GisPlan

Medium Voltage Planning

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ESRI User Conference 2011

OUTLINE

Data and context

GIS Generations at Copel

GISPLAN

Main benefits

Conclusions

CONTEXT

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.

CONTEXT

State of Paraná

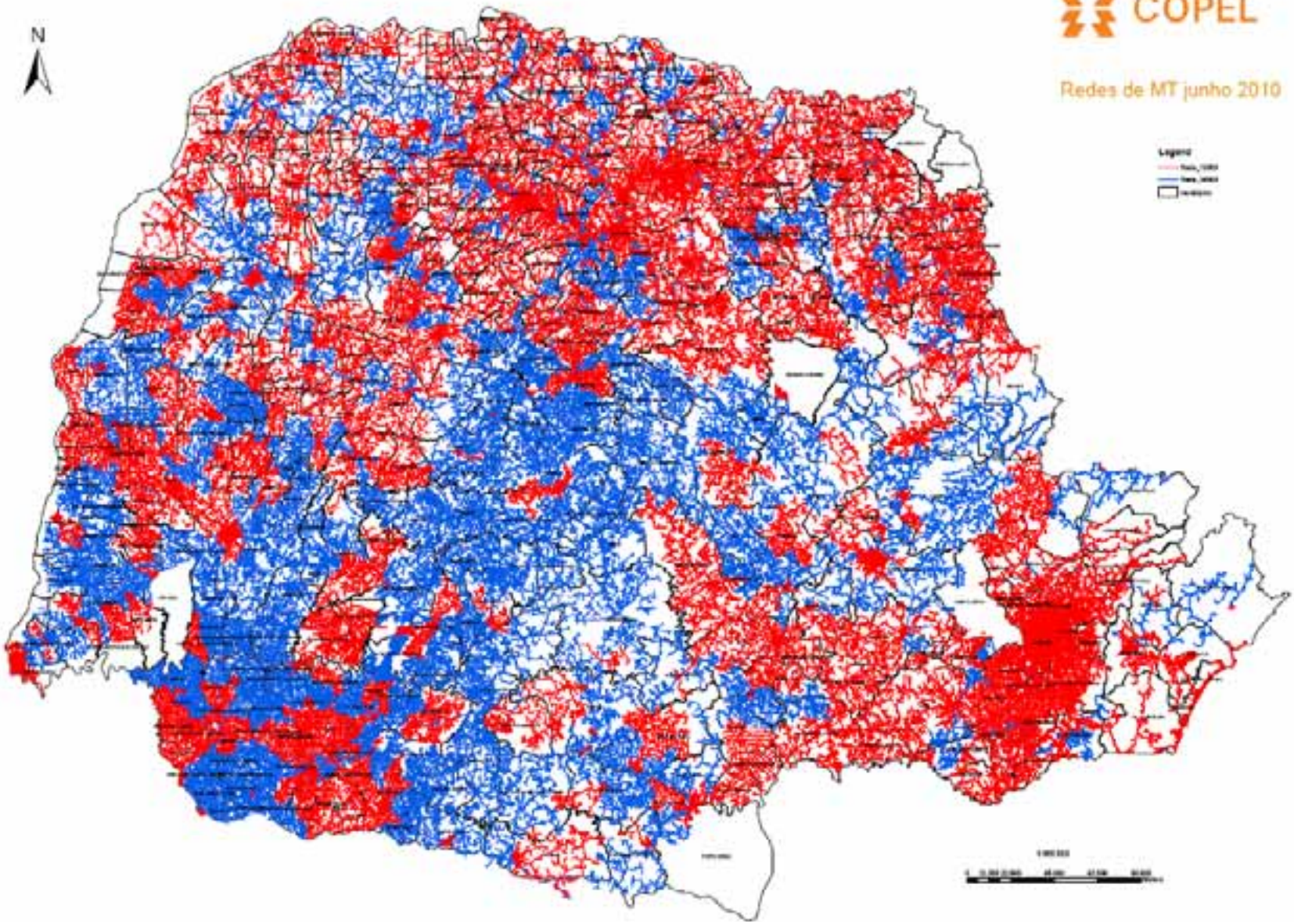
Population: 10,439,601 (2010 census)

Capital and largest city: Curitiba

Copel's Numbers

8,973	Employees
3,780,000	Meters
18	Hydroeletric Power Plants
1	Thermoelectric Power Plant
4,552 MW	Installed Power
12,070 miles	Transmission Lines
283,244 miles	Primary distribution lines
351	Substations
349,000	Transformers
300.000	Switches
2,565,000	Poles

Electric Network



FIRST GENERATION GIS

1974

Software: Prodadis from CAEEL (São Paulo)

Batch processing

Alphanumeric System (UTM coordinates)

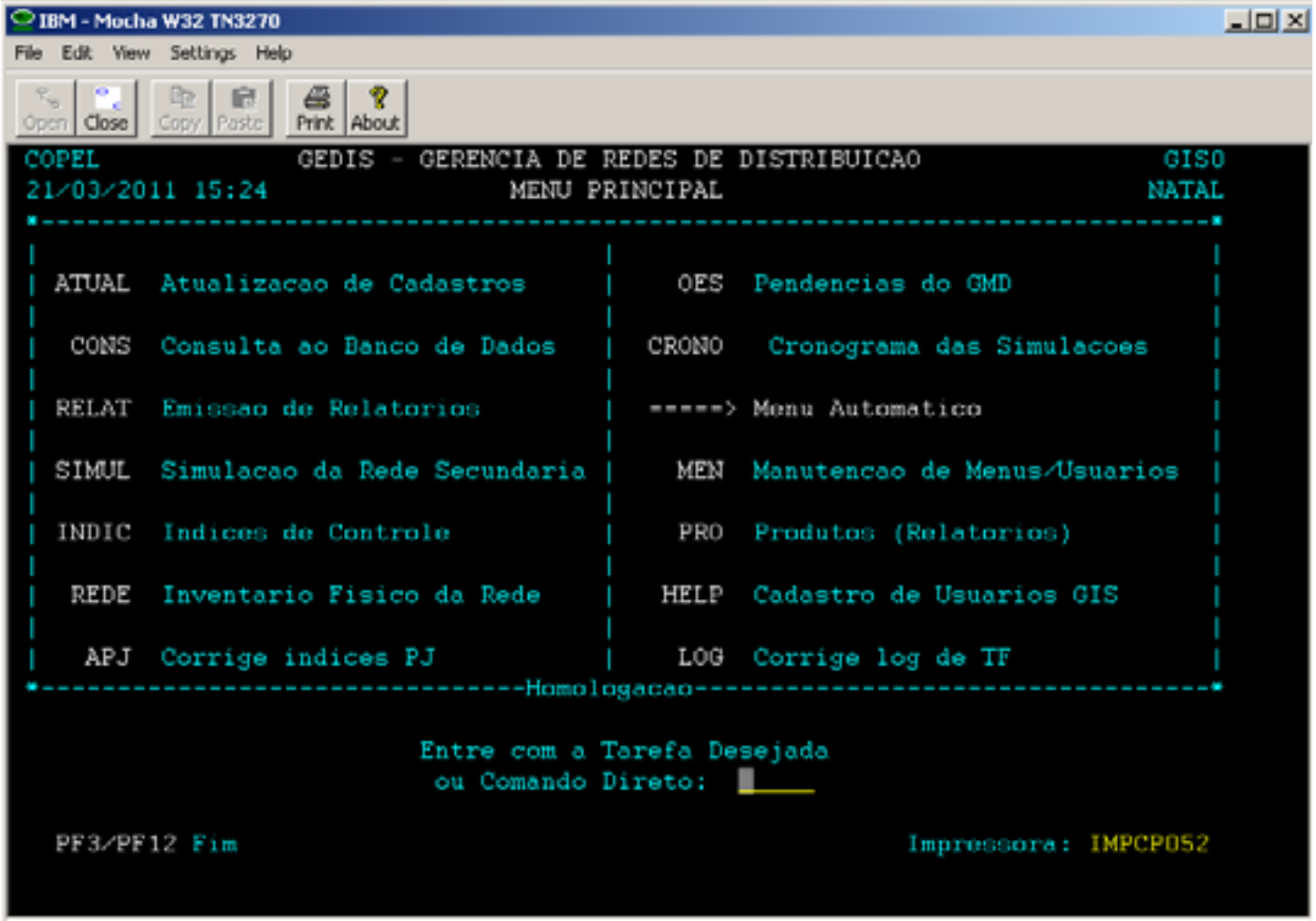
1993

Technological evolution

Online processing

Alphanumeric System (UTM coordinates)

FIRST GENERATION GIS



Software Vision - Autodesk

Graphical system

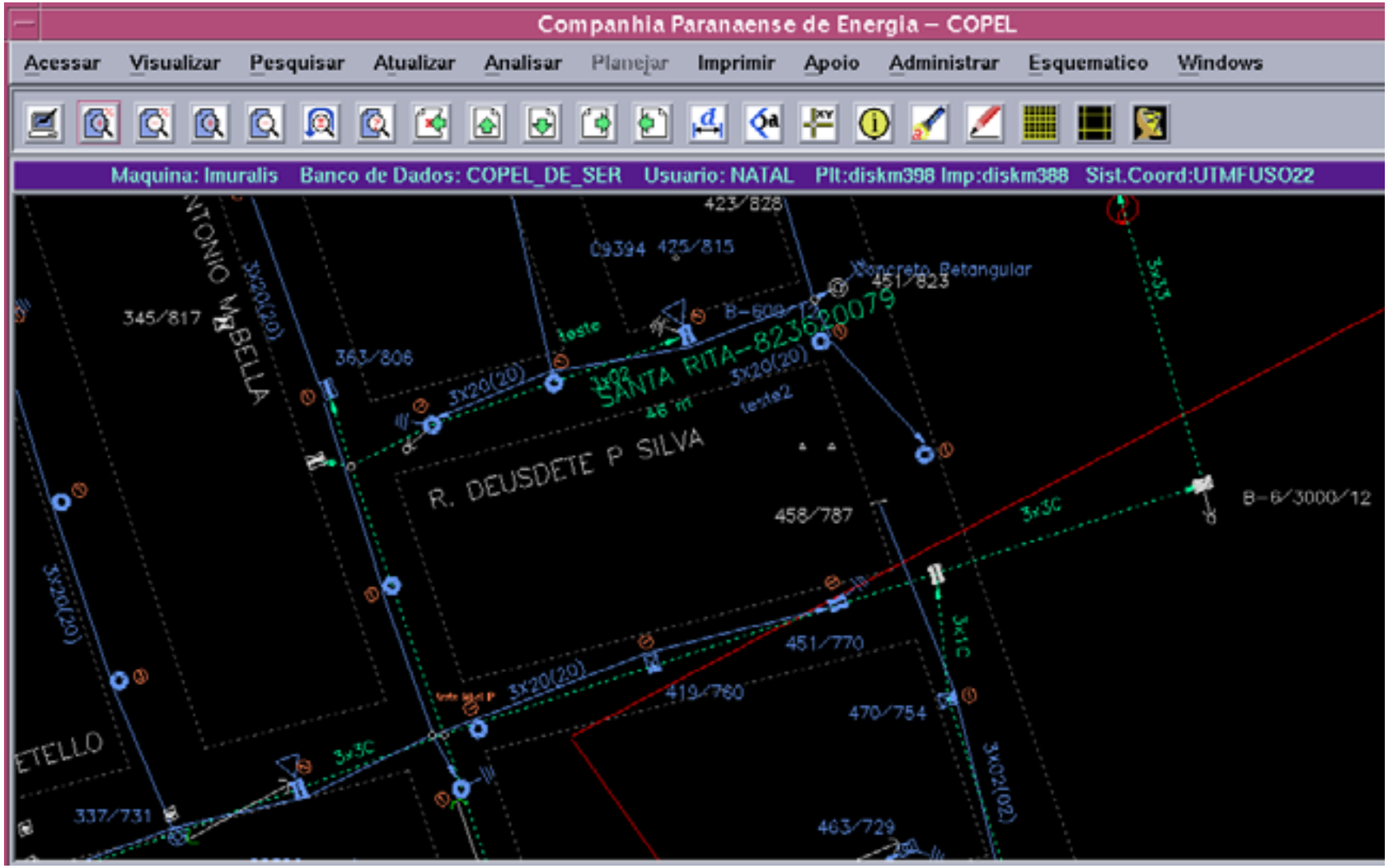
Software acquisition: 1995

Unix environment

1997 – Data conversion from Mainframe to Vision

2001 - AutoDesk discontinues Vision evolution

SECOND GENERATION GIS



THIRD GENERATION GIS (ArcGIS)

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.

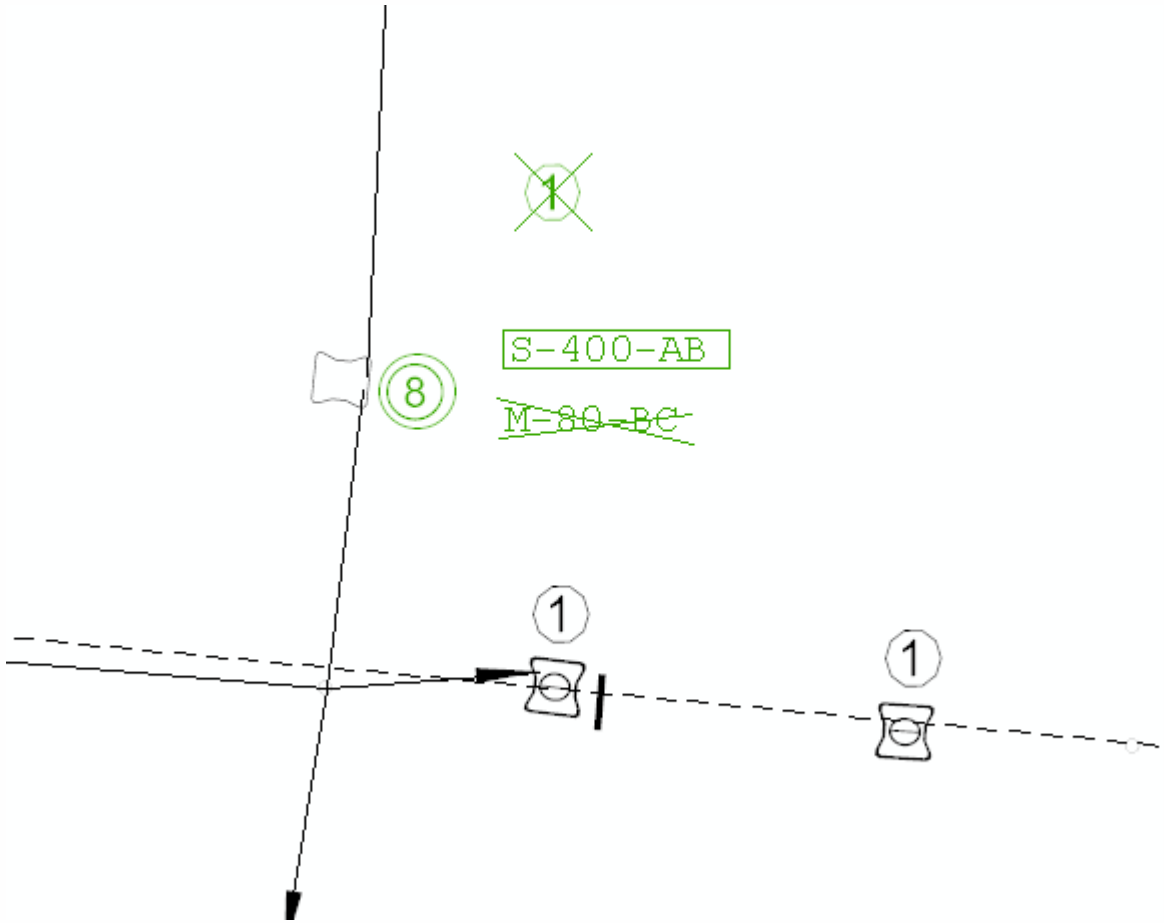
Besides day-to-day activities, information must also be provided to the Brazilian Regulatory Agency (ANEEL).

All systems must be highly customized, with a complex symbology.

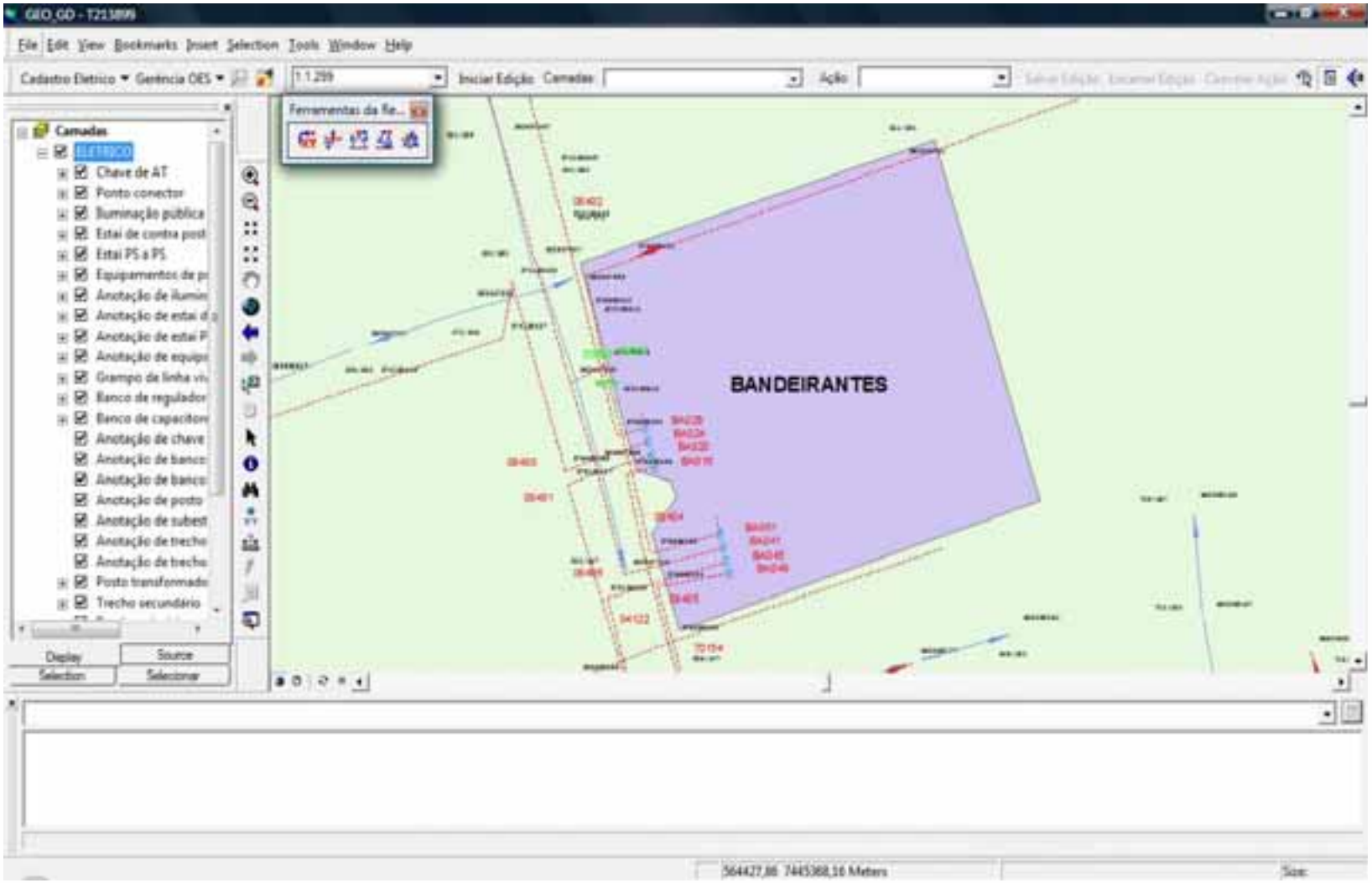
Use of non-proprietary programming language(s)

Good technical support provided by the software vendor

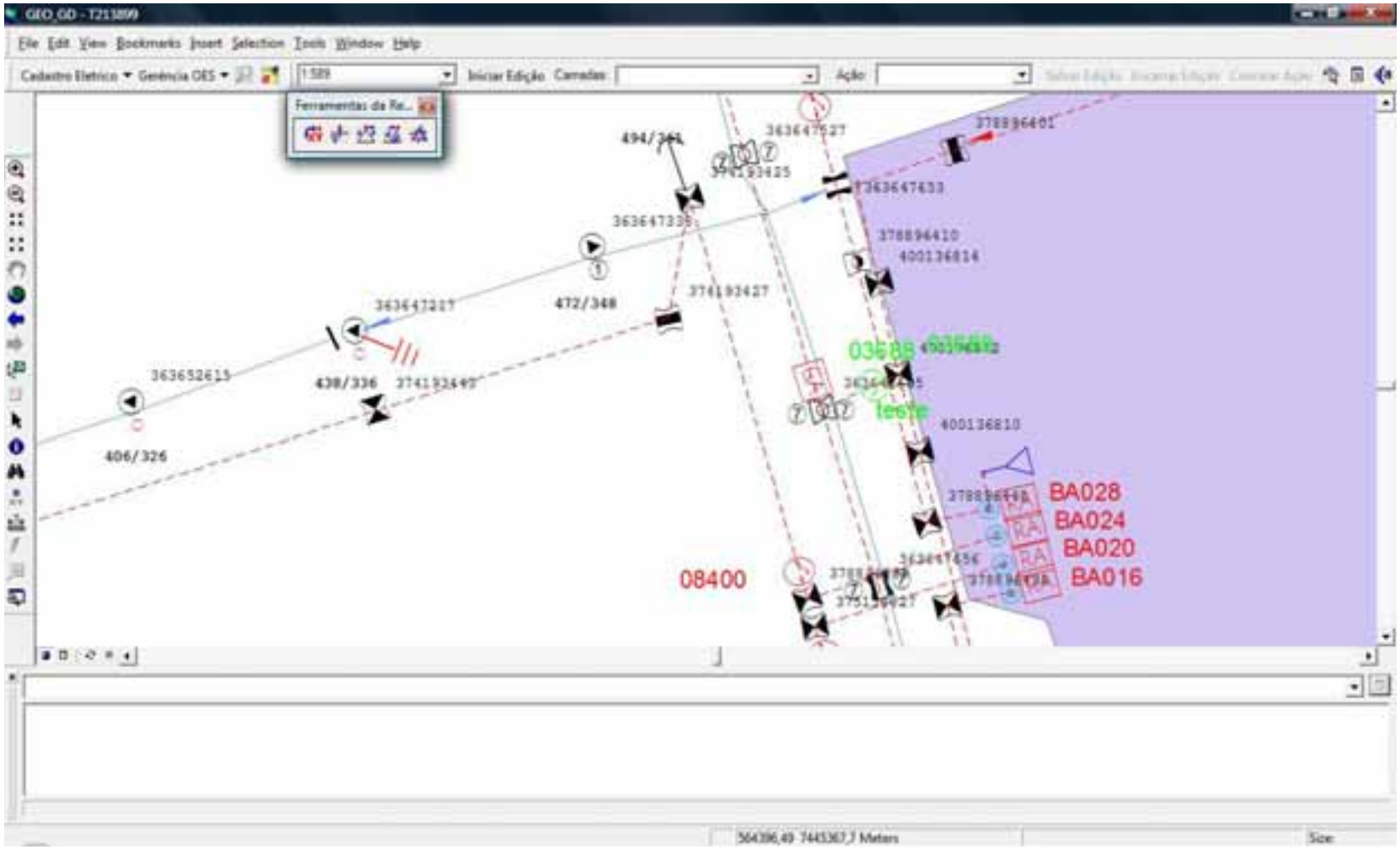
Complex Symbology



ArcMap Customization



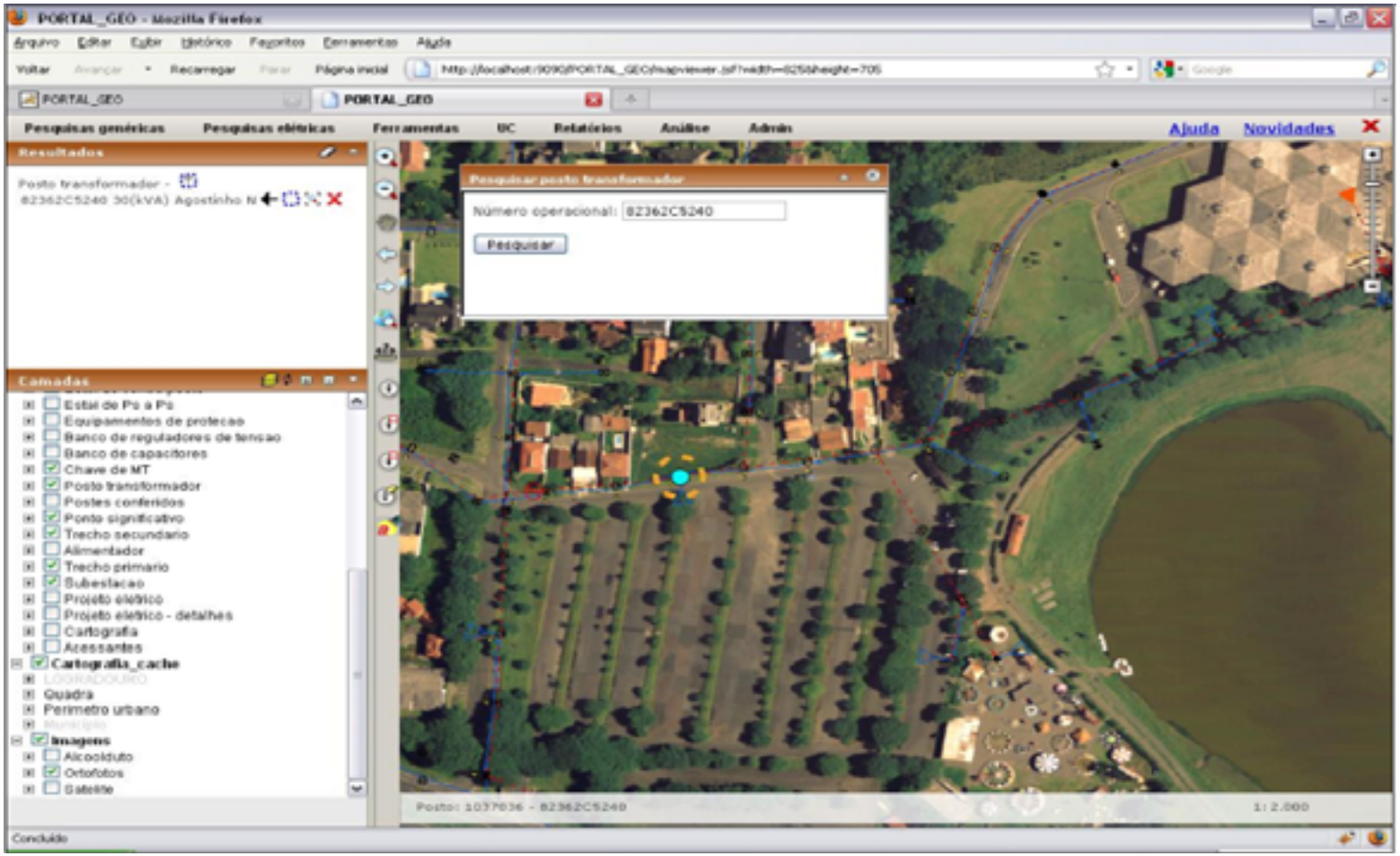
ArcMap Customization



THIRD GENERATION GIS (ArcGIS)

Web Application

Users: 3,500



GISPLAN

Medium Voltage Planning

THIRD GENERATION GIS (ArcGIS)

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

GISPLAN

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.

GISPLAN

Version 2 12/2006

Delivered 09/2007

Features:

Using file geodabase (.gdb)

Using logic connectivity.

Better performance.

Improvements in symbology.

GISPLAN

Version 3 11/2007

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)

Interfaces

GISPLAN Interfaces with:

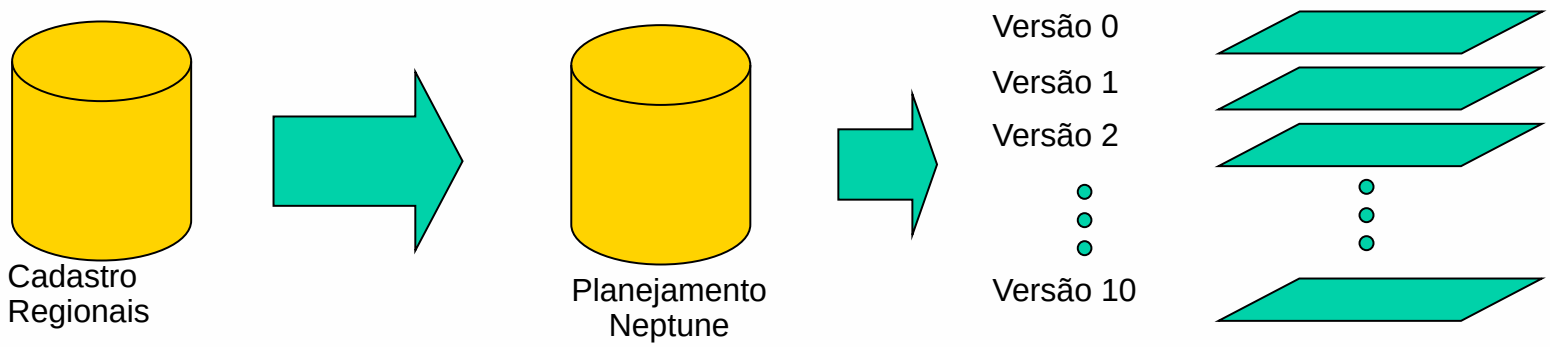
GD-Redes: Electric network.
GASA: metering system.
MEE: market system – demand projection for large customers, cities and circuits.
GCO: our Customer Information System.
Security system.
APOIO: Basic functions – printing, plotting, enrolment of new users.

Main functions

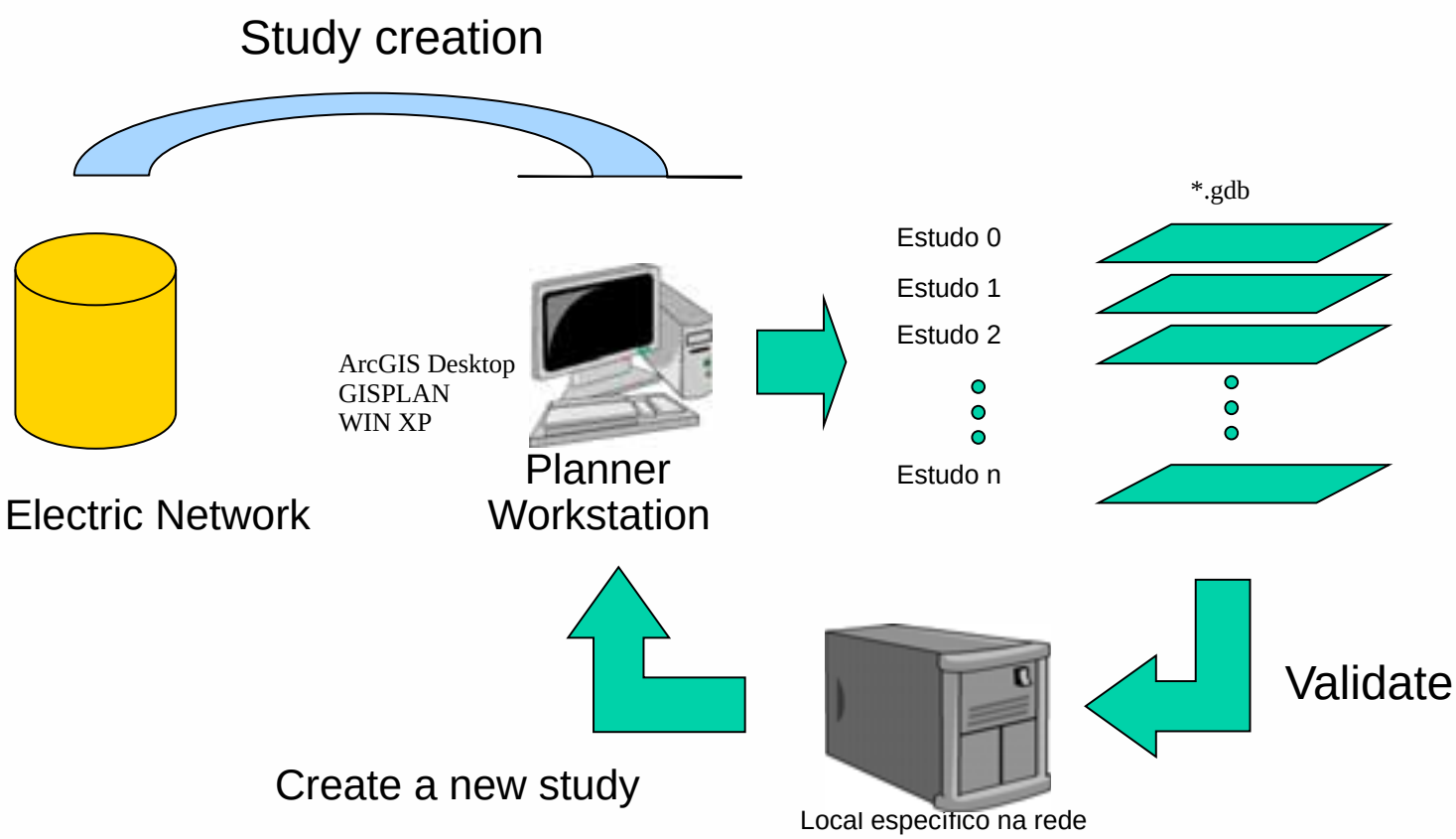
- Short circuit analysis;
- Power flow;
- Losses;
- Load increase;
- Interruption management;
- Medium Term Planning (10 years);
- Reliability studies

First Design

Overnight processing



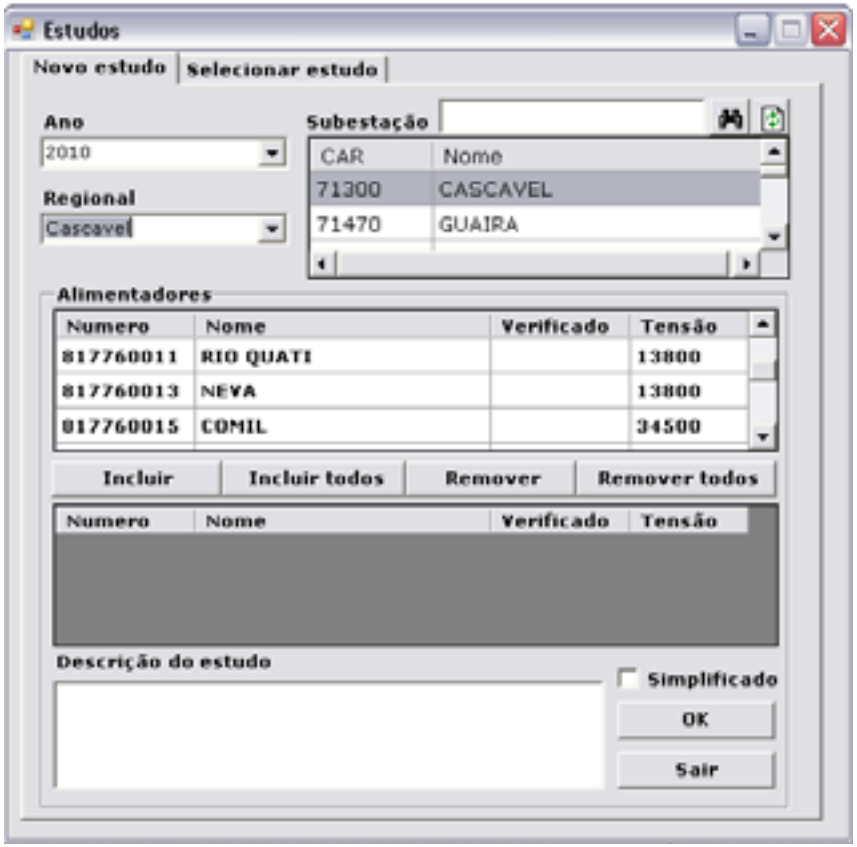
Current design



Functionalities

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

COPEL

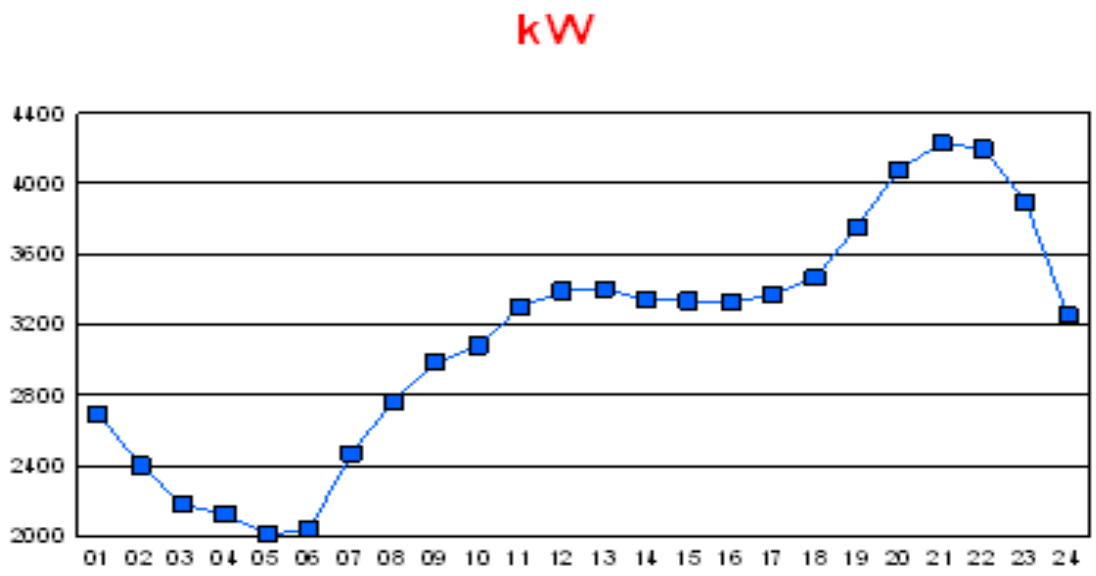
Companhia Paranaense de Energia 25-março-2008 15:51

CURVA TÍPICA DO ALIMENTADOR Usuário:

SE: BACACHERI Conjunto: 12259

Alimentador: 823620090 - BANESTADO

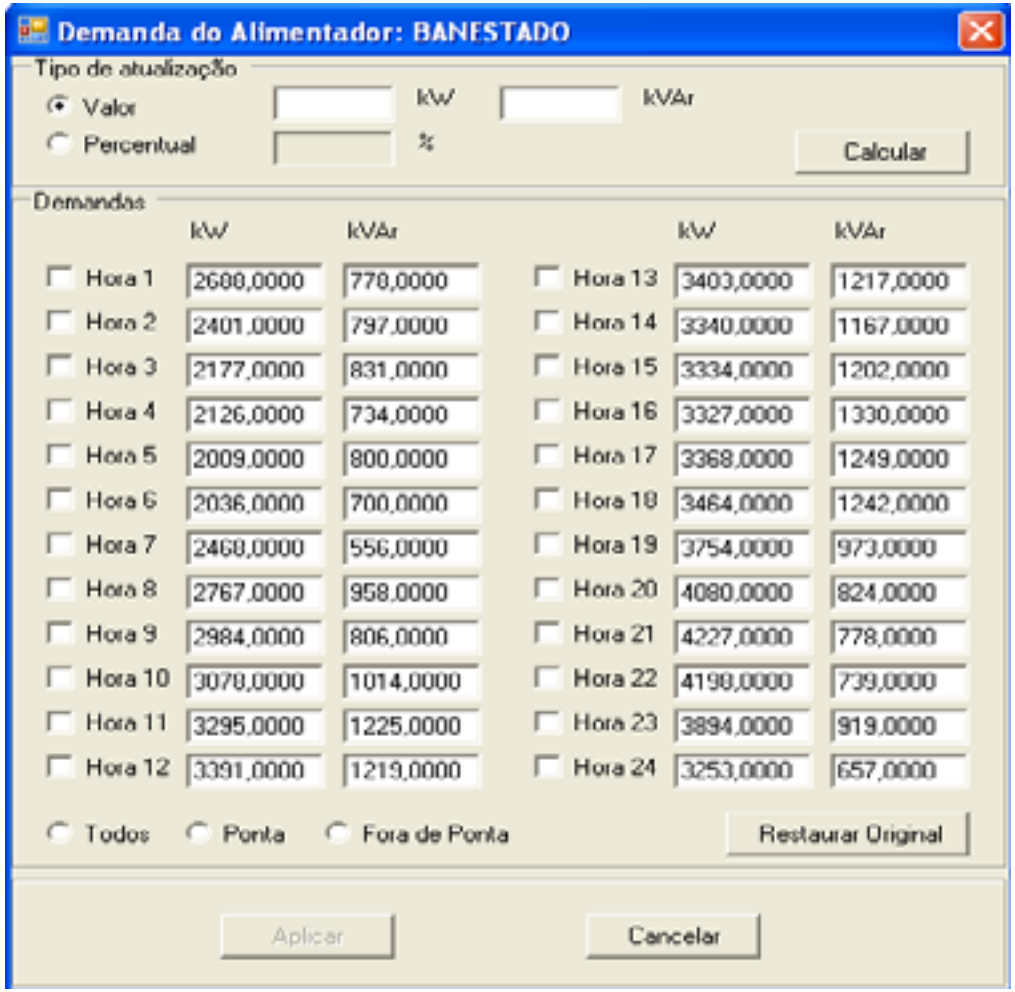
DIA ÚTIL



HORA	kW
01	2.688,00
02	2.401,00
03	2.177,00
04	2.126,00
05	2.009,00
06	2.036,00
07	2.468,00
08	2.767,00
09	2.984,00
10	3.078,00
11	3.295,00
12	3.391,00
13	3.403,00
14	3.340,00
15	3.334,00
16	3.327,00
17	3.368,00
18	3.464,00
19	3.754,00
20	4.080,00
21	4.227,00
22	4.198,00
23	3.894,00
24	3.253,00

Feeder demand

Flexibility to alter parameters

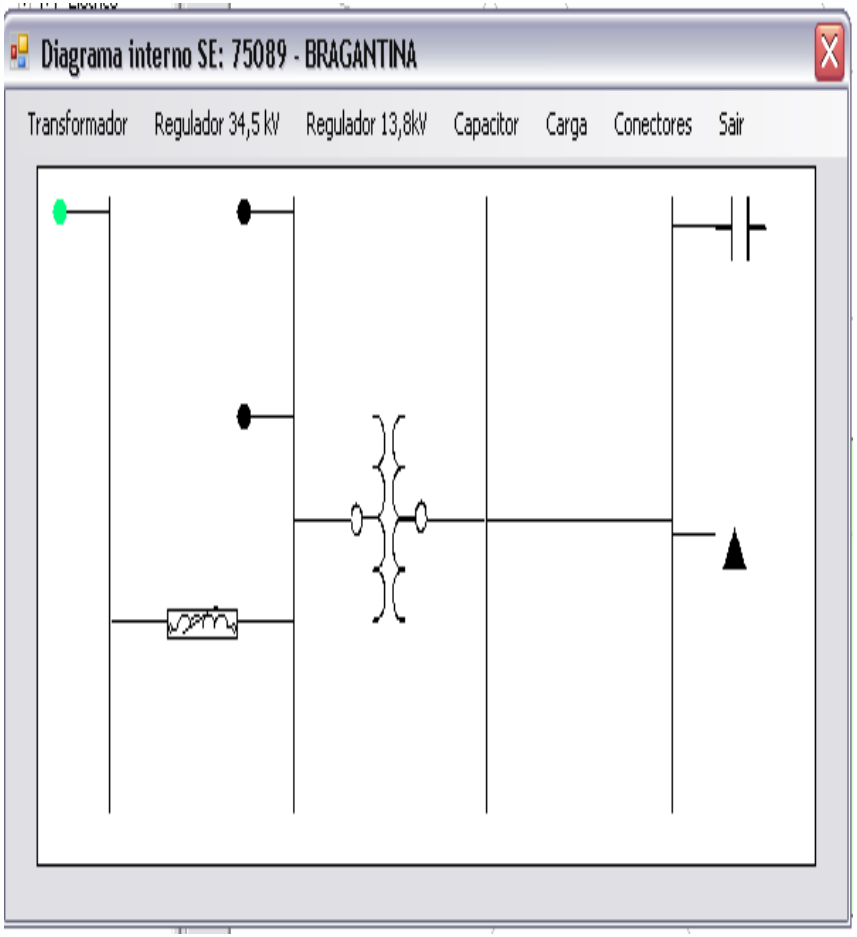


Substation Configuration ++

Configuration alteration for 34,5/13,8kV

Can alter:

- Substation load
- Transformer capacity
- Capacitor
- Regulators



34.5 Feeder Simplification ++

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

34.5 Feeder Simplification ++

Load grouping

Neighborhoods, cities, small villages

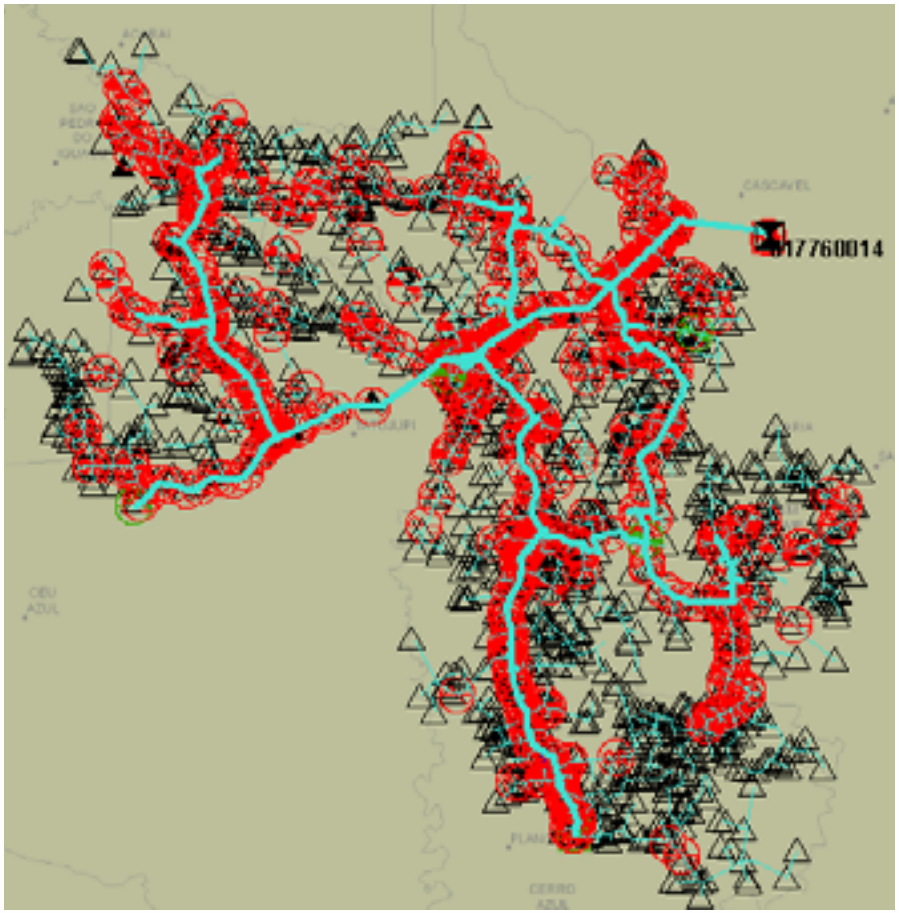
Identification of the points

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

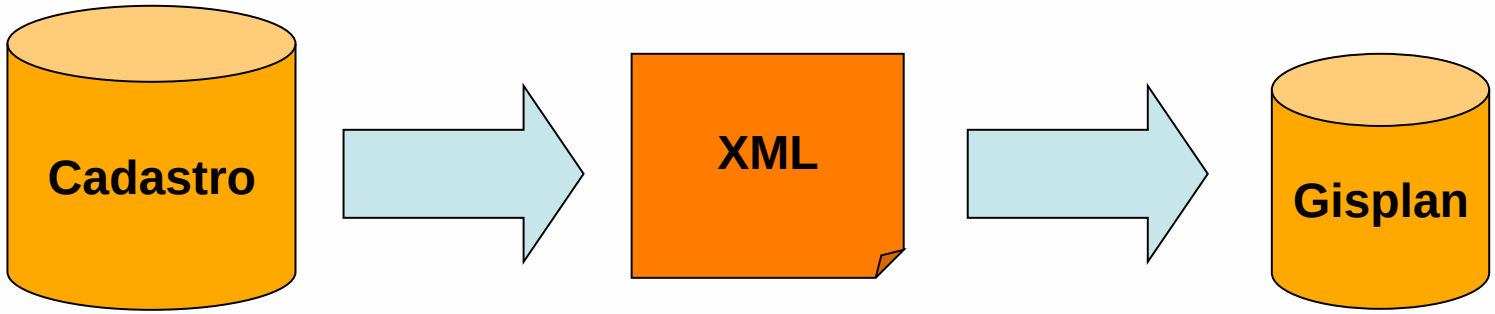
Visualization

Studies

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



Vision

ArcGIS

Electric calculation

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

Symbology

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.

Conclusion

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

Conclusion

GisPlan can work with 13.8 or 34.5 feeders

Two big ‘pluses’

- Fedder simplification

- One-line diagram – one can work inside the substation

Conclusion

The most important benefits were:

- Planning time reduced,
- better solutions,
- good performance of calculations,
- easy drawings and
- easy and fast input of data

User remark

“ We believe that each one of the planners will save 3 months of work / year thanks to this system “