

Final Thesis

30 juin 2020

Fault management in a telecommunications power supply system

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Master in Industrial Engineering Sciences

Finality: Industry



Presentation Plan

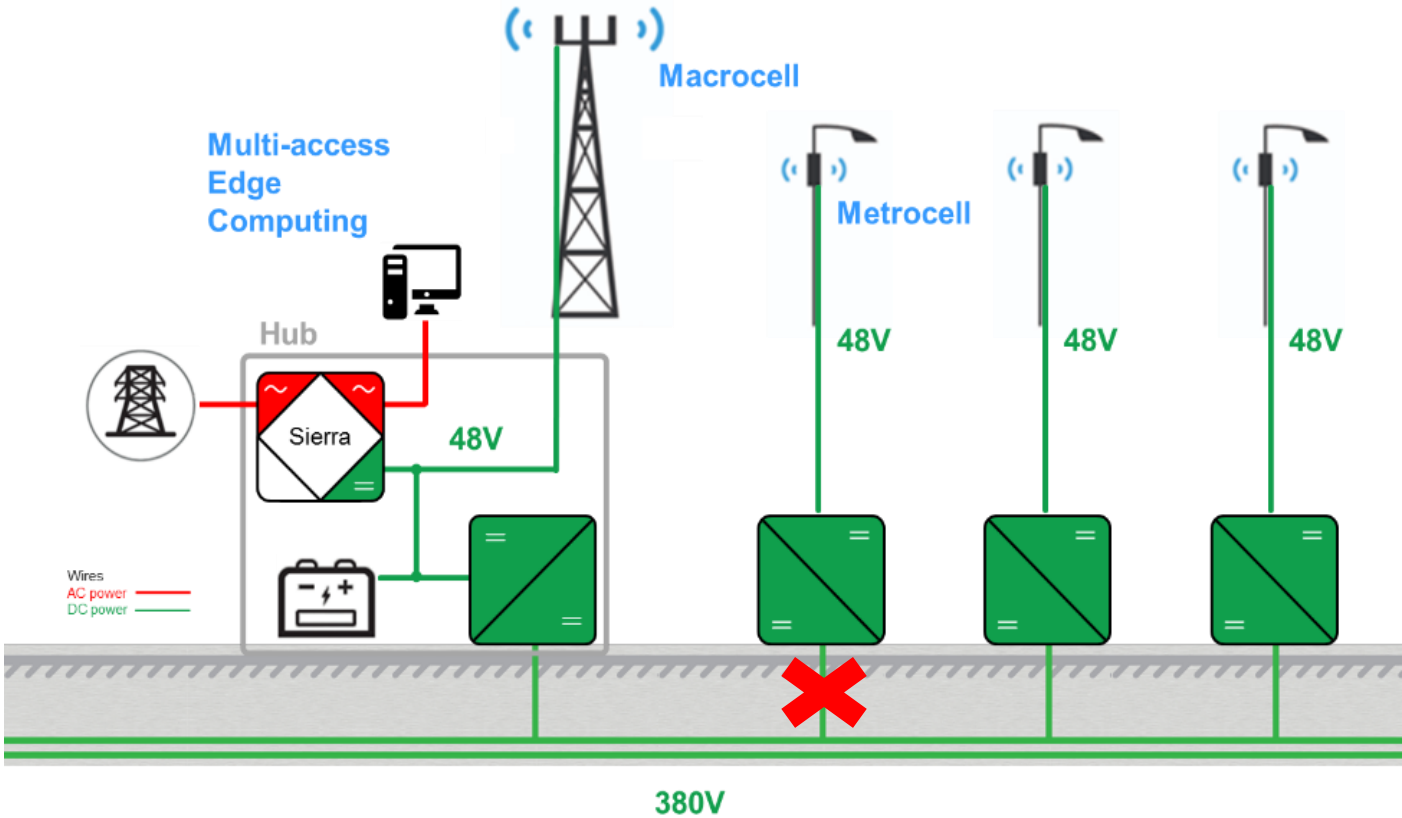
- **Introduction**
- **Task performed**
 - Methodology et Fault characteristics
 - Fault detection and location
 - Advanced fault management method
- **Conclusion**

Issue : Fault management

- **MetroGrid project**

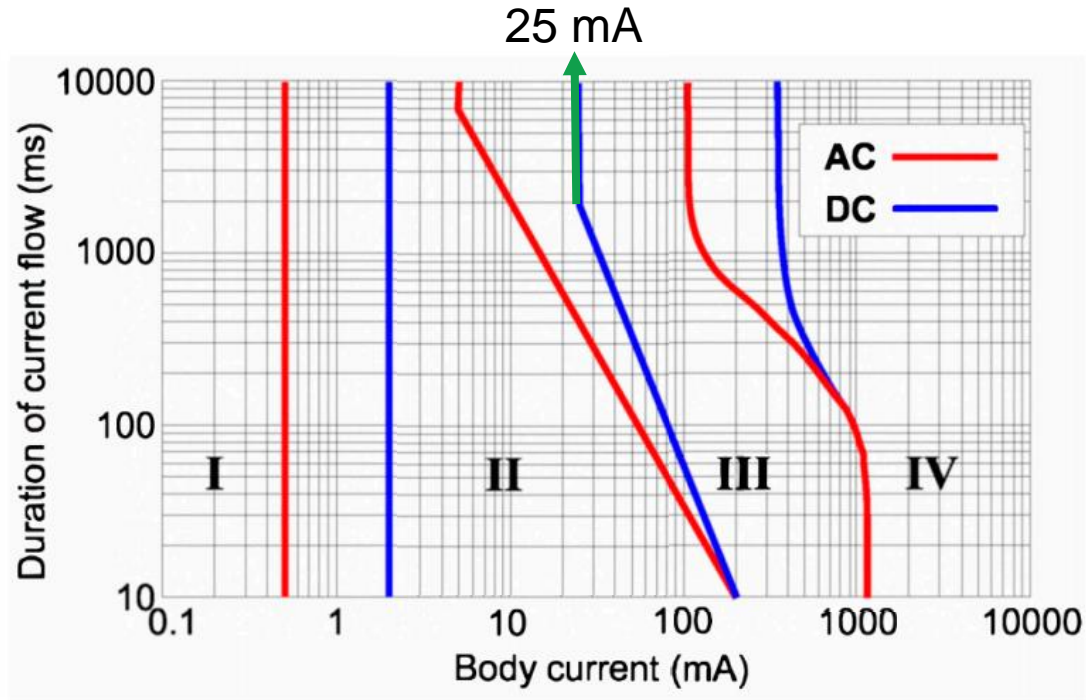
Power supply

→ 380 Vdc



Problématique : gestion de défauts d'isolement

- **Effects on the human body**



- I. No effect
- II. Small pain but no dangerous effect → 2 mA
- III. Muscular contraction and respiratory distress, reversible effects → 25 mA (> 2 s)
- IV. Ventricular fibrillation, critical effects → 350 mA (> 400 ms)

- **Isulation monitoring device (IMD)**



Our goals

- **Research on IMD and insulation fault**
- **Technical Manual**
- **Ideas that can be used in the project**

Methodology and Fault characteristics

Fault detection and location

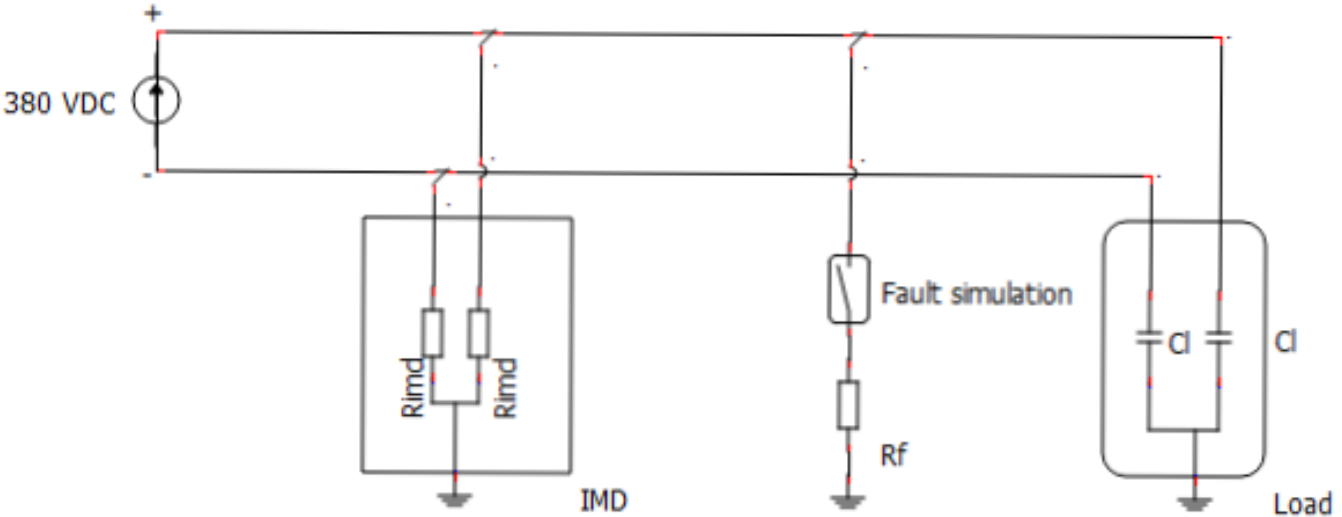
Advanced fault Management

Methodology

- First fault simulation

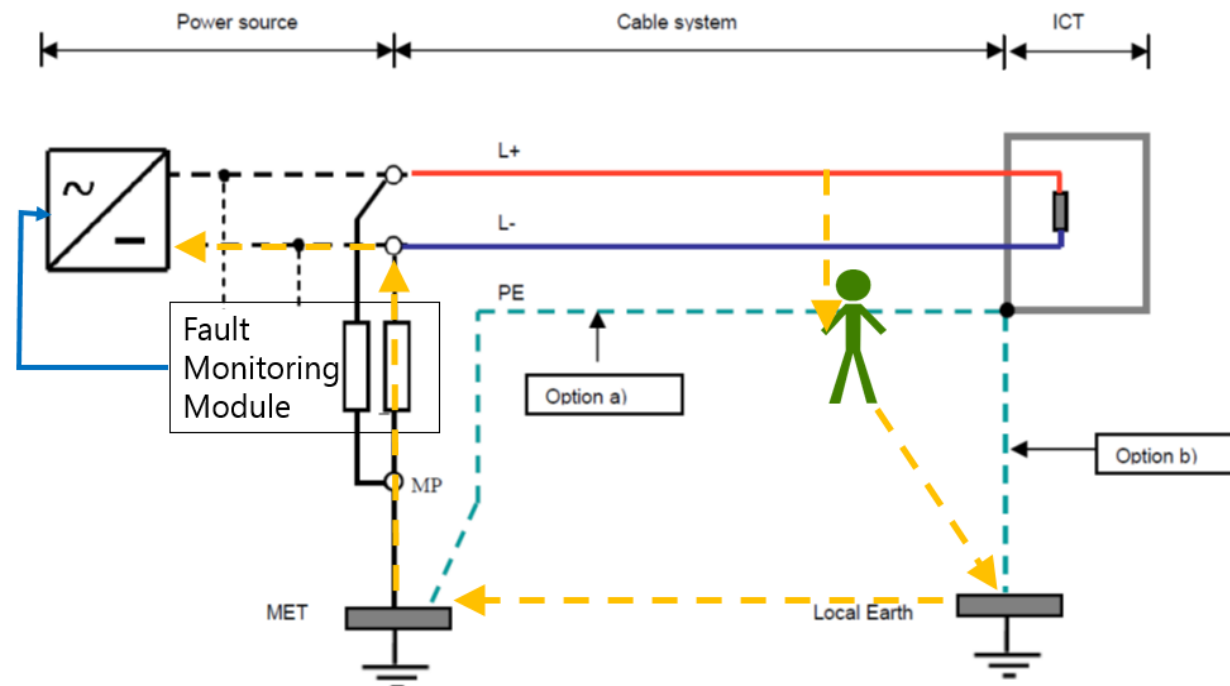


1.2-kΩ resistor representative for human body



- Comparison with AC

Safety of an IT system relies on a high-resistance midpoint grounding device

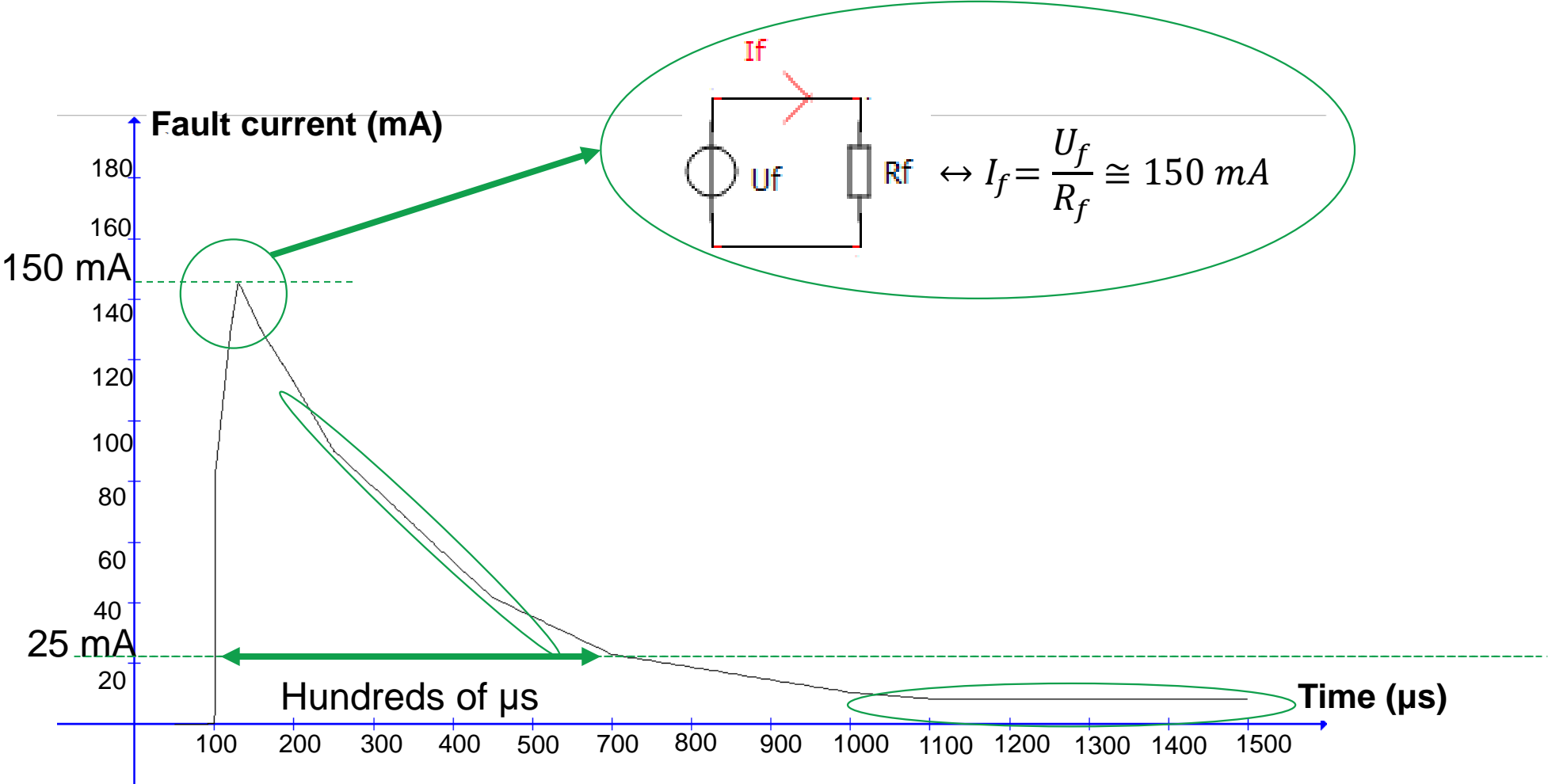


- Large R_{IMD}
- Absolute voltages equal but opposite (+/- 190 V)
- ~~Appearance of fault~~ **Appearance of fault on the second conductor = Risk of short-circuit**

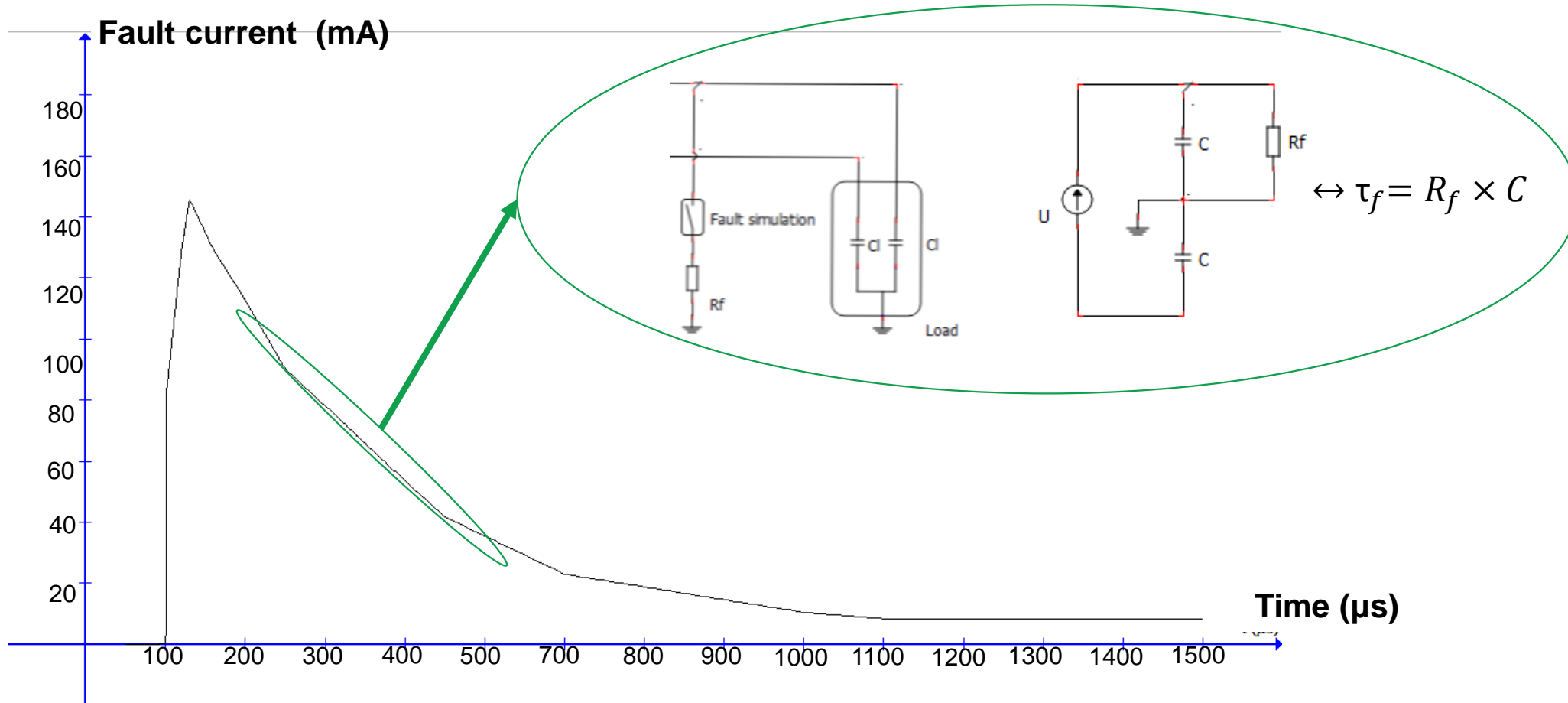
I limited

0 voltage on faulty conductor

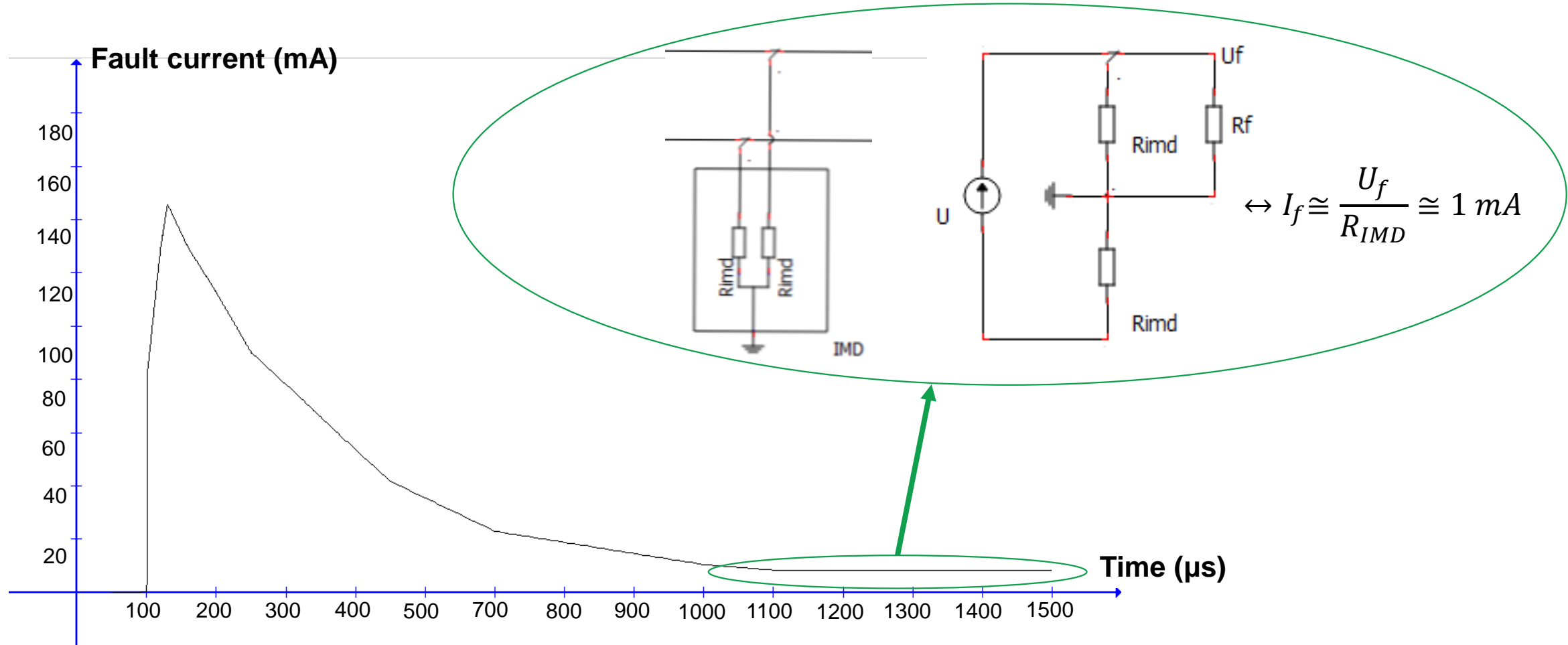
The typical fault current pattern depends on 3 characteristics (1/3)



The typical fault current pattern depends on 3 characteristics (2/3)



The typical fault current pattern depends on 3 characteristics (3/3)



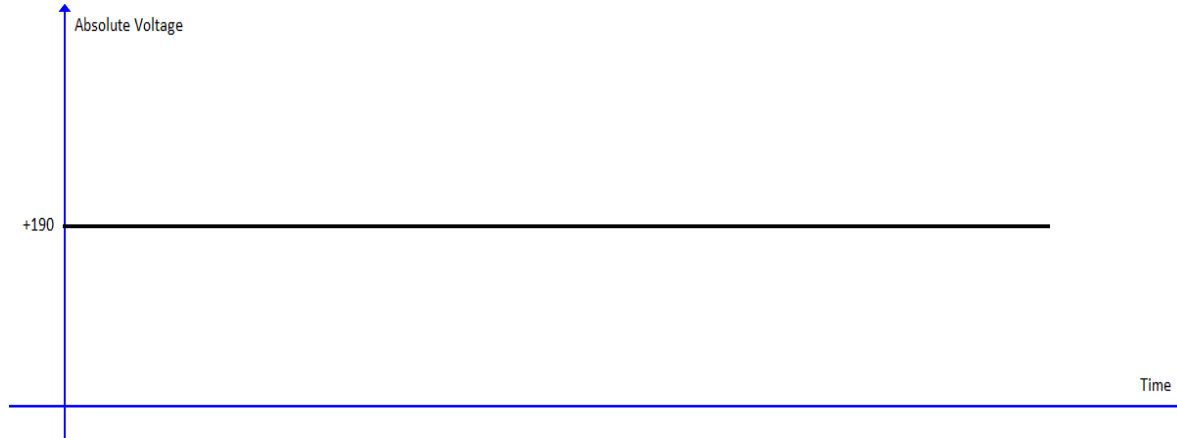
Methodology and Fault characteristics

Fault detection and location

Advanced fault Management

There are two methods of fault detection

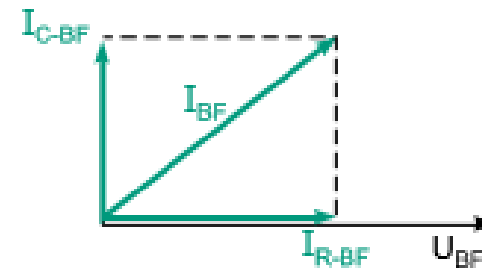
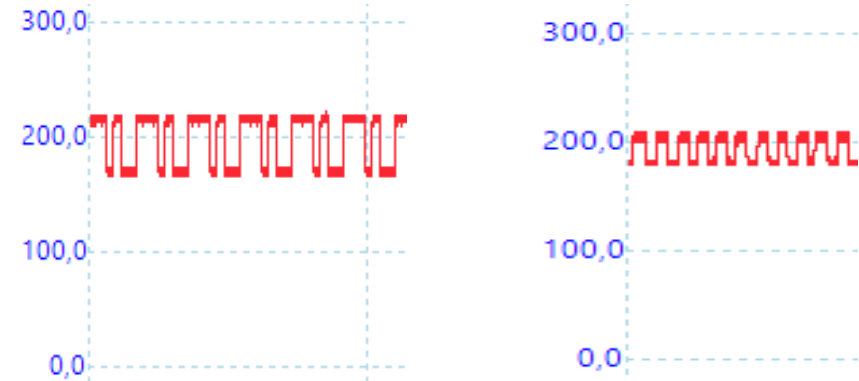
- **Detection by voltage level measurement**



Voltage drop = insulation resistance drop

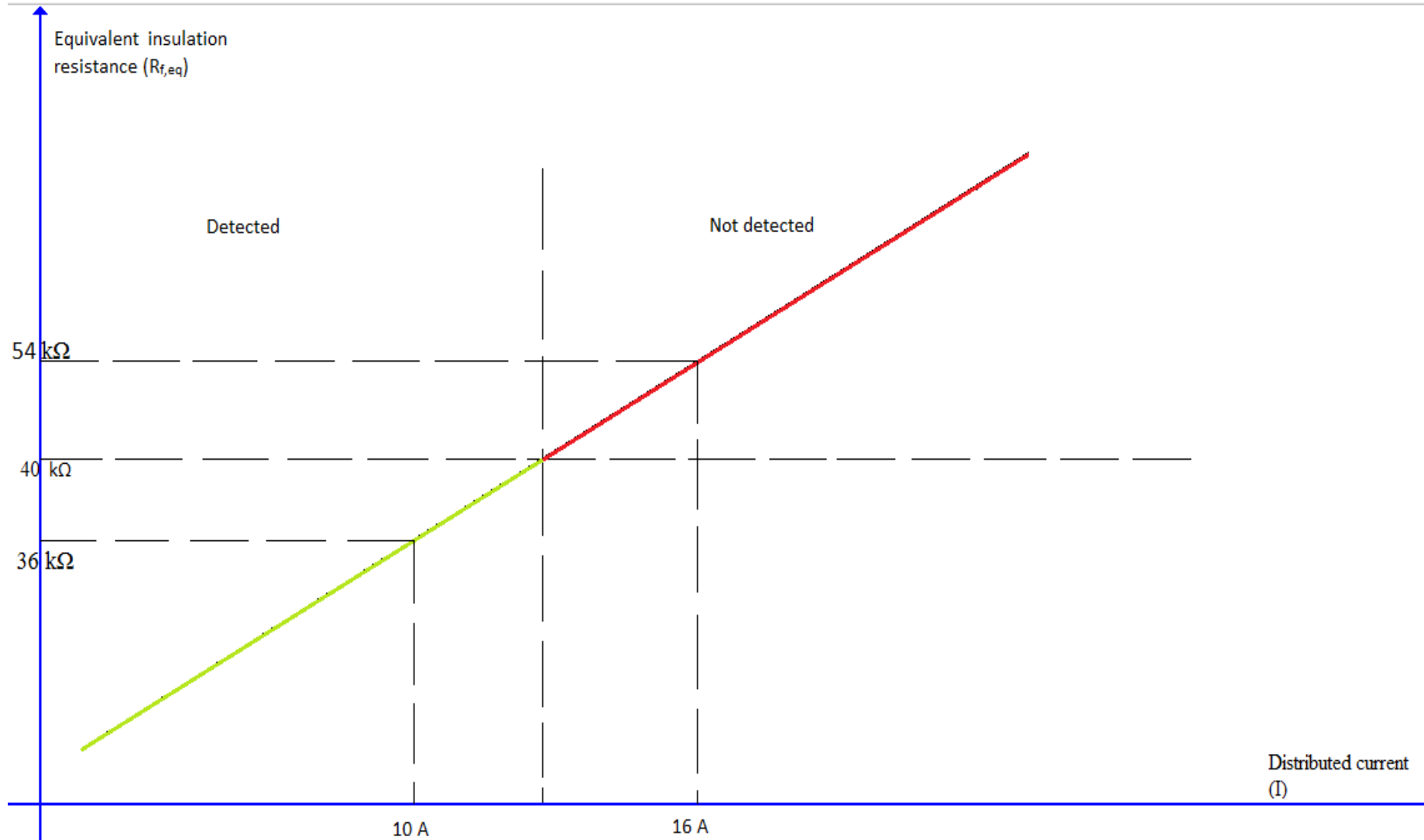
Insulation resistance is compared to a threshold

- **Detection by a modulated current injection**



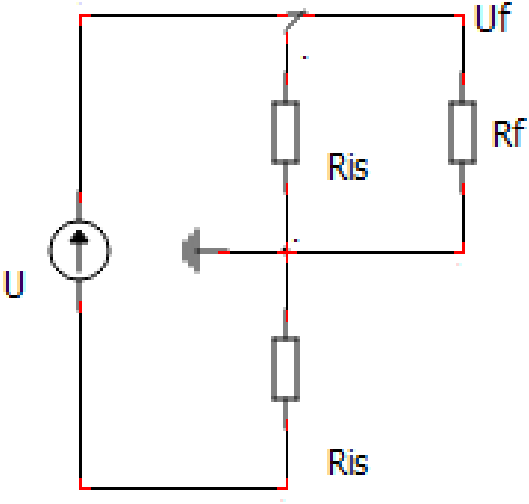
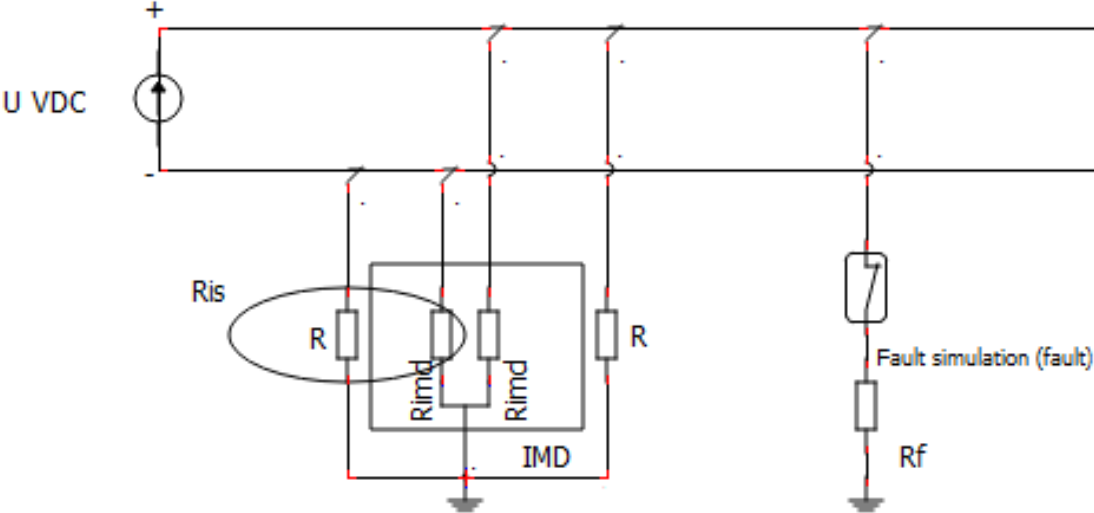
The resistive component of insulation is compared to a threshold

The distributed current influences the apparent insulation resistance



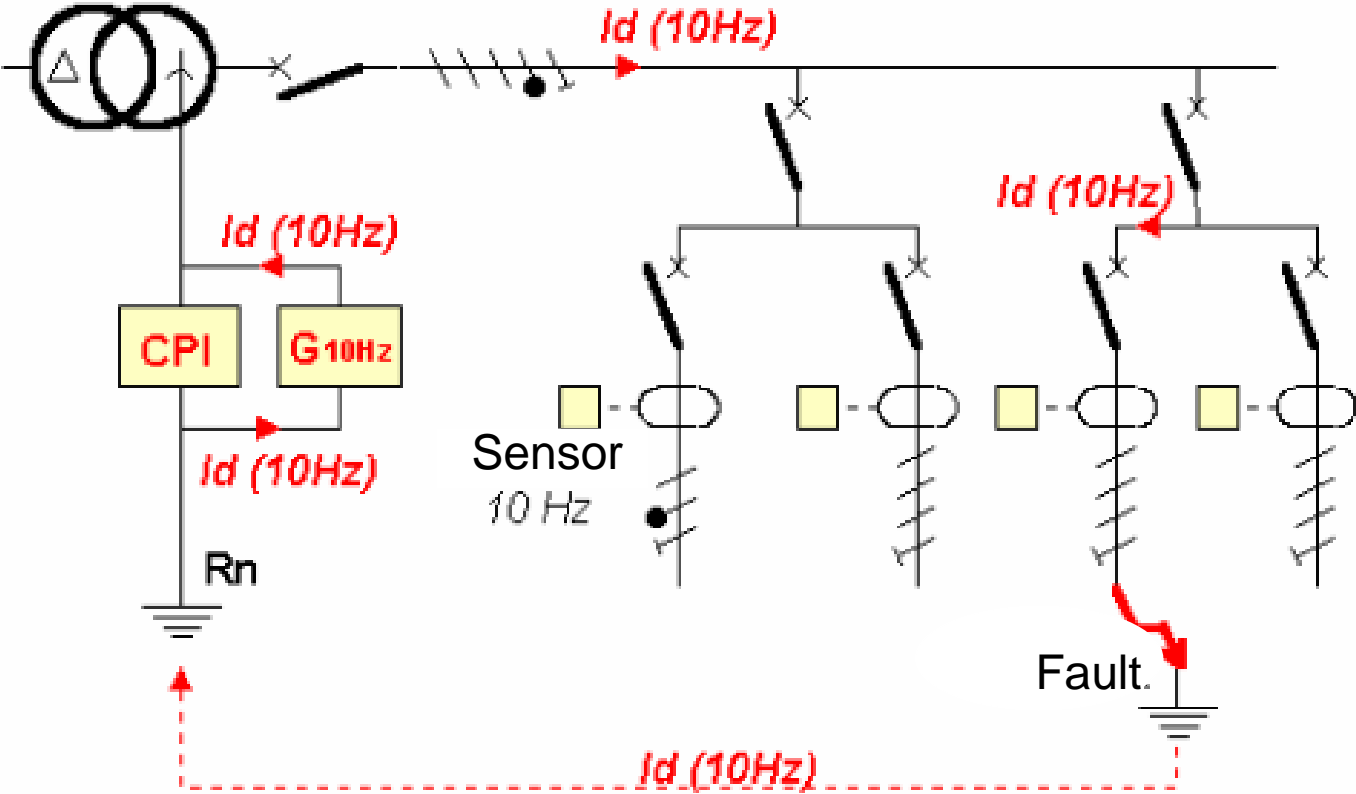
Fault location (1/2)

- Fault current detection



Fault location (2/2)

- Detection of an injected current

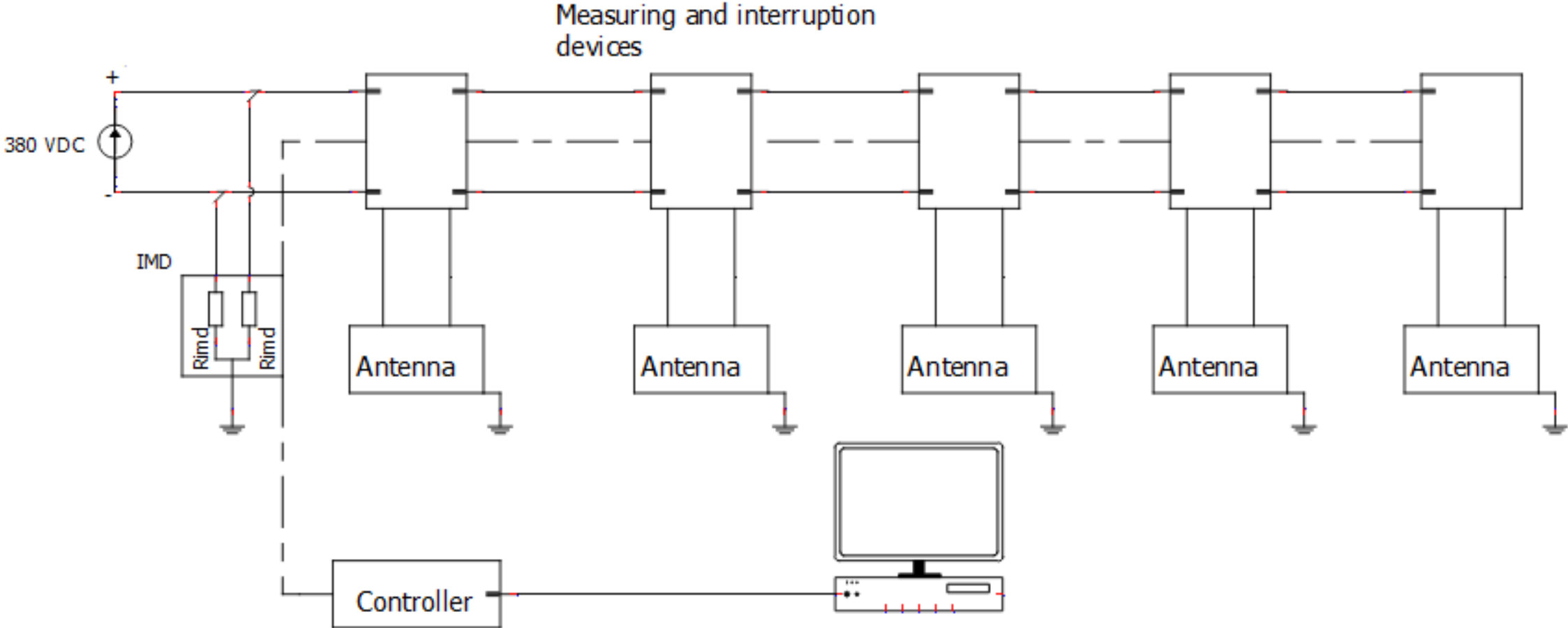


Methodology and Fault characteristics

Fault detection and location

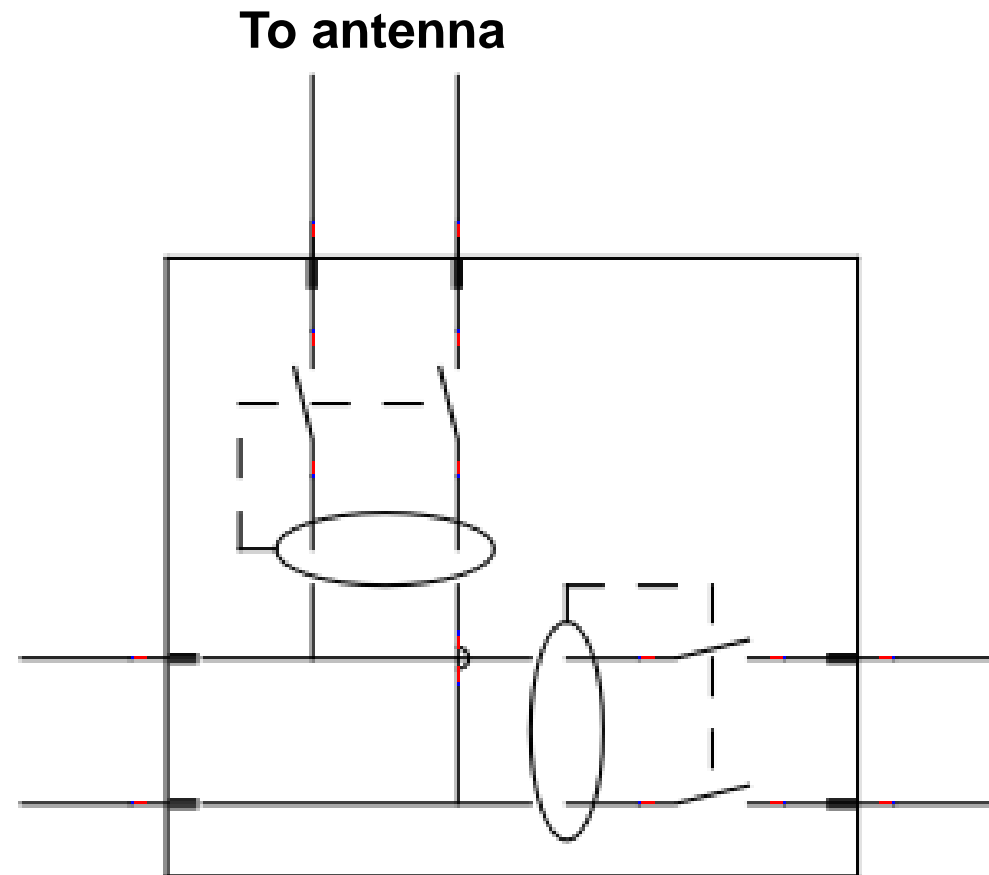
Advanced fault Management

Principle of the method



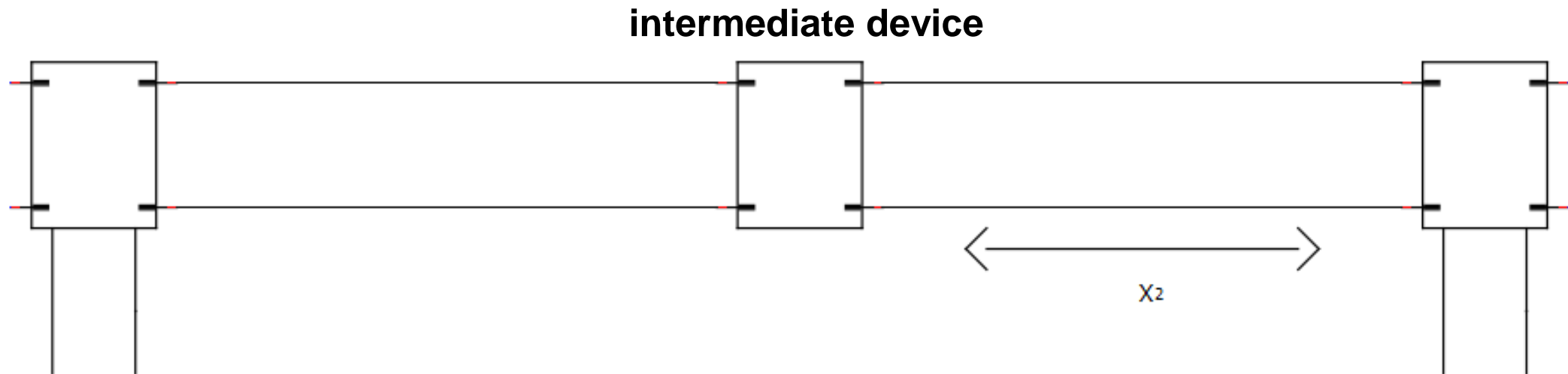
Principle of the method

- Two independent systems
- Allow power supply to the rest of the circuit



Discussion on design choices (1/3)

- Position of MID



Discussion on design choices (2/3)

- **Time of the interruption**

At the first fault

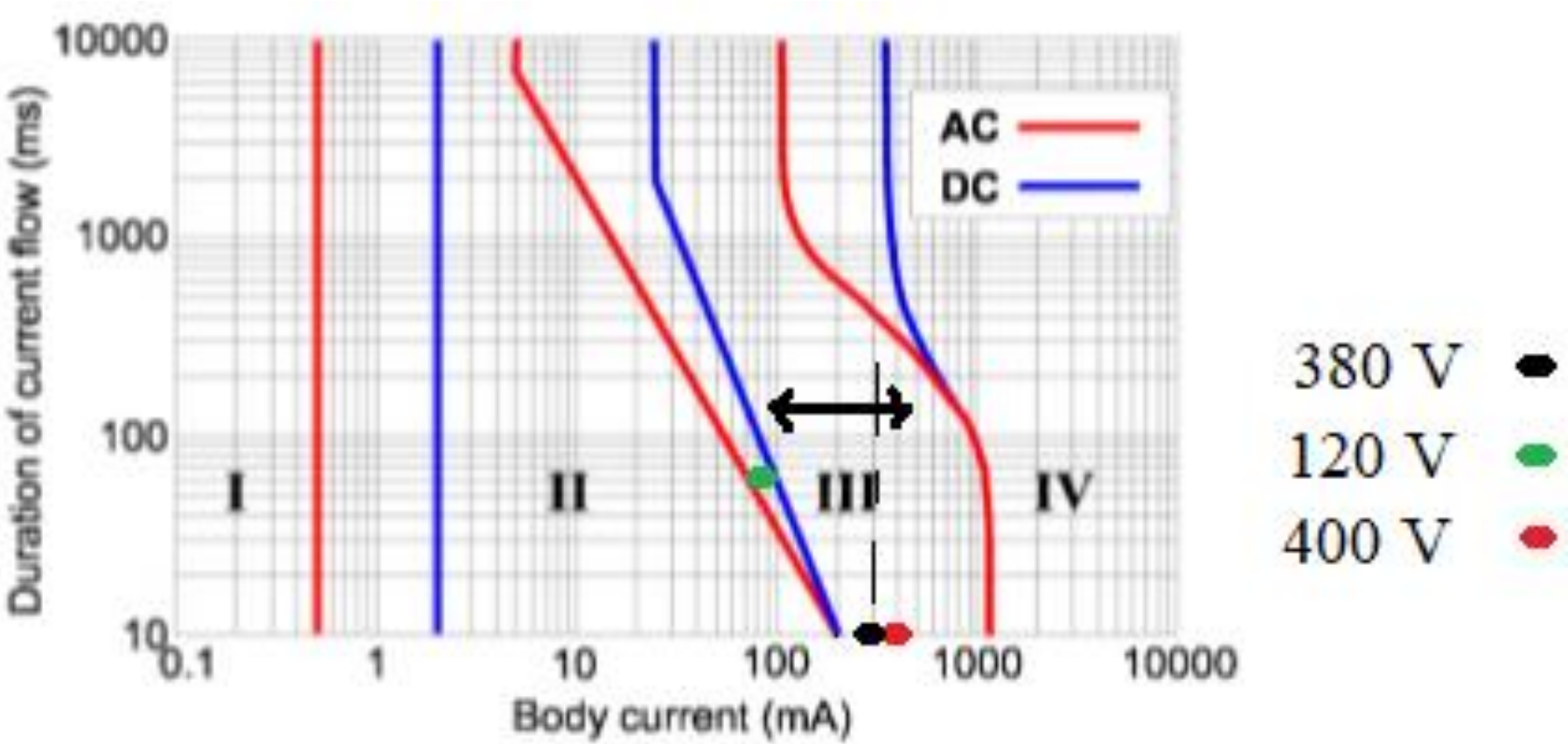
- Total security
- 5G network performance maintained
- Higher time respond allowed

At the second fault

- Philosophy of the IT system
- Little risk of disconnection if good maintenance
- More complex device

Discussion on design choices (3/3)

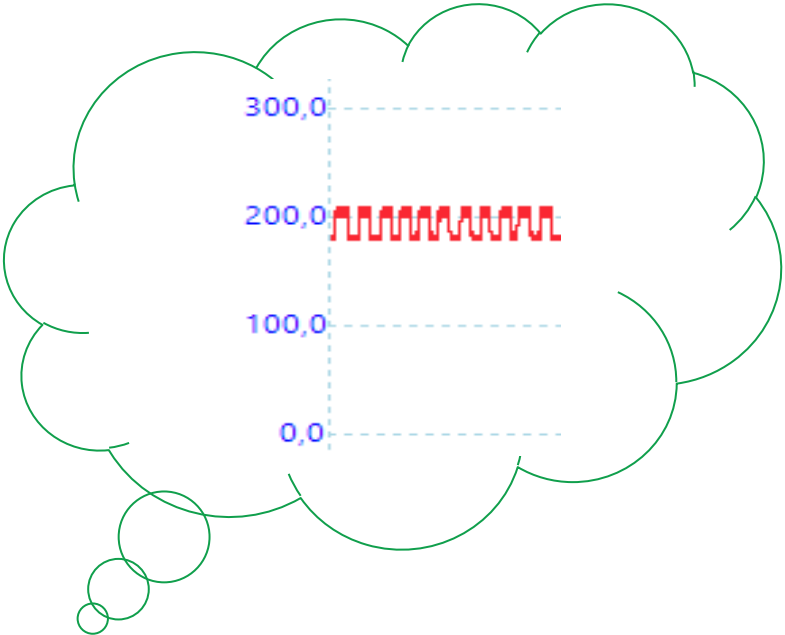
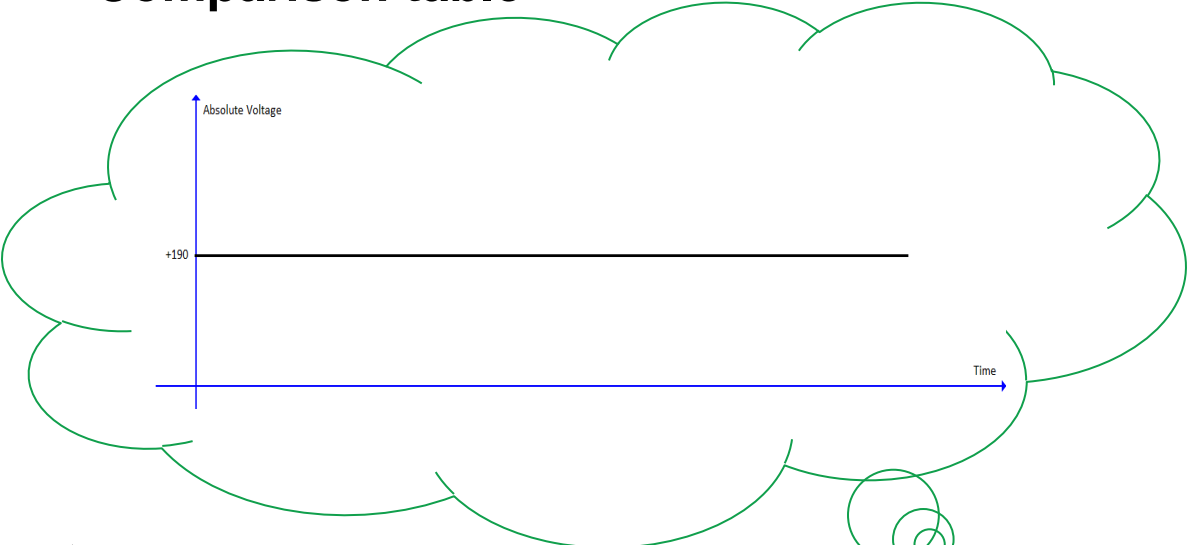
- Respond time



Conclusion

Summary and comparison of the 3 methods

- Comparison table



Methods	Detection by voltage level	Detection by a modulated current injection	Advanced method
Characteristics			
Fault detection	-	+	++
Selective disconnections	--	--	+

Goals

- **Research on IMD and isolation fault**
- **Technical Manual**
- **Ideas that can be used in the project**



THANK YOU
FOR YOUR
ATTENTION

