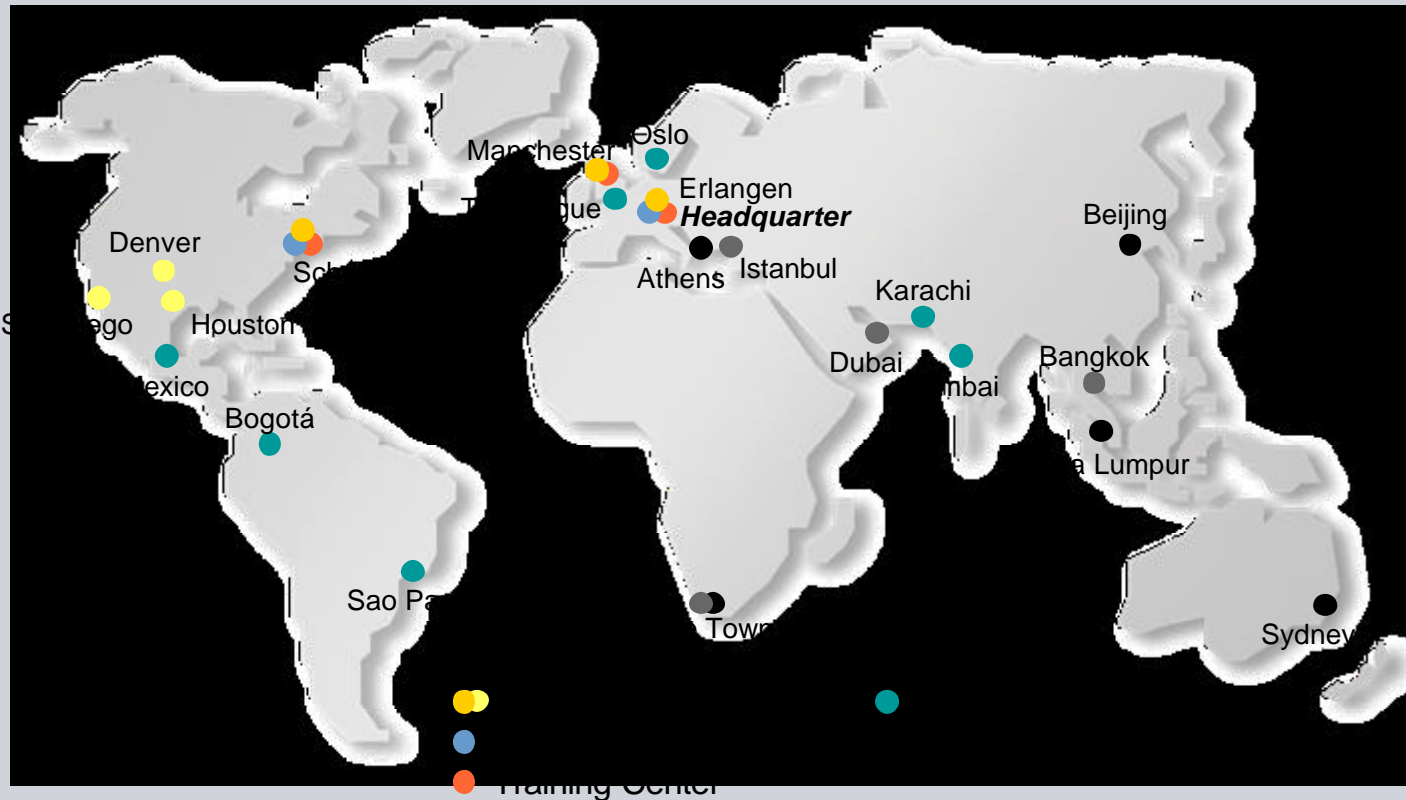


Network Consulting for Power Grid Optimization

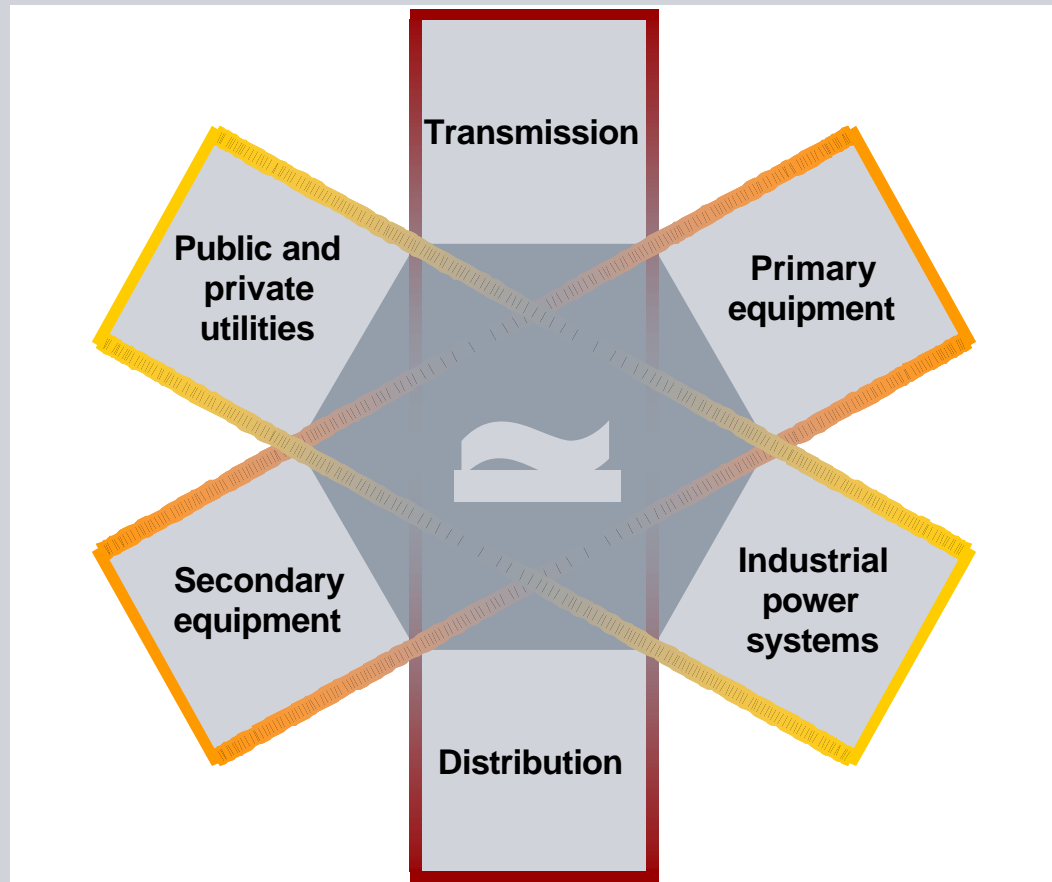
Project experience in India

PTD SE PTI Network Consulting Competences

PTD SE PTI – Our worldwide representation



PTD SE PTI – Our system planning competences



PTD SE PTI – Our portfolio

▪ **Network Consulting**

- System planning
- System dynamics
- Power quality
- System protection

... full range of consulting competences

▪ **Software**

- PSSTME
- PSSTMSINCAL
- PSSTMNETOMAC
- PSSTMODMS
- PSSTMMUST
- PSSTMLMP

... transmission system planning
 ... distribution system planning
 ... dynamic system analysis
 ... operational data management
 ... system transmission analysis
 ... location marginal pricing analysis

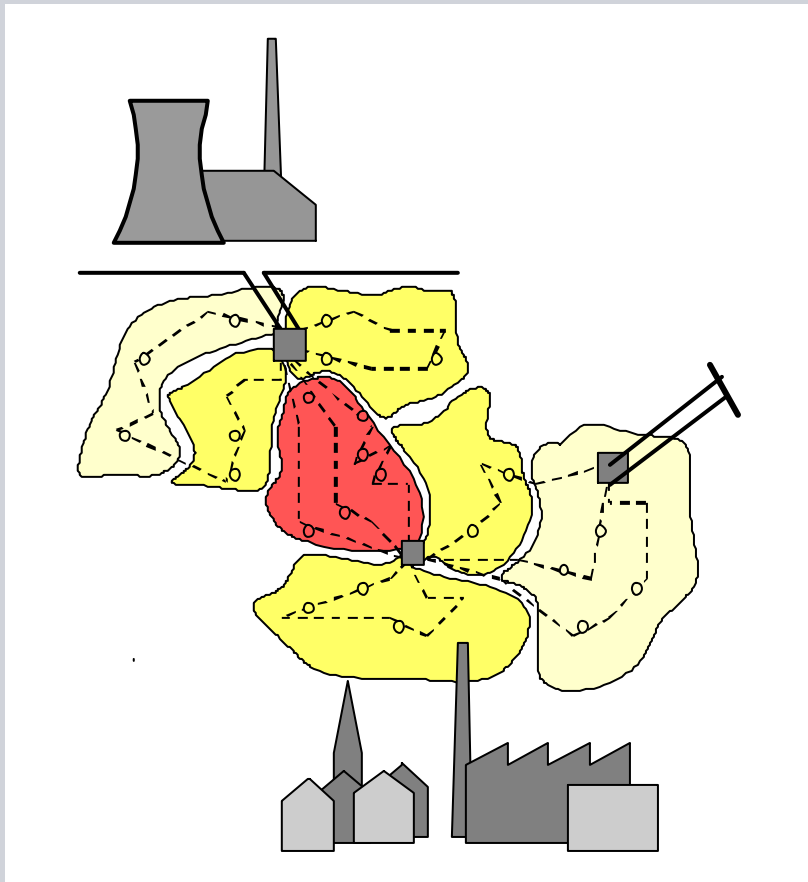
▪ **Training**

- Standard training courses
- Customized training courses

... meeting any requirement

PTD SE PTI –Network Consulting System Planning

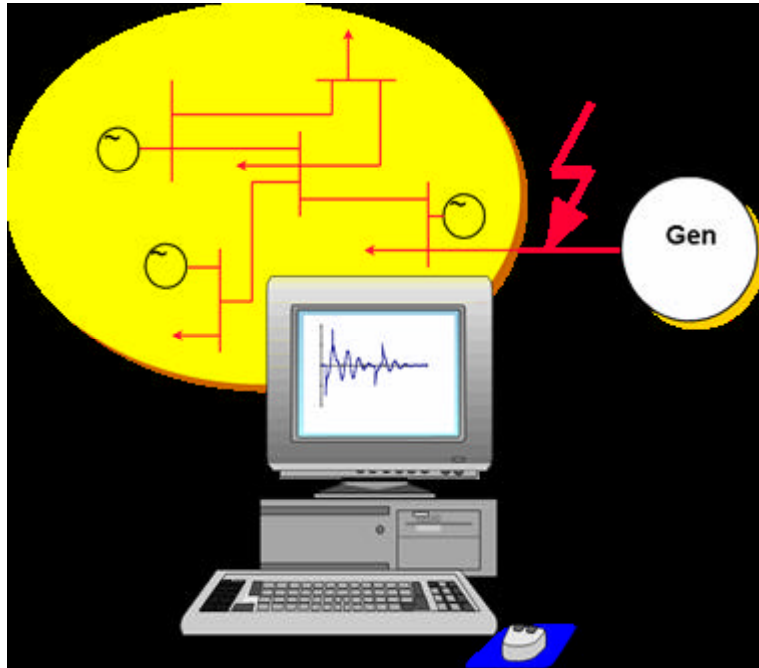
SIEMENS



- Transmission System Planning
- Distribution System Planning
- Industrial System Planning
- Transportation System Planning

- System Design
- System Restructuring
- System Development
- Supply Reliability
- Maintenance Strategies
- Earthing Systems -
Design and Measurements
- Interference Investigations
- Regulatory and economic analyses
- Decentralised Energy Management

PTD SE PTI –Network Consulting System Dynamics



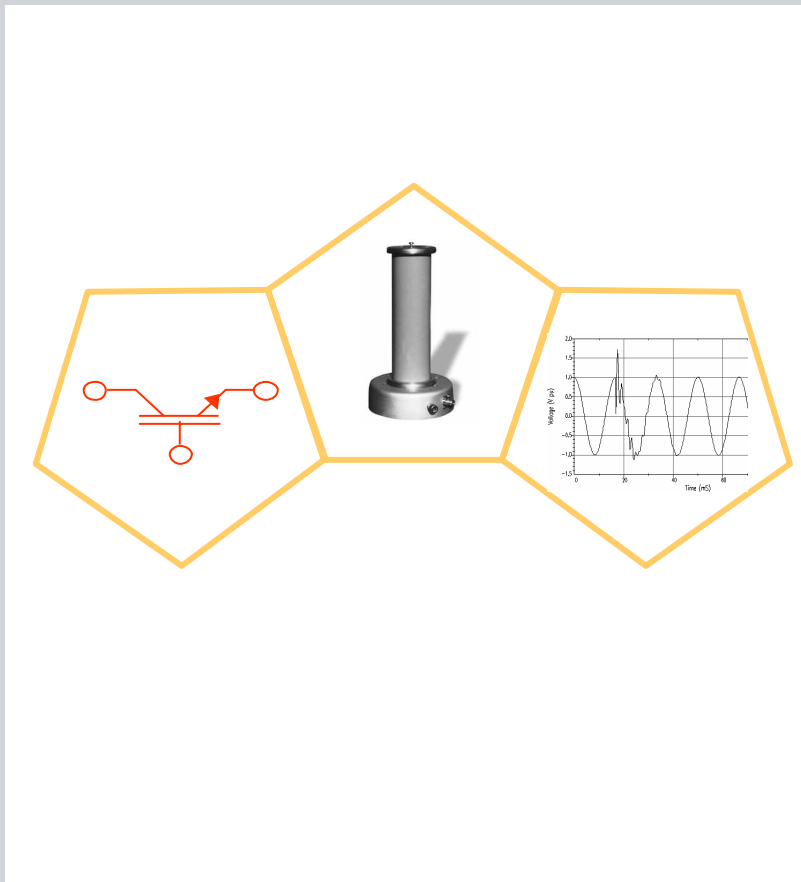
- Standard and Special Industrial Networks
- Power System and Machine Interactions
- System Interactions of HVDC and FACTS

- System Dynamics
- Stability
- Modal analysis
- Control and Automation

- Wind farms and their grid connection

PTD SE PTI –Network Consulting Power Quality

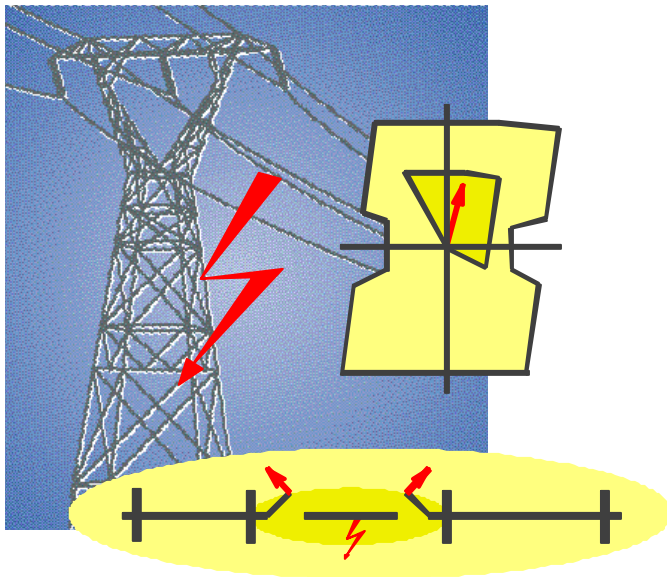
SIEMENS



- Power Quality
 - Power Quality Measurements
 - Design of Mitigation Equipment
 - Investigation of Failures
- Transients
 - Insulation Co-ordination
 - Switching Overvoltages / Transients
 - Measurements
- Power Electronics
 - System Connection of Power Electronics
 - New Technologies
 - Design of Controls

PTD SE PTI –Network Consulting System Protection

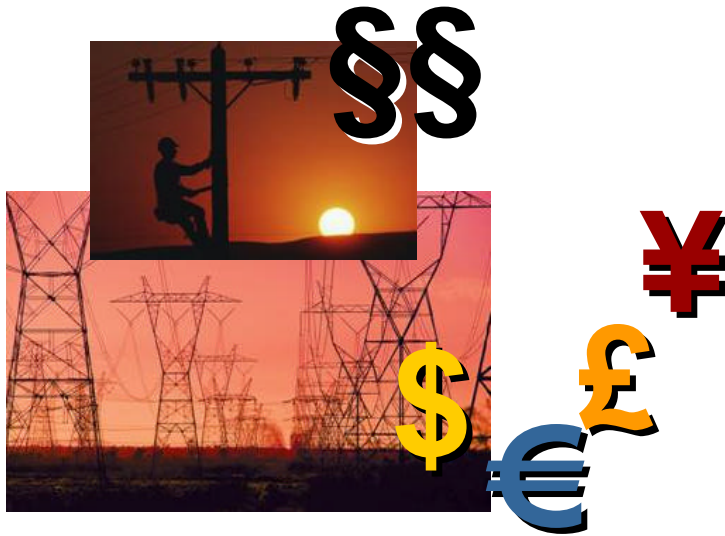
SIEMENS



- Protection Design
- Protection Coordination
 - Power Plants
 - Utility Systems
 - Transportation Systems
 - Industrial Systems
- Real Time Relay Testing
 - Real time system simulator
- Disturbance Analysis
- IT Solutions, E-Business

PTD SE PTI –Network Consulting Regulatory/Due Diligence Support

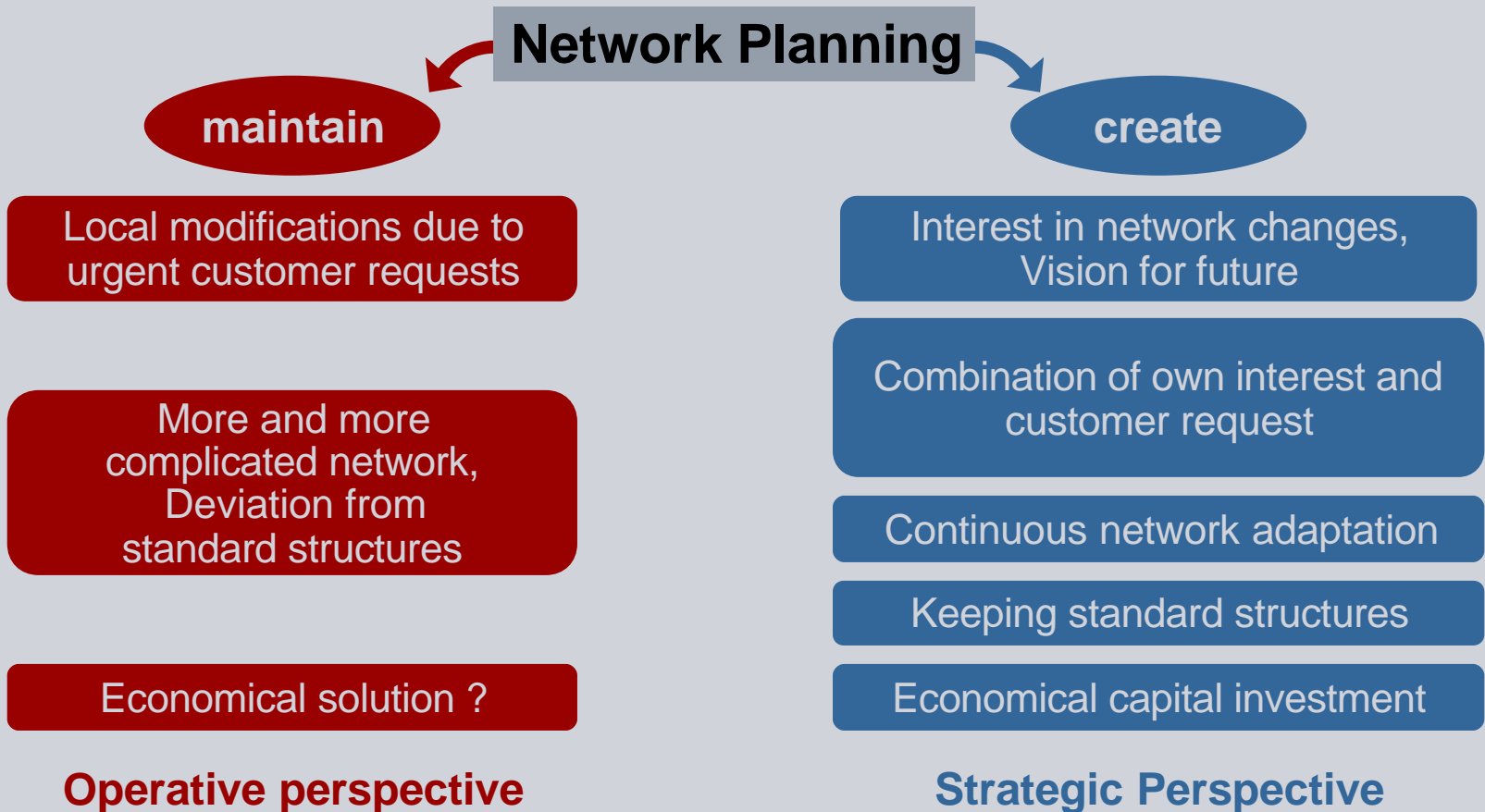
SIEMENS



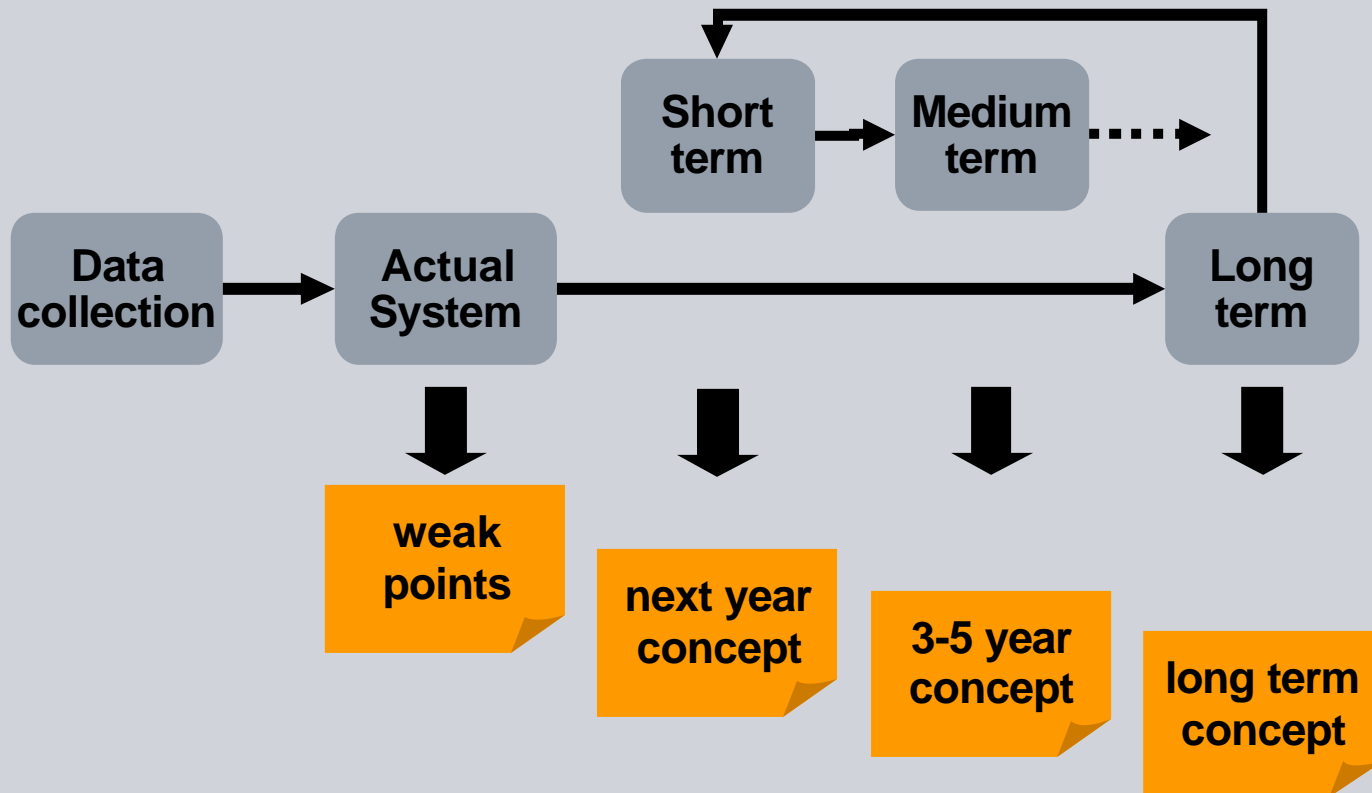
- Due diligence processes
- Regulatory policy assessment
- Impact studies:
 - CapEx and OpEx performance
 - Electricity tariffs
 - Top-down and bottom-up forecasts
 - Independent assessments
- Load forecasting and distribution expansion planning
- Optimization of reliability vs. cost
- T&D operations and condition review/assessment
 - Performance benchmarking against experience database
- T&D inventory and mapping services

Principles of Systematic Network Consulting

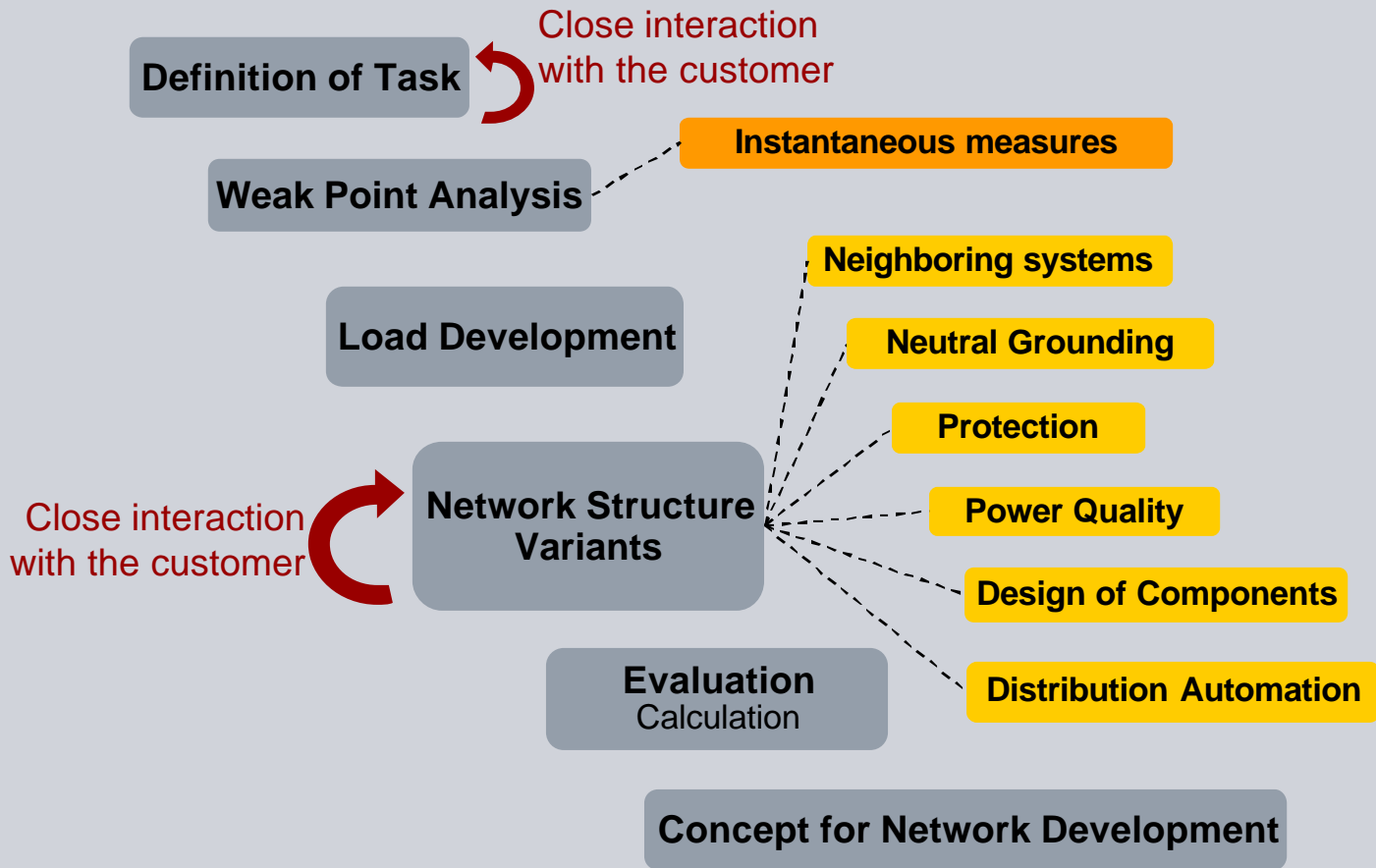
Strategic network planning



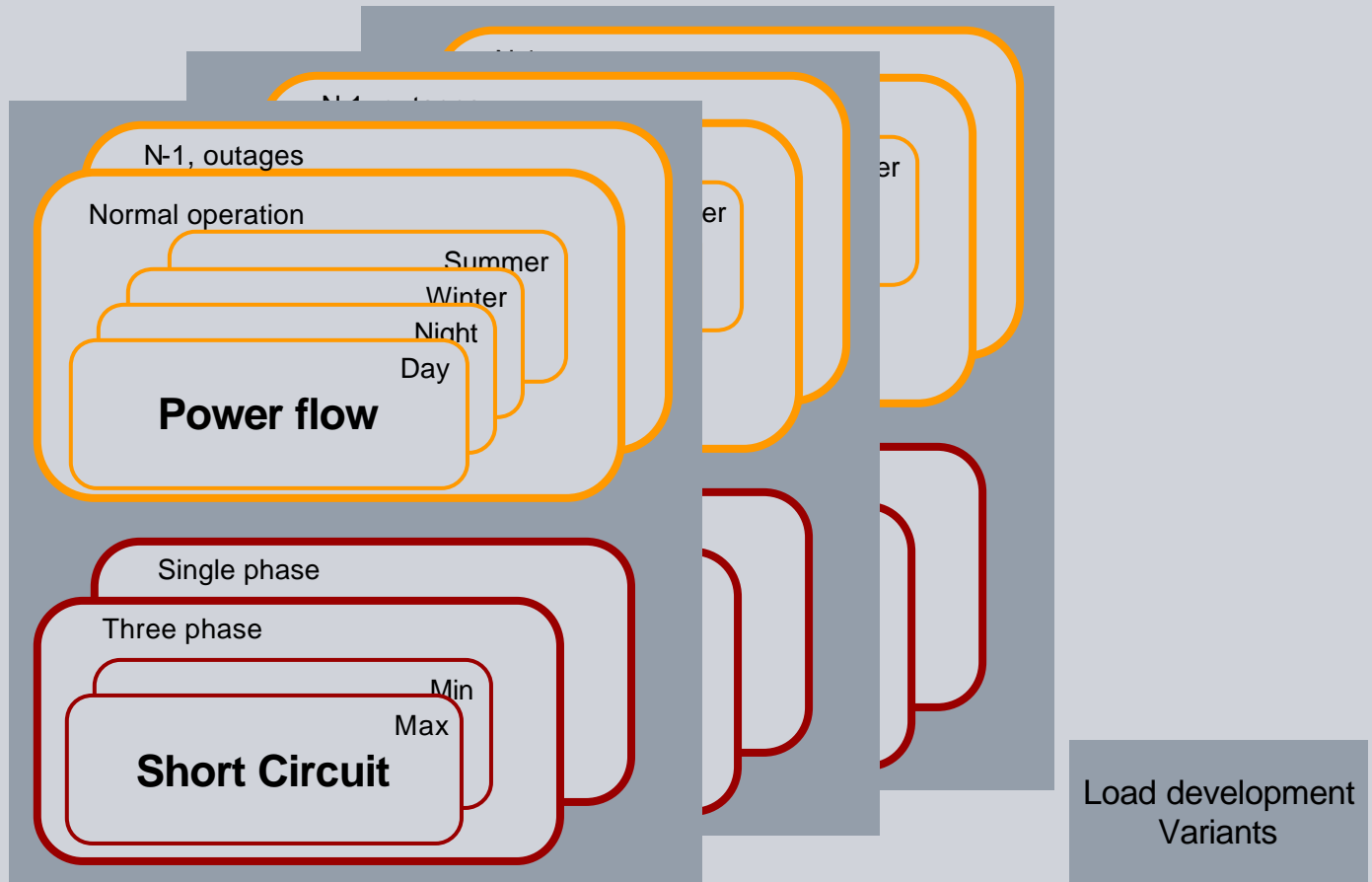
Procedure for long term planning



Strategic network planning process



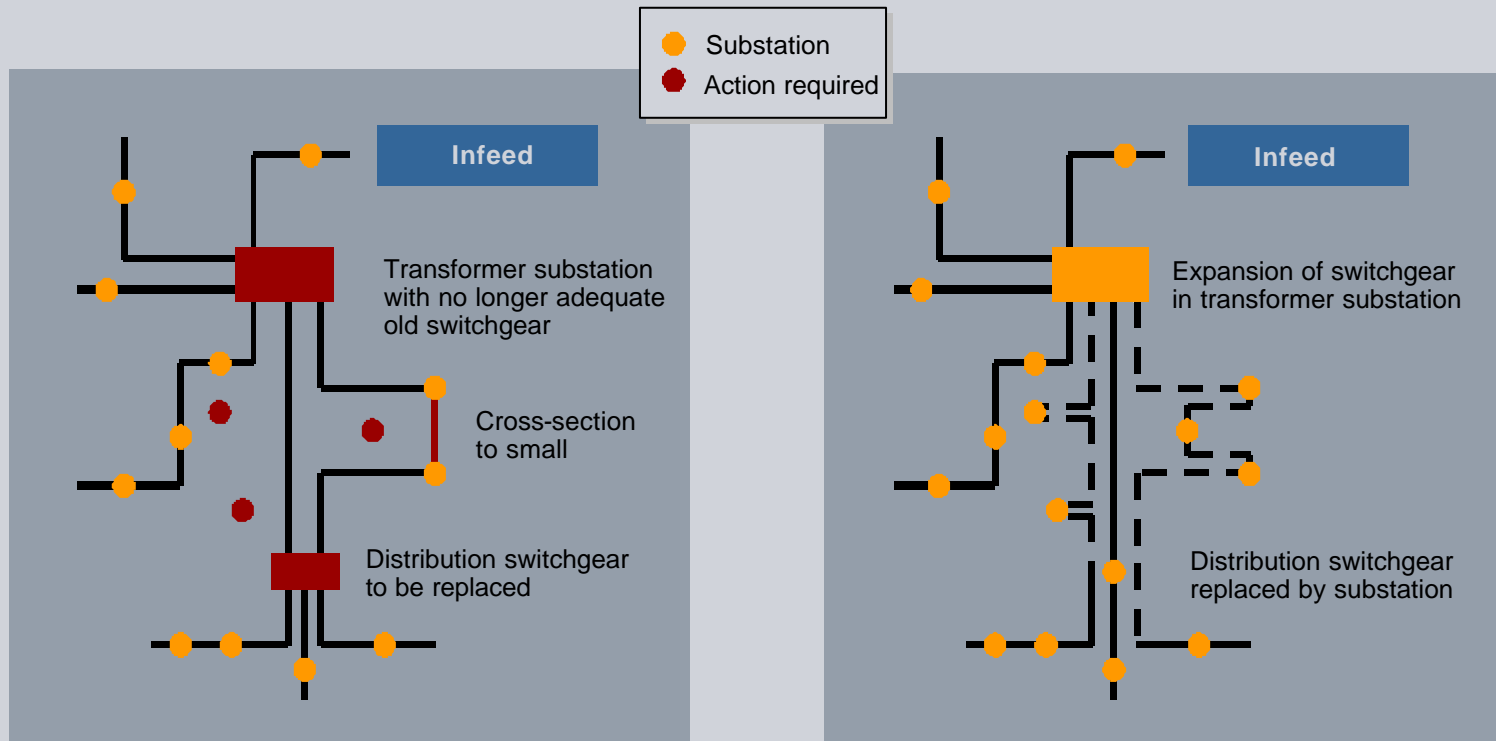
Planning steps for network development



Subjects in electrical network planning

- Load development
- Power flow and short circuit
 - for normal operation
 - for contingencies
- Motor start
- System dynamics, voltage stability, load rejection
- Insulation co-ordination
- Protection concept and settings
- Reactive power management
- Voltage Quality and Supply reliability
- Economical steps of network development
- Standard network components
- System operation
- Supply restoration strategies
- System automation

Refurbishment with strategy



Customer Benefits

Customer benefits from joint planning (1/2)

- Identification of weak points from independent point of view
- Start of modernization in area with best cost/benefit ratio
- Avoiding misleading investment or upgrading
- Benchmark of network performance
- Knowledge of sources of losses, mitigation strategies and losses reduction
- Back-up from long term and world-wide Siemens experience
- Participation of local Siemens experts
- Qualification of own staff
- Data base to meet future challenges
- Identification infeed/generation requirements
- Improvement of power reliability and quality
- Satisfied customers

Customer benefits from joint planning (2/2)

- Best practice concepts for Transmission and Distribution from the world market leader
- Unique Software solutions for all problems
- Simple and reliable operation
- Reduction of failure impact
- Economical Investment
- Priority steps for network enhancement
- Standardization of network components
- Minimization of operational expenses
- Personal safety

Our Goal

**To be the most competent and convenient partner
in power system consultancy**

Greenfield Planning for Mumbai

Characteristics of different system levels

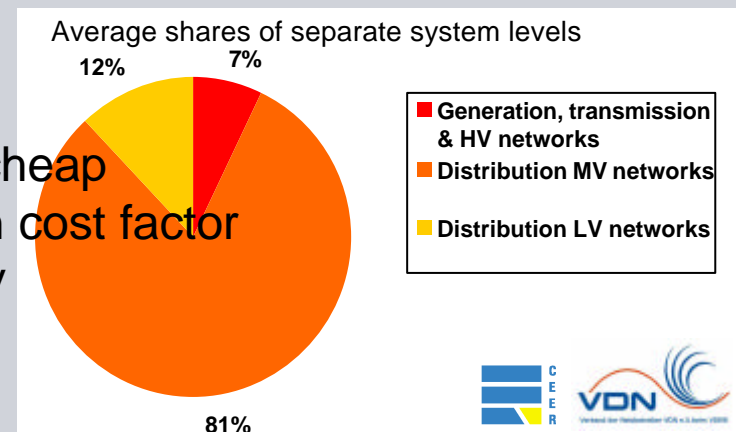
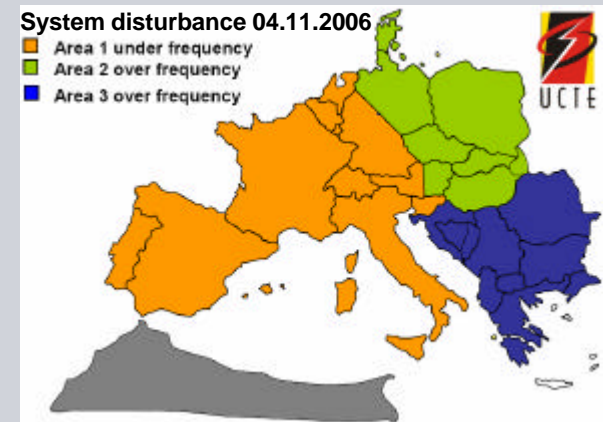
Transmission systems

- Individual components very expensive
- Outages imply risk of blackouts
- ➔ Responsible for system security

Subtransmission systems

Distribution systems

- Individual components comparably cheap
- High number of components → Main cost factor
- Outages → “Normal” Non-availability
- ➔ Responsible for supply reliability



Overview

- Purpose and goal of the study project

Development of a long-term strategy for the city of Mumbai by using a “Greenfield” approach

- Aspects covered in the study project
 - Long-term network development
 - Optimization of network operation
 - Roadmap for transition phases and required project schedule
 - Specific goals
 - Reduction of losses
 - Increase of supply reliability
 - Cost-effectiveness of network investment and operation

Greenfield planning approach – Structure

- Step 1: As-Is-Analysis
 - Analysis of load structure
 - Analysis of geographical information
 - Analysis of network parameters and planning guidelines

- Step 2: Base Case Investigation
 - Pre-analysis of options based on the network parameters
 - Selection of suitable options

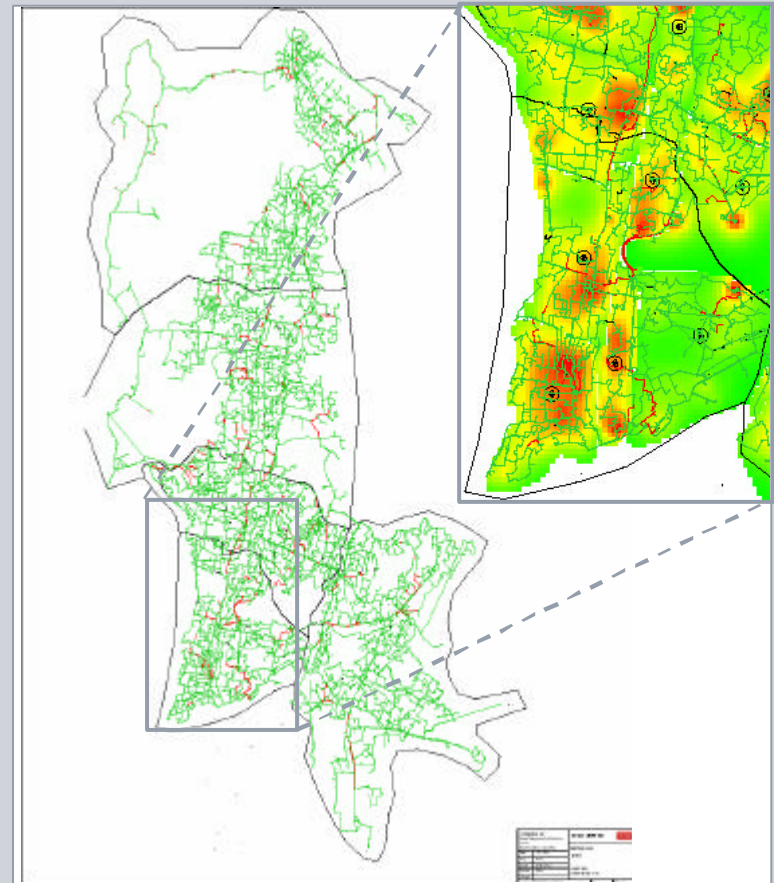
- Step 3: Preparatory Tasks
 - Division of whole area into sub-areas

- Step 4: Determination of Greenfield Structure

- Step 5: Superimposition of Greenfield Structure and Existing Network

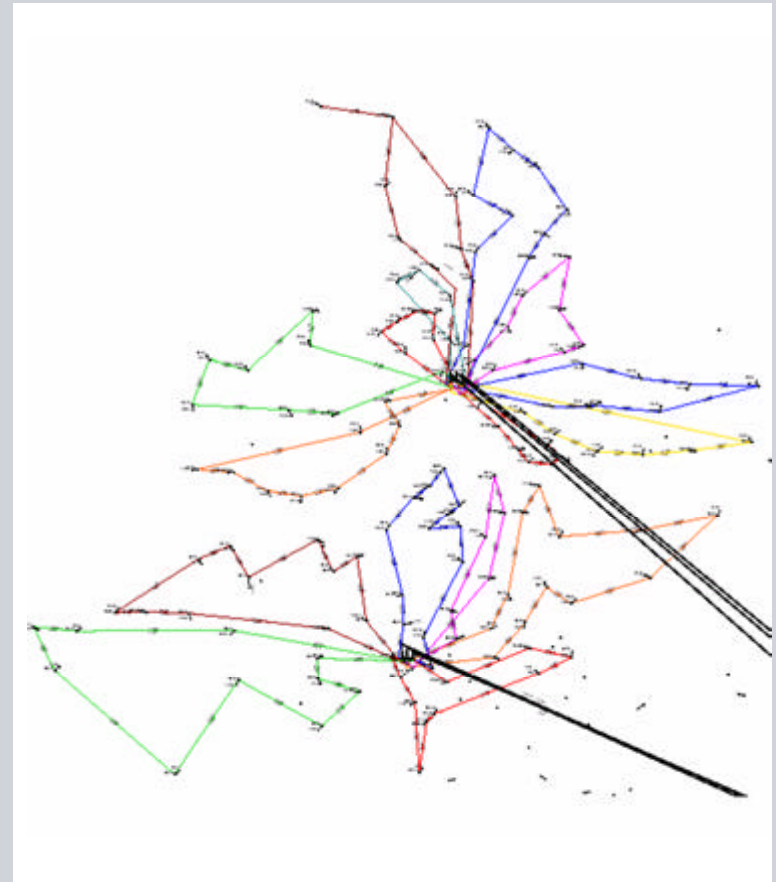
Initial system situation

- As-Is Analysis
 - Voltage levels:
 - 33 kV sub-transmission network
 - 11 kV distribution network
 - Meshed network
 - operated with open rings
 - Overloaded distribution substations
 - Overloaded Feeders
 - (n-1)-criterion partly violated
 - Long feeders
 - ➔ Voltage drops
 - ➔ Losses
 - ➔ Huge number of equipment
 - Future Demands
 - High load increase



Results of Greenfield planning

- Greenfield network variant
- Typical network structure
 - Ring structure fed by one receiving substation only
 - Remote lines between two receiving substations
- Exceptional network structure
 - Radial connection of stations
 - Only in special circumstances



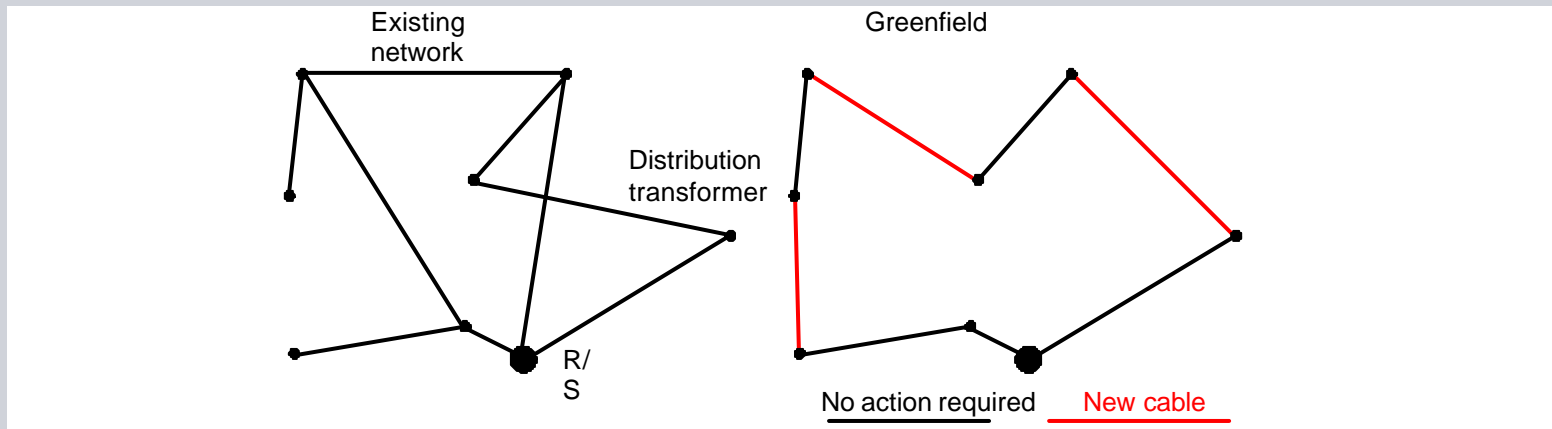
Greenfield planning approach - Characteristics

- Fixed parameters
 - Loads and load locations
 - HV/33kV infeeding points
 - Existing infrastructure
- Greenfield
 - Analysis of load density distribution
 - Definition of infeeding points to the 11kV network
 - Build-up of new optimal lines
 - No consideration of existing lines
- Superimposition
 - Comparison of Greenfield and As-Is networks
 - Network improvements



Superimposition

- Superimposition of Greenfield and existing networks
 - Comparison of existing lines and lines proposed in Greenfield variant
 - Determination of line sections to be used in target network structure
 - Definition of required changes in the connections of existing line sections
 - Definition of required new line sections

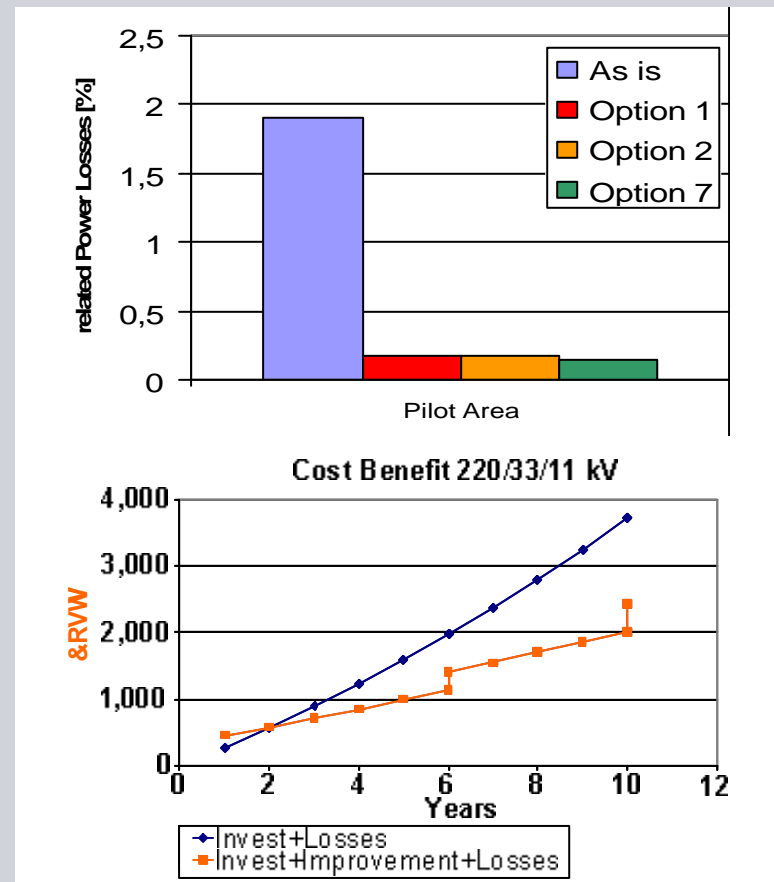


Results

- Losses
 - Reduction of losses even for higher load levels

- Cost-Benefit
 - Comparison of the investment for necessary network improvement and network restructuring

➔ ROI after less than three years



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