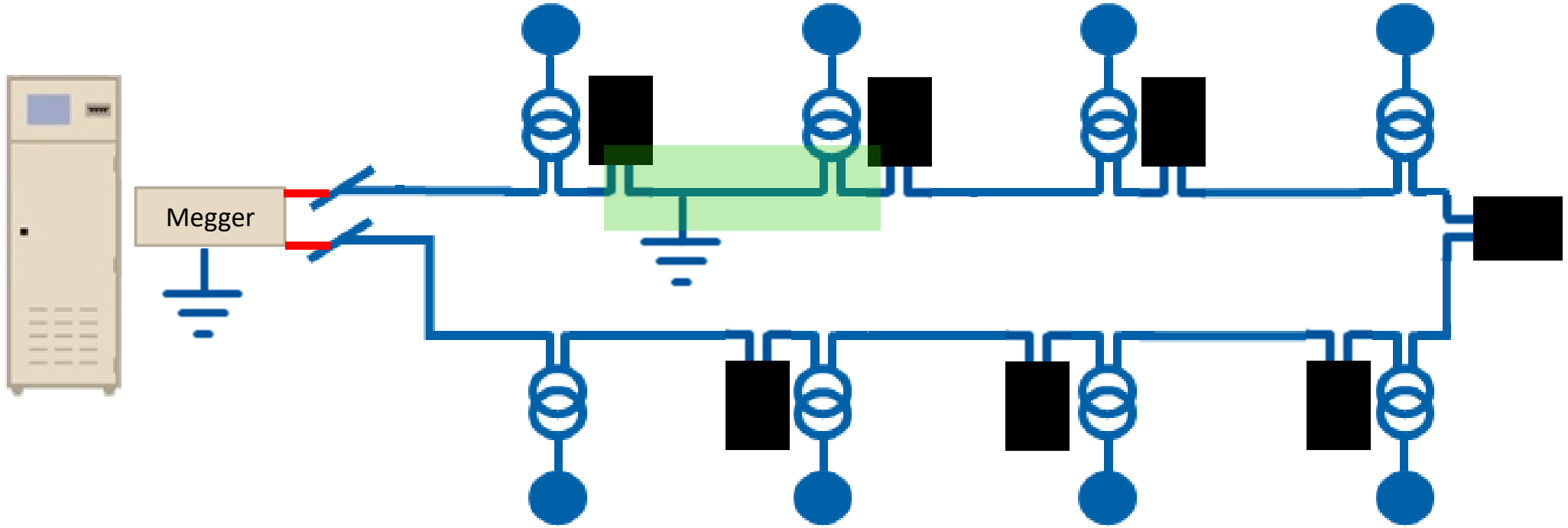
Earth
Fault
Search system by GRP

- **Distributed megger system.**
- **15 minutes time to find the fault.**
- **Maintenance tool for low insulation.**

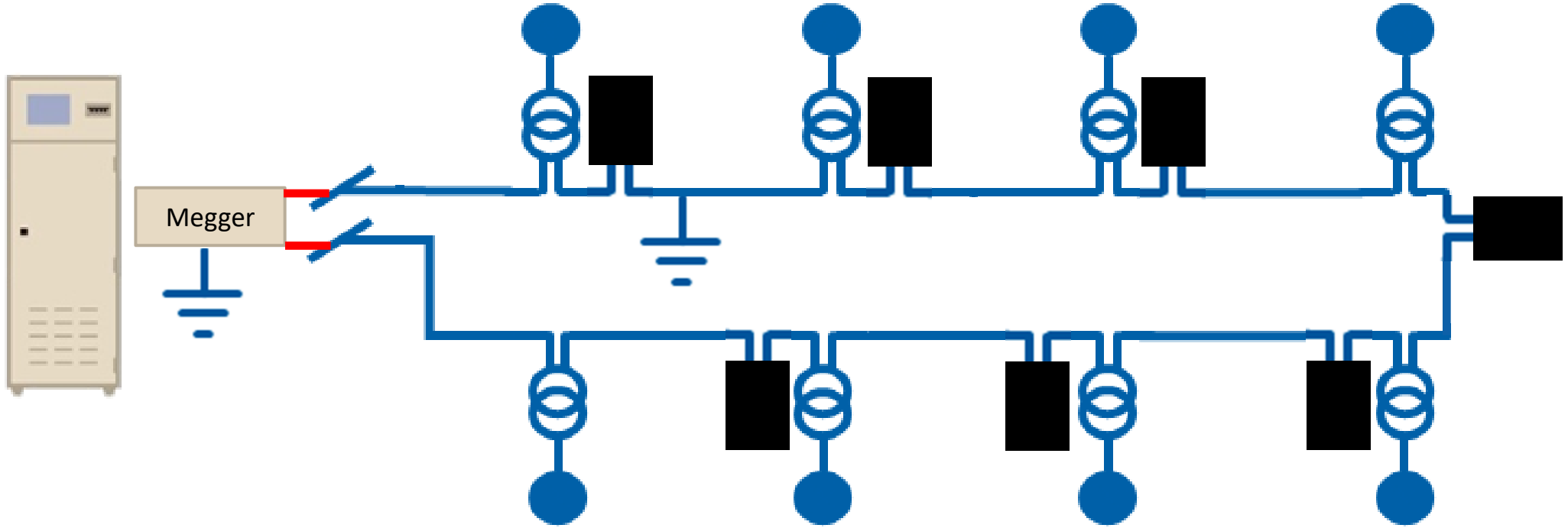
Distributed Megger



Distributed Megger

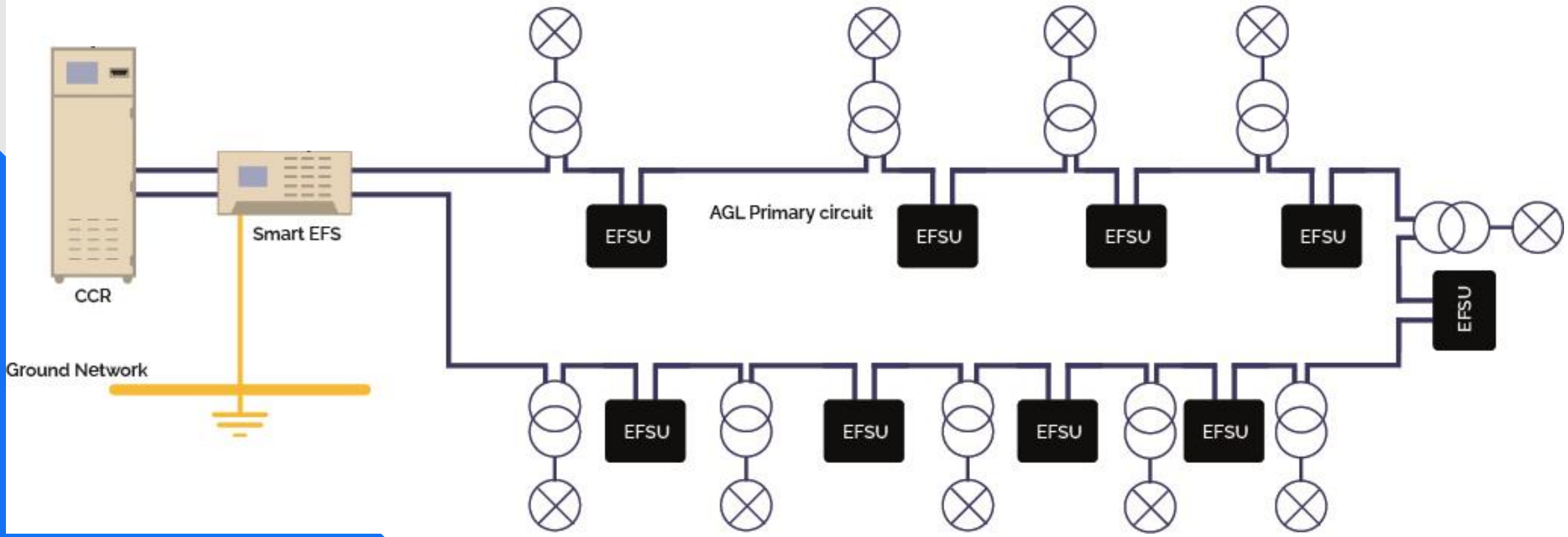


Distributed Megger. Challenges



Key challenges:
How field devices measure when no current in the circuit?
How to receive in “Megger” the field remote measurements?

EFS architecture



EFS-GRP components

SMART EFS:

Master unit installed at the output of constant current regulator (CCR).

EFSU (Earth Fault Search Unit):

Installed in the AGL primary cable in manholes, pits or deep bases.

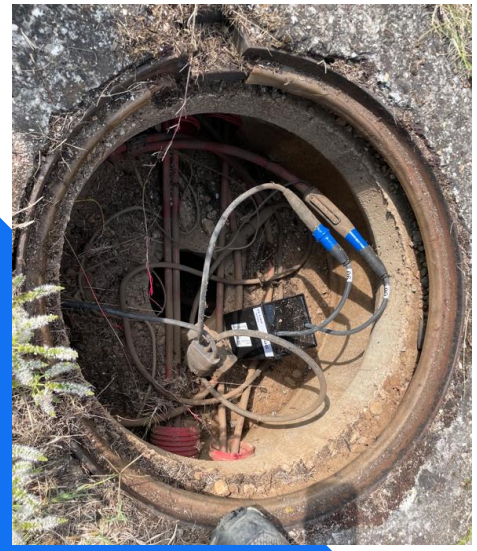
Megger → SMART-EFS

- Automatic connection and disconnection of CCR.
- During test:
  - When CCR OFF: Injection from 0,5kV to 5kVdc.
  - When CCR ON: reading EFSU parameters by AGL circuit **(powerline communication)**.
- Analysis of EFSU measurements.

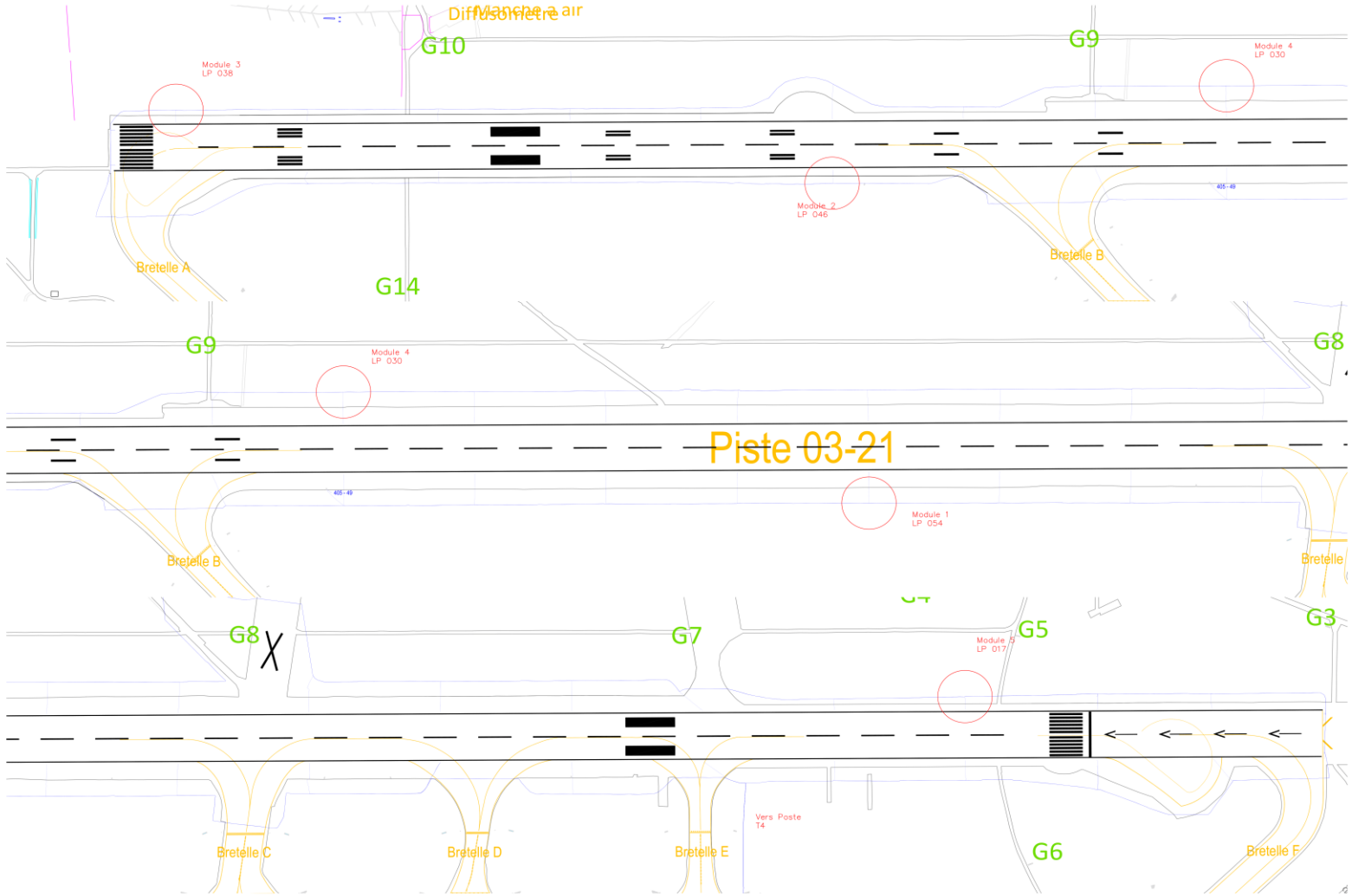
Field device → EFSU

EFSU → Earth Fault Search Unit

- **Store energy to keep on functioning when no current in the circuit.**
- Connected directly to AGL circuit, for **power** and **communication**.
- Dimensions: 23 x 11 x 12 cm
- Weight: 4Kg
- Coating: PUR – IP68.



EFS-GRP Installation study



EFS-GRP measurement process

EFS field feedback – Singapore Changi Airport

Airport description

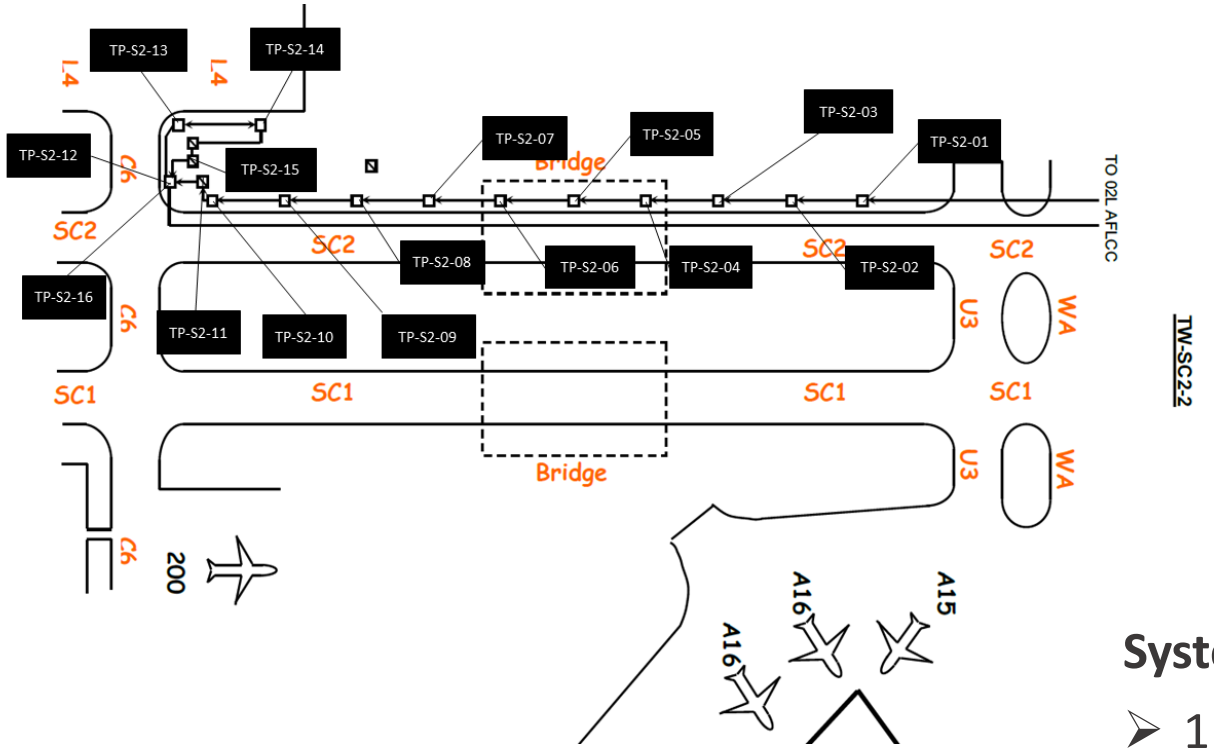
- 2 Runways
- Busy international airport
- 42,9 MPAX 2023 (68,3MPAX 2019)
- 241 Kmov 2023 (382 Kmov 2019)

EFS field feedback – Singapore Changi Airport

Airport problematic

- Taxiway connecting north and south runway
- Bridge over terminal access without standby position available
- Busy traffic
- Heavy rain all year long

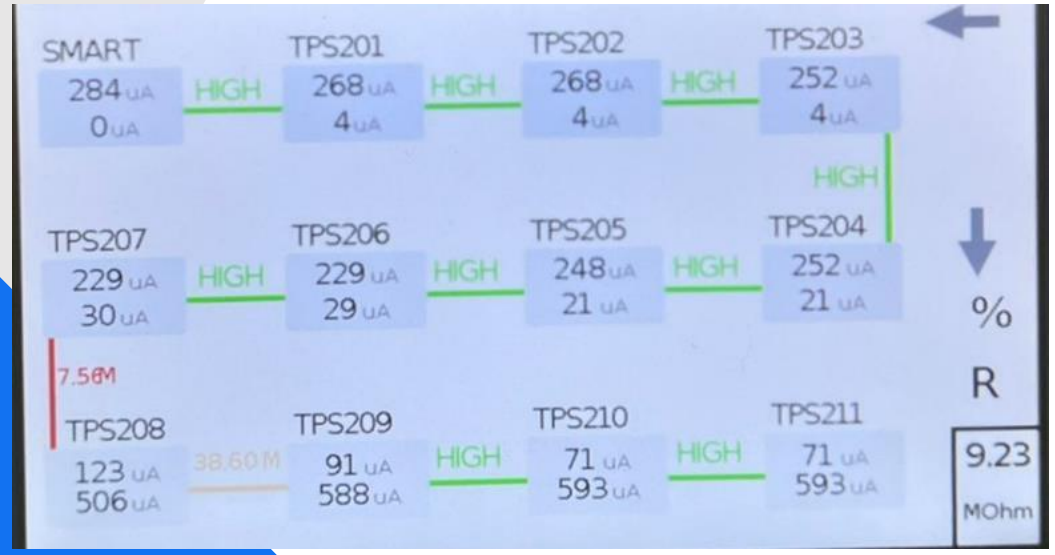
EFS field feedback – Singapore Changi Airport

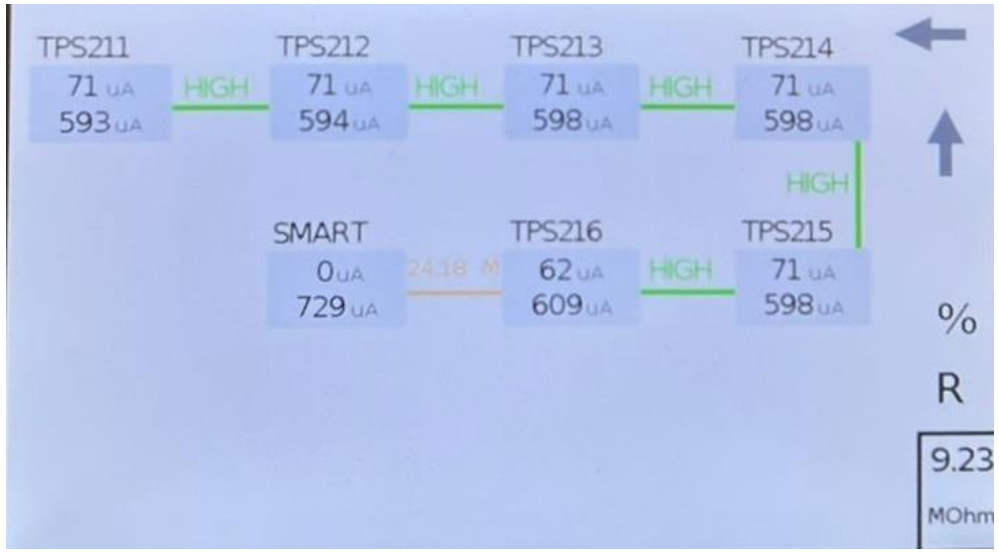


System description

- 1 taxiway edge
- 16 field units

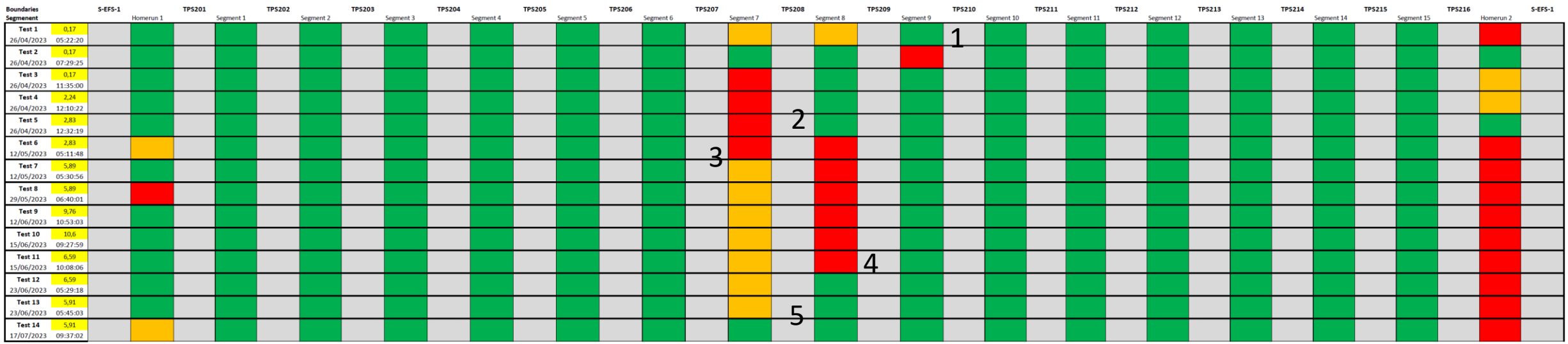
EFS field feedback – Singapore Changi Airport





- 2 bad sections
- one low homerun section

EFS field feedback – Singapore Changi Airport



- Event 1: emergency action - cable
- Event 2: heavy rain
- Event 3: maintenance (transformers, connectors)
- Event 4: maintenance (transformers, connectors)
- Event 5: water drain

EFS field feedback – Singapore Changi Airport

ROX

- Emergency fixing time: 1h30 vs ?
- Ability to perform measures in any conditions
- Map updated every week
- Targeted maintenance set in place

EFS field feedback – Aéroports de Paris – LBG

Airport description

- 3 Runways
- Busiest general aviation airport in Europe
- 63,7 Kmov 2022 (54,6 Kmov 2019)

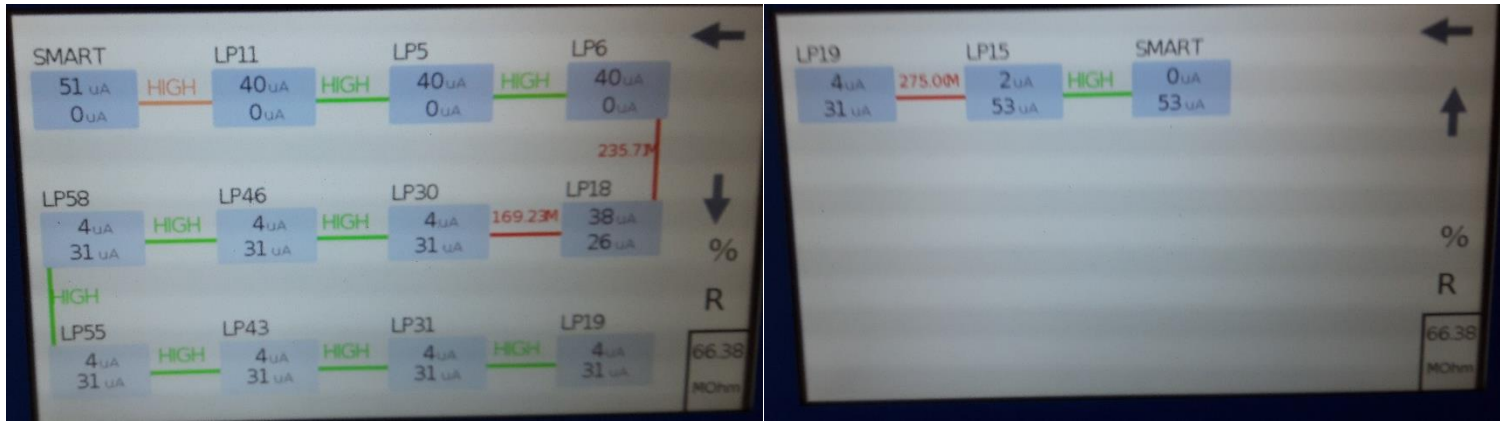
EFS field feedback – Aéroports de Paris – LBG

Airport problematic

- Busiest general aviation airport in Europe
- Old electrical installation
- Poor overall insulation
- No field access

EFS field feedback – Aéroports de Paris – LBG

F30



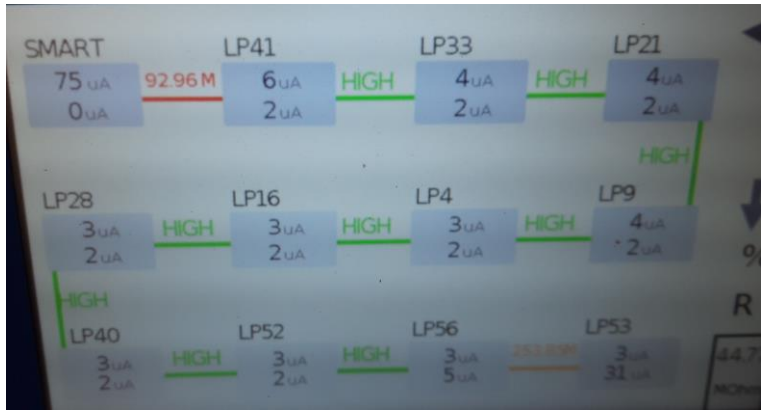
F15

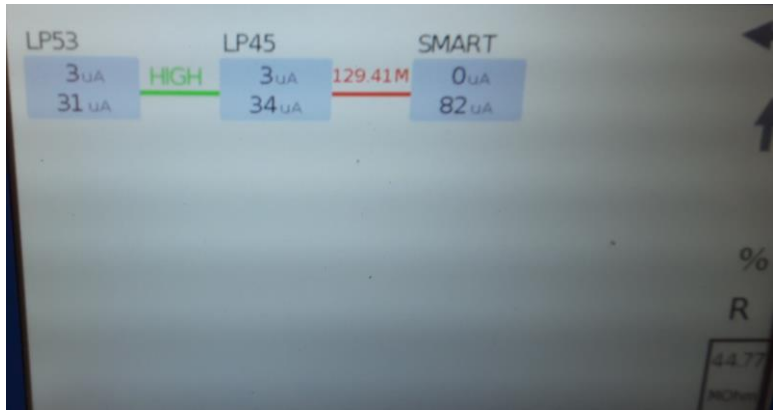
System description

- 4 runway edge circuit
- 16 field units per circuit

EFS field feedback – Aéroports de Paris – LBG

M30





K10

EFS field feedback – Aéroports de Paris – LBG

Results

- 2 circuits from vault F can be improved working on the field
- One circuit from vault M, is not critical (home run to be monitored)
- One circuit from vault K needs field investigation

EFS field feedback – Aéroports de Paris – LBG

ROX

- Ability to perform measures in any conditions
- Maintenance activity planning
- Runway closure activity optimisation
- Reduced runway time slot for measures

EFS field feedback – London Gatwick

Airport description

- Single runway
- Busiest runway in Europe
- 32,9 MPAX 2022 (46,6 MPAX 2019)
- 214,8 Kmov 2022 (280,7 Kmov 2019)

EFS field feedback – London Gatwick

Airport problematic

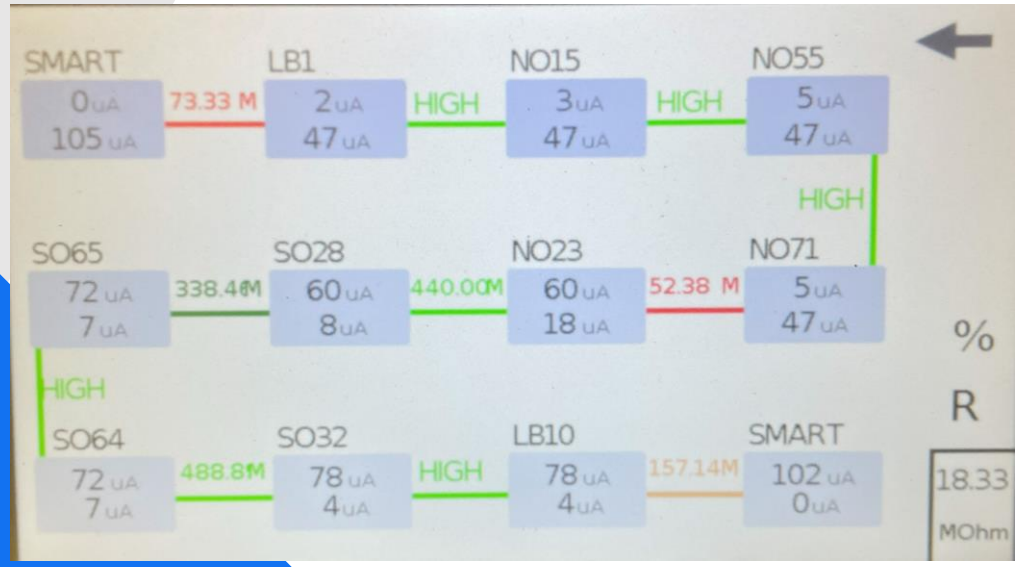
- Single runway
- Poor overall insulation
- No field access
- Substation in remote location

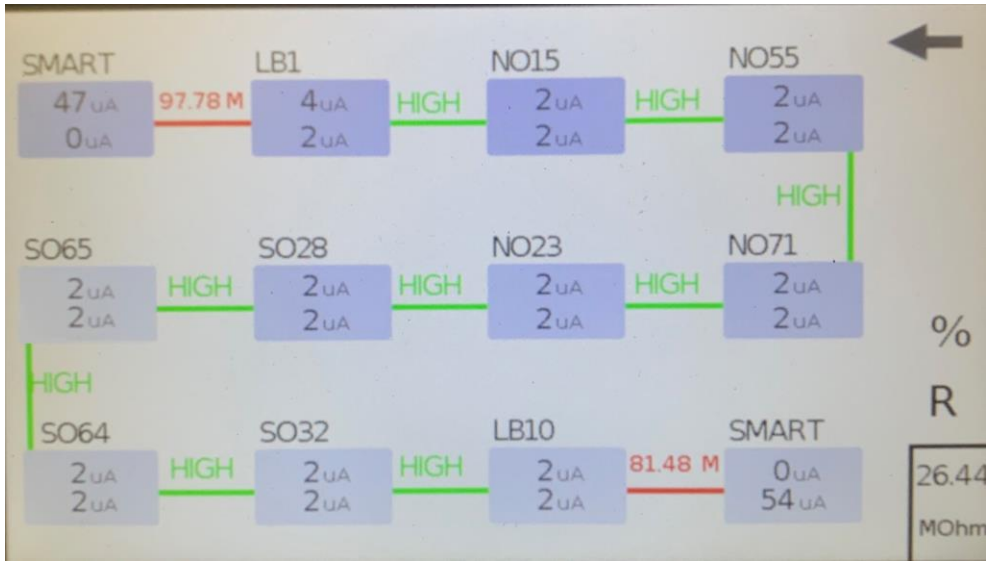
EFS field feedback – London Gatwick

System description

- 1 Runway edge circuit (four legs)
- 10 Field units on each circuit.

EFS field feedback – London Gatwick





EFS field feedback – London Gatwick

Results

- 2 home runs show low insulation level
- One section at the legs crossing location shows the lowest value
- Work plan is on-going to target the weak points

EFS field feedback – London Gatwick

ROX

- Ability to perform measures in any conditions
- Enhanced people safety despite lighter procedure
- Runway closure activity optimisation
- Reduced runway time slot for measures

EFS – Main Return On Experience

- Enhanced runway availability for operation
- Enhanced AGL technicians' safety
- Maintenance budget optimisation tool
- Maintenance planning tool

Thank you

GRP

The Smart Airfield
Primary cable is the backbone

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QUESTIONS?

GRP

The Smart Airfield
Primary cable is the backbone

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