

# What is Transmission Infrastructure?

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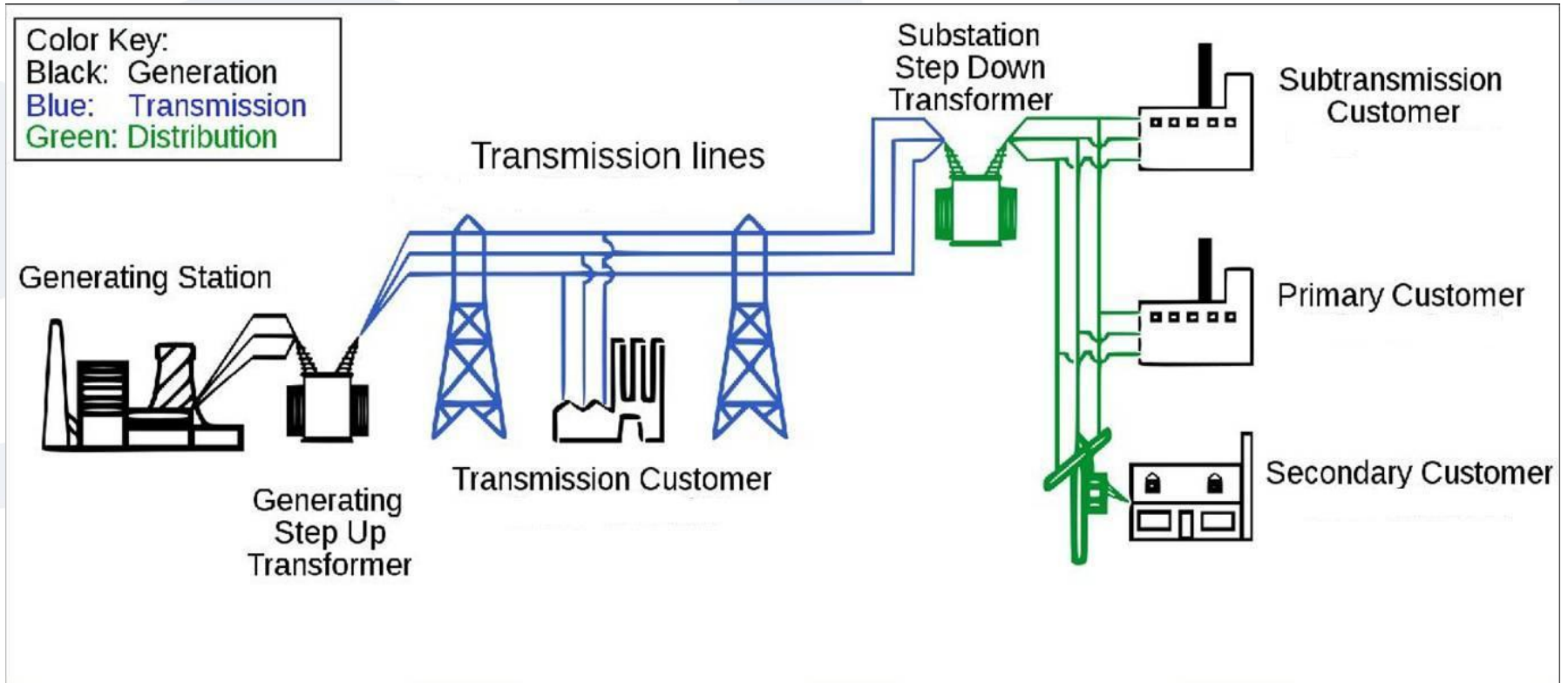
**RIDP Project Manager**

# Electrical Networks

## Distribution Networks



# Electrical Networks



# Electrical Networks

## Transmission

- **Transport large amounts of electrical energy**
- **High Voltage: generally above 100kV**
- **In Ireland: 110kV, 220kV, 275kV and 400kV**

... but first...

## Why High Voltage?

**When electrical energy is transported,  
heat is given off relative to the current  
=> Losses**

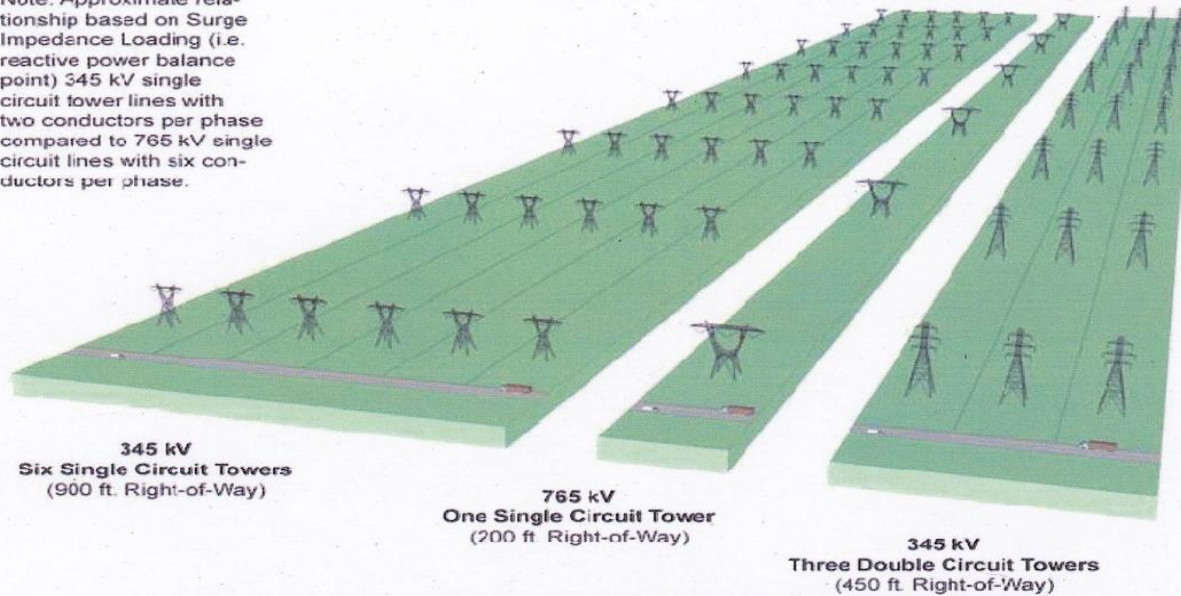
**Power = Voltage X Current**

**Voltage ↑ = Current ↓**

# High Voltage

## Environmental Benefits of Higher Voltage Transmission

Note: Approximate relationship based on Surge Impedance Loading (i.e. reactive power balance point) 345 kV single circuit tower lines with two conductors per phase compared to 765 kV single circuit lines with six conductors per phase.

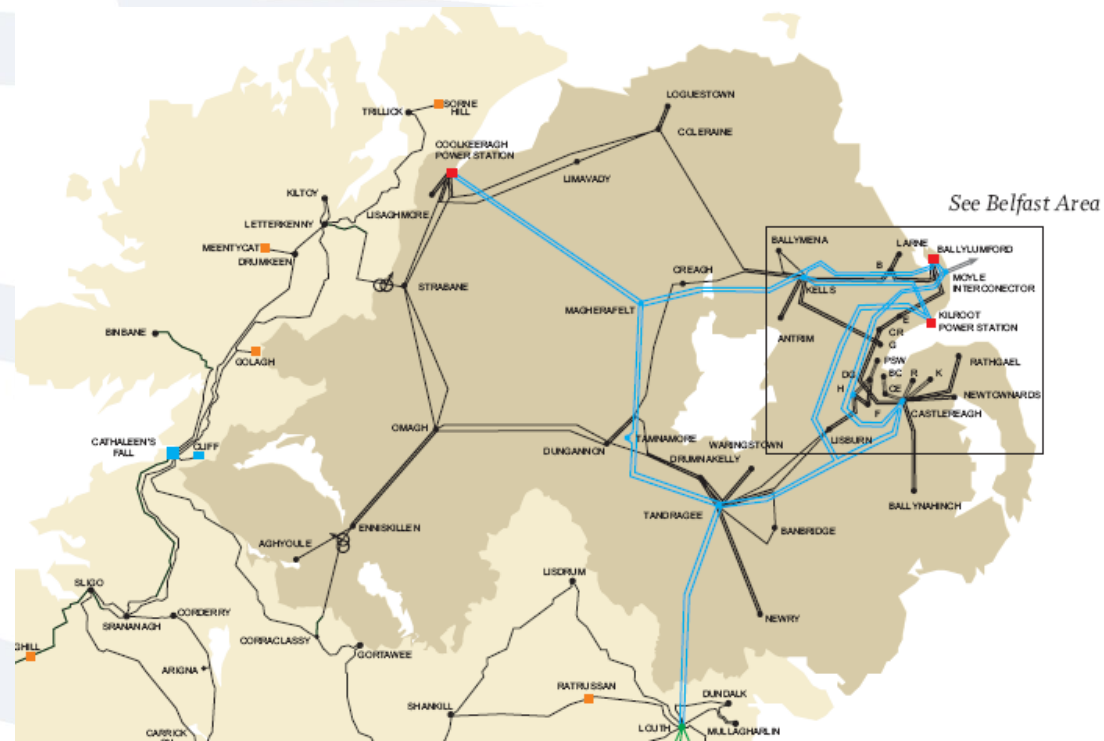


Transmission voltage selection significantly affects performance, cost and the environment.

# Components of Transmission Infrastructure

A power transmission system is composed by a series of elements such as:

- Overhead lines
- Underground cables
- Submarine cables
- Substations
- Converter stations





← Tower composed by metallic elements  
In some cases (typically for parts of 110 kV) → wooden poles can be used



## Familiarisation with transmission components: overhead lines

Foundations, with a → variable depth depending on the characteristic of the soil



← Conductors: usually in aluminium alloy; they represent about 1/3 of the line cost





# Familiarisation with transmission components: overhead lines

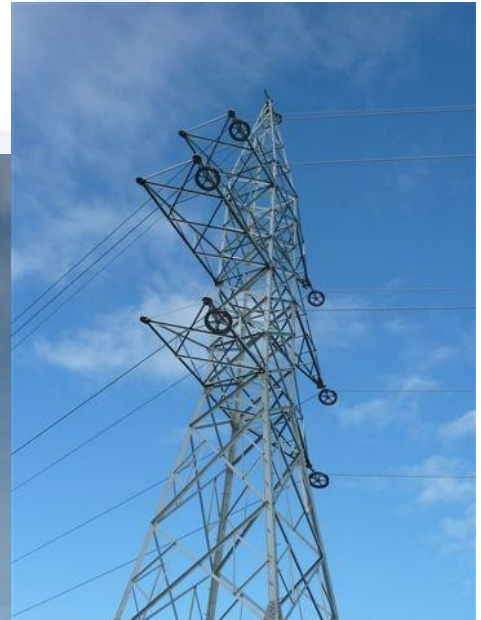


- **Visual Impact**
- **Land occupation: tower supports take up a variable area**

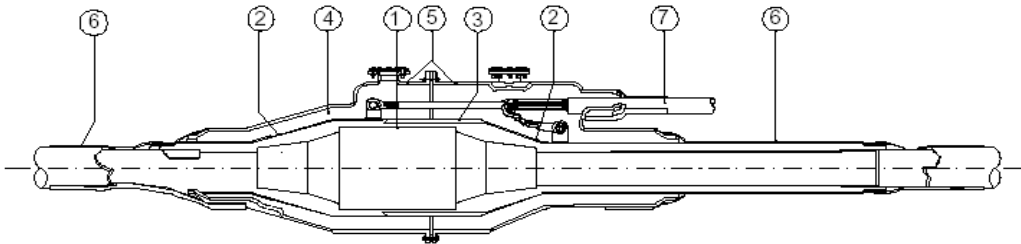
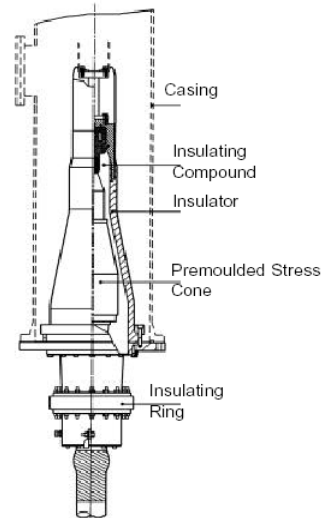
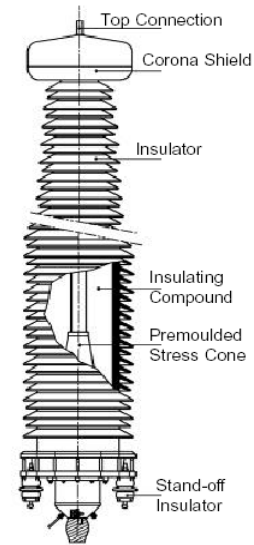
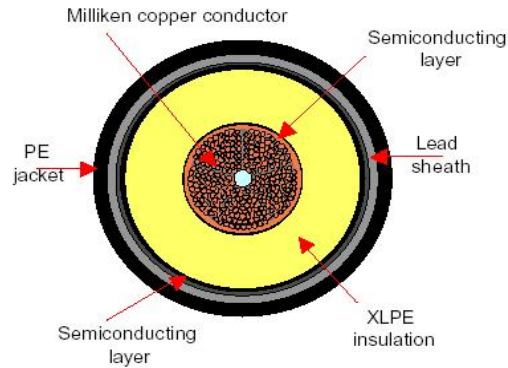
**Irish reference: 275kV:  
7.3 – 12.2 m<sup>2</sup>**

# Familiarisation with transmission components: overhead lines

## Construction



# Familiarisation with transmission components: underground cables



- 1 - Premoulded sleeve
- 2 - Casing
- 3 - Insulating ring
- 4 - Insulating compound

- 5 - Outer protection
- 6 - Heat shrinkable tube
- 7 - Concentric cable

**(\*) 1 joint per phase every 500-700 m**

# Familiarisation with transmission components: underground cables

## Methods for laying cable



**Trench (various solutions)**



**Tunnel (normally in urban areas)**



**Tubes**



# Familiarisation with transmission components: underground cables

## Joints chamber

Figure 4: Example of a 400 kV joint bay directly buried into the ground; Typical dimension: length 10-25 m, width 2.5 m, depth 2.1 m



**Trench and associated  
“site” for laying cables  
along a road**

# Familiarisation with transmission components: underground cables



**Impact on the land having buried the cables in the countryside**

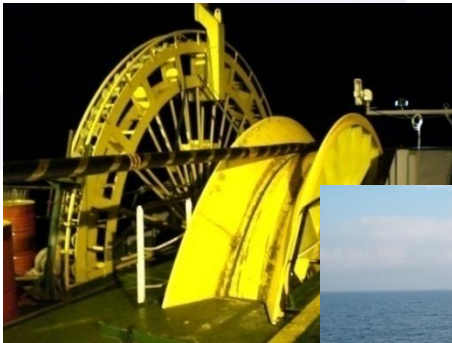


# Familiarisation with transmission components: submarine DC cables



- 1000 mm<sup>2</sup> Copper conductor
  - Semiconducting paper tapes
  - Insulation of paper tapes impregnated with viscous compound
  - Semiconducting paper tapes
  - Lead alloy sheath
  - Polyethylene jacket
  - Metallic tape reinforcement
  - Synthetic tape or yarn bedding
  - Double layer of flat steel wire armour
  - Polypropylene yarn serving
- Diameter      118 mm  
Weight        44 kg/m

Submarine cables are laid down directly from the ship - Section of cables having a length exceeding 100 km – submarine joint only for long submarine links

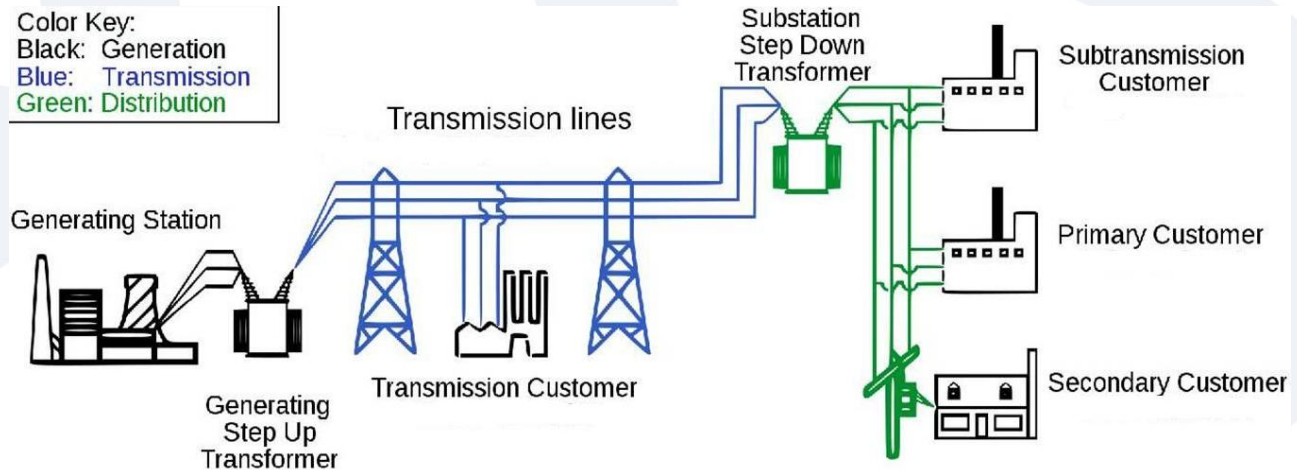




# Familiarisation with transmission components: Substations

## AC Substations:

- AIS
- GIS
- Hybrid



## DC Converter Stations

# Familiarisation with transmission components: AIS substations



# Familiarisation with transmission components: GIS substations



# Familiarisation with transmission components: Substation Design

**AIS**



**GIS**



# Substation switchgear technology: hybrid solutions

**AIS**



**AIS  
Compact**



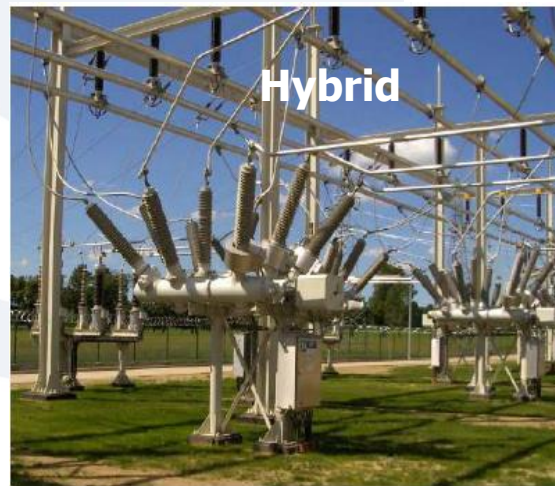
**GIS**



**Hybrid**



**Hybrid**



# Familiarisation with transmission components: converter stations

SAPEI – Latina Converter Station



Source: Terna

**Example of the new converter station (500+500 MW) of the HVDC link between Sardinia and Continental Italy, commissioned in 2009-2010**

# Familiarisation with transmission components: converter stations

HVDC Light converter station  
Woodland, Ireland

