

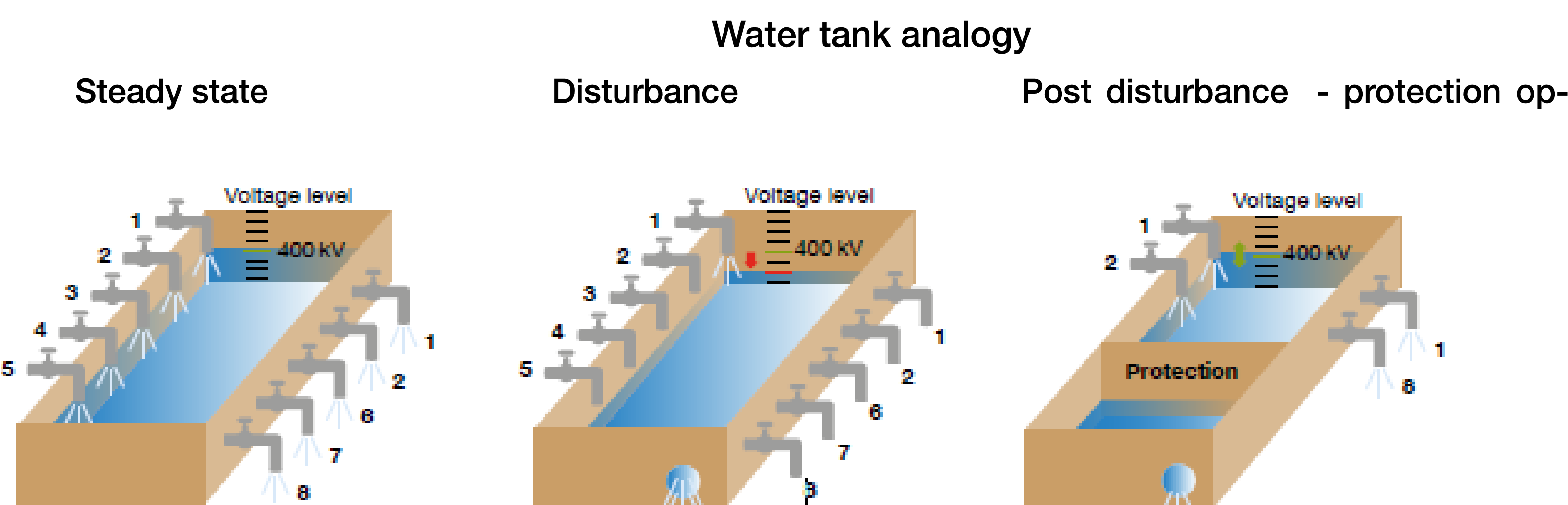
Understanding the Impact of Declining Fault Levels

System Operability Framework

There is a trend of declining fault levels. We want to work with the users of the whole system to understand in which year and which region of the whole system will declining fault levels be a problem.

Why is protection important?

- Key**
- 1. Generators
 - 2. Consumer loads
 - 3. Cable circuits
 - 4. Lightly loaded overhead lines
 - 5. Capacitive compensators
 - 6. Transformers
 - 7. Heavily loaded overhead lines
 - 8. Inductive compensators

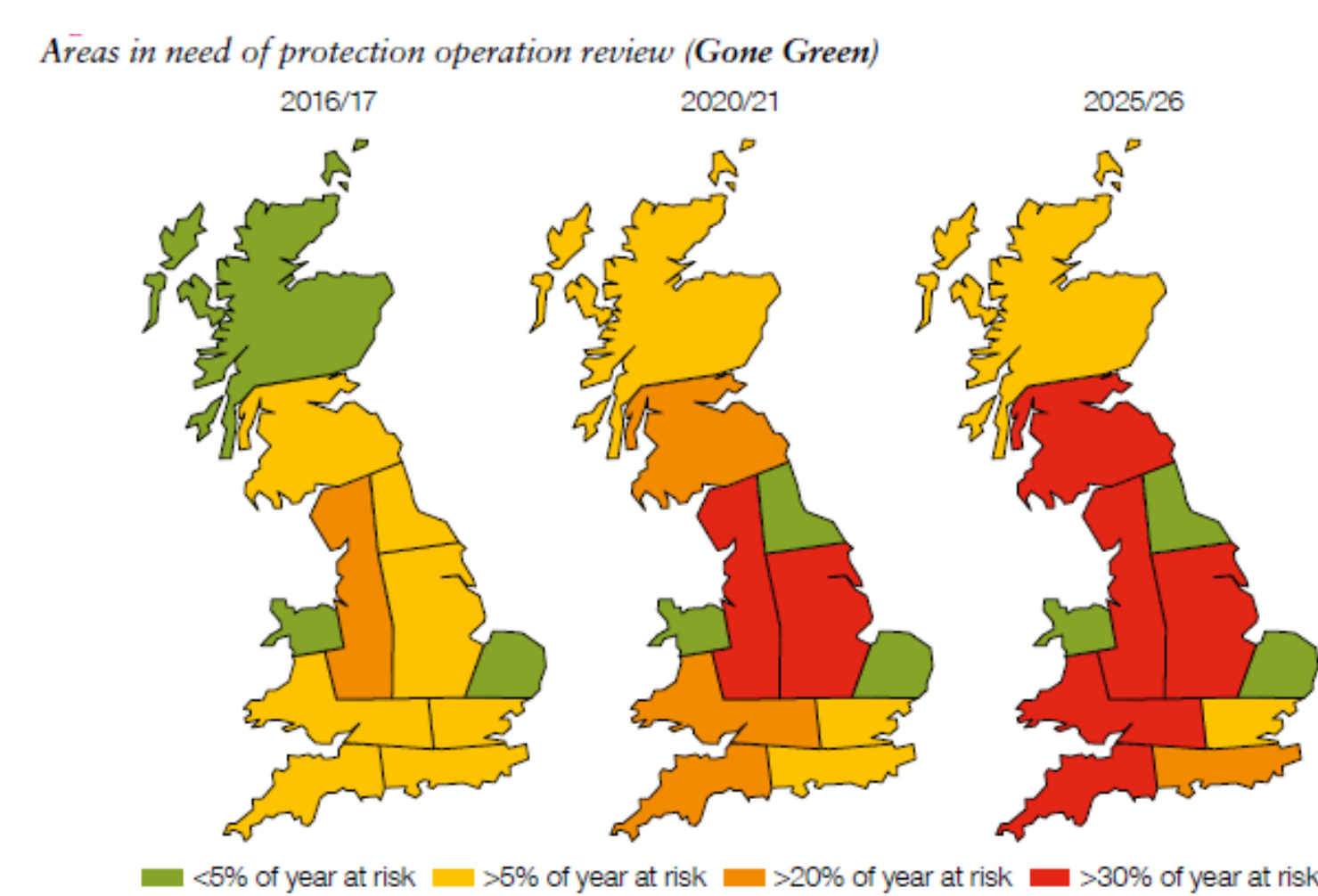


In this water tank analogy, a hole in the tank represents a fault/disturbance which has been isolated by a protection system. This allows the water level in the remainder of the tank to recover.

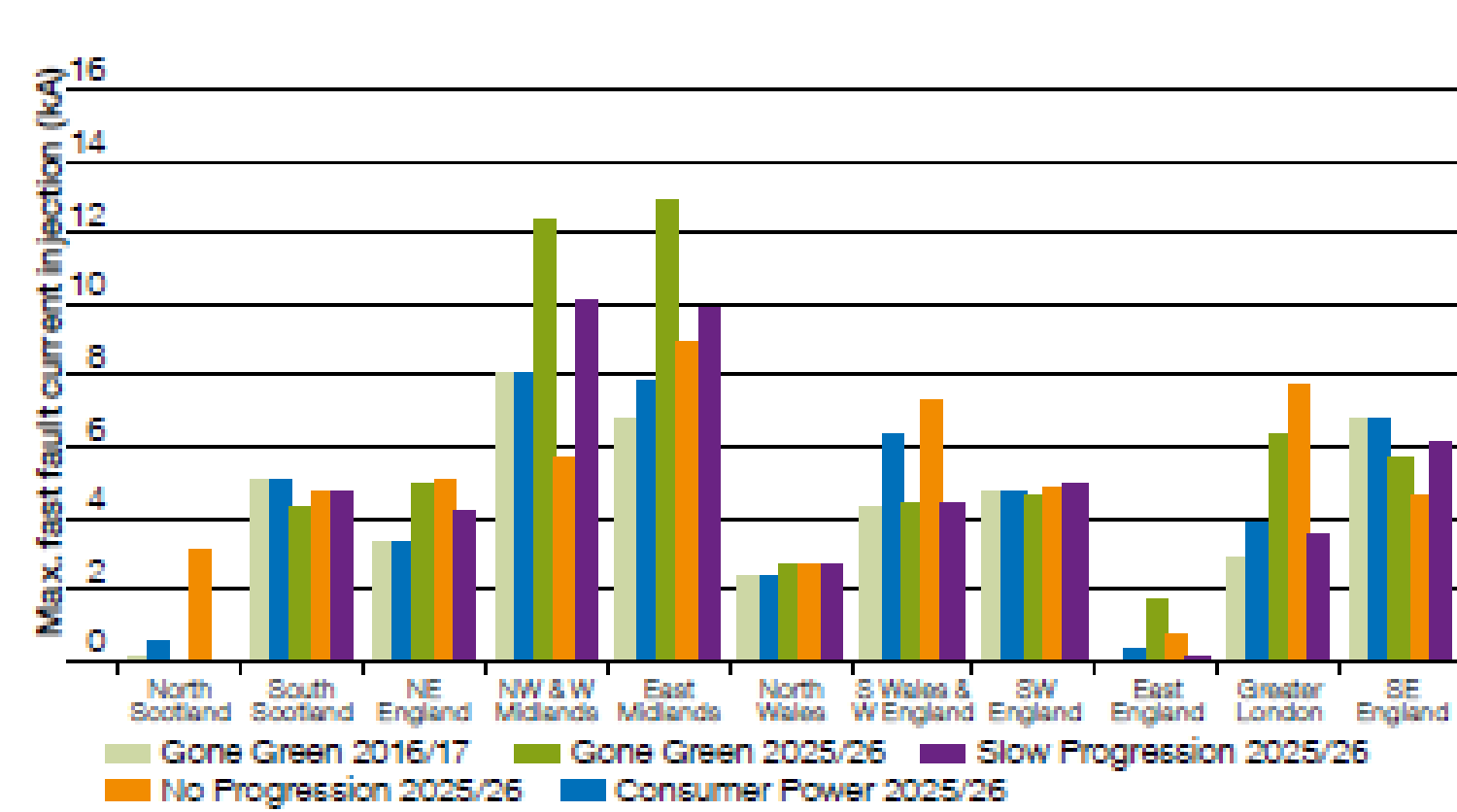
In a post disturbance scenario after operation of protection system, the configuration and flows in the available taps have changed to restore water to the original level without rising too high or remaining too low.

What does SOF analysis say?

Fault levels are declining on the transmission network over the next decade due to decline in synchronous generation.

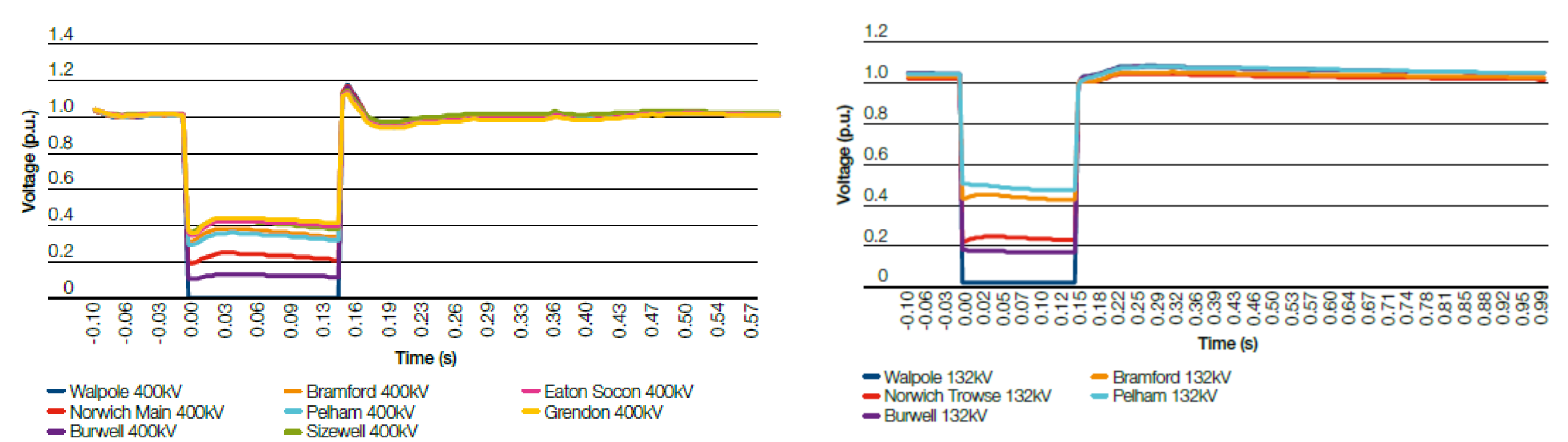


Additional fast fault current injection in 2020/21



Impact of transmission system fault can be seen at both transmission and distribution levels

3 phase fault at Walpole 400 kV substation 2025



What is the risk to you?

Protection failure

- Overcurrent protection

This protection risks not triggering at all, at low short circuit level or operating far more slowly than is acceptable.

- Distance protection

No effect, provided the decline in short circuit level retains the ratio of voltage to current.

- Differential protection

At times of low short circuit level, the difference may be so small that the relay doesn't operate. This will require different bias for peak and off-peak currents.

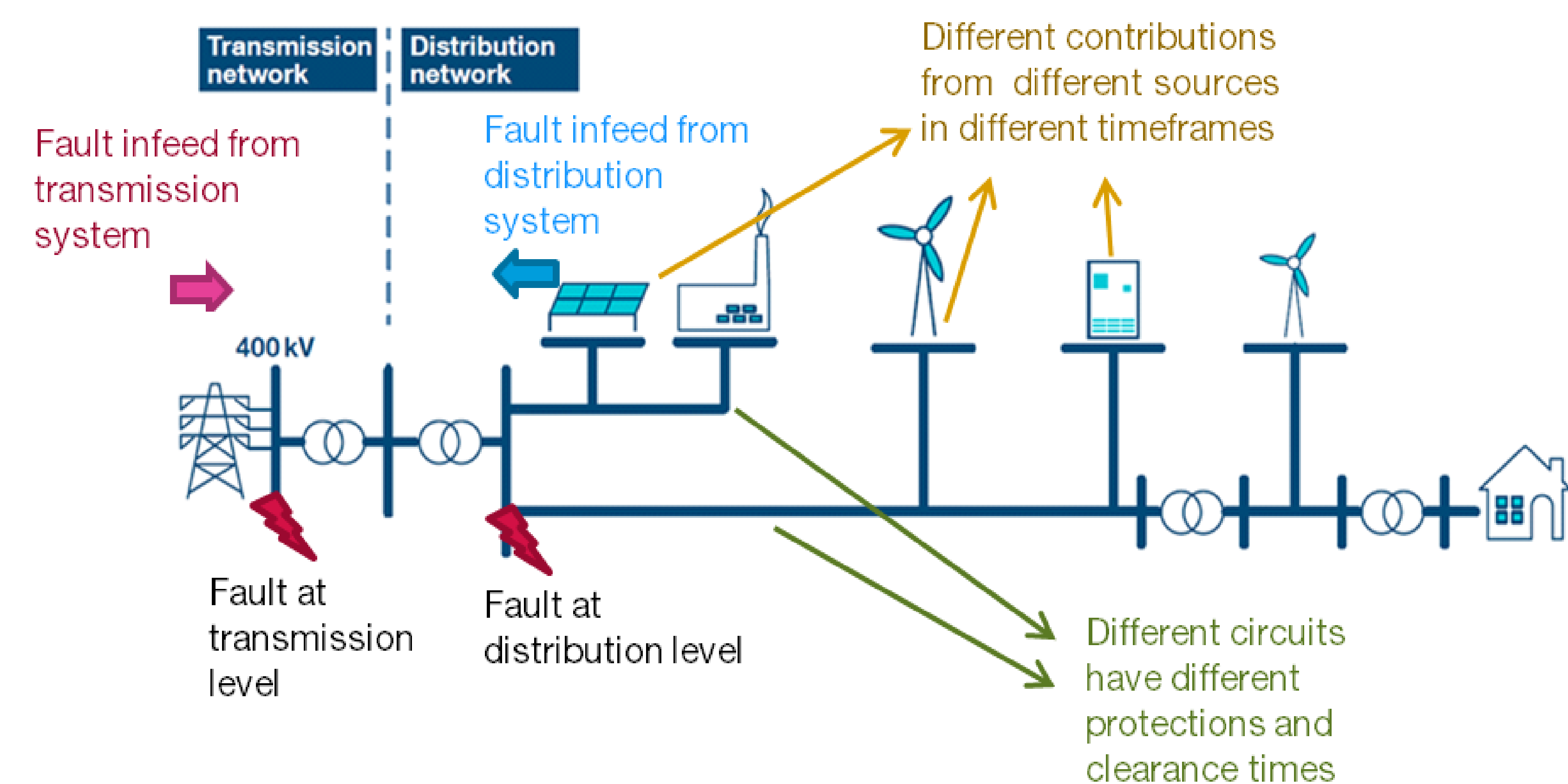
High Voltage Direct Current (HVDC) failure

- Commutation of current source HVDC

For some HVDC converters, as short circuit level declines, maintaining the requisite short circuit ratio becomes more challenging, influenced by network configurations and local synchronous generator availability.

- Generator's performance

There is a range of performance requirements for generators to satisfy as per grid code obligations. Our recent analysis of performance of PLL controllers shows that declining fault levels results in PLL not being able to track system voltage.



Next steps—understanding the whole system impact

Which area of the whole system in which year will experience protection mal-operation?

What can you do to help?
What do you need from us?

Please contact us: sof@nationalgrid.com

