XSICEL 2021

Transición energética en la 4ta revolución industrial

Universidad Tecnológica de Pereira

UNIVERSIDAD NACIONAL DE COLOMBIA

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Application of Distance Protection on Active Distribution Networks: A Qualitative Comparison

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Contents

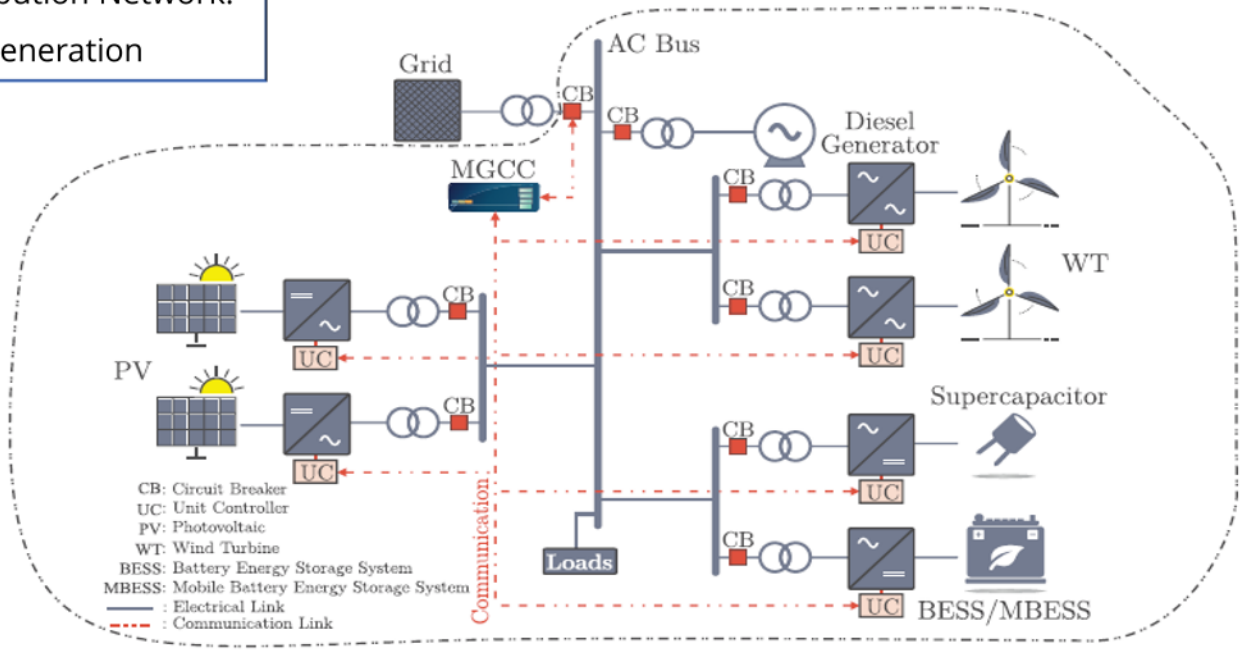
Source: https://www.flaticon.es/resultados?word=lista&type=icon

I. Introduction

Nomenclature:

ADN: Active Distribution Network.

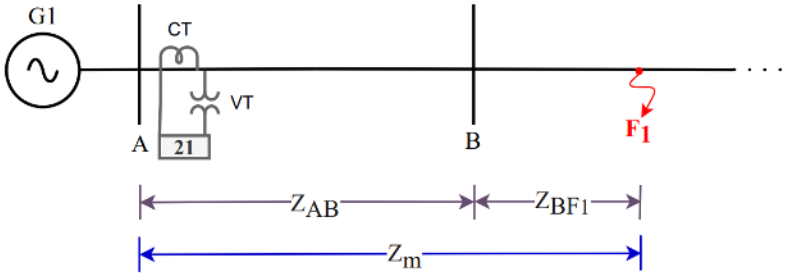
DG: Distribution Generation



Source: P.H.A. Barra, D.V. Coury, R.A.S. Fernandes, A survey on adaptive protection of microgrids and distribution systems with distributed generators, Renewable and Sustainable Energy Reviews, 2020.

II. Theoretical aspects

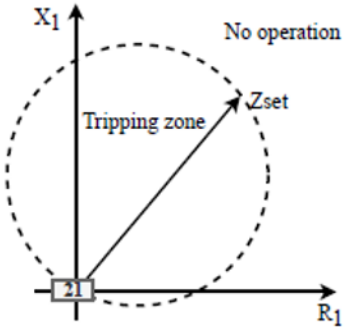
Fundamental concepts – Distance protection



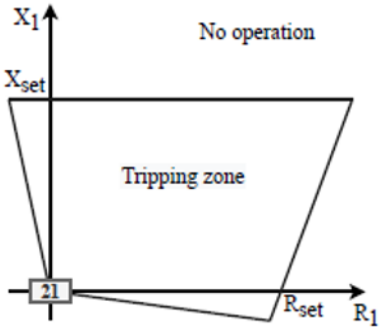
$$Z_m = \frac{\dot{U}_m}{\dot{I}_m}$$

If $Z_m < Z_{set}$, then send trip signal

Operational characteristics of distance protection.



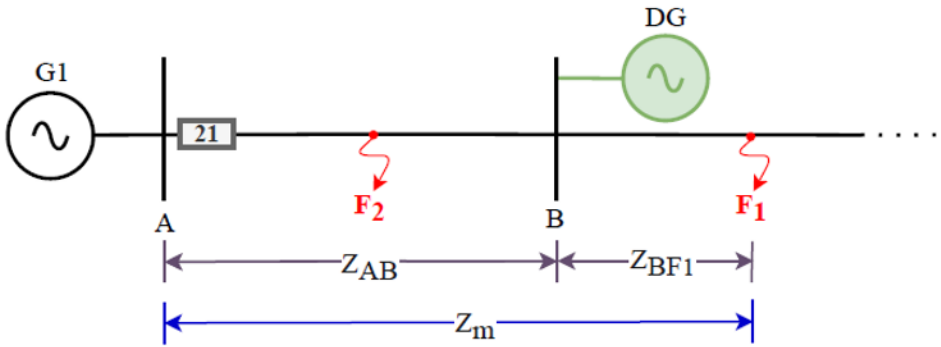
(a) Mho-type characteristics.



(b) Quadrilateral characteristic.

III. Description of some recent distance protection approaches for ADN

Reference	Description
Sinclair, Finney, Martin, y Sharma (2014)	The complexity of additional distance protection measures increase with DG integration.



$$Z_m = Z_{AB} + Z_{BF_1}$$

$$Z_{m,infeed} = Z_{AB} + \frac{I_{G_1}+I_{DG}}{I_{G_1}} Z_{BF_1}$$

$$Z_{m,R_F} = Z_{AB} + Z_{BF_1} + R_F$$

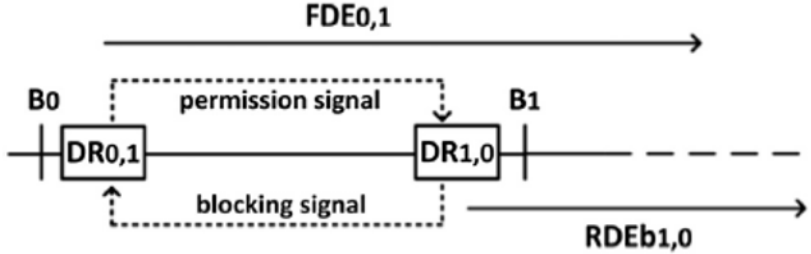
III. Description of some recent distance protection approaches for ADN

Reference	Description
Tsimtsios y Nikolaidis (2018)	Compensation factor to guarantee correct relay operation during single-line ground faults.

$$K_0 = \frac{(z_0 - z_1)}{K z_1}$$

$$Z_m = \frac{Z_{m,nc}}{(1 + K_0)}$$

Reference	Description
Tsimtsios, Korres, y Nikolaidis (2019)	A pilot-based distance protection scheme for meshed distribution systems with a high penetration of DG.



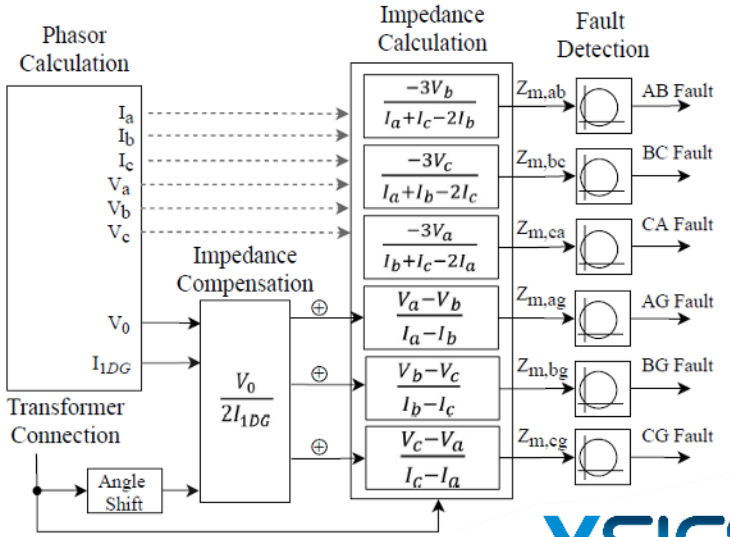
III. Description of some recent distance protection approaches for ADN

Reference	Description
Liang, Li, Lu, Xu, y Wang (2020)	The immunity to fault resistance is improved by constructing the virtual measured voltage.

$$\left|\dot{I}_m\right| |Z_m| \leq \left|\dot{I}_m\right| |Z_{set}|$$

$$\begin{cases} |\dot{U}'_m| \geq |\dot{U}_m| & , \quad \text{in-zone fault} \\ |\dot{U}'_m| < |\dot{U}_m| & , \quad \text{out-of-zone fault} \end{cases}$$

Reference	Description
Yin, Fu, Zhang, y Zamani (2021)	The designed distance relay executes an enhanced apparent impedance calculation using residual voltage compensation.



IV. Comparative analysis

Ref.	Issues					Applied to		
	Infeed Effect	Fault Resist.	Direction	Communic.	K_0 factor	Transmission	Distribution	ADN
[3]	✓	✓	✗	✗	✓	✗	✓	✓
[6]	✓	✗	✗	✗	✓	✗	✓	✓
[7]	✗	✓	✗	✗	✓	✓	✗	✗
[8]	✗	✓	✗	✗	✗	✓	✗	✗
[9]	✗	✓	✓	✗	✓	✗	✓	✓
[10]	✗	✗	✓	✗	✗	✓	✗	✓
[11]	✓	✓	✓	✓	✓	✗	✓	✓
[12], [13]	✓	✓	✗	✗	✓	✓	✓	✓

IV. Comparative analysis

Ref.	Issues					Applied to		
	Infeed Effect	Fault Resist.	Direction	Communic.	K_0 factor	Transmission	Distribution	ADN
[3]	✓	✓	✗	✗	✓	✗	✓	✓
[6]	✓	✗	✗	✗	✓	✗	✓	✓
[7]	✗	✓	✗	✗	✓	✓	✗	✗
[8]	✗	✓	✗	✗	✗	✓	✗	✗
[9]	✗	✓	✓	✗	✓	✗	✓	✓
[10]	✗	✗	✓	✗	✗	✓	✗	✓
[11]	✓	✓	✓	✓	✓	✗	✓	✓
[12], [13]	✓	✓	✗	✗	✓	✓	✓	✓

V. Conclusions

There is ***no efficient strategy*** for all types of fault in a selective, sensitive, reliable, and cost-effective way, ensuring minimum supply disruption to consumers.

Source: https://www.flaticon.es/icono-gratis/senal-de-stop_4151491?term=stop&page=1&position=14&page=1&position=14&related_id=4151491&origin=search

Finally, this paper aims to provide ***future directions*** for developing more complete strategies.

Source: https://www.flaticon.es/icono-gratis/voto-positivo_1533913

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QUESTIONS?

Source: https://www.womenshealthmag.com/life/a22500573/questions-to-ask-to-get-to-know-someone/