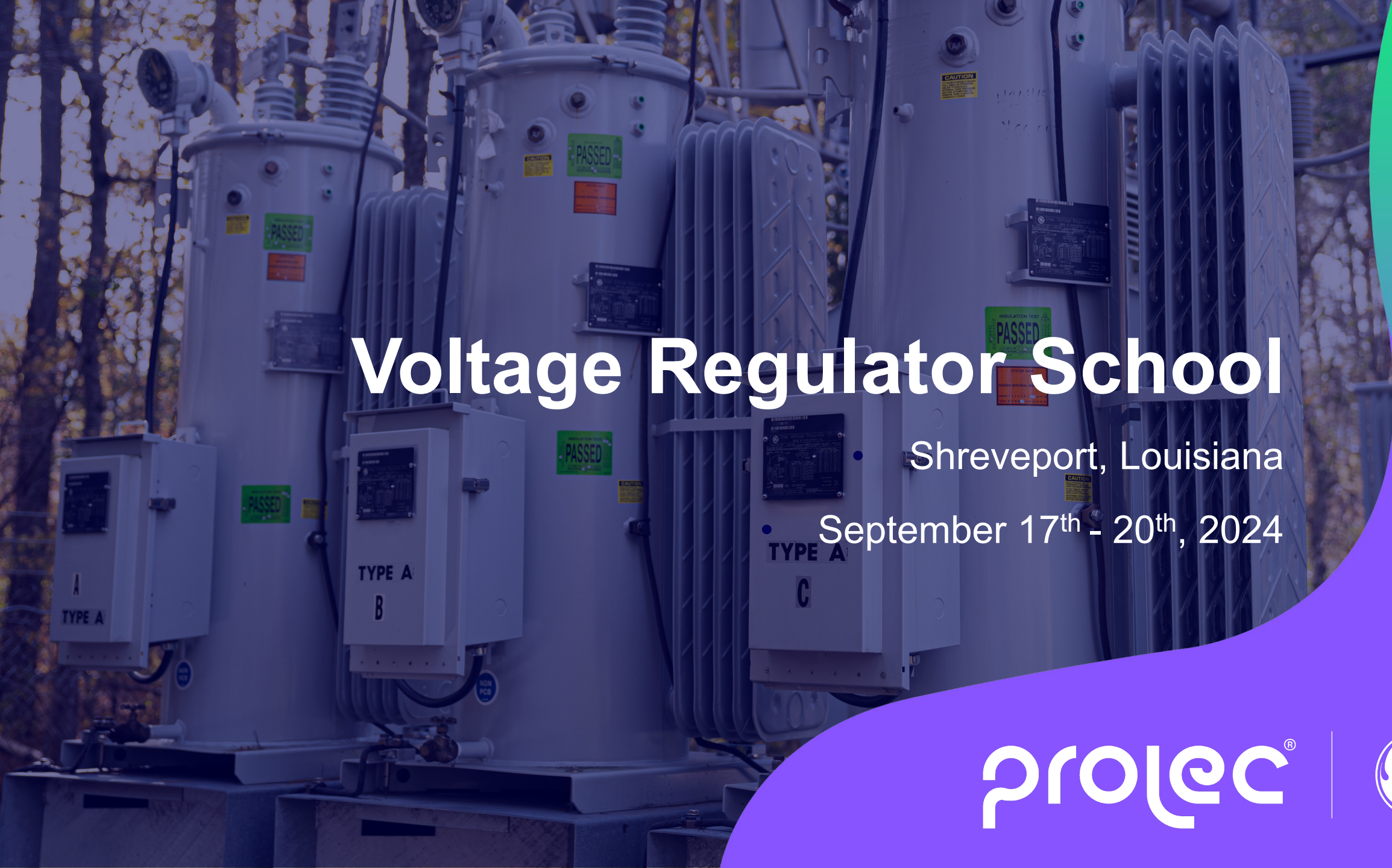


Voltage Regulator School

- Shreveport, Louisiana
- September 17th - 20th, 2024

Voltage Regulator Introduction

Voltage Regulator Introduction

The future of the electric utility industry is one of dynamic expansion

ASK YOURSELF

- **Why** do voltage variations occur on distribution systems?
- **What** problems do they create?
- **What** can you do to correct them and maintain the proper voltage levels?

Introduction

In the **control** and **operation** of **Electrical Power Systems,** four important variables coexist that are critical for the stability of the system.

1. **Active Power**
2. **Reactive Power**
3. **Frequency**
4. **Voltage**

They are linked as follows:

Introduction

Voltage control can affect reliability and commerce in three ways:

1

Both customer and power-system equipment are required to operate within a range of voltages.

2

Reactive power consumes generation, transmission and distribution resources.

3

Moving reactive power on the system incurs in real-power losses.

Introduction

Which elements absorb and produce reactive power?

Produce	Absorb	Regulating transformers
• Synchronous generators • Capacitors • Overhead power lines at low load • Underground power lines	• Transformers • Overhead power lines at high load • Electrical loads – Industry – Households	Don't absorb or generate reactive power but they force voltage up or down by changing it transformation ratio.

All previous elements will modify the voltage.

Introduction

What problems voltage variations create?

Sensitive Loads

Lights

Outlets

Electrical Machines

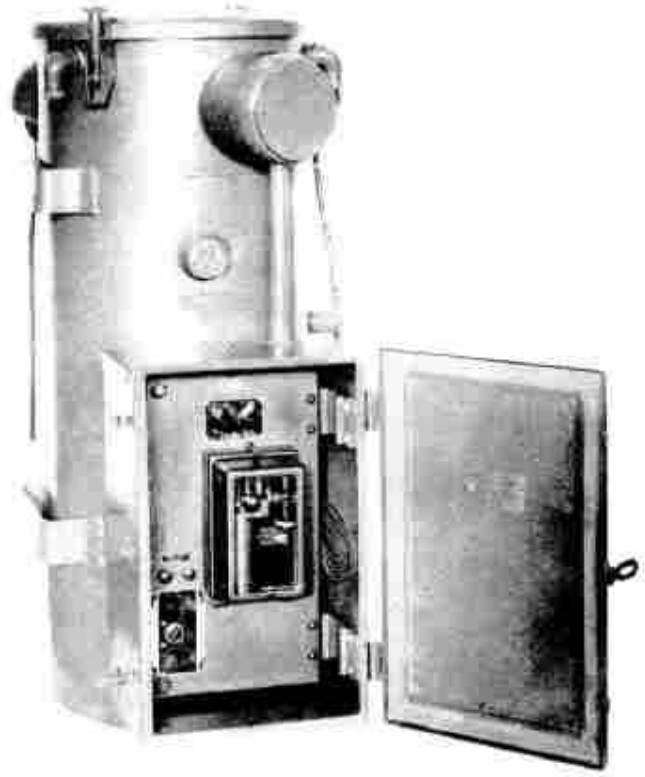
- **Negative impact** in the **power quality** deliver to the customer.
- Devices will **not be able to operate** at outrange voltages.
- **Damage of electrical equipment** due to overheating (undervoltage) and **insulation damage** (overvoltage).

Voltage Regulator History
1936 to Present

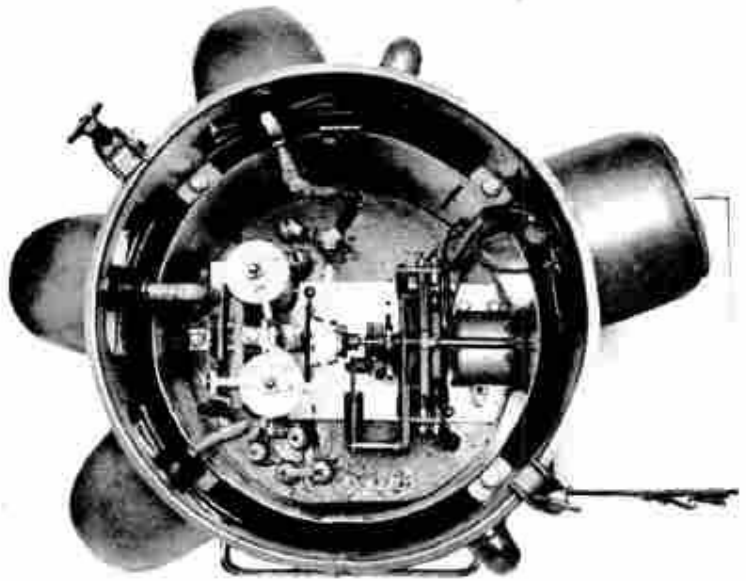
Regulator & Control History

- Original home of GE Voltage Regulators
- GE transformer plant in Pittsfield, Massachusetts
- Original plant was bought from William Stanley in 1903

GE ML-4 Step Voltage Regulator

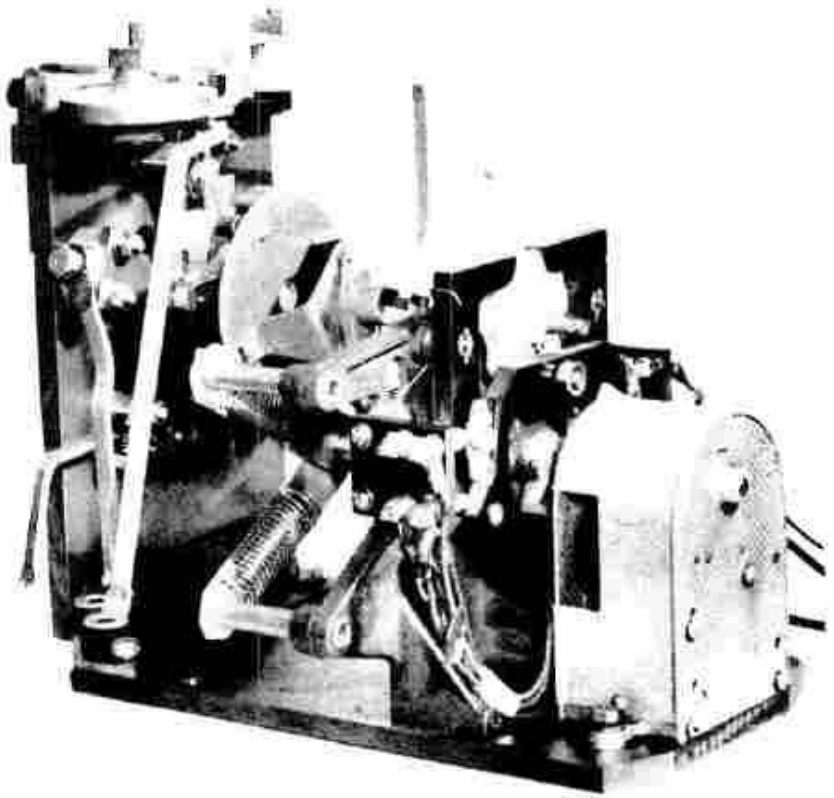


T79638 G-E STEP-VOLTAGE REGULATOR, TYPE ML-4. CONTROL SIDE.
FILING NO. 5400 6332.1 3-25-56
Fig. 1



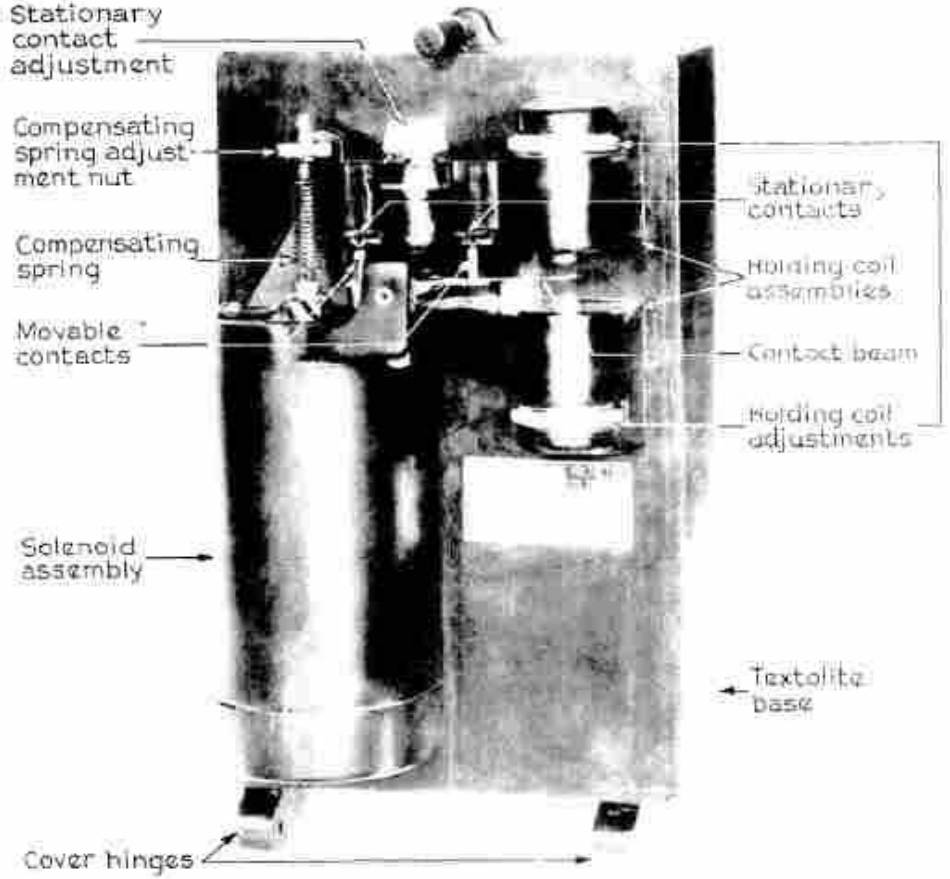
T79637 G-E STEP-VOLTAGE REGULATOR, TYPE ML-4, WITHOUT COVER TO SHOW MECHANISM. TOP VIEW.
FILING NO. 5400 6332.1 3-25-56
Fig. 2

LR-20 Switch



779623 SWITCHING MECHANISM, TYPE LR20, FOR G-E SINGLE-PHASE STEP-VOLTAGE REGULATORS. VIEW SHOWING OPERATING MECHANISM AND SWITCH CONTACTS.

FILING NO.5400 E332.1 3-27-36
Fig. 3



493606 G-E CONTACT-MAKING VOLTMETER, TYPE B-20, FOR USE WITH VOLTAGE REGULATORS.

FILING NO.5400 E353.24 2-21-35
Fig. 4

Regulator & Control History

1955

1958

1962

1965 ML-32 Untanking

VR-1 1983 VR-1 Untanking

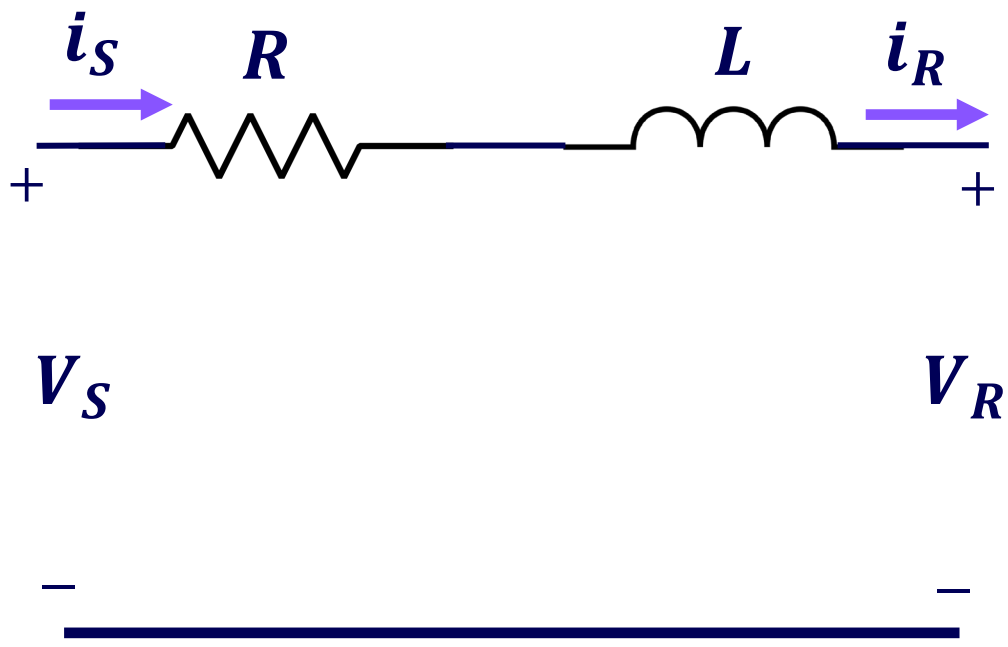
Plant Overview

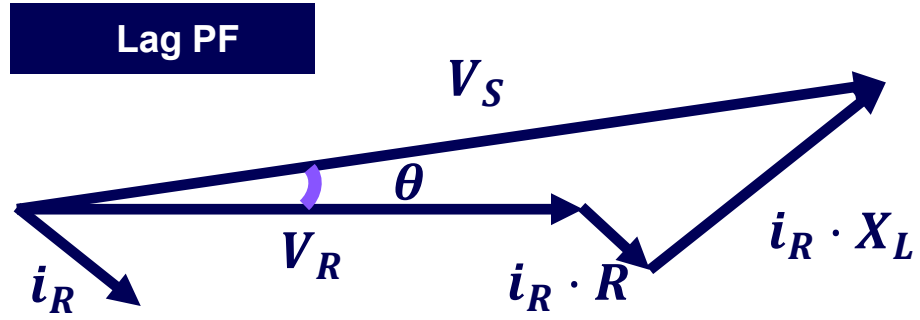
- Built in 1970
- 200 Acres – 600,000 Sq Ft
- 434 Hourly Employees
- 95 Salaried Employees
- Non-Union
- 6 Sigma Quality Standards
- ISO Certified 9001:2015

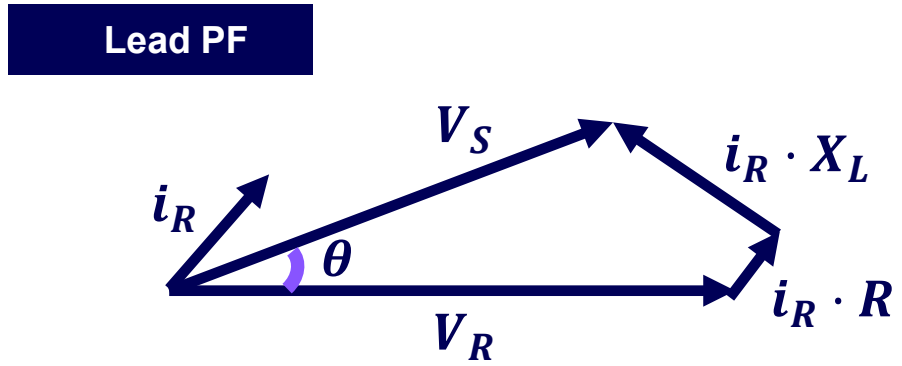
Voltage Regulators on Distribution Systems

Power Transfer

The power transfer capability rises as the PF swings towards the leading region and diminishes as it swings towards the lagging region:







Distribution Systems

Automatic voltage regulation of distribution systems is provided by using one or more of the following methods:

- **Bus regulation** at substation
- **Individual feeder** regulation in the substation
- **Supplementary regulation** along the feeders

3ph bank at substation bus

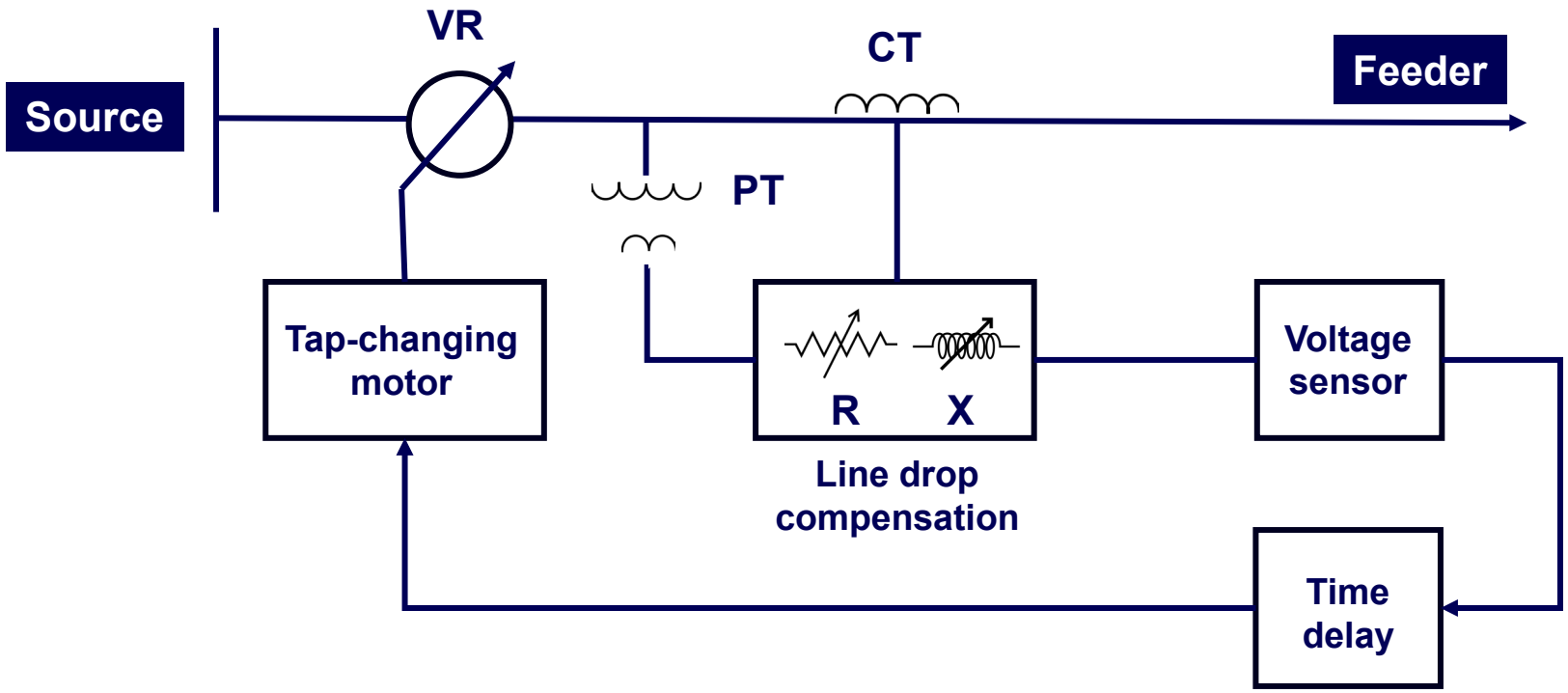
Feeder

VR Locations

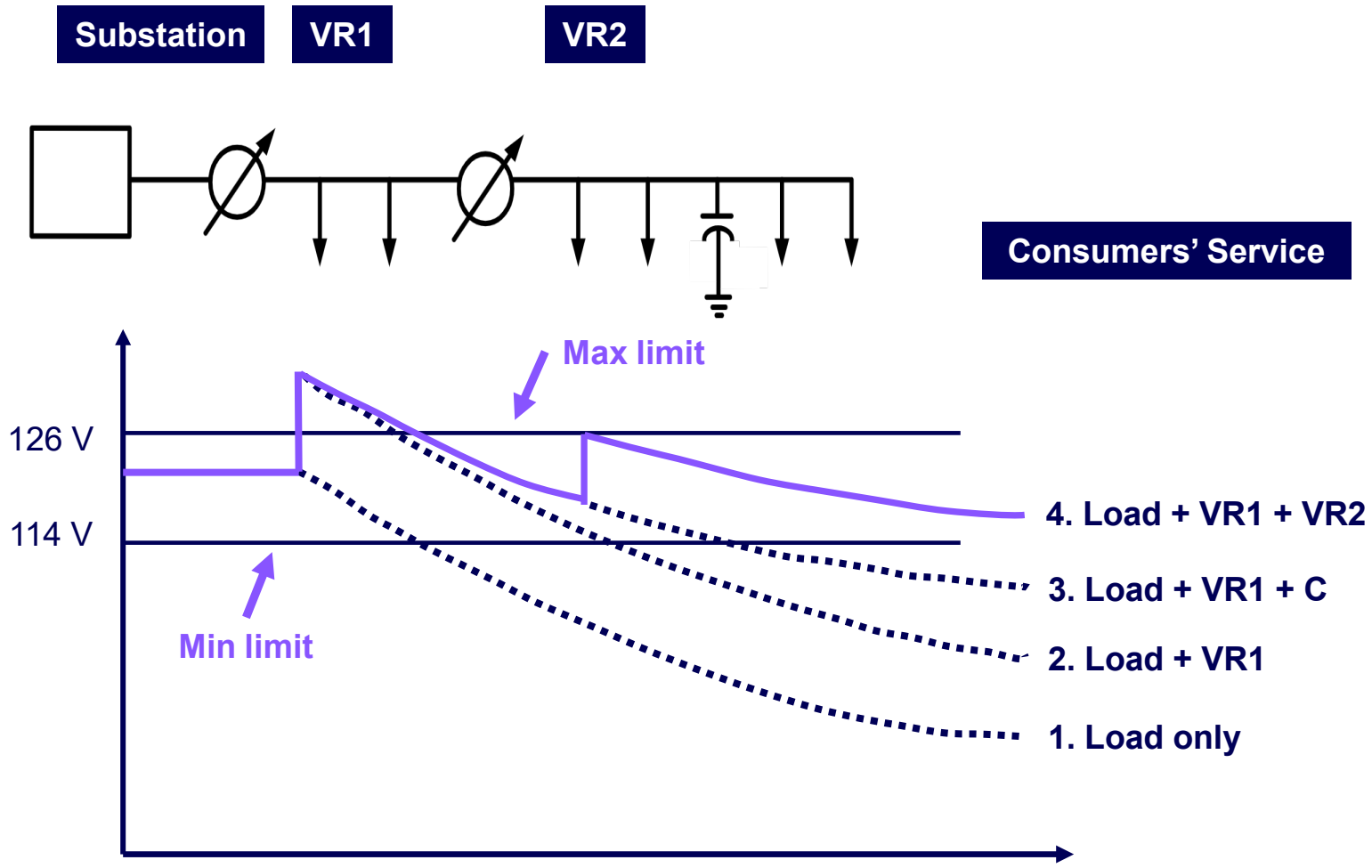
Bus/Group Regulation

Feeder Regulation

Control Mechanism



Applications



Voltage Regulator Application

- Pole-Mounted Voltage Regulator
- Controller with Integrated Wireless Communications

- Substation Voltage Regulator
- Controller with Integrated Communications