GisPlan
Medium Voltage Planning

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ESRI User Conference 2011
Data and context
GIS Generations at Copel
GISPLAN
Main benefits
Conclusions
Copel is a utility company that provides services in the generation, transmission and distribution of electricity.

In 1998 started providing telecommunications services, IP networks and voice services.
State of Paraná
Population: 10,439,601 (2010 census)
Capital and largest city: Curitiba
## Copel's Numbers

- Employees: 8,973
- Meters: 3,780,000
- Hydroelectric Power Plants: 18
- Thermoelectric Power Plant: 1
- Installed Power: 4,552 MW
- Transmission Lines: 12,070 miles
- Primary distribution lines: 283,244 miles
- Substations: 351
- Transformers: 349,000
- Switches: 300,000
- Poles: 2,565,000
Electric Network
FIRST GENERATION GIS

1974
Software: Prodadis from CAEEL (São Paulo)
Batch processing
Alphanumeric System (UTM coordinates)

1993
Technological evolution
Online processing
Alphanumeric System (UTM coordinates)
FIRST GENERATION GIS
SECOND GENERATION GIS

Software Vision - Autodesk
Graphical system
Software acquisition: 1995
Unix environment
1997 – Data conversion from Mainframe to Vision
2001 - AutoDesk discontinues Vision evolution
SECOND GENERATION GIS
Requirements

A large number of users accessing and updating the central database. This database must be accurate and represent what is installed in the field. Besides day-to-day activities, information must also be provided to the Brazilian Regulatory Agency (ANEEL). All systems must be highly customized, with a complex symbology. Use of non-proprietary programming language(s); Good technical support provided by the software vendor.
Complex Symbology
THIRD GENERATION GIS (ArcGIS)

ArcMap Customization
ArcMap Customization
THIRD GENERATION GIS (ArcGIS)

Web Application
Users: 3,500
GISPLAN

Medium Voltage Planning
Production Environment
Electrical Power Network Planning (GISPlan): 30 users
WebGeo: 3,500 users
Go live - July 2011

Electrical Network Cadastre
Electrical Power Network Design
Cartography
Underground network
Total users: 750
Simultaneous: 200
Project started 04/2005
First version delivered 12/2006
Features:
Using personal geodatabase (.mdb)
Using Geometric Network for electric network.
Simulation program running in Windows.
Baseland (streets and blocks) using shapefiles.
Version 2 12/2006
Delivered 09/2007
Features:
Using file geodatabase (.gdb)
Using logic connectivity.
Better performance.
Improvements in symbology.
Delivered 10/2009
Features:
New functions for 34.5 kV network
Simplification of the electric network.
One-line diagram editing.
Better performance and symbology.
Use of cache for the baseland (ArcGIS Server)
Imagery with orthophotos (ArcGIS Server + Image Server)
GISPLAN Interfaces with:

**GD-Redes**: Electric network.
**GASA**: metering system.
**MEE**: market system – demand projection for large customers, cities and circuits.
**GCO**: our Customer Information System.
**Security system**.
**APOIO**: Basic functions – printing, plotting, enrolment of new users.
Main functions

- Short circuit analysis;
- Power flow;
- Losses;
- Load increase;
- Interruption management;
- Medium Term Planning (10 years);
- Reliability studies
Overnight processing

Cadastro Regionais ➔ Planejamento Neptune ➔ Versão 0
Versão 1
Versão 2
Versão 10
Current design

Study creation

Electric Network

Create a new study

Planner Workstation

ArcGIS Desktop
GISPLAN
WIN XP

Estudo 0
Estudo 1
Estudo 2
Estudo n

Local específico na rede

Validate

*.gdb
Study Creation
Select one or more feeders to study. Possible to include feeders from different substations

All the information from the selected feeders
Feeder load

Companhia Paranaense de Energia
25-março-2008
15:51

CURVA TÍPICA DO ALIMENTADOR
SE: BACACHERI
Alimentador: 823620090 - BANESTADO
DIA ÚTIL

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Feeder demand

Flexibility to alter parameters
Configuration alteration for 34,5/13,8kV
Can alter:
- Substation load
- Transformer capacity
- Capacitor
- Regulators
34.5 kV at Copel is referred to as subtransmission

Very long feeders, small medium and large customers in the same circuit – generates a lot of data to analyze

A tool was created to simplify the feeders, speeding the analysis

The simplification process:
- identification of important points:
  - regulators, substation entrance and exit, switches, reclosers, etc.
  - load allocation - special customers - trafo
Load grouping

Neighborhoods, cities, small villages
Identification of the points
Insertion of a transformer to group these loads
Cables with the same material and gauge result in a ‘super span’
34.5 Feeder Simplification Example

Complete

Simplified
Power Flow Simulation

Power Flow → Report
Voltage drop and Load Visualization
Data coming from the main database is included in XML file that is prepared with the filegeodatabase schema and consistency tables.

Studies are saved in XML just like ArcGIS schema.
Study creation

Cadastro → XML → Gisplan

Vision
ArcGIS
Calculation is performed by a tool developed internally (C Ansi), that can run in Unix or Windows.
Input file is generated and output has the electric characteristics of each network element.
A report is also generated
ArcMap layer files are used. In one case IRender was used. Changes in symbology can be achieved just by changing the layer files. Size of the symbols can be changed easily.
Total control of the electric network
Shows the situation for each feeder (voltage and load)
Shows the critical points (this year and in the future)
Short turnaround
Budget optimization
Construction where it is really needed now or in short term
Better customer response
Mid-term planning up to 10 years
GisPlan can work with 13.8 or 34.5 feeders

Two big ‘pluses’

- Fedder simplification

- One-line diagram – one can work inside the substation
The most important benefits were:
• Planning time reduced,
• better solutions,
• good performance of calculations,
• easy drawings and
• easy and fast input of data
“We believe that each one of the planners will save 3 months of work / year thanks to this system“