European Network of
Transmission System Operators
for Electricity

INTEROPERABILITY TEST “CIM FOR SYSTEM DEVELOPMENT AND OPERATIONS” 2011

APPENDIX A: INFORMATION ON TOOLS TESTED/USED IN THE IOP

15 AUGUST 2011

FINAL VERSION

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6 APPENDIX A: INFORMATION ON TOOLS TESTED/USED IN THE IOP

6.1 CIMCONTEXTOR

6.1.1 VENDOR PRESENTATION

Zamiren is a small consultant and engineering company which offers services related to TC57/CIM and TC57/IEC61850 environment.

Zamiren

18 bis quai Pierre Brossolette

94340 Joinville-le-Pont

France

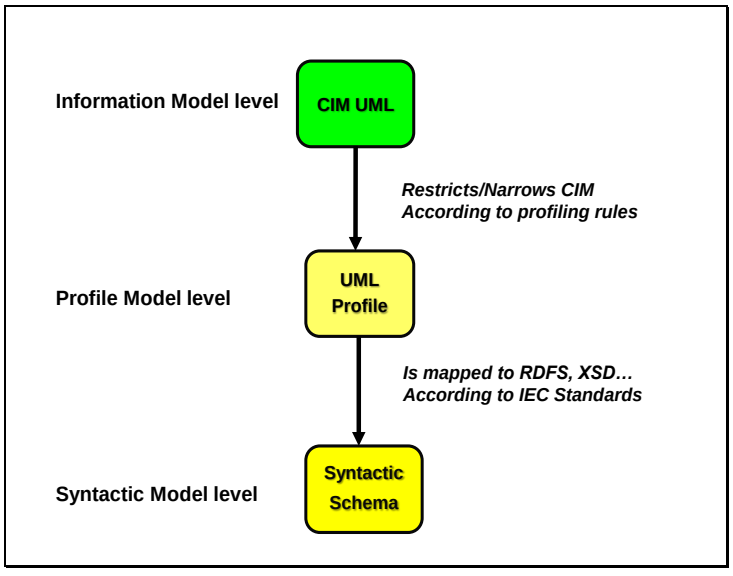
Tel : +33148854006

Mail: contact@zamiren.fr

6.1.2 TOOL DESCRIPTION

CimConteXtor is an open source add-in to "*Sparx Systems Enterprise Architect*" (EA) product.

It extends EA functionalities by providing a framework that allows creation and management of UML profiles "*based on*" existing UML models, and helps you to do these profiles according to a rigorous methodology based on a «layered» approach:



CimConteXtor first target is to build profiles (i.e restricted subset of the model) based on the Common Information Model (CIM), which is the standard information model defined by the International Electrotechnical Commission for the Power System domain. But, in fact, it could be used to do any profiles based on a UML model.

CimConteXtor web site : http://www.cimcontextor.net

6.1.3 OTHER TOOLS LINKED TO CIMCONTEXTOR

CimConteXtor is coming with companions’ add-in tools to deal with generation of specific artifacts using language like XML or RDF. *CimSyntaxGen* is one of them and generate schemas according to IEC standard like TC 57 XML NDR draft or TC 57 WG 13 IEC 61970 part 501 (RDFS).

6.1.4 EXPECTED CIM FUNCTIONALITIES

CimConteXtor and its companions will evolve according to reflect any decisions made by the various TC57 working groups.

6.2 CIMCLIPSE

6.2.1 VENDOR PRESENTATION

Supélec (http://www.supelec.fr) is a French engineering institute with a threefold mission: degree courses, research & development, continuing education. It is the reference in its field, electric energy and information sciences, with classes of 440 engineers graduating each year.

6.2.2 TOOL DESCRIPTION

CimClipse (http://wwwdi.supelec.fr/software/cimclipse) is a set of tools used within or based on Eclipse or its plugins, used for CIM related tasks and released as Open Source as an Eclipse plugin. Currently, it encompasses tools developed in the Computer Science Department of Supélec with funding from EDF R&D. CimClipse is designed as a demonstrator of the benefits of using Model Driven Engineering approach in the context of CIM tasks.

The tools currently available in the CimClipse plugin allow to:

- import and merge CIMXML files

- import and merge ZIP (as defined in ENTSO-E profile version 2) of CIMXML files (headers not checked)

- display and edit objects and their attributes

- export data as CIMXML files

- check data against constraints expressed in OCL (Object Constraint Language). These rules can correspond to a profile or can be defined by a company to enforce some business rules.

- apply incremental file to loaded data

- create incremental file by comparing existing data to a CIMXML file

6.2.3 OTHER TOOLS LINKED TO THE CIMCLIPSE OCL VALIDATOR

Other CIM tools are available on the CimClipse site that are either used inside CimClipse or used to build it:

- Some versions of CIM models compliant with the UML2 layer of Eclipse

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- Same versions of CIM models compliant with the Ecore layer of Eclipse
- Some model transformation tools used to obtain previous models

6.2.4 EXPECTED CIM FUNCTIONALITIES

The full support of sub-profiles (profile defines by several parts corresponding to different data files) is expected for the next release.

CimClipse does not support the computation of load flow. A preliminary version for this task exists, but is not adapted to ENTSO-E profile.

6.3 CIMPHONY

6.3.1 VENDOR PRESENTATION

Open Grid Systems

Open Grid Systems Ltd. is a consultancy and software company based in Glasgow, UK providing services to the electrical power industry focussed on model-driven software engineering, open standards and cutting-edge technologies. Open Grid Systems provides expertise in the areas of data management, information modelling, data transformation, data-exchange technologies, visualisation and power system network analysis software. We utilise the power of open standards and model-driven architectures to provide modern, scalable solutions to the challenges faced by utilities in the smart-grid enabled world.

6.3.2 TOOL DESCRIPTION

CIMPHONY

CIMPHONY began as a research project in the University of Strathclyde and in its previous incarnation was utilised at a number of EPRI and UCA-sponsored interoperability tests for model validation. The new version is fully re-engineered, based on open-source software and utilises the OSGi modular system and an Eclipse-based UI to provide a multi-platform framework for data management and power system analysis tools.

The core CIMPHONY modules provide model-independent services for:

- Data management and editing
- OCL-driven validation
- Model-driven transformation
- Distributed database persistence
- Graphical visualisation
- Geographical export using KML

The model-driven architecture allows support for new formats and data models to be added to CIMPHONY without requiring the core frameworks to be altered. Support is already in-place for a number of data models including established open standards such as CIM (multiple versions including ENTSO-E profiles), MultiSpeak and IEC61850; or proprietary formats such as PSS®E (v30-32) and extended standard models such as that used at ERCOT. Transformation and

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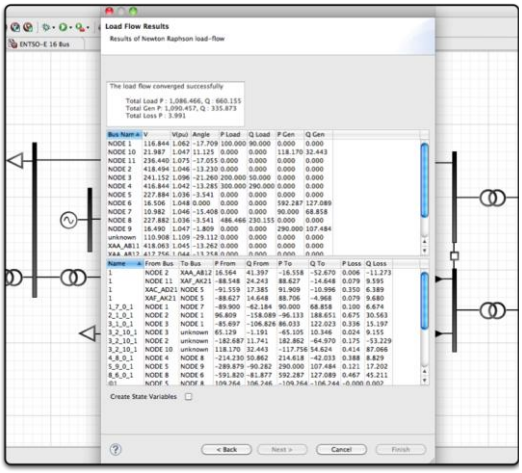
validation services using these models are defined using OMG standard languages allowing the rapid development of transformation mappings between data models.

Multiple resources can be combined in dynamic working sets, supporting the ENTSO-E model multiple profiles and authority set concepts. The workspace provides gives the user the ability to integrate, export, substitute, add and remove individual resources on an ad-hoc basis from their dynamic working set.

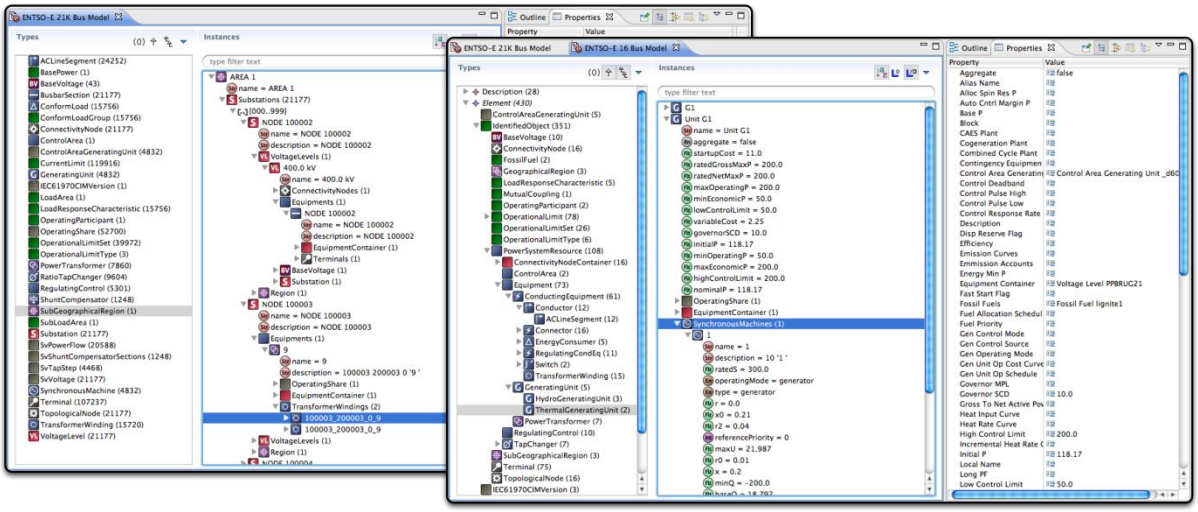
In addition to the model management service, CIMPHONY provides CIM and power-system specific functionality including the ability to execute load-flow simulations on balanced, three-phase models using the **Jacobi** load-flow engine, and supports the export of these results using the IEC 61970-456/ENTSO-E CIM XML State Variable profiles. In addition a topology processor module allows operational models compliant with IEC 61970-452 to be imported and a topology file (as defined by IEC 61970-456) to be created and exported thus allowing an ENTSO-E compatible planning model to be generated from an operational CPSM model.



Load Flow Results

The CIMPHONY components can be deployed in a number of environments: an application library for integration with other Java applications; web-services; command-line application; web-based UI; distributed, cloud-computing environments; or as a native, rich-client UI utilising Eclipse frameworks.

The rich-client UI can be run on Windows, Linux or OS X. As well as providing a UI for the validation, transformation, import/export and difference model functions, it provides an *infinite-tree* model-driven browser and graphical editor with preliminary support for single-line diagram creation and editing in a common UI (with support for multiple data-models).



Browser Interface with different hierarchical views

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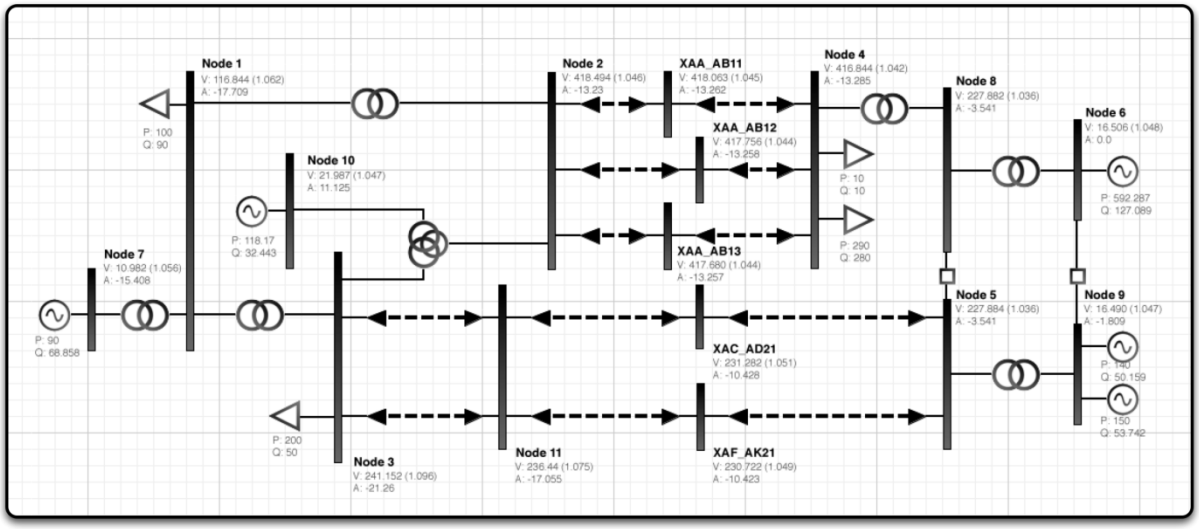

Graphical Editor acting as a Single Line Diagram editor

6.3.3 OTHER TOOLS LINKED TO CIMPHONY

The core CIMPHONY modules for RDF import/export, profile support, validation, transformation and difference model generation/merging can be utilised for building custom model-driven interfaces and applications and has been utilised to create stand-alone transformation and validation applications.

Jacobi is the load-flow engine used within CIMPHONY, part of a suite of services that can be integrated to provide:

- Newton-Raphson and Fast Decoupled load-flow engines
- Optimal Power Flow
- Contingency Analysis
- Steady State Estimator

These tools are being integrated with the graphical viewer to provide a rich UI for visualising simulation results.

An unbalanced distribution network simulator is currently under development, which will be integrated into CIMPHONY to support simulation of distribution models. This will enhance the existing model-management and geographical visualisation export support for the IEC 619768-13 Common Distribution Power System Model (CDPSM) profile.

6.3.4 EXPECTED CIM FUNCTIONALITIES

CIMPHONY currently supports the core functionality required for managing the exchange of CIM data including support for CIM v10-14 (plus v15 draft) and associated modules:

- Full dataset RDF XML import/export
- Incremental dataset Difference Model RDF XML import/export/generation and merging
- Profiled importing and exporting and transparent inter-dataset dependencies
- ENTSO-E Profiles and model authority set support
- IEC 61970-452/456 CPSM Profile
- IEC 61968-13 CDPSM Profile
- IEC 61970-552 Header model support including dependency verification

- Preliminary support for draft IEC 61970-453 CIM Graphics Exchange standard

Open Grid Systems was one of six vendors that participated in the EPRI CPSM Interoperability test in Knoxville, Tennessee (June 2010) and CIMPHONY will continue to support the latest versions of the CIM in addition to other IEC and industry standards. Open Grid Systems is committed to continuing involvement with future interoperability tests while supporting the international standards process through active participation at the working group level.

6.4 CIMSPY EE/CIMDESK

6.4.1 VENDOR PRESENTATION

Power Info LLC (www.powerinfo.us) is an independent consulting firm specializing in providing the standard-based solutions to electric utilities in the power industry. Our area of expertise includes standard-based enterprise application integration, CIM-based model exchange and information management, and power grid visualization.

6.4.2 TOOL DESCRIPTION

CIMSpy Enterprise Edition (CIMSpy EE) is a CIM-based tool framework designed to address a wide range of common information engineering requirements in the power industry.

Architecturally, CIMSpy EE is a distributed Web-based enterprise application containing three tiers: a Web browser based user interface (UI), an application server, and a CIM-compliant data repository. Functionally it includes a set of infrastructure and application modules designed to significantly reduce the engineering effort required to exchange and manage information in a utility environment. Based on the open architecture and the infrastructure support of the CIMSpy EE framework, new solutions can be quickly built and deployed to address the changing business requirements in various CIM-based application areas, ranging from model exchange to power system modelling and grid visualization.

For example Power Info LLC has delivered the CIM data engineering solution kit (CIMdesk) to the European Network of Transmission System Operators for Electricity (ENTSO-E) and its Transmission System Operator (TSO) members. CIMdesk was built on the top of CIMSpy EE. It was customized to support the ENTSO-E/CICIM profile and model merging business processes specifically designed to support the model exchange among ENTSO-E and its TSO members.

More specifically, CIMdesk is designed to provide an integrated data engineering environment in support of CIM-based model exchange. Users can load reality-based exchanged CIM/XML files into the tool and perform various data engineering functionalities, including model browsing, visualization, validation, editing, merging, partitioning, and applying incremental update. The engineered models can be further exported into various formats such as XML or CSV, ready to be consumed by other CIM-compliant information infrastructures.

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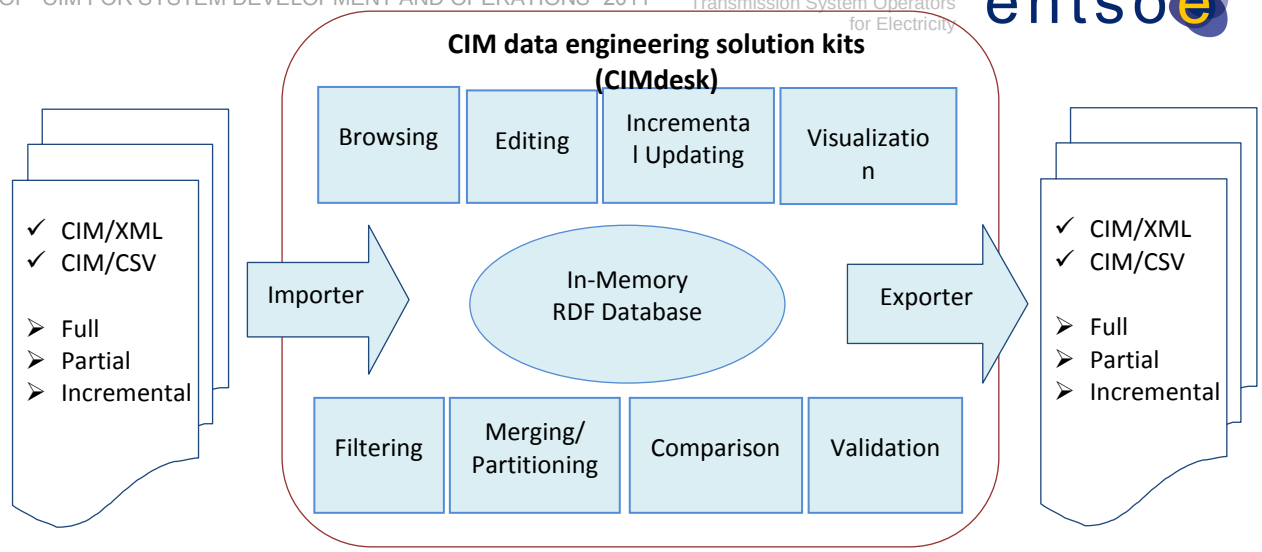
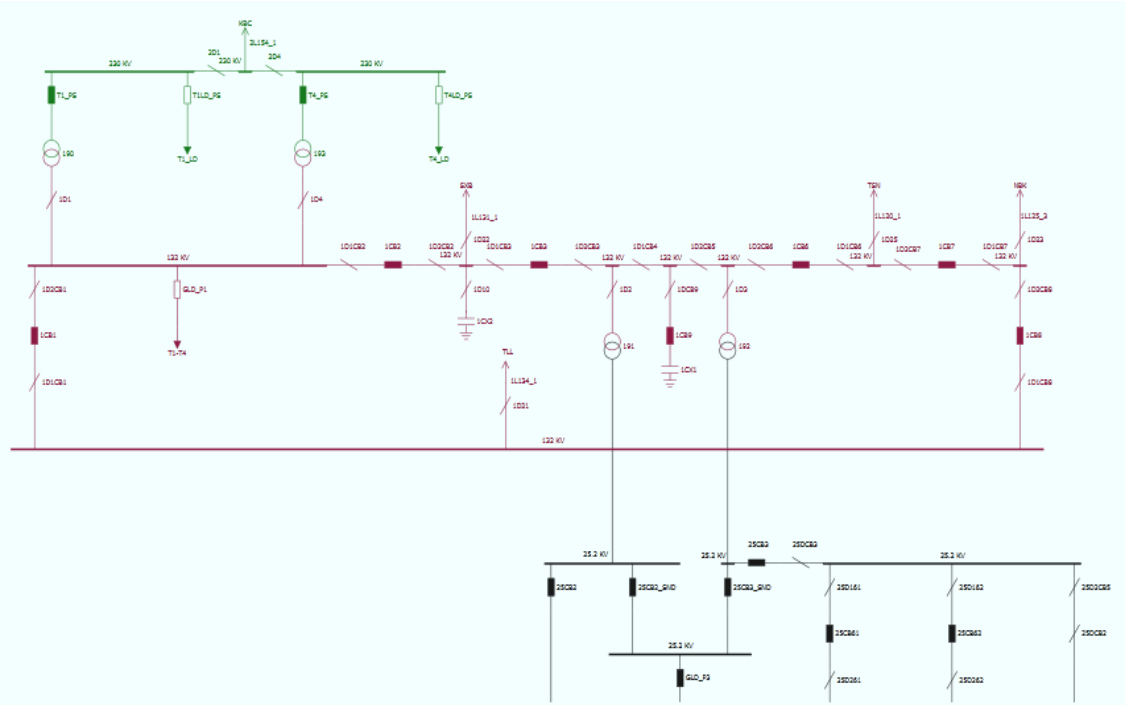


One of the key design goals of CIMSpy EE tool framework is supporting CIM visualization. Information visualization has proved to be one of the effective techniques for meeting the emerging business requirements in today's power industry. It involves visual representation of large-scale collections of information and use of graphical techniques to help people understand and analyze the data. The existing commercial power system visualization tools require the visualizations to be manually-built and restrict the visualization process to follow a limited number of pre-defined patterns created by human designers, thus hindering users’ ability to discover. CIMSpy EE adopts a different approach. Built upon CIM, CIMSpy EE yields the power of visualization to users. A variety of data-driven techniques are applied to auto-generate the high-quality visualization displays, enabling users to visualize the power system’s physical and electrical configurations at various levels and from different perspectives. Furthermore, by leveraging the latest-and-greatest information visualization technologies and open industry standards, CIMSpy EE is aimed to deliver a rich user experience and provide a standard-based visualization solution that can be seamlessly integrated with the existing utility information infrastructure.

CIMSpy visualization was designed to support multiple business functions in an electric utility environment. Some of the identified business functions that have been put into practical use include:

- Facilitating power system model exchange - Utilities that exchange their operational/planning models can leverage this tool to understand different configurations of the power system in their neighboring utilities.
- Interpretation of analytical result - Analytical results, including planning, operational, and marketing, etc., can be intuitively displayed on top of the generated network diagram to facilitate interpretation.
- Speeding up operator display building - For EMS display designers, this tool can perform majority of the tedious work for them. All they need to do is simply adjusting the auto-generated diagrams for better look-and-feel and then fixing the adjusted to create operator displays.
- Assisting application development - A user-driven graphical tool will significantly facilitate development and debugging of network applications.



In May 2011, US Department of Energy (DOE) awarded Power Info LLC an innovation grant in support of the continuous research on data-driven visualization of power grid,

6.4.3 OTHER TOOLS LINKED TO THE CIMCPY EE

In addition to CIMSpy EE/CIMdesk, Power Info LLC also provides a set of CIM-based data engineering components that can be embedded into other CIM compliant information infrastructure, including high-performance CIM/XML parsing, station diagram auto-generation, operational to planning model transformation, and model merging and equivalencing, etc.

6.4.4 EXPECTED CIM FUNCTIONALITIES

The following features and enhancements have been planned for the future versions of CIMSpy EE:

- Supporting CIM Schematic Layouts Standard (IEC 61970-453)
- Supporting IEC 61970-456 and interfacing with EMS/SCADA to enhance situational awareness in a grid control centre environment.
- Supporting visualization of bulk power system operating conditions over wide geographical region.

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6.5 CIMTOOL

6.5.1 VENDOR PRESENTATION

CIMTool is developed by Langdale Consultants as an open source project with the support of a number of vendors and utilities in the CIM community.

Langdale Consultants is an independent consulting firm based in Sydney, Australia which provides support for CIM projects internationally. More generally, Langdale assists utilities to specify, select, deploy and integrate their information systems.

Langdale has been engaged in the CIM standards process for more than 10 years. See: http://www.langdale.com.au

6.5.2 TOOL DESCRIPTION

CIMTool creates and edits profile definitions, which are subsets of the CIM that govern data exchanges. It also validates exchanged data against these profiles. See: http://cimtool.org

The ENTSO-E CIM profile was created with CIMTool, including the RDFS and OWL artefacts and the per-class documentation. CIMTool also provided a validation capability during the ENTSO-E interoperability tests.

CIMTool is designed to maintain a profile throughout its life. It can compare profile versions, reconcile profiles with CIM changes and find errors in a profile and offer corrections.

CIMTool can assist in the construction of CIM-based software. It generates implementation artefacts such as database schema definitions and programming language bindings. A template system makes it possible to customise these as required.

6.5.3 OTHER TOOLS LINKED TO CIMTOOL

CIMTool is built on the eclipse tools platform and forms part of the eclipse integrated development environment (see http://eclipse.org). It can be used in concert with the eclipse XML document and schema editors and the many other eclipse modelling and software development tools.

The CIMTool validation functions are available as a standalone command line tool called CIMCheck (see http://wiki.cimtool.org/CIMCheck.html). This allows validation to be automated via scripting.

The OWL artefacts produced by CIMTool, both profiles and the CIM as a whole, are OWL 2 compliant. They can be used in ontology editors including Top Braid and Protege (see http://www.topquadrant.com and http://protege.stanford.edu).

6.5.4 EXPECTED CIM FUNCTIONALITIES

CIMTool is under ongoing development. Forthcoming features include:

- Datatype definition refinements using XML Schema facets such as an allowed range of values or a string pattern.

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- More flexible profile definitions and the ability to share definitions between profiles.
- Multispeak-compatible XML schemas.

6.6 CONVERGENCE 2.0

6.6.1 DEVELOPER PRESENTATION

RTE is the operator of the French electricity transmission system. It is a public service company which operates, maintains and develops the high and very high voltage network.

With the largest network in Europe, consisting of more than 100,000 km of lines ranging from 63 to 400 kV and 46 cross-border connections, RTE is a central player in the construction of the European electricity community.

www.rte-france.com/

6.6.2 TOOL DESCRIPTION

Convergence is the energy management system (EMS) developed by RTE, the French transmission system operator. It has been designed for users from both grid operation and grid development divisions.

Convergence is based on a client-server model. This allows centralization of computational processors and shared databases on the server side, and thus only requires a light interface on the client side.

Main figures about Convergence 2.0:

- Handles over 350 users in total, 250 simultaneously,
- Handles over 7000 nodes networks.

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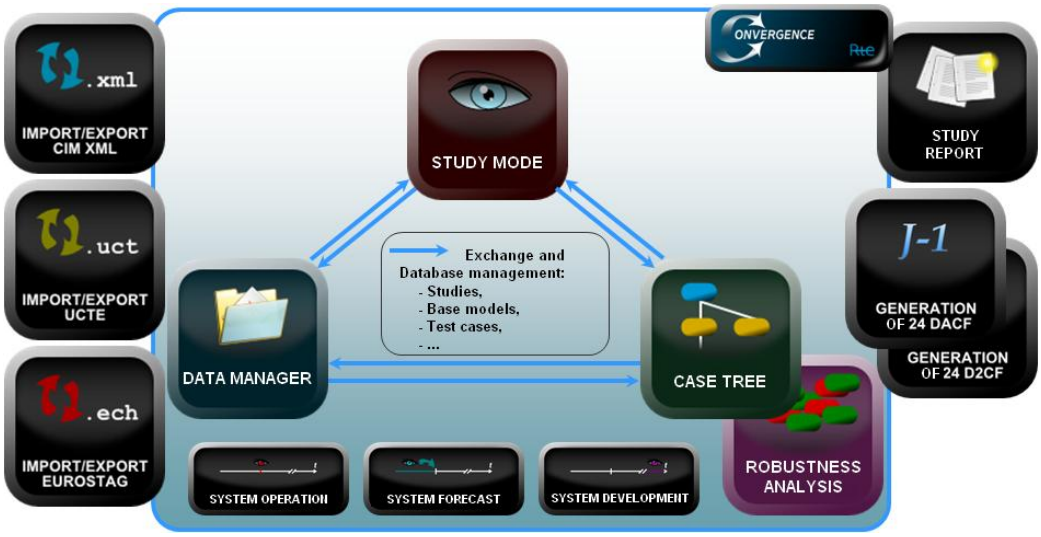


OVERVIEW OF CONVERGENCE'S MODES AND FUNCTIONALITIES

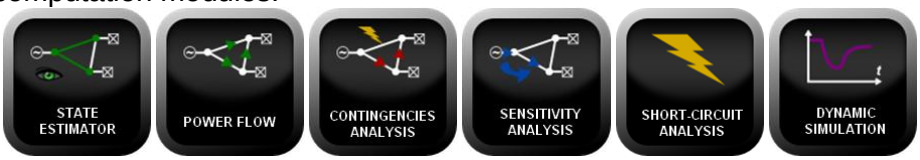
Convergence has three central modes:

- Study mode,
- Case tree mode,
- Data manager mode.

6.6.2.1 STUDY MODE

In study mode, the user starts by loading a network base case with a fixed structure. The user can then perform a study on the network base case by doing the following:

- Run computation modules:



  Available modules are:
  - State Estimator,
  - Power Flow,
  - Contingencies Analysis,
  - Sensitivities of Active Flows to Active Injections (in DC approximation),
  - Three-phase Short Circuit Analysis (symmetrical and dissymmetrical),
  - Dynamic Voltage Security Analysis (ASTRE tools with QSS: Quasi Steady-State simulation)
  - Initialization of Generations,
  - Initialization of Voltages (OPF: Optimal Power Flow),
  - Analysis of Power Flow divergence (OPF).
- Display different graphic representations:
  - A simplified map of the area described in network case with aggregated flows on borders between sub areas,
  - A full map of the network with different levels of details depending on the zoom level (cluttering/de-cluttering),
  - User-defined sub area map,
  - Substation representation.

  From these graphic representations, the user has access to most of the functions: explore, edit data, browse results, and launch computations.

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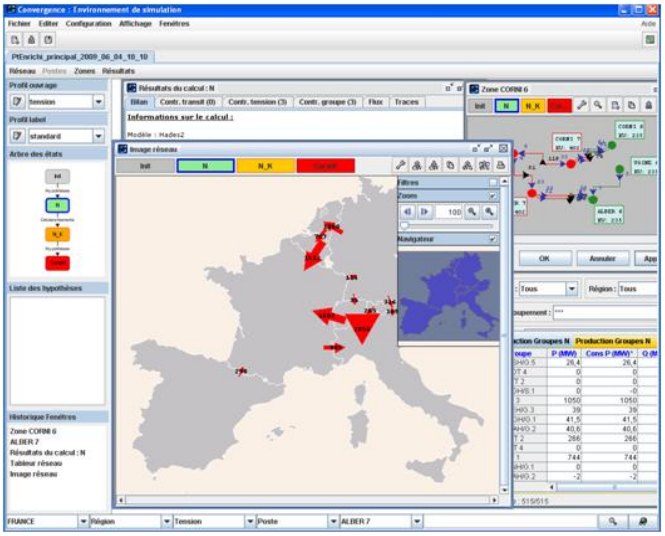
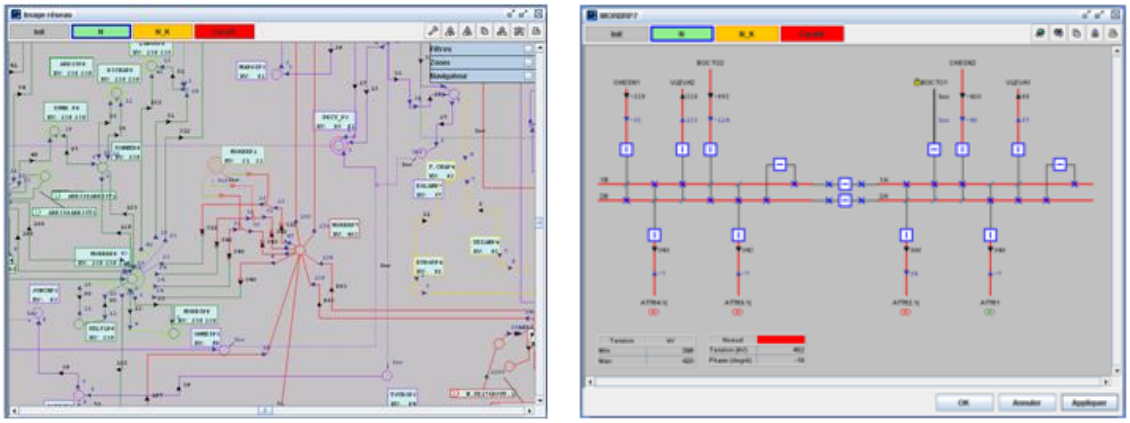


SCREENSHOT FROM THE STUDY MODE: CENTRE: SIMPLIFIED MAP; TOP RIGHT: USER-DEFINED SUB AREA MAP; BOTTOM RIGHT: CUSTOMIZED RESULTS TABLE



SCREENSHOT FROM THE STUDY MODE: LEFT: MAP OF THE NETWORK; RIGHT: SUBSTATION REPRESENTATION

- Compare network states,
- Apply efficiently data modification (generation, load, topology…).

Two other kinds of user interfaces are provided to edit data and analyze results:

- User-defined tables allow browsing computation results and browse/edit data of network case,
- Specific tables or curves allow to display specific results using cross reference or in synthetic way and to enter some specific data.

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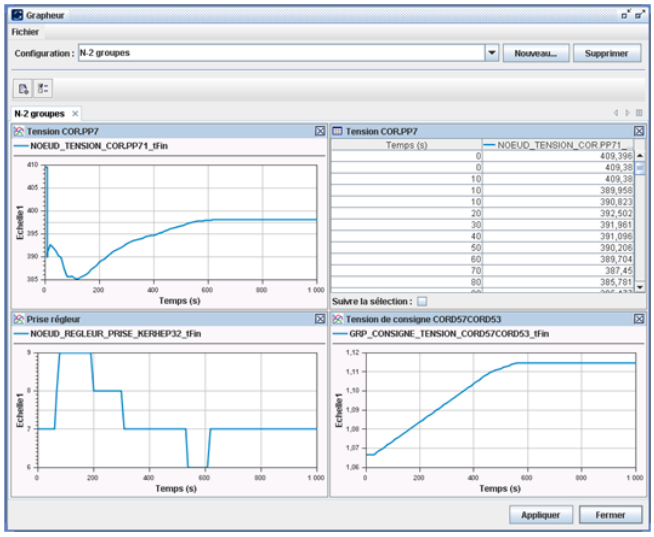


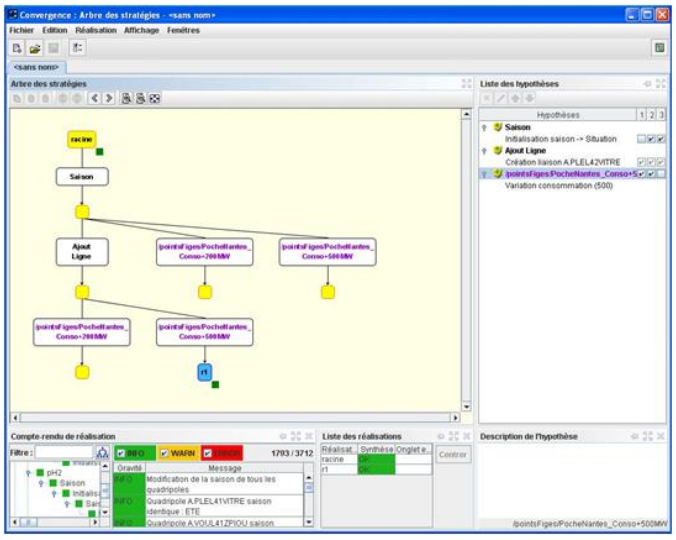
SCREENSHOT FROM THE STUDY MODE: RESULTING CURVES FOR DYNAMICS

6.6.2.2 CASE TREE MODE

Case tree is a tool to organize all type of studies including studies with structural modifications.

The Case tree mode has been designed for studies which last few days or which require a significant amount of work for building the network use cases. Starting from the base model, only the modifications (state or structure, single or massive scale) are stored. This also allows tracing the study management process.

A function to perform a robustness analysis is available in this context. This function allows assessing the security of the system in case of combination of generation, load and/or topology changes.



SCREENSHOT FROM THE CASE TREE MODE: USE CASES DEVELOPING FROM A SINGLE BASE MODEL ARE REPRESENTED THROUGH TREE BRANCHES; BOXES REPRESENT MODIFICATIONS ON THE USE CASES, PURPLE IS USED WHEN MODIFICATION IS SHARED

6.6.2.3 DATA MANAGER MODE

Data manager allows managing all the data used by Convergence:

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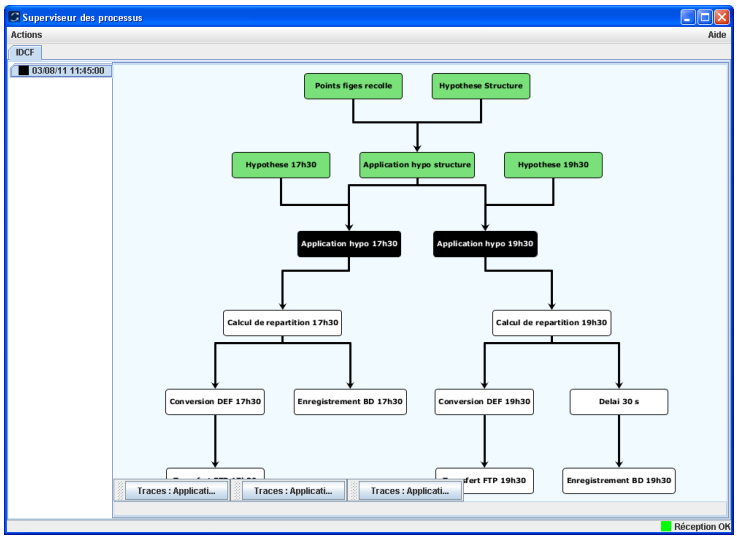
- Exploring own network cases, studies, case trees, modifications (state or structure),
- Collaborative sharing of data:
  - Network cases, studies, case trees, modifications (state or structure),
  - Customized configurations, graphic representations, user interfaces,
- Executing generic processes :
  - Merging or extracting networks (regional and European),
  - Daily generation of 24 DACF, D2CF and IDCF,
  - Flow-based and ATC parameters calculation (PTDF…),
- Importing/exporting in other data formats (CIM, UCTE, EUROSTAG…),
- Managing auxiliary data:
  - Time series definition (generation, load…),
  - External parameters configuration (Xnodes…),
  - Users and groups management (definitions, customizations and rights).



PROCESS SUPERVISOR FOR IDCF GENERATION: BASE CASE LOADING, EXECUTION OF STRUCTURE AND STATE MODIFICATIONS (FOR EACH TIMESTAMP), LOAD FLOW CALCULATION, UCTE EXPORT, FTP TRANSFER, LOCAL DATABASE COPY

6.6.3 OTHER TOOLS LINKED TO CONVERGENCE

None.

6.6.4 EXPECTED CIM FUNCTIONALITIES

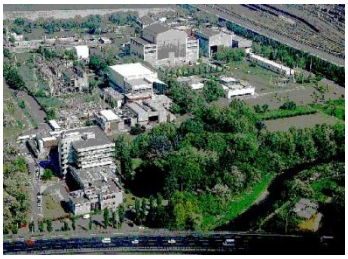
Convergence allows import and export in CIM ENTSO-E profiles 1st and 2nd edition. The main objective is TSO-to-TSO file exchange for ENTSO-E needs.

6.7 CRESO

6.7.1 CESI PRESENTATION

Established in 1956, since the beginning CESI has been a market leader in Consulting Activities in the Energy sector, Testing and Certification of electromechanical equipment offering its

services to electrical utilities, electro-mechanical and electronic manufacturers, large-scale users of electric power.



Since 2000, CESI has enlarged its fields of activity covering all sectors in the electro-energy fields from generation, to transmission, distribution, end-use of electricity, as well as environment and renewable energies. Now CESI is a global power consultant offering its services world-wide.

In October 2004 CESI took over ISMES, a Company that enables CESI to expand the range of services by working in the fields of environmental risk, design support and structural assessment on buildings and structures, with tests and studies on mechanical and industrial components.

Through the acquisition, in 2005, of IPH (Berlin) and of it's controlled FGH (Mannheim), CESI becomes leader on the international market of electric equipment testing.

CESI has been operating world-wide; has a marketing network in about 40 countries offering its services to:

- Electrical Utilities (production, transmission and distribution)
- Independent System Operators (ISO)
- Regulation Authorities
- Electromechanical and Electronic Manufacturers
- Industrial Users
- Public Administrations
- International Financial Institutions.

CESI activities cover, apart from erection, the whole cycle of a project i.e:

- feasibility,
- design,
- commissioning,
- operation
- disposal.

The offer concerns:

- techno-economic studies on networks, systems, plants and components
- consulting and specialised diagnostic and maintenance interventions
- plant and component life assessment / life extension studies
- management and training procedures and tools

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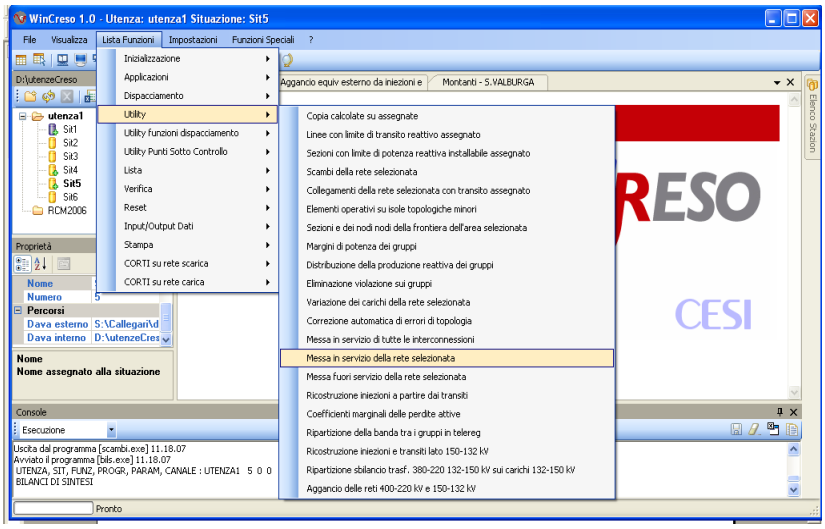
- qualification tests, component, system and plant certification
- supply of testing laboratories, special components
- environmental studies and services: monitoring and assessments, design and realisations, structure engineering, technology developments.

6.7.2 TOOL DESCRIPTION

CRESO (Network Calculation for Security Operation and Optimization) is a Windows-platform integrated software system that permits the simulation and the analysis of a power network under steady-state conditions, as well as the optimization of the active and reactive power generation. Advanced functions for network studies are also available, such as, for instance, the calculation of the distance from the voltage failure point.

The following are the system main characteristics:

- user-friendly MMI (Man-Machine Interface), promptly understandable and making the operator-system interaction extremely easy;
- extreme modularity of the software architecture, permitting the easy addition of new properties without abandoning a complete integration;



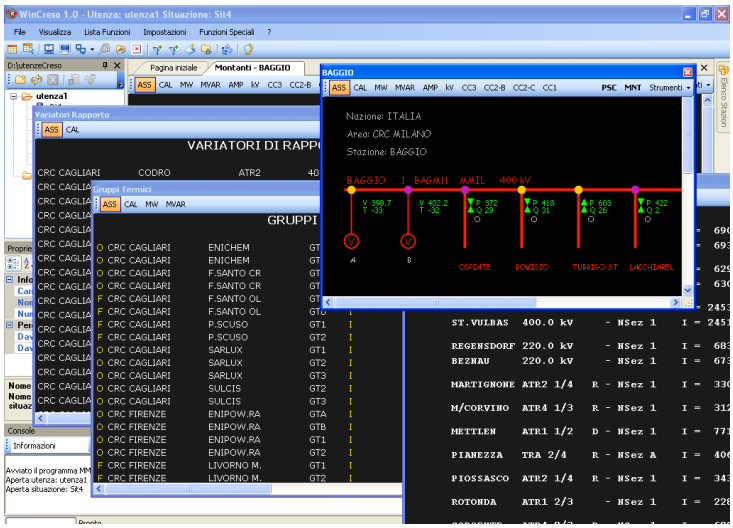
- a complete set of algorithms comprehensive of all the functions necessary for the simulation and the analysis of a power network under steady-state conditions, the security assessment, the optimization of the active and reactive power generation, the short circuit calculation and the harmonic distortion evaluation;
- absolute universality and completeness of the model system and of the algorithmic solutions adopted to implement the different functions; this permits the use of CRESO for the study of any type of network.

Even though it is a typical tool for off-line analysis within operation planning and post-mortem analysis, CRESO can be easily integrated with the Italian on-line control system, this aspect being underlined even more by the fact that CRESO provides also the Estimate of the state, which is a classical function of on-line control systems.

Another remarkable characteristic is the construction of all the data and processing results displays, starting from network data only, such construction being entirely automatic and transparent for the User.

The following are the main functions available with CRESO:

- Acquisition of analogue and topologic quantities; the latter can be provided either as switchgear position or under the more summarized form of electric node
- Estimate of the state and validation of remote signals and acquired remote measurements
- Load flow calculation (considering or not considering the Active/Reactive decoupling)
- Static Security analysis that establishes the steady-state conditions of the network, considering the speed primary regulation of units only, or else the frequency-power regulation. The two versions that consider or do not consider the active/reactive decoupling are available for this function as well
- Security Analysis of the entire network (N-1, with the tripping of transmission lines and power generators), underlining the contingencies that give rise to current and/or voltage violations, also taking into account the system automatic actions, such as primary and secondary power regulation or load-shedding actions



- Optimal dispatching of active power generation (OPF), based on an economic or safety objective function, considering the following constraints:
    - the current passage limits on all the connections;
    - N-1 security limits on a selected set of connections;
    - the limits for the exchange of active power between countries and between different areas within the same country
- Optimal dispatching of the reactive power generation (ORPF), so as to minimize network active losses and to minimize the voltage distortion from and assigned profile, considering also the following:
    - the voltage limits for all the nodes;
    - the reactive power generation limits of the generators
- Security Analysis of Voltage Profiles and calculation of the distance from the failure point, with the indication of the maximum loadability of the system
- Calculation of active and reactive power balances at country level and/or regional level within the same network

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- Short circuit calculations, such as calculation of single-phase or multi-phases short circuits, in every bus or along intermediate point of the transmission lines, evaluation of voltage drop, check of the protection system. Furthermore, there are also functions for the evaluation of the harmonic and flicker distortion.
- Numerous functions are available as a support for data validation, for network configuration analysis and for the display and interpretation of results.

6.7.3 THE POWER SYSTEM MODEL

The network model managed by CRESO is made up of the following components:

- countries;
- stations;
- sections;
- AC lines (for interconnection and loading);
- DC lines (for interconnection only);
- 2-winding transformers (for interconnection and loading);
- 3-winding transformers (for interconnection only);
- tap changers (ratio changers, phase transformers, diagonal and mixed changers);
- thermal units and plants;
- hydroelectric units and plants;
- wind farms;
- synchronous compensators;
- capacitors;
- reactors;
- Thyristor Controlled Series Capacitors (TCSCs);
- Static VAR Compensators (SVCs);
- AC/DC converters.

The main regulations are the following:

- the primary voltage regulation of thermal and hydroelectric units and of synchronous compensators, within their reactive producible condition limit (capability);
- the secondary voltage regulation (area regulation) with thermal and hydroelectric units and possibly with synchronous compensators, interlocked with the same regulator and aligned at the same level of reactive power generation, within their reactive producible condition limits (capability);

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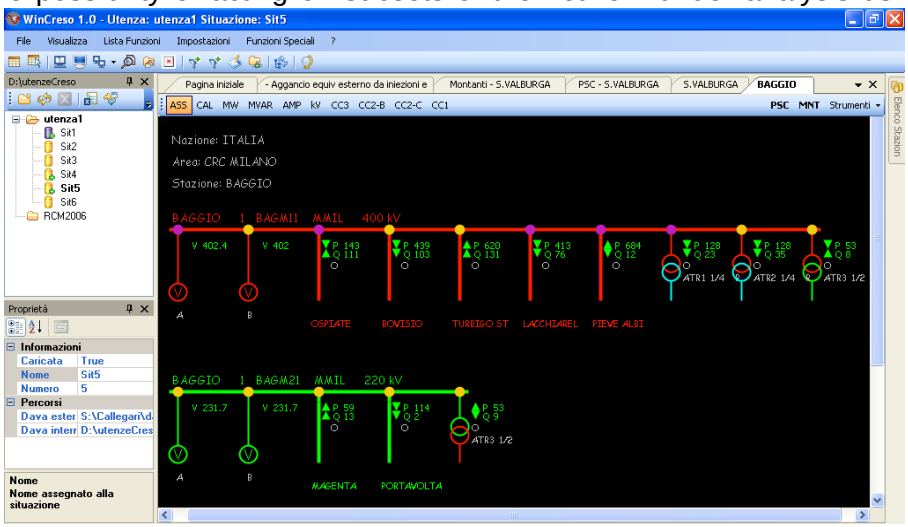
- the speed regulation of thermal and hydroelectric units;
- the f/P regulation;
- the regulation of converters;
- the regulation of the secondary voltage of transformers equipped with ratio changer;
- the regulation of the active power flow for the phase shifting transformers and for TCSCs;
- the voltage regulation of SVCs;
- the voltage and frequency dependency of the loads.

It is worth underlining the possibility of acting on subsets of the network under analysis using the network selection functions made available by CRESO.



The selection takes place at section level on three aggregations of items:

- geographical area;
- managerial responsibility;
- voltage level.

This permits, for instance, the carrying-out of a static security analysis in a selected country to assess whether or not it is in a position to autonomously remedy the active power deficit provoked by the loss of a generator set, avoiding the recourse to adjoining countries.

6.7.4 NAVIGATION WITHIN CRESO

The use of CRESO takes place through the navigation across the displays that represent the interface with the user and that can be divided into two large groups:

- layout displays;
- table displays.

The first type of displays provides the information by means of a graphical display characterized by a high degree of communicability; the displays that illustrate a

section layout, for instance, belong to this type: they represent a section layout with its bus bar trunks, its connections to the feeders and the position of the switchgear, as well as the power and current values that flow through the different feeders and the voltage values of each trunk.

The second type of displays, instead, provides the information under the form of tables: such displays are characterized by a high density of information and are fundamental for an appropriate use of instruments.

The passage from one display to another takes place by means of sensitive hyper-links that allow a simple and immediate passage from one display to another.

The information level of individual displays is strengthened also by the use of the overlay technique, that permits the use of the same physical field to display different types of information (such as, for instance, to display first the active power flowing through a given feeder and then the reactive power).

6.7.5 OTHER TOOLS LINKED TO CRESO

CRESO, with the support of SICRE, is also the tool used to set up the scenarios for the simulations performed by the Dispatcher Training Simulator (DTS) and by the Dynamic Security Assessment (DSA). The links between these tools and CRESO is via internal proprietary format;

- DTS is used for training Control Room Operators as a replica of Control Room System with teaching sessions representing different real situations, from normal condition (e.g. morning load ramp) to extreme critical situation (e.g. blackout).
- DSA is an on-line security preventive assessment; taking the most recent steady state power flow calculation DSA performs the screening of several network contingencies.

6.7.6 EXPECTED CIM FUNCTIONALITIES

At the beginning of 2010 CESI starts to support the development of internationally unified data definition and data exchange mechanisms and is therefore committed to integrate and continuously update CRESO in order to cover ENTSO-E needs and rules regarding the reliability of load-flow and short circuits results. Up to now the software is under development in order to be compliant with the models (rev1. and rev 2) used during the IOP tests.

In the future CRESO (used also in the TERNA Operation departments) would include also the operational profile of CIM.

CESI will continue supporting the development of CIM related standards and the innovations supplied with next releases.

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6.8 DIgSILENT PowerFactory

6.8.1 Vendor presentation

DIgSILENT GmbH
Company Profile

DIgSILENT GmbH is a consulting and software company providing engineering services in the field of electrical power systems for transmission, distribution, generation and industrial plants.

DIgSILENT GmbH was founded in 1985 and is a fully independent, privately owned company located in Gomaringen/Tübingen, Germany, where the new offices have been in operation since early 2002. DIgSILENT continued expansion by establishing offices in Australia, South Africa, Italy, Chile and Spain, thereby facilitating improved service following the world-wide increased use of its products and services. DIgSILENT has established a strong partner network in many countries such as Mexico, Malaysia, UK, Switzerland, Colombia, Brazil, Peru, Argentina, Iran, Venezuela and China. DIgSILENT services and software installations have been conducted in more than 110 countries.

DIgSILENT PowerFactory
DIgSILENT develops the leading integrated power system analysis software PowerFactory, which covers the full range of functionality from standard features to highly sophisticated and advanced applications including wind power, dispersed generation, real-time simulation and performance monitoring for system testing and supervision. For wind power applications, Power Factory has become the power industry's de-facto standard tool, due to PowerFactory models and algorithms providing unmet accuracy and performance.

DIgSILENT StationWare is a reliable central protection settings database and management system for the complete power system substation data based on latest .NET technology. Station-Ware stores and records all settings in a central database, allows modelling of relevant workflow sequences, provides quick access to relay manuals, interfaces with manufacturer specific relay settings software and integrates with PowerFactory software, allowing powerful and easy-to-use settings co-ordination studies.

DIgSILENT Consulting
DIgSILENT GmbH is staffed with experts of various disciplines relevant for performing consulting services, research activities, user training, educational programs and software developments. Highly specialized expertise is available in many fields of electrical engineering applicable to liberalized power markets and to the latest developments in power generation technologies such as wind power and dispersed generation. DIgSILENT has provided expert consulting services to several prominent wind-grid integration studies.

PowerFactory Monitor is a flexible performance recording and monitoring system that copes easily and efficiently with the special requirements for system test implementation, system performance supervision and the determination and supervision of connection characteristics. Numerous Monitoring Systems installed at various grid locations can be integrated to a Wide-Area-Measurement-System (WAMS). The PowerFactory Monitor fully integrates with the PowerFactory.

DIgSILENT GmbH
Heinrich-Hertz-Straße 9
72810 Gomaringen
Germany
Phone: +49-7072-9168-0
Fax: +49-7072-9168-88
Internet: www.digsilent.de
E-mail: mail@digsilent.de

6.8.2 TOOL DESCRIPTION

DIgSILENT
Power System Analysis Software

DIgSILENT has set standards and trends in power system modelling, analysis and simulation for more than 20 years. The proven advantages of PowerFactory software are its overall functional integration, its applicability to the modelling of generation, transmission-, distribution- and industrial networks and its comprehensive user interface. PowerFactory is the ideal tool for studying the grid integration of new generation-technologies.

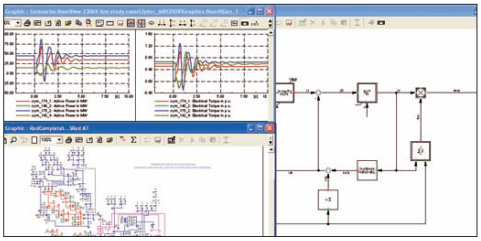
PowerFactory Applications

POWER TRANSMISSION

PowerFactory offers a complete suite of functions for studying large interconnected power systems integrating new technologies for power generation and transmission such as wind generation, virtual power plants, HVDC-VSC or FACTS. The fast and robust load flow algorithm can be applied to any AC or DC network topology. It uses highly accurate models including various types of MW and Mvar-controllers. PowerFactory's functions can be applied to improve the security, stability and economics of complex power transmission systems.

Typically required functions include:

Load flow/Contingency analysis/OPF
Nodal price and marginal cost indices
Short circuit analysis (IEC 60909, ANSI C37, multiple fault analysis)
Reliability assessment
Integrated stability and transient (EMT) simulation
Small signal stability analysis, also for very large networks
Transmission system protection coordination and simulation
Interfaces to SCADA/Energy Management Systems



POWER DISTRIBUTION

Different phasing technologies, such as single-wire earth return, two-phase, bi-phase or classical three-phase systems, have created a need for multi-phase distribution system modelling. PowerFactory provides the most comprehensive modelling features for studying all kinds of phasing technologies, meshed or radial topologies and railway supply systems connected to public distribution systems. In order to reduce network unbalance, improve quality of supply and optimize distribution networks, PowerFactory offers a large variety of functions, such as multi-phase load flow analysis, short circuit analysis (IEC 60909, ANSI C37 and multiple fault analysis), harmonic analysis, time-domain simulation and reliability assessment. Other standard features include the modelling of distributed generation and virtual power plants, voltage drop analysis, branch loading calculation, daily load curves and the consideration of LV load diversity. This is complemented by an easy-to-use protection coordination wizard.

Other important aspects are:

Open tie optimisation
Optimal capacitor placement
Cable reinforcement strategies
Quality of Supply Analysis ▪ Geographic Information Systems (GIS) ▪ Network Control Systems (SCADA)

INDUSTRIAL SYSTEMS

Industrial power systems supplying refineries, paper-mills, car factories or other plants with high power quality requirements benefit from high precision PowerFactory load flow algorithms, short circuit calculation features, 4-wire modelling, harmonics-analysis and filter design options.

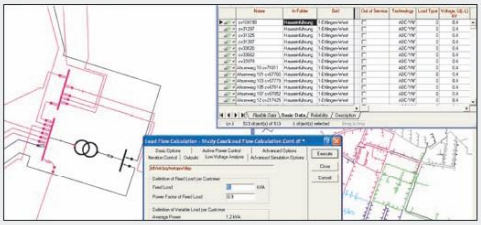
Other relevant functions include:

- Motor starting, voltage sag analysis and plant re-acceleration
- Protection coordination and settings verification
- Stability analysis and electromagnetic transients

DISTRIBUTED GENERATION

Generation at distribution levels defines entirely new challenges for distribution planning engineers due to reverse power flows, voltage drops and extreme variations in equipment loading. Various generation technologies are possible, such as synchronous and asynchronous cogeneration units, PV-cells, wind turbines, fuel cells and micro-turbines. Typical studies include steady-state and dynamic analyses, taking into consideration time-varying correlated or un-correlated energy sources.

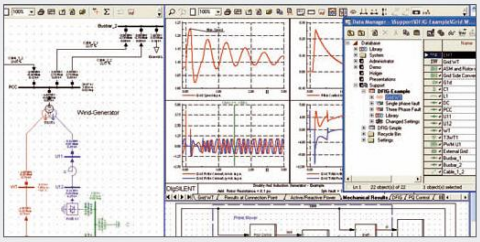
PowerFactory is the ideal tool for analyzing the impact of distributed generation on the network. It combines classical distribution system analysis functions such as voltage drop calculation, unbalanced network, load and generation modelling, selectivity analysis, etc. with the power of a highly modern analysis tool featuring dynamic simulation functions and reliability analysis. Full support is available for developing and analysing the impact of virtual power plants and new control techniques on distribution networks.



WIND GENERATION

Complex studies for the integration of wind generation into distribution and transmission networks are becoming increasingly important. PowerFactory, the de-facto standard in wind generation modelling, combines extensive modelling capabilities with advanced solution algorithms, providing the analyst with tools to undertake the full range of studies required for grid connection and grid impact analysis. The modelling capabilities of PowerFactory allow the inclusion of complex control dynamics, new generator technologies, blade control and wind turbulence.

Detailed wind turbine models
- Doubly-fed induction generator models (DFIG)
- Converter driven synchronous machine models (CDSG)
- Squirrel-cage induction generator models
- Manufacturer-specific high precision model with built-in control code



- Power electronic devices and grid harmonic analysis
- Generator protection and Crow Bar modelling
- Blade control
- Wind turbulence and gust models
- Stability and EMT analysis
- Integrated modelling of large wind parks

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DIgSILENT

PowerFactory Features

Basic Functionality

Data Organization and Access
Single-user[1] and Multi-user[2] database
User accounting and user roles
Parameter characteristics on any parameter
User-friendly Data Manager
Non-redundant data modelling
Data versioning and data sharing
Management of multi-user data editing
Time stamped model variations
Highly flexible Study Case management and Operation Scenario administration

Interfaces
Standard data formats, e.g. UCTE
Flexible DGS interface (ASCII,CSV,ODBC)
OPC and RPC Client- / Server support

Scripting
DPL-DIgSILENT Programming Language
C++ Interface for DPL scripts
Parameter variation studies

Network Diagrams
Schematic and semi-geographical diagrams
Overview single line diagrams
Classical single line diagrams
Design diagrams/Switch diagrams
Integration of overview and substation diagrams

Results and Reporting
Text and spreadsheet reports
Reporting in network diagrams
Around 30 diagrams for result visualisation
Specific diagrams for protection, harmonics, stability and transients

Models
Support of any kind of meshed / radial 1-, 2-, 3- and 4 wire AC and DC networks
Synchronous and induction machines
Network branches (cables, OHLs, transformers, etc.)
Line routes and sections
Shunt and filter elements
FACTS and HVDC systems
AC/DC voltage and current sources
Virtual power plants
Doubly-fed induction machine
Wind generators, PV, fuel cell, micro- turbines
VSC, thyristor converters
Diodes, thyristors and transistors

Power Flow
AC and DC load flow algorithms
SVC, shunt and tap controllers
Generator capability curves
Station- and network control features
Secondary and primary control
Inertial response
Accurate induction machine models
Voltage dependent load models
Sensitivity analysis

Contingency Analysis
AC or DC load flow analysis
Fast contingency screening
Modelling of multiple time phases
Fault case management
Event-based post-fault actions
Tracing of individual contingency cases

Fault Analysis
IEC 60909, ANSI C37 and VDE 0102/0103
Complete superposition method
Multiple fault analysis

Integrated Functions
Network reduction
Voltage stability (PV curves, dV/dQ)
OHL parameter calculation
Cable loading (IEC 364)
Cable parameter calculation
Asynchronous machine identification
Comprehensive DPL script library

Optimal Power Flow (OPF)
AC optimization (interior point method)
DC optimization (linear programming)
- Contingency constraints (DC only)

Various objective functions such as:
- Minimization of losses
- Fuel costs

Various controls such as:
- Generator P and Q
- Transformer and shunt taps

Flexible constraints such as:
- Branch flows and voltage limits
- Generator active / reactive power limits
- Active/reactive power reserve
- Boundary flows

Time Domain Simulation and Small Signal Analysis

Dynamic Modelling
Graphical Editor for block diagram definition
Library of IEEE standard models
DSL - DIgSILENT Simulation Language
High precision built-in macros & functions
Multi-level dynamic modelling environment
MatLab/Simulink and C++ Interfaces
OPC interface for real-time applications

Stability Functions
Multi-phase AC networks
DC-networks
Fast, adaptive step-size algorithm
A-stable numerical integration algorithms
High precision event handling
Simulation of any kind of fault or event
Support of all protection library relays
Small signal analysis
Selective Eigenvalue analysis

Electromagnetic Transients (EMT)
Fast, adaptive step-size algorithm
Constant and frequency-dependent distributed parameter cable/OHL models
Non-linear elements and saturation characteristics
Surge arrestor models
Stochastic switching analysis
Impulse voltage & current source for lightning surge analysis
Discrete R-L-C elements
FFT and user-defined models via DSL
Ferro resonance, SSR and TRV
COMTRADE-file support
Combined RMS/EMT simulation

Protection Functions
Comprehensive relay library with detailed static and dynamic relay models
Transient / steady state response checks
Synchronization with StationWare

Overcurrent-time protection
Fuses and low-voltage circuit breakers
Cable and transformer damage curves
Coordination Wizard for settings calculation
CT verification according to IEC 60044

Distance protection
Comprehensive relay library
Electromechanical, static & digital relays
Any relay characteristic (MHO, polygonal)
R-X diagrams
Automatic time-distance diagrams

Harmonic Analysis
Harmonic load flow
Harmonic voltage and current indices
Continuous frequency sweep
Multi-phase or positive sequence model
Harmonic current and voltage sources
Unbalanced harmonic sources
Non-characteristic harmonics
Inter-harmonics
Frequency-dependent R and X values
Various filter models & filter sizing
Ripple control analysis

Reliability
Fast and accurate state enumeration
Failure models:
- Line, transformer, generator, busbar and circuit breaker failures
- Common mode failures
- Double earth faults
- Protection/circuit breaker failures

Maintenance schedules
Network Analysis:
- Connectivity analysis
- Power flow analysis

Failure effect analysis (FEA):
- Automatic protection-based fault clearing
- System restoration
- Sectionalizing
- Overload alleviation
- Undervoltage load-shedding

Tracing of individual cases
Calculation of all common indices
Components' contributions to reliability indices

Distribution Network Optimization
Optimal capacitor placement
Open tie optimization
Cable reinforcement optimization

Low Voltage Network Analysis
Line loads and load unbalances
Consideration of simultaneity factors
Voltage drop and cable loading analysis
Feeder plots and feeder scaling

State Estimation
P, Q, I and V-measurements
Observability and bad data checking
Pseudo measurements
Consideration of load flow constraints
Support of OPC

[1] Workstation Edition with local hardlock
[2] Server Edition incl. license server and driver for ORACLE and MS-SQL

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6.8.3 OTHER TOOLS LINKED TO THE POWERFACTORY SOFTWARE

PowerFactory does not require any additional software such as an external database for handling CIM data import and export tasks. Typically required tools for handling of various grids, grid scenarios, timed grid expansion stages, data revisions and operational scenarios are integrated to the PowerFactory software data management system incl. 3-way compare and merge tools. In addition, working team is directly supported via multi-user database operation as well.

6.8.4 EXPECTED CIM FUNCTIONALITIES

DIgSILENT is supporting the development of internationally unified data definition and data exchange mechanisms and is therefore committed to integrate and continuously update a number of CIM standards.

DIgSILENT GmbH has contributed in the past to the CIM standard development and participated successfully in various CIM related IOPs.

The DIgSILENT PowerFactory software is currently supporting the following CIM profiles:

- ENTSO-E profile 2009

Future versions of PowerFactory will provide data transfer based on:

- ENTSO-E profile 2011
- CIM for Dynamic Models

Further, ENTSO-E planning processes as well as operation processes such as DACF, D-2CF are already fully supported by PowerFactory.

DIgSILENT will continue contributing to the development of CIM related standards and future profiles.

6.9 EDF CIM-ENTSO-E CONVERTERS

6.9.1 VENDOR PRESENTATION

EDF R&D developed for March 2009 UCTE Data Exchange Format to CIM converters. The converters were made available to each TSO in 2009, 2010 and 2011 in order to help them to migrate to **CIM ENTSO-E profile Edition 1**.

The CIM-ENTSO-E converters convert a UCTE DEF 2.0 file to CIM XML ENTSO-E Edition 1 profile, and are able from CIM XML ENTSO-E Edition 1 profiles to produce the original UCTE DEF file.

In 2011, ENTSO-E asked EDF R&D to upgrade the converters in order to take into account the boundary nodes.

6.9.2 TOOL DESCRIPTION

The version provided for 2011 IOP tests is v2.7.

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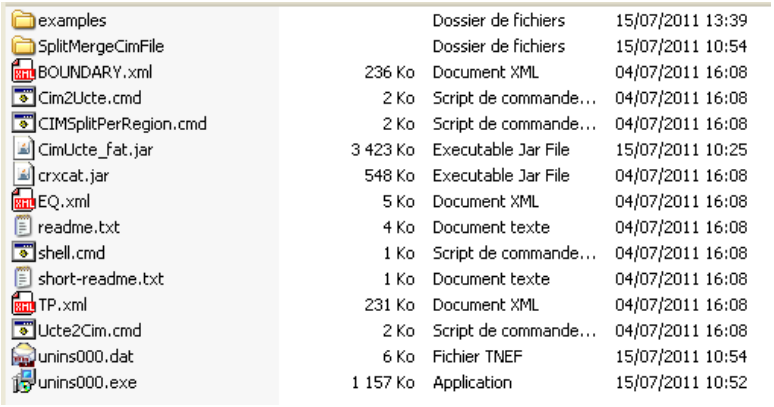
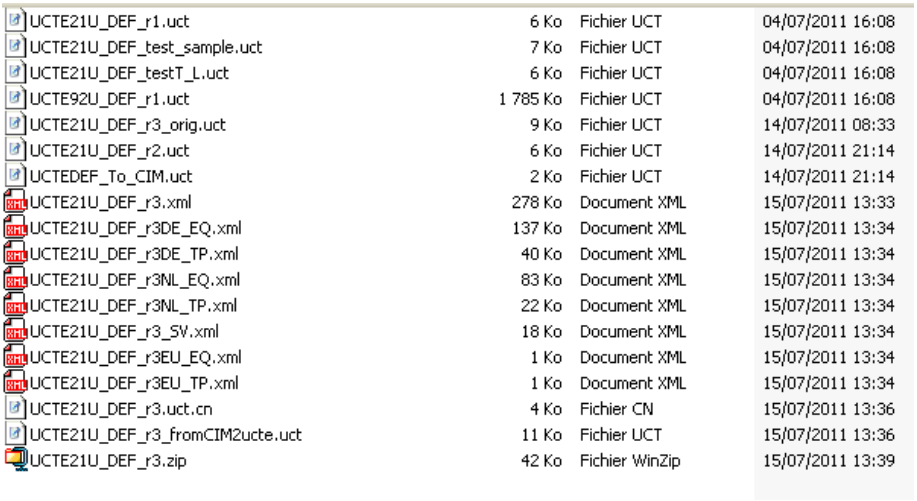
The EDF CIM-ENTSO-E converters are delivered as an exe file:

When installed, the installation folder will contain the following files:



It is recommended to users to read the readme.txt, and short-readme.txt files.

Examples folder after a conversion will provide the following files:



Files .uct are UCTE files provided by ENTSO-E to test the converters. In this example, UCTE21U_DEF_r3.uct was provided, converted to CIM XML files, and the CIM XML global file UCTE21U_DEF_r3.xml was converted back to uct format (after renaming, we end-up with UCTE21U_DEF_r3_orig.uct and UCTE21U_DEF_r3_fromCIM2ucte.uct)

6.10 ENTERPRISE GATEWAY

6.10.1 VENDOR PRESENTATION

GE is a diversified infrastructure, finance and media company taking on the world's toughest challenges. From aircraft engines and power generation to financial services, medical imaging, and television programming, GE operates in more than 100 countries and employs about 300,000 people worldwide.

GE has a strong set of global businesses in infrastructure, finance and media aligned to meet today's needs, including the demand for global infrastructure; growing and changing

demographics that need access to healthcare, finance, and information and entertainment; and environmental technologies.

For more detail about GE, please visit http://www.ge.com

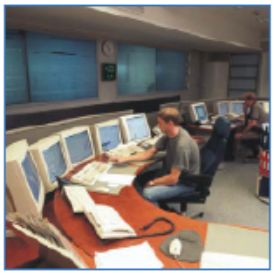
GE Energy's XA/21 is a field proven, scalable and feature-rich Supervisory Control and Data Acquisition (SCADA) / Energy Management System (EMS) solution that is specifically designed to meet the needs of today's electric utilities.

Since its debut as the first open Energy Management System (EMS) offering in early 1990, the **XA/21*** system from GE Energy has continued to revolutionize the industry. With an established track record of field performance—over three and a half million hours of online operation—the XA/21 system is entrusted with the management of critical transmission & generation infrastructure in over 100 locations worldwide. GE Energy's worldwide team of professionals and the XA/21 system's modular software and open system architecture combine to enhance service performance and overall reliability, while facilitating continued compliance with ever-changing industry requirements.

Benefits

- Scalability from one to over 150 computing nodes
- Field proven reliability – over 100 installed systems, over 3.5m hours of online operation
- Flexibility to adapt to the ever-changing market and regulatory demands
- Low total cost of ownership
- A foundation of industry and de-facto standards including:
  - UNIX®
  - Windows®
  - ODBC
  - POSIX®
  - SQL
  - TCP/IP
  - ANSI® C
  - Fortran, C++
  - JAVA™
  - CORBA®
  - XML
  - SSL
  - HTTP
  - DNP 3
  - IEC® 870-5 101
  - IEC® 870-6 TASE.2 (ICCP)
  - ELCOM 90
- Rich portfolio of world class advanced applications for transmission and generation
- User driven, internally funded and highly vital product evolution

The XA/21 system is all about improving your performance



Decision Support – Information Versus Raw Data

The XA/21 system presents a consistent real-time view of the entire electrical network to operators and management based on established end-user permissions. The capability to analyze alternate operating strategies based on current or postulated system conditions provides your operations team with valuable insight into possible courses of action. The XA/21 system is designed to ensure that timely, accurate information is available when you need it most.

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Grid Security

As asset utilization levels continue to rise, the importance of secure grid operation becomes paramount. Explosive growth in the number of wholesale power trades continually stresses the transfer capability of the transmission grid. The XA/21 system supplies your operational staff with a powerful suite of information management tools that allows them to visualize, anticipate, and respond to ever changing system conditions. Whether through the smooth, reliable management of generated power in response to system disturbances, the vigilant monitoring of system conditions against operating limits, or the automated development of corrective and preventative strategies, the XA/21 system delivers.

Cyber Security

Equally important to the security of the grid itself is the security of the IT systems used to manage the grid. With an ever-changing spectrum of plausible threats ranging from disgruntled employees to cyber-terrorists, sound IT security has become an ongoing process that requires effective utilization of the latest technologies. In addition to more fundamental security mechanisms, such as firewalls and user ID/password protection, the XA/21 system also provides advanced security measures including centralized management of end users, user authentication, data/communication encryption, and file tampering detection.

Total Cost of Ownership

Tired of wrestling with your antiquated EMS? The XA/21 system is designed to reduce total operating and maintenance costs, including costs of ownership. The XA/21 system's next generation Java™-based, full graphic user interface (EnterNet Suite*) eliminates client side installation and maintenance costs and substantially enhances overall operational efficiency. The EnterNet Suite interface support for embedded URLs provides tremendous impact on your Total Cost of Ownership by providing "out of the box" interface functionality with respect to other web-enabled systems. View documents and/or launch applications on other Enterprise systems, all without writing a single line of code. With the EnterNet Suite interface, the XA/21 system also provides the capability to cost effectively consolidate existing control centers—while continuing to support the geographically dispersed user community—resulting in significant savings.

Operating Costs

Fuel cost is far and away a generating company's single largest operating expense. The XA/21 system helps to minimize fuel and fuel-related O&M costs while satisfying unit, plant, and system level operating constraints. It also helps reduce contractual and regulatory constraints, such as limited availability fuels and emission levels. The XA/21 system also can provide reduced transmission losses through the use of available reactive compensation and voltage controls. By providing an up-to-date, accurate picture of current system conditions relative to operational constraints, the XA/21 system can help to maximize the utilization of existing assets, allowing costly capital expenditures to be deferred.

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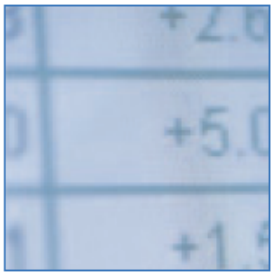
Architectural Scalability and Flexibility

From single-computer development systems to geographically dispersed operational systems in excess of 150 nodes, you can rest, assured that the XA/21 system will fit your operational needs today, tomorrow, and beyond. The XA/21 system provides for a myriad of options with respect to physical system configuration and user access including, but not limited to:

- Centralized, hierarchical or peer-to-peer control centers
- Geographically dispersed systems
- Dedicated standby emergency backup systems
- Remote user workstations and data acquisition nodes
- Corporate data warehouse



Conditional Online Database Editing

Add, modify or delete database entries online. Enter your data once. Choose from batch or interactive mode. With the industry's only true online integrated database editing facility, changes can be made to the database and committed to the online system without interruption of online operations. No reconfiguration or re-starting of the system required—just edit and commit your changes to the online system. All changes are automatically subjected to the full range of syntactic and semantic validation prior to being committed, thereby ensuring the integrity of the online data model is preserved. Once committed, you have the opportunity to evaluate your changes online and then accept or reject them. Rejection of previously committed changes results in only those changes being "rolled back" and the previous version of the online database being automatically restored.

Components of the XA/21 System

The XA/21 system is a high performance distributed control system that provides electric utilities worldwide with the capability to monitor, control, and optimize the operation of geographically dispersed assets in real time. Scalable from a single node—nonredundant system upward to geographically-dispersed systems containing literally hundreds of interconnected processing nodes—the XA/21 system is a common computing foundation that is fully configurable and can be tailored for specific system functions. The XA/21 system collects data from RTUs, IEDs and other operational systems to provide a single unified view of operational data across the utility's operational enterprise. At the foundation of this architecture are the XA/21 System Base, Data Acquisition and Control, Data Link, Database, and EnterNet Suite Graphical User Interface modules. Together, they provide the basic framework for the day-to-day operation and maintenance of the generation and transmission grid.

Besides the Core Modules mentioned above, a system can also enable optional modules, which includes **SCADA Applications** such as Load Shedding & Restoration, Network Status Processor, Sequential Control, CRDB Playback and **Power System Applications** such as Generation Dispatch and Control, Transmission Security Management, Voltage/Transient Stability, Unit Commitment/Transaction Evaluation, Demand Forecasting, Dispatcher Training Simulator. For detail and other related XA/21 software, please check website http://site.ge-energy.com/prod_serv/products/scada_software/en/downloads/GEA14736_XA21SCADA_EMS_HR%20.pdf

6.10.2 TOOL DESCRIPTION

Enterprise Gateway (EG) is GE Energy's tool for CIM exchange in EMS area and supports Full Export and Import, Incremental Import and Export, Partial Import and Export, ICCP data

exchange, model exchange (import and export), Equivalent Network Export and Import, Model Authority Set Import, Update and Export, Multiple profile processing. It was totally redesigned and upgraded to a powerful version 3.x. Here are some benefits of EG.

Performance: EG can finish full import or export for most moderate power system networks (around 1000 buses) in less than 1 minute.

Compliance: Passed the strict Interoperability Tests for both model exchange and power flow solution. EG supports CPSM 3.0 up to latest CIM/CPSM standards, as well as Planning profiles for ENTSO-E.

Self-Adaptive: EG is model-driven and adaptive to change in the CIM RDF or OWL Schema and XA/21 network model schemas. This minimizes maintenance/upgrade efforts.

Partner Organizer: EG organizes the partners (e.g. surrounding utilities who exchange CIM/XML model with the user) automatically and keep track of their transactions for model retrievals.

Multi-user: EG supports multiple users, who can work on model exchange in parallel.

Model Comparison/Merge: EG can compare different version of CIM or XA models and show the changes side-by-side to easy viewing. It also supports merging CIM or XA models.

EGTree: EG carries an EGTree tool to view and modify the CIM/XML model directly in a tree view format. Cascading delete is also supported. Another benefit of EGTree is to conveniently define the boundary for Partial model exchange. The tree hierarchy is user-configurable and compatible with all CPSM versions when the respective RDF schema is provided.

One-line auto-generation: An EG supporting tool can be used to generate the one-line diagram from the import of the CIM model with the option to show parameters of the power system devices.

6.10.3 OTHER TOOLS LINKED TO THE ENTERPRISE GATEWAY

XA/21 Transmission Security Management (TSM) is a network analysis application for electric utilities that monitors and controls their high voltage transmission networks. The application provides a powerful set of tools to perform network analysis, contingency analysis, network optimization (SCD, Voltage/VAR Scheduling, Remedial Action, Preventative Action), and fault-level analysis with transmission security management. Control center operators can quickly identify and analyze potential operating problems and formulate preventative strategies.

This network analysis package includes a comprehensive suite of applications:

Network Analysis - Provides system operators with a detailed representation of the overall power system.

State Estimator - Determines the operating state of the network model based on available real-time telemetry. Estimated values are provided for all input measurement types, bus phase angles, branch series, and shunt impedances.

Penalty Factor Calculator - Computes transmission loss penalty factors for all generating units in the power system model. Penalty factors are then used to adaptively update the appropriate segment of a matrix of penalty factor sets, know as the penalty factor grid.

Contingency Analysis - Assesses power system operating conditions from the simulation pre-defined lists of contingency cases.

Security Constrained Dispatch - Derives a recommended schedule of active power controls to optimize a user-specified objective, while simultaneously satisfying system-operating constraints.

Voltage/VAR Scheduling - Derives a recommended schedule of reactive power controls to optimize a user-specified objective, while simultaneously satisfying system operating constraints.

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Remedial Action - Determines independent optimized corrective rescheduling plans for harmful contingency cases.

Preventative Action - Determines optimized preventative scheduling plans for a list of contingency cases.

Short Circuit Calculation - Calculates three-phase, phase-ground, phase-phase and phase-phase-ground fault currents.

Equipment Outage Scheduler - Provides the dispatcher with the capability to prepare and maintain outage plans for any generator, load, shunt, SVC, line, transformer, DC Lines, series reactive device, static VAR controller, or switching device in the transmission network.

Fault Level Analysis - Provides real-time and study capability tools to simulate three-phase, phase-ground, phase-phase and phase-phase-ground fault currents.

6.10.4 EXPECTED CIM FUNCTIONALITIES

Enterprise Gateway supports both CPSM and ENTSO-E profiles and already has the full functionality related to CIM/XML exchange. It will be updated continuously to be compliant with later CIM standards updates for Operation and Planning.

6.11 E-TERRASOURCE - A POWER SYSTEM MODELER

6.11.1 VENDOR PRESENTATION

Alstom Grid supplies automation systems for electric power transmission, distribution and market operations.

6.11.2 TOOL DESCRIPTION

e-terra*source* is a sophisticated, RDBMS-based tool for managing power system models, based on the CIM standards. It provides a full-featured user interface for navigating and editing models. It supports concurrent operation by multiple users. It captures changes in annotated and effective dated projects. It supports generation of past, present and future / hypothetical views of the model. It supports CIM model authority set concepts. It provides complete audit trails of activity. It manages multiple kinds of models.

For more information, send email to jay.britton@areva-td.com.

6.11.3 OTHER TOOLS LINKED TO THE E-TERRASOURCE

e-terra*source* is linked to **e-terra***platform* (Alstom's EMS product).

6.11.4 EXPECTED CIM FUNCTIONALITIES

e-terra*source* is especially targeted toward the cooperative development of models that must take place in large interconnected power grids such as that covered by ENTSO-E. It provides members or regional entities in such an interconnection a tool for managing their own model territory and for constructing analytical models from submitted models of other members. We expect that the current level of ENTSO-E CIM interchange of models is only the beginning. We expect that these procedures will need to be extended so that the models used for EMS

operations are consolidated with the models used for day-ahead analysis and for longer-term planning. **e-terra***source* is the tool with the right complete set of features and a robust RDBMS-based design that will satisfy future as well as present requirements and unify modelling for all purposes.

6.12 EUROSTAG®

6.12.1 VENDOR PRESENTATION

Eurostag is co-developed by RTE and Tractebel Engineering.

6.12.2 TRACTEBEL ENGINEERING

Tractebel Engineering is part of GDF SUEZ Energy Services, one of the business lines of GDF SUEZ and the European leader in multitechnical services.

With about 3,700 employees around the world, Tractebel Engineering (GDF SUEZ) is one of Europe's major engineering companies, and offers state-of-the-art engineering and consulting solutions to power, nuclear, gas, industry and infrastructure customers in the public and private sector. Services include a full range of engineering assignments throughout the lifecycle of the customers' installations: architect engineer, owner's engineer and consulting engineer.

Power System Consulting (PSC), belonging to Tractebel Engineering (GDF SUEZ) is a group of 40 high profile electrical engineers and mathematicians acting worldwide as consultant in power system operation and development. PSC is a centre of excellence in power system analysis for the delivery of high added value services to public and industrial power systems.

6.12.3 RTE

RTE is the French TSO. (www.rte-france.com).

The missions of RTE are:

- Balancing electricity generation with consumption at all times
- Guaranteeing the secure operation of the power system (carrying electricity 24 hours a day, 7 days a week)
- Maintaining and developing the network to allow generators, distribution networks and consumers to be connected, as well as interconnection with neighbouring countries
- Guaranteeing non-discriminatory access to the transmission network, whilst ensuring that commercially sensitive information remains confidential
- Integrating transmission installations into the environment and ensuring the security of people and property

➔ all at the most economical cost possible

6.12.4 TOOL DESCRIPTION

Objective

Accurate simulation of the dynamics in all electric power systems.

Application

EUROSTAG® covers the full range of transient, mid and long-term stability, from electromechanical oscillations up to daily load evolution. By allowing understanding in depth all critical system mechanisms, EUROSTAG® helps solving

- conventional problems such as critical clearing times, power oscillations, tuning of generating units controllers, or load shedding policies
- as well as highly complex power system problems such as voltage collapse and black-out scenarios, set up of defence plans and restoration procedures, transfer capability, study of centralized voltage or frequency controls, or power electronics : FACTS and HVDC.

It also provides an entry point for new opportunities such as on-line dynamic calculations in EMS, system modelling in an integrated environment for analysis, and use of other compatible simulation applications. In every way, EUROSTAG®

A unique algorithm

EUROSTAG is based on a unique and robust algorithm using a continuous varying integration time step-size from 1ms to 100sec which will adapt automatically to the accuracy requirement. The step-size becomes short if a fast phenomenon (such as a loss of synchronism) is excited. It remains long and allows extended simulations (up to several hours) if only slow phenomena are excited.

Main advantages

- Continuous display of both fast and slow phenomena – EUROSTAG ® enables scenario simulations of a few seconds to several hours, making it ideal for studying conditions over time in which fast and slow phenomena interlock.
- Reliable simulation – EUROSTAG ® replicates and integrates all power system components, as well as the actions of operators, to produce authentic real-time dynamic simulation. Observation of any physical variation is possible at any moment, without any prior declaration.
- Flexible but secure power system modelling – EUROSTAG ® offers a vast library of power system models (including dispersed and renewable generation facilities) and processes. These can be used directly or modified - using an advanced modelling language that automatically generates the appropriate equations, removing all risk of human error. It allows representing in a specific way any type of process or controller, whatever the technology.
- Open software - EUROSTAG® reads data in international formats and can recover models and parameters used in older programs. Results can also be exported to other specialised programmes (Mathworks Matlab®, Microsoft® Office). EUROSTAG 4.5 is also CIM compliant.

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- Faster and easier studies – EUROSTAG® offers a user-friendly graphical interface for rapid modelling, data edition, simulation, results interpretation and analysis. The advanced modelling language enables for instance the customization of standard existing models or the input of new models, directly on the screen without any programming.

6.12.5 OTHER TOOLS LINKED TO EUROSTAG

6.12.5.1 TRACTEBEL ENGINEERING

Tractebel Engineering developed the following tools linked to EUROSTAG®:

1. Three complementary modules that can be plugged on EUROSTAG®
   - Dynamic security assessment (SYSCAN);
   - Dynamic Response Optimization (STAG-O!);
   - Small signal stability (HERCULES).
2. ***PSA PLATFORM***, for both Advanced Dynamic and Static Power System Analysis, that includes EUROSTAG®

   Static
   - Load-Flow;
   - Contingency Analysis;
   - Short-circuit calculation (static).
   - Short circuit currents (SHOCC);
   - Optimum power flow (IPSO);
   - Network reduction (REI).

   Dynamic

   EUROSTAG® (cf. above)
   - Dynamic security assessment (SYSCAN);
   - Dynamic Response Optimization (STAG-O!);
   - Small signal stability (HERCULES).

3. ***FAST***, dynamic real time Dispatcher Training Simulator. FAST is compatible with EUROSTAG®.

The PSA Platform is a planning tool where the different integrated software solutions are using the same internal format. Supporting CIM with EUROSTAG® will facilitate to connect the whole PSA Platform to CIM.

On the other hand, our real time Dispatcher Training Simulator FAST uses an operational model and is thus concerned with the CIM CPSM.

6.12.5.2 RTE: ASSESS

ASSESS allows to generate new systematic or random situations modelling the uncertainties. It is possible to model uncertainties on any variable defining the studied network.

To do so, the user has access to a great variety of probability laws. In a typical ASSESS study, the user generates between 1000 and 30000 new situations. Then each situation can be analyzed with a full range of tools.

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6.12.6 EXPECTED CIM FUNCTIONALITIES

The aim is to be able to import CIM data files in EUROSTAG®, run simulations on those cases and export the results in CIM format. EUROSTAG® being not a daily exchange tool, we are more interested by the full model exchange than by the split by MAS, incremental or partial exchanges.

The first step was to be compliant with CIM static data files. The version 4.5 of EUROSTAG® is already compliant with the CIM ENTSO-E Edition 1.0.

The next step is to take into account CIM dynamic data in the next versions of the software.

6.13 INTEGRAL 7 (FGH)

6.13.1 VENDOR PRESENTATION

FGH (Forschungsgemeinschaft für Elektrische Anlagen und Stromwirtschaft e. V.) is a non-profit research association of electricity supply industry and electrical industry with the aim of developing and providing competence and practice-oriented technical knowledge together with its members. The bundling of these tasks and the independent safeguarding of the member’s interests attain increasing meaning in the liberalised market. Here, our members and partners from network operation, industry, service and science profit by the activities of FGH.

The co-operation with RWTH Aachen University as well as other research institutes guarantees the comprehensive coverage of the entire sphere of activity. As an interface FGH ensures a fast transfer of solutions from science into practice. FGH has a relevant share to the world-wide top-ranking of the security and quality of German transmission and distribution networks. With our services we help to protect this position in the liberalised market.

Current topics of our work include e.g.

- Reliability-oriented network planning according to deterministic or probabilistic criteria
- Implementation of the new outage and availability statistics
- Asset management and development of appropriate maintenance strategies
- Condition evaluation and estimation of the residual life duration of technical equipment
- Integration of decentralised power generation units into the network
- Evaluation of protection and control systems
- Certification of the power generation characteristics of wind energy converters

For more than 30 years software development has been a core competence of FGH. Together with our member companies, FGH has conceived and is continuously improving the network planning system INTEGRAL.

With the program INTERASS, FGH offers another leading software product for the collection and evaluation of disturbance data according to the statistic schemes of FNN and VEÖ.

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Beside the standard products INTEGRAL and INTERASS, FGH develops individual software solutions that support special processes in utilities.

Internet: *http://www.fgh-ma.de*

6.13.2 TOOL DESCRIPTION

INTEGRAL is a powerful tool for the planning of electrical power systems. The roots of INTEGRAL go back for more than 30 years. Until 1974 the German TSOs did their own development of software for network analyses. In 1974 finally their efforts were centralized at FGH and a first program for power flow and short-circuit calculation was developed. In 1982 the first graphical output of networks was added and since 1986 the user is able to interact via a graphical user interface. Since 1990 additional calculation modules like state estimation and voltage-var optimization were added.

Main calculation modules in INTEGRAL are:

- Power flow calculation and outage simulation
- Short circuit calculation according to IEC 60909 (single fault and Takahashi’s method)
    - 1-phase faults
    - 2-phase faults (with/without ground connection)
    - 3-phase faults
- Universal fault calculation: Definition of arbitrary fault combinations (with/without consideration of the current power flow situation)
- Extended Ward network reduction (separately for power flow and short circuit calculation)
- State estimation
- Calculation of line parameters for overhead lines
- Reliability analysis
- Voltage-var optimization
- Simulation of fault clearing
- Analysis of harmonics propagation
- Cost analysis

Customer specific program modules can be developed and integrated into the graphical user interface.

INTEGRAL uses a detailed data model with complete modelling of the switch gear. This is a prerequisite for reliability analyses, simulation of fault clearing and cost analyses. But it also enables automatic creation of network graphics from the data model. Figure 1 shows the graphical user interface of INTEGRAL with an open network graphic.

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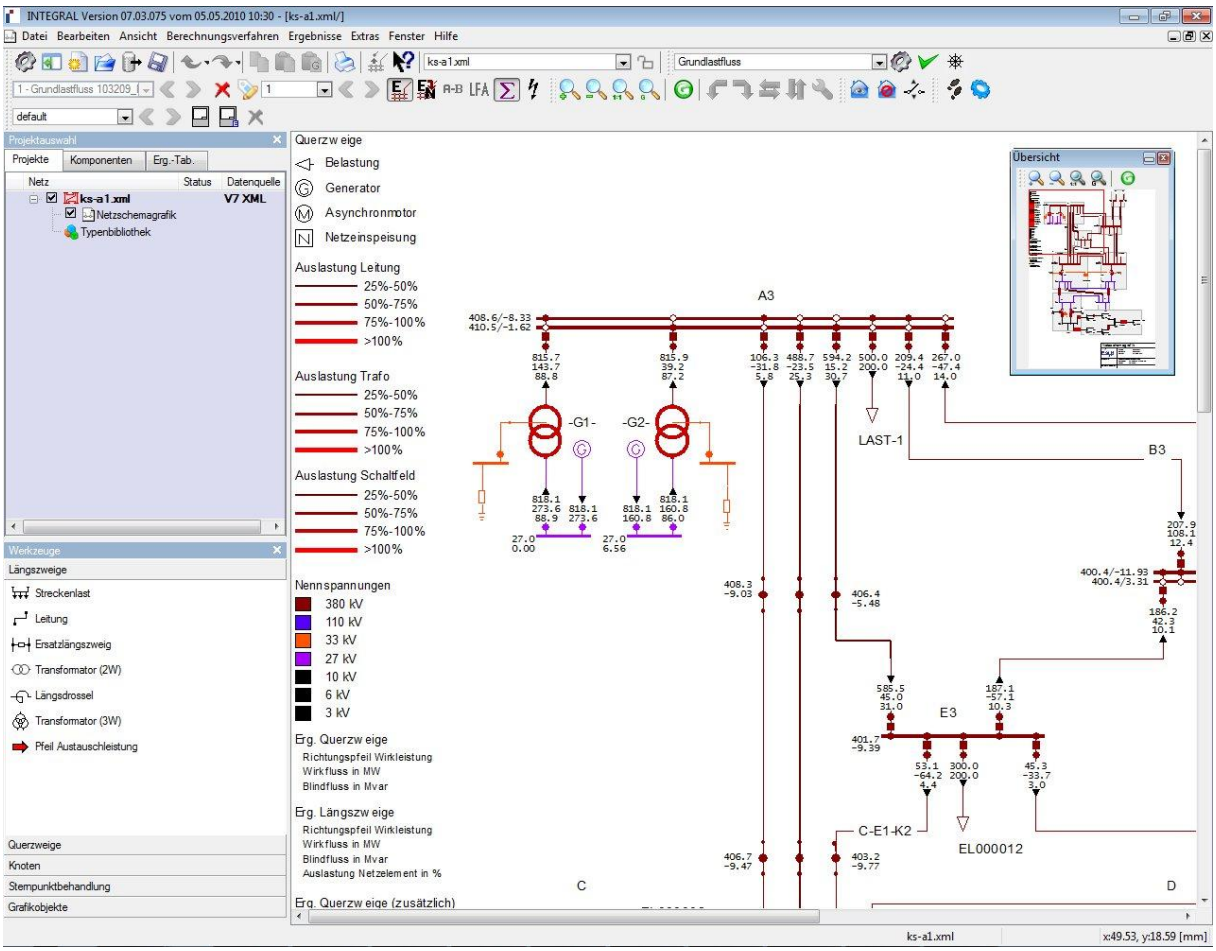

Fig. 1: GUI of INTEGRAL 7 with open network graphic

Additionally to the classic network graphic INTEGRAL provides a geographical presentation of the network, shown in figure 2. This geographic presentation gives a simplified overview of the network. Some calculation results can be visualized by background colors. This graphic is also an easy way to define a route model of the network.

Routes connect substations. They can bare poles and trenches. If overhead lines are assigned to poles, the line parameters of the overhead line can be calculated from the pole geometry (Fig. 3), including mutual couplings. Also poles can be used to easily define common-mode failures for reliability analyses.

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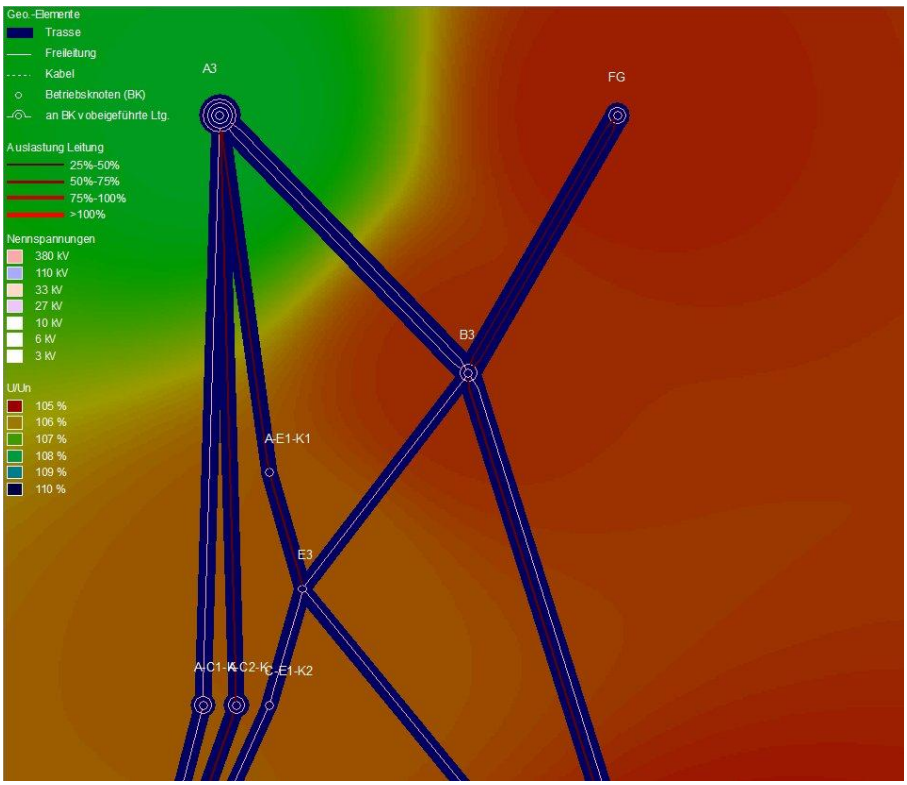

Fig. 2: Geographical presentation with visualisation of voltages as background colour

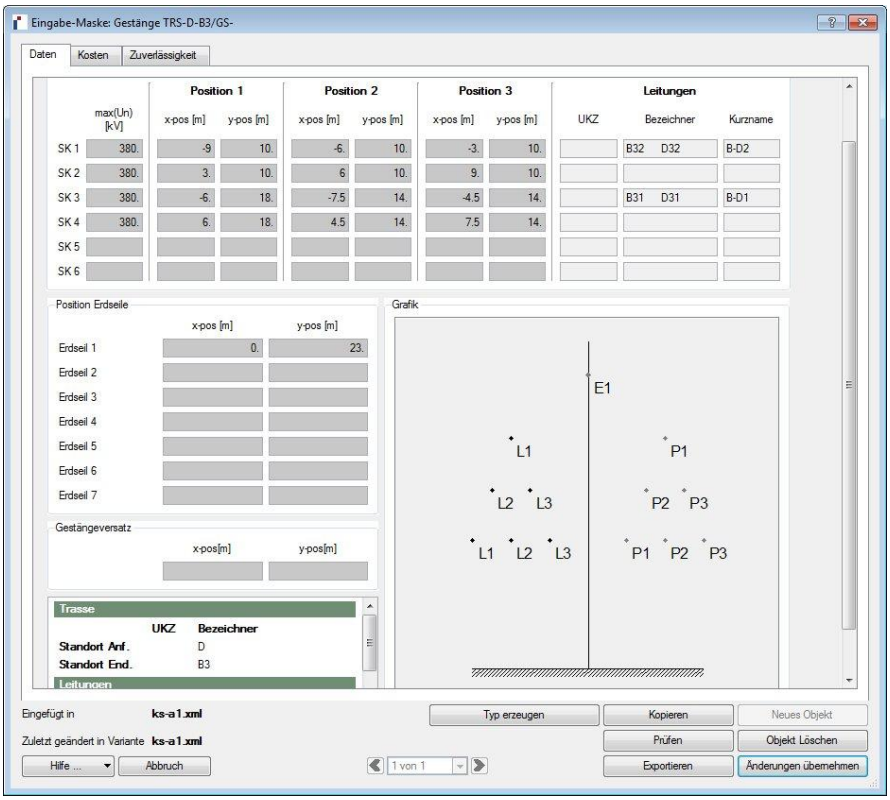

Fig. 3: Template for pole geometry

Periodical execution of always the same working steps is time consuming. Therefore in INTEGRAL a macro language is integrated to automate working procedures. The macro language is based on JavaScript. More than 3000 instructions allow access to the complete

data model and calculation modules of INTEGRAL. Additionally it is possible to create own GUIs within the macros.

6.13.3 OTHER TOOLS LINKED TO INTEGRAL 7

None

6.13.4 EXPECTED CIM FUNCTIONALITIES

In the future the connection to a stability program is planned. After that also the CIM import/export routine can be extended to dynamics data.

6.14 ISPEN

6.14.1 VENDOR PRESENTATION

Intercompro has more than 30 years of experience in the field of Power Application Software. The focus is on simulation software used by the dispatchers in the control centre of a TSO.

http://www.ispen.ch/

6.14.2 TOOL DESCRIPTION

ISPEN is the centrepiece of a product family specialized for on-line applications. The software can simulate networks of the magnitude 25'000 nodes and 30'000 lines. The basic import interfaces are designed for:

- UCTE-DEF

- CIM/XML

The import features allow the user to enter n MAS files of the kinds EQ, TP and SV in order to form the desired network. Thus, n EQ files serve as input to the EQ import converter and the corresponding n TP and SV files serve as input to the TP and SV import converters.

The export can be done in UCTE-DEF format or in the CIM/XML format with EQ, TP and SV files. The exported EQ file is the same file(s) as once was imported since the simulations carried out in ISPEN do not involve any creation of new network elements.

The CIM/XML import converters is a very fast high performance software that converters the large network (9'600 nodes) used at the UCTE 2009 interoperability test held in Paris in about 4.5 seconds when running on a standard lap-top.

6.14.3 OTHER TOOLS LINKED TO THE ISPEN

All the tools in the ISPEN family have a common proprietary data structure and each tool can use ISPEN to perform import/export as described in the previous section.

An outstanding tool is ISPEN/OCD that is used by several TSOs for the automated monitoring of the N-1 security. This is a standard application in which the on-line network of the TSO is embedded in the ENTSO-E network model of the European interconnected network in order to have a real external network that is needed to model the erratic flows of the deregulated energy

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market. The execution of a standard N-1 contingency list for a large power system with about 9500 nodes and ca 1400 contingency cases is done in about 13 seconds. This very fast performing software allows any TSO to detect any N-1 problem in time to carry out counter measures.

http://www.ispen.ch/

6.14.4 EXPECTED CIM FUNCTIONALITIES

One major development of the tool will be to import state estimation results from a SCADA/EMS system that will be used as base case for the ISPEN on-line applications.

A second development involves the import of short-circuit data in order to carry out a standard 3-phase symmetrical short-circuit calculation as security check in the dispatching of a TSO.

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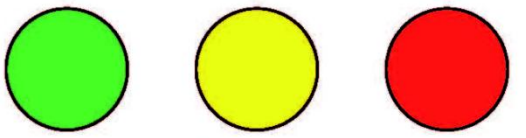
ISPEN
For Your Secure Power Network

Your Power Network

The security of supply is one of the main responsibilities of a transmission system operator, who has to fulfill the Multi Lateral Agreement of the UCTE. It is a challenging task to do that in a complex environment with interconnected networks, with independent traders and producers.

How Secure is Your Power Network?

To answer this question you need a security monitor, displaying relevant security indices. If these indices show, that your network is not secure, it is helpful for you to have more information about the overloaded elements and the causers of the overload condition.



ISPEN/OCD is our online contingency diagnosis tool giving you accurate information about the *n-1* security and *n-k* security (cascading risk) of supply in a few seconds.

Planning an Action

If you plan to switch off a branch or change the topology, the question is if the network will be secure after that action.

ISPEN/IPFA is an interactive power flow simulation tool enabling you to answer the question mentioned above.

Your SCADA/EMS System is Out Of Service

If your SCADA/EMS system is out of service, you have no information about your system and you do not have a chance to control it. You only have planning data available (e.g. for production, topology). If the planning data is accurate, why not use them instead of no data.

Based on selected ISPEN functions we develop your customized **ISPEN solution** building virtual power networks. You can use it for controlling the network or for monitoring the security.

Integrating Neighbor's Online Networks

In order to control your power network its near real time data are displayed on your SCADA system. And your neighbors also have a similar environment, but up to now, you can not integrate their data in a large online network.

The best base for control and security monitoring is an online network including the online data of your neighbors.

Having access to the estimated data of your neighbors, **ISPEN/MON** can merge them to a large online network und gives you a new dimension in network control and security monitoring.

Proper DACF Files

The Day Ahead Congestion Forecast files (DACF) in the UCTE format are widely used. For the user of the DACF files as well as for the producer of them it is important that the DACF files are proper.

ISPEN/UFA is an analyzer of files containing data in the UCTE format. It not only analyzes the syntax but also checks the plausibility of the values by calculating the power flow.

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Converting Files

It is often necessary to convert files from one format to another one. An example is our converter from the DVG format to the UCTE format.

ISPEN/CON is the solution for that task.

Ways to a secure power network

Optimizing the Power Flow

On customer request, it is possible to perform optimization (OPF) based on operational objectives.

For customer specific **ISPEN solutions** ISPEN functions will be used

Consulting

Applying simple best practices results within a more secure network. We are proud on our 30 years' experience in the field of estimation, power flow calculations and security monitoring. Rely on our Consulting services to meet your requirements.

EPS Software Engineering AG
Pestalozzistrasse 27
CH-9501 WIL (SG)
+41 (0)71 914 40 50
info@eps.ch
www.eps.ch

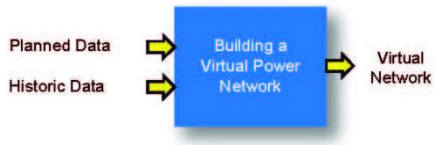
ISPEN solutions

Emergency Operation and Forecasting

In case of emergency operation as well as forecasting, no current online data is available. However, in such cases, we can build a virtual power network as input for controlling and monitoring of security state in the future using schedules.

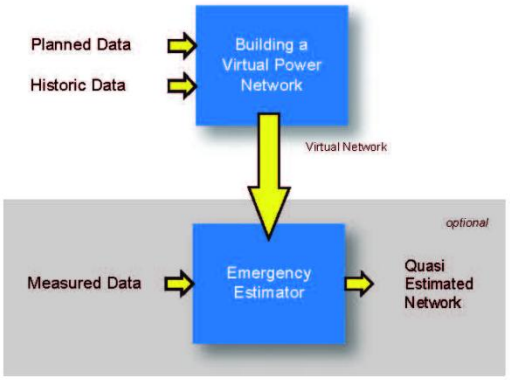
Building Virtual Power Networks

If your planned data for topology, exchange, production, as well as history data are available and this data reflects the real state of your network in sufficient accuracy, you can build a virtual network based on this data.



Emergency Operation

In case of emergency operation, a better result can be achieved if you also have access to some measured data.



Application of Virtual Power Networks

Virtual power networks can be applied in the same manner as online networks:

- As input to the SCADA/EMS system
- As input to the security monitoring system (ISPEN/OCD)
- As input to simulation tools like ISPEN/IPFA

Optimizing

Power flow optimization (OPF) is a method to improve the operational and economic objectives. We are experienced in implementing power flow analysis and optimization algorithms. Therefore, we are skilled to tailor optimization algorithms and objectives to the individual needs of the customers. Benefit from our expertise and our already developed algorithms.

EPS Software Engineering AG
Pestalozzistrasse 27
CH-9501 Wil (SG)
+41 (0)71 914 40 50
info@eps.ch
www.eps.ch
www.ispen.ch

6.15 NEPLAN®

6.15.1 VENDOR PRESENTATION

BCP Busarello + Cott + Partner AG was founded 1988 in Zurich, Switzerland and is specialized in the field of power systems engineering. BCP is the developer and owner of the power system analysis tool NEPLAN and is one of the leading companies in the power system engineering software market. Small and large utilities, industrial organizations, engineering companies and universities in more than 90 countries around the world appreciate our high Swiss quality products.

BCP is member of the international NEPLAN®-Consulting group, which offers a wide range of power system studies and consultancy work, like network reliability analysis, defining new maintenance concepts, stability studies, consultancy on integration of wind energy and much more. Within this NEPLAN ®-Consulting group we have successfully carried out more than 1000 power system analysis and planning studies with NEPLAN®.

Product: NEPLAN
Company: BCP Busarello + Cott + Partner AG
Bahnhofstr. 40
CH-8703 Erlenbach (Switzerland)

Web: www.neplan.ch
E-Mail: giatgen.cott@neplan.ch

6.15.2 TOOL DESCRIPTION

NEPLAN® is a high end power system analysis tool for transmission, distribution and industrial networks.
A quick overview about the NEPLAN functionalities may be found here:
http://www.neplan.ch/pdf/english/factsheets/NEPLAN.pdf

Further information about the NEPLAN Transmission package may be found at:
http://www.neplan.ch/pdf/english/packages/NEPLAN_TransmissionModules.pdf

Further information about the NEPLAN Distribution package may be found at:
http://www.neplan.ch/html/e/pdf_e/NEPLAN_DistributionModules.pdf

According to our customers NEPLAN distinguishes oneself especially by these features:

1) It is very easy to use. The graphical user interface is very user-friendly and offers all features of a modern CAD system. Planning task may be done extremely **efficiently**.

2) It is a very complete analysis tool, with a huge range of different analysis modules. It offers for every electrical phenomenon in a power system network a calculation module. Main modules for transmission networks are:

   single line diagram editor, power flow, short circuit analysis, transient stability, EMT analysis, voltage stability, contingency analysis, protection coordination, OPF, NTC, C/C++ API to develop user defined applications and more.

3) The "NEPLAN® **Risk based planning**" tool is the benchmark tool for investigation of the power system network reliability (e.g. SAIFI, SAIDI).
   Further info at
   http://www.neplan.ch/html/e/e_brochures_default.htm

4) NEPLAN® is a very open system. The NEPLAN® algorithm and functionalities may be easily integrated into any existing environment like a GIS (geographical information systems) or SCADA/ DMS systems through a C/C++ API. NEPLAN® may be connected directly on a TCP/IP bus and used as calculation server or as a GUI client. This architecture allows building user defined flexible applications like **DACF** implementations or sophisticated **SmartGrid** concepts.
   Further info DACF:
   http://www.neplan.ch/pdf/english/modules/NEPLAN_T05_DACF_engl.pdf
   Further info C/C++ API:
   http://www.neplan.ch/pdf/english/modules/NEPLAN_B11_NPL_engl.pdf
   Further info SmartGrid:
   http://www.neplan.ch/pdf/english/factsheets/e_neplan-SmartGrid-v2.pdf

5) The **NEPLAN® dynamic simulator**" offers unrivaled features for transient stability and electro magnetic transient analysis. It is fast and easy to use. It includes many predefined models. Researchers and developers like the powerful modeling capabilities for developing new models and control strategies (e.g. for renewable energy systems like wind power and solar energy plant).
   Further info at:
   http://www.neplan.ch/pdf/english/modules/NEPLAN_B08_Simulator_engl.pdf

6) The NEPLAN® allows modeling of all types of **renewable energy resources (DER)** in an extremely easy and efficient way. Many models are available in NEPLAN.
   Further info at:
   For **wind power systems** modeling:
   http://www.neplan.ch/pdf/english/factsheets/e_dynamic_wind_power_simulation.pdf
   For other renewable energy resources modeling:
   http://www.neplan.ch/pdf/english/factsheets/Distributed-Generation.pdf

6.15.3 OTHER TOOLS LINKED TO NEPLAN®

1) BCP develops also analysis tools for **Gas, Water and District Heating** Networks. All data may be accessed via MS-Excel or SQL database.

2) The **'NEPLAN®-Asset Management'** product includes two main modules:

   - **Reliability Centered Maintenance** module

   The radical changes taking place in the energy markets are putting huge pressure on the affected companies to cut costs. There is considerable potential for this in the field of maintenance, among others. By selecting suitable custom maintenance strategies, the cost of maintenance can be substantially reduced without putting the

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required functionality at risk. The ‘Reliability Centered Maintenance’ module includes a budgeting tool, which calculates the cost for the following maintenance strategies:

- Corrective
- Time-based
- Condition-based
- Reliability-centered

- **Asset Simulation** module:

It simulates the future behaviour of network components based on experience of the past. Among others, the module calculates the CAPEX and OPEX costs for each year of simulation. The asset simulation helps the asset manager, together with the future objective network and maintenance strategy, to optimize:

- Investment timing
- Network structures
- Network operation
- Power supply reliability and quality

The asset management product integrates smoothly into our NEPLAN power system analysis tool. The results from the NEPLAN risked based analysis may be used as input. The data are stored in a SQL database (like Oracle, SQL-Server, MS-Access, etc.) and is as such unique on the market.

More information about our asset management product maybe found at: http://www.neplan.ch/html/e/e_brochures_default.htm

6.15.4 EXPECTED CIM FUNCTIONALITIES

1) We will further improve the NEPLAN risk based simulation and the asset management modules, since we see that here is a big cost savings potential for many utilities.

2) The NEPLAN Programming Library (C/C++ API), which allows building customized NEPLAN procedures and products (e.g. SmartGrids), will be enhanced with additional functions.

3) The ‘Phasor Dynamic Algorithm’ of the ‘NEPLAN® Dynamic Simulator’ module will be improved. The ‘Phasor Dynamic Algorithm’ allows more accurate simulations than the traditional transient stability algorithms (RMS simulations) and is more computationally efficient than the traditional EMT simulations for phenomena’s which are outside the fundamental frequency range. Additional models for renewable energy systems will be added.

6.16 PSLF 18B

6.16.1 VENDOR PRESENTATION

For nearly a century, a core group of leading GE technical and business experts has focused on solving the electric power industry’s most pressing challenges—driving the evolution of electric power systems with greater affordability, reliability, and efficiency.

GE Energy Consulting provides innovative solutions across the entire spectrum of power generation, delivery, and utilization. With our cross-company resources, GE Energy Consulting is able to serve a diverse global client base with a strong local presence.

GE Energy Consulting's Power Economics group's areas of expertise include analysis of power market fundamentals such as supply and demand; energy and capacity prices and spark spread forecasts; resource investment analysis (including new generation and transmission); existing plant purchase opportunities; integration of renewable resources; power market design and implementation; and energy policy impact. We factor in the effects of new policies and regulations that may alter the boundaries of traditional electric utilities, expand power system infrastructure, and increase constraints on fuel and emissions.

Drawing upon the group's knowledge of power system engineering and operations, power economics consultants develop analytical models and tools that reflect power system operations and practices to give customers a better understanding of the power marketplace. One essential tool is GE's proprietary Multi-Area Production Simulation (MAPS) software, which has become an industry standard in the U.S. for accurately analyzing the complex interaction between generation and transmission, within a local system or across a regional interconnection.

With over 500 person-years of experience designing thermal power systems, the GE Energy Consulting Generation Solutions group is a worldwide leader in applying expertise to provide customers optimized energy solutions. The group develops solutions for a wide range of technologies, including combined-cycle power plants, industrial and fossil steam turbines, heavy duty and aero gas turbines, expanders, gas engines, gasification, solar, and wind generation. This expertise covers both electric utility applications and several process industries, including steel, aluminum, petrochemical, refining, pulp and paper, cement, and food and beverage applications.

The key to the group's continued success is our ability to provide customers with real-world technical and financial analysis that helps them choose the solution that best meets their operating parameters and load profiles. The systems we design are optimized around customer-specific needs for flexibility, reliability, efficiency, and life cycle cost.

Drawing on our expertise with green field and upgrade projects, GE Energy Consulting's Equipment Applications team provides consultation and analyses on generation, transmission, and distribution solutions. Areas of expertise include excitation systems, generator/switchyard protection, power system stabilizer tuning, electromagnetic transient, and electromechanical modelling and simulation—along with dynamic performance testing and model verification of turbine-generators and renewable energy inverter systems. Practical research on distribution systems is co-developed with utilities in our DSTAR program (http://www.dstar.org).

With a growing knowledge base gained from thousands of power systems projects, GE Energy Consulting's Systems Engineering experts provide expertise in literally every aspect of power grid performance. The group's experienced engineers understand the physical characteristics of generation and transmission equipment—and their dynamic performance and interaction characteristics when operated as a large integrated power grid.

Recent power system disruptions have prompted regulating agencies to more closely examine generating units' capabilities for dynamic support, from both frequency and voltage/reactive power control perspective. These same realities have raised significant interest in the models of generation equipment that are used in power system planning and analysis. This has led to requirements that generating units be tested to confirm proper dynamic performance of their controls, and to update the associated model data. Testing for these purposes is now recognized as practical, having minimal intrusion on plant operations, and yielding significant

benefits to generating plants and to the interconnected grid. The Grid Code Compliance Test team executes power plant dynamic performance tests, and GE Energy Consulting's team of engineers has more than 100 person-years of experience in performing tests and analysis for all segments of the power generation industry.

GE Energy's Smart Grid Strategy team provides strategic level business and technical consulting expertise empowering customers to achieve success through the application of smart grid systems and solutions. The group does this by working broadly with key stakeholders from across customer organizations to create enterprise-level road maps (architecture, business case, and execution plans). To solve these problems, the group leverages its broad and deep domain expertise, spanning AMR/AMI, IT architecture, utility communications, T&D automation, plug-in vehicles, renewables integration, energy storage, demand response, and dynamic pricing.

The Software team within GE's Energy Consulting group develops, licenses, and supports the Concorda Software Suite—PSLF*, MAPS* and MARS*. These products are internationally known and widely used for planning and simulating electric power grids, assessing the economic performance of large electricity markets, and evaluating generation reliability.

Multi-Area Production Simulation (MAPS) accurately models the economic operation of a power system, so decision makers can assess the value of generating assets or identify costly transmission bottlenecks. It analyzes hour-by-hour market dynamics to capture complex interactions between generation and transmission systems. Multi-Area Reliability Simulation (MARS) modeling software enables power system planners to quickly and accurately assess the ability of a power system to satisfy customer load requirements. MARS performs a chronological hourly simulation that compares hourly load demand in each area to the total available generation—while accounting for planned maintenance and randomly occurring forced outages. Detailed information on PSLF is given below.

GE Energy Consulting's annual Power Systems and Energy Course (PSEC) is highly regarded as a valuable investment for anyone working in the energy industry today. Demand for energy industry experts is constantly growing, driven by rapidly expanding infrastructures and an aging workforce. With a 60-plus year history, PSEC is specifically designed to enhance the skills and knowledge considered essential for engineers and other energy professionals to become successful leaders in the industry. PSEC courses provide valuable insights about industry trends, best practices, and the latest technologies. The professional experts at PSEC are considered some of the best practical engineers in the world, understanding customer problems with proven real-world expertise in a wide range of technologies—from power systems planning and energy economics to power markets and emerging generation solutions—including renewables. This program enhances learning through the use of the latest industry software and includes tours of GE's research centers, manufacturing facilities, and other industry businesses.

For more information on GE Energy Consulting, please visit us online at http://www.ge-energy.com/energyconsulting.

6.16.2 TOOL DESCRIPTION

As the number of power transactions increases, new supply patterns are pushing transmission systems to the limits. This increased line loading results in reduced margins and a significant challenge to system reliability. At the same time, system planners are seeing more volatile

dispatch patterns. This trend will continue as market prices affect the demand for power in a competitive market.

All of these factors point to the need for increased accuracy in modelling, and greater productivity in system planning. GE Positive Sequence Load Flow Software (PSLF) helps utilities achieve these goals. This full-scale program is designed to provide comprehensive and accurate load flow, dynamic simulation and short circuit analysis. Using this tool, engineers can analyze transfer limits while performing economic dispatch. PSLF is ideal for simulating the transfer of large blocks of power across a transmission grid or for importing or exporting power to neighbouring systems.

PSLF is a suite of analytical tools that can simulate large-scale power systems up to 80,000 buses. For ease of use, the data are organized in sensible terms, such as nameplate values, rather than per-unit modelling parameters. Since PSLF has its own fully configured programming language, users can build new models that interact with models within the program, perform post-processing and construct macros that automate execution of repetitive simulations and generate reports.

PSLF provides precise modes for lines, transformers, generation and other components that encourage data specification on a nameplate basis. Its high accuracy results in fewer errors than may arise with software that uses "reduced" models.

PSLF allows its users to accomplish data management and system manipulation with a full-screen data table editor that includes comprehensive features for searching, sorting and selecting data. Numerous reports are available to facilitate system planning.

PSLF's detailed graphics allows users to browse power system models, select components, display and edit their data records, and use this information as the focus of a new display.

PSLF includes detailed dynamic models of GE’s doubly fed and full converter wind turbine generators, as well as a GE PV solar plant model.

6.16.3 OTHER TOOLS LINKED TO PSLF

In addition to the traditional load flow analysis, GE developed the following tools linked to PSLF:

1. **SSTOOLS** (Steady-State Analysis Tools) has been developed to combine in one program traditional thermal and voltage analysis, static voltage stability analysis and transfer limit analysis.
2. **ProvisoHD** is a completely new software tool to enhance PSLF users’ ability to analyze and visualize post-contingency data.
3. **DYTOOLS**, or Dynamic Analysis Tools, is a program to help in the batch production of dynamic stability simulations. This tool automates the running and plotting of all scenarios, and cross-plotting of multiple scenarios.
4. StepResponse tools.

6.16.4 EXPECTED CIM FUNCTIONALITIES

PSLF 18b supports both version 1 and version 2 of the ENTSO-e Profile. PSLF merges power flow assets from distinct modelling authority sets into a single unified model. At this time PSLF supports power system planning and dynamics (standard models). Some support for short-circuit data is included; this support will be finalized throughout the remainder of summer 2011.

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At present the PSLF CIM extension is a tool external to PSLF, but it is expected that the tool will be integrated with the PSLF solution engine by the end of 2011.

GE’s goals include support for the CIM diagram exchange and geographical profiles by spring 2012.

6.17 PSS®ODMS

6.17.1 VENDOR PRESENTATION

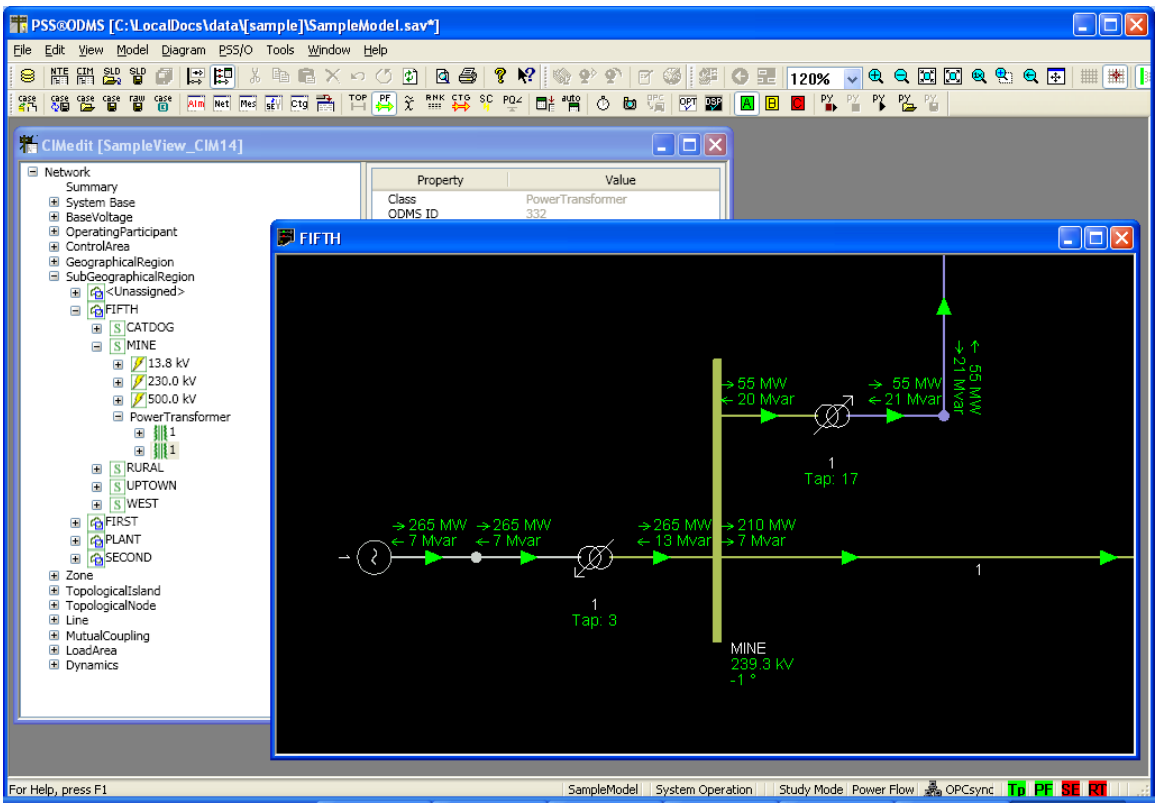
Siemens Power Technologies International (Siemens PTI), the provider of network consulting, software solutions and T&D training within Siemens Energy, Inc., is a world leader in electrical power network analysis for generation, transmission and distribution systems, industrial plants and Smart Grids.

www.energy.siemens.com/hq/en/services/power-transmission-distribution/power-technologies-international/

6.17.2 TOOL DESCRIPTION

PSS®ODMS is a software product built on a CIM-based relational database schema. It contains built-in CIM/XML import and export functions that support full model, partial model (MAS) and incremental CIM/XML files. The product is also fully compatible with PSS®E with import and export functions that support the PSS®E RAW, SEQ and DYR file formats. PSS®ODMS offers an intuitive Windows user interface with extensive network modelling features including an integrated one-line diagram generator and model editor and a fully customizable and extensible hierarchical network editor. PSS®ODMS is designed to support a unified transmission operations-planning model through past, present and future conditions. It offers integrated network analysis functions (Power Flow, State Estimator, Short Circuit and Contingency Analysis) with advanced results visualization capabilities. The product has an open architecture with comprehensive API’s and supports custom user extensions to the database schema. PSS®ODMS can be deployed as either a single-user application or a multi-user enterprise solution and is currently used in production at various electrical power organizations throughout the world.

www.energy.siemens.com/hq/en/services/power-transmission-distribution/power-technologies-international/software-solutions/pss-odms.htm



6.17.3 OTHER TOOLS LINKED TO PSS®ODMS

PSS®E is a commercial software product that has provided transmission planning engineers with an advanced set of functions to study future transmission system modifications. PSS®E is an integrated, interactive program for simulating, analyzing, and optimizing power system performance. It provides the user with the most advanced and proven methods in many technical areas, including:

- Power Flow
- Optimal Power Flow
- Balanced or Unbalanced Fault Analysis
- Dynamic Simulation
- Extended Term Dynamic Simulation
- Open Access and Pricing
- Transfer Limit Analysis
- Network Reduction

www.energy.siemens.com/hq/en/services/power-transmission-distribution/power-technologies-international/software-solutions/pss-e.htm

6.17.4 EXPECTED CIM FUNCTIONALITIES

PSS®ODMS is continually updated to support the latest CIM version and ENTSO-E and CPSM profiles has successfully participated in all the UCTE and ENTSO-E interoperability tests. The next major release will include support for ENTSO-E Profile 2 (CIM15). PSS®ODMS provides tools to maintain, analyze and exchange network models in CIM/XML. All its functions support both “planning” (bus-branch) and “operations” (node-breaker) models for all functions. PSS®ODMS provides a native CIM platform for maintaining a network model through its entire life cycle and manages historical as well as planned future changes.

6.18 SCOPE®

6.18.1 VENDOR PRESENTATION

Nexant, Inc. is a leading provider of intelligent grid software and clean energy solutions — pioneering, developing, and advancing electric power grid and alternative energy technologies and services. Our exclusive focus on energy, combined with our well-respected and experienced professionals, proven technology, and proprietary industry information, has earned us distinctive brand recognition and a reputation as a top energy solutions company.

Nexant's innovative software manages energy efficiency, demand side management, demand response, and distributed generation. It enables smart grid rates and customer-facing products and services and improves the physical and financial operational efficiency of the power grid. It also supports market operations by addressing critical deregulation and security issues.

To date, Nexant's software applications and platforms are actively in service in over 120 control centres at utilities worldwide. Our clients include utilities, and transmission and distribution system operators.

Nexant (http://www.nexant.com) is headquartered in San Francisco, California, United States of America and operates from corporate, representative, and project offices located throughout the United States, Europe, the Middle East, Africa, and Asia.

6.18.2 TOOL DESCRIPTION

SCOPE® is the industry's most sophisticated software application for power system engineers. It complements the traditional suite of power system analysis software by providing advanced features required to solve the difficult problems of today's grids, including:

- Transmission planning-conducting studies of transmission equipment feasibility, siting, interconnection, and engineering design
- Decision-making under outage conditions-providing a solution that enables operators and engineers to make decisions even when the base case is significantly degraded due to outages or bad states
- Operational planning-performing rapid powerflow and contingency analysis studies with user-defined contingency lists to confirm reliability status-such as powerflow and contingency analysis and performing look-ahead simulations.
- Optimal power flow (OPF) - offering an unparalleled choice of objective functions (single or combined) and constraint definitions to enable modelling and study of remedial control actions, MW transfer maximization, loss minimization, capacitor installation (sizing and placement), etc.
- Market simulations-simulating economic cost or price-based dispatch in mixed spot and bilateral markets, as well as comprehensive zonal and nodal location marginal pricing
- Reactive power prices-defining the value of reactive power and setting the price for generation bids in day-ahead or real-time markets

SCOPE is fast and reliable. It is delivered as the Energy Management System (EMS) dispatcher powerflow, real-time contingency analysis and real-time OPF to over 120 control centres around the world. This real-time experience makes it the most robust study tool for power engineers

and the perfect bridge between the operational world (breaker-node) and the planning world (bus-branch).

SCOPE functionality includes:

- Power flow analysis
- Network topology processor
- Contingency analysis
- Switching control
- Security constrained optimal powerflow
- Flexible data manager with conversion to all standard formats
- Comprehensive macro language to automate studies
- Extensive input data and report management

6.18.3 OTHER TOOLS LINKED TO SCOPE

SCOPE shares its data within Nexant's family of power system software applications.

- **MODELEX®** – A comprehensive solution for external network modelling. MODELEX produces small, accurate reduced models for online and study use. It automates the most difficult and time-consuming tasks in network model design, construction, validation and updating. MODELEX-derived models are valid over a wide range of system operating conditions and promote good behaviour for state estimators and other network calculations. Its sensitivity analysis process identifies and ranks the external elements needing explicit modelling and status/value data.

- **GEN-SE®** – This is the industry's only major generalized state estimator, which directly solves a network modelled with mixed bus-branch and bus-section-breaker representations. GEN-SE estimates a power system's state, topology and network impedances to construct the statistically best power flow model for online monitoring and optimization functions. It is based on highly robust orthogonal transformations and advanced error detection/identification technologies. As a study tool, it is invaluable for state estimator tuning and trouble-shooting.

- **TOPAZ®** – This unique software product uses a rigorous combinatorial approach for detecting and identifying status errors in network switches (breakers and isolators), fully representing the interaction between analogue and switch measurements. It reports the most probably set of erroneous switch statuses and analogue measurements.

- **FLASH®** - FLASH performs primary and secondary fault analysis for a detailed network with mixed bus-branch and bus-section-breaker modelling. It supports multi-section/mutually coupled unbalanced lines and multiple simultaneous faults. It produces IEC 909 compliant individual breaker duties, and is optimized for online application.

6.18.4 EXPECTED CIM FUNCTIONALITIES

SCOPE presently supports the CIM-15 ENTSO-E profile with the functionality to full model CIM/XML exchange. We intend to enhance the product capabilities for incremental updates and to be compliant with CIM standards' updates for Operation and Planning.

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6.19 SICRE

6.19.1 CESI PRESENTATION

See. 6.7.1

6.19.2 TOOL DESCRIPTION

The SICRE Power System Dynamic Simulator has been being developed since 1990s, earlier at the former ENEL research centre and then at the CESI network studies department.

6.19.3 MAIN FUNCTIONALITIES

SICRE consists of a set of functions devoted to simulation and analysis which are able to represent the dynamic behaviour of power systems, over different time scales, both in normal and emergency conditions. Simulation of short-term and long-term dynamics is possible, with an integration step suitable for ranging between electromechanical transients (power oscillations) to slow phenomena (voltage instabilities), and taking into account of all the components, modelled in high detail, involved in the system dynamics.

The package is complete from the viewpoint of the components that are modelled with a high degree of detail, efficient from the viewpoint of the algorithms and based on modern SW/HW technologies.

The main application fields of SICRE are analysis and control during both the operational planning and the day-by-day operation stages, in order to assess the overall dynamic performances of the system. For example:

- design and test of control strategies and controllers tuning (with linear – eigenvalues analysis functions);
- large incident reconstruction, in order to completely understand events and dynamic phenomena and verify system components (protections, automatons, regulators, etc.);
- design and verification of new automatic defence actions, in order to avoid and prevent incidents or to limit and control their consequences;
- verification of restoration procedures, from internal black-start units or survived external networks;
- Analysis and control during the operational planning and day-by-day operation stages in order to assess the overall dynamic performances of the system.

Besides the wide variety of AGC, AVR, PSS, PST and Tap changer models in SICRE are available additional elements and controls:

- Primary and secondary voltage controllers;

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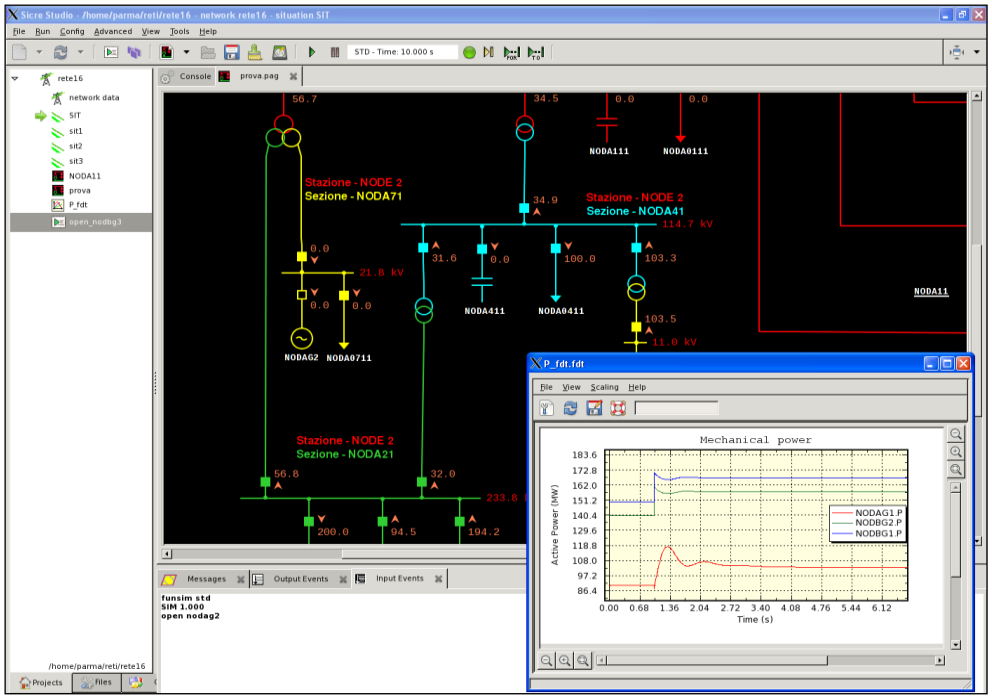
- Ballast loads;
- HVDC models;
- Wind farms;

and defence plan logics and devices:

- Protection systems operating on power/frequency/voltage/current measurements;
- Fast valving;
- Load shedding;
- Line distance protections;
- Unit out of step protections;
- Remote trip of units, lines, loads;



VIEW OF SICRE HMI

The SICRE highly interactive and user friendly HMI allows the user to create and manipulate displays of the network plans and diagrams, as well as send commands to the core (engine) of the simulator. It is very easy to set up complete diagrams containing the trends and the transients of all the variables of interest. It is also possible to create text reports containing information about the network that is simulated. Trends and Cartesian diagrams can be displayed during the simulation and through the page editor is possible to create and modify displays containing network schemes.

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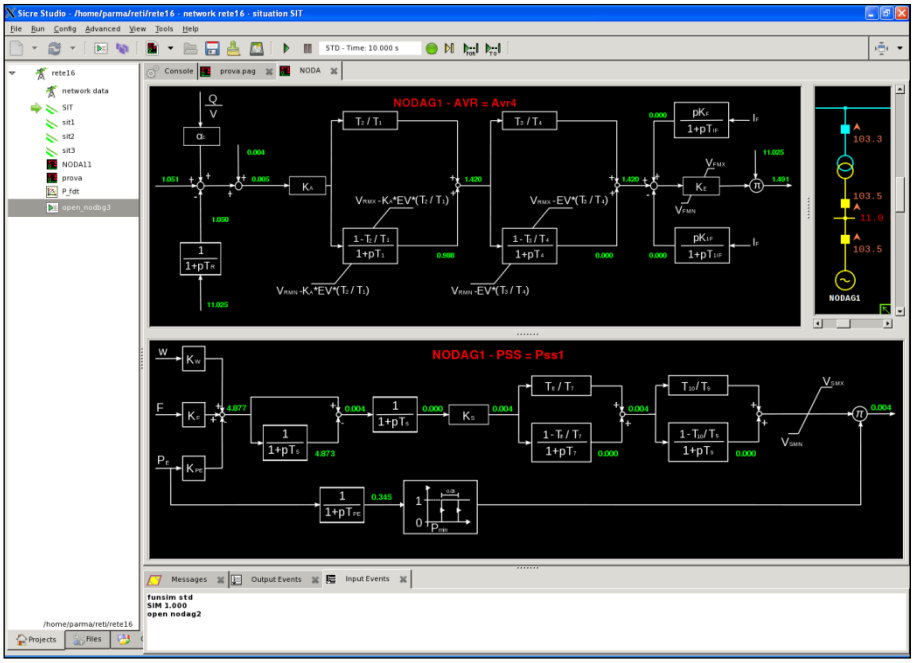

Example of Block schemes view

The user interacts with the simulated system introducing perturbations (e.g. load modifications, variation of set points, three phase short circuit and unsymmetrical faults) or executing manoeuvres (such as breaker opening or closing) either through the HMI facilities or in a pre-established scenario. A specific HMI oriented to the analysis of power systems is available.
In recent years a complete rewrite of the HMI has been carried out: the result is a completely new HMI, based on open source graphics libraries, fully compliant with Windows platform but operable also to Linux platforms.

The accuracy of SICRE simulator results has been confirmed by comparing its simulation outputs with real trends measurements, restoration tests and outage reconstruction studies.

More details are available at CESI web site http://www.cesi.it/ in the section →supplies →services →software tools.

Basic features related to CIM import/export

The SICRE CIM dynamic data acquisition stage is developed in order to be integrated with the proprietary dynamic format and database.

6.19.4 OTHER TOOLS LINKED TO SICRE

SICRE, with the support of CRESO, is also the simulation engine of the Dispatcher Training Simulator (DTS) and of the Dynamic Security Assessment (DSA). The links between these tools and SICRE is via internal proprietary format;

- DTS is used for training Control Room Operators as a replica of Control Room System with teaching sessions representing different real situations, from normal condition (e.g. morning load ramp) to extreme critical situation (e.g. blackout).
- DSA is an on-line security preventive assessment; taking the most recent steady state power flow calculation DSA performs the screening of several network contingencies.

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6.19.5 EXPECTED CIM FUNCTIONALITIES

At the beginning of 2010 CESI starts to support the development of internationally unified data definition and data exchange mechanisms and is therefore committed to integrate and continuously update SICRE in order to cover ENTSO-E needs and rules regarding the reliability of the calculations made with the dynamics models used during the IOP tests. Up to now the software is under development in order to be compliant with the models (rev 2) used during the IOP tests.

In the future CRESO (used also in the TERNA Operation departments) would include also the operational profile of CIM.

CESI will continue supporting the development of CIM related standards and the innovations supplied with next releases.

For the July 2011 IOP, SICRE takes part to the tests related to import of full dynamic model (standard models only) and comparison of dynamic simulation.

In the future SICRE functionalities will be extended to satisfy the CIM test procedures for the import/export interoperability of dynamic files containing user-defined model.

6.20 SPIRA

6.20.1 CESI PRESENTATION

See. 6.7.1

6.20.2 TOOL DESCRIPTION

SPIRA (Integrated system for the planning of HV transmission networks) is an advanced computing system (on Windows platforms) for the planning of HV transmission networks that:

- includes both optimisation and power analysis computing models developed by CESI and applied since many years in several electric system studies carried out both on Italian and foreign Country networks
- constitutes an interactive graphic system to manage digital programs utilised in the search of optimum strategies of short/long term expansion of HV networks
- allows one line schematic and-geographic diagrams of the network under consideration to be created by assuring formal coherence between the network topology and alpha-numerica the electrical parameters relevant to its components and graphic functions.
- allows the creation, up-dating and queries of the data base with the electrical parameters of the network to be studied being managed, by means of specific menus and forms.

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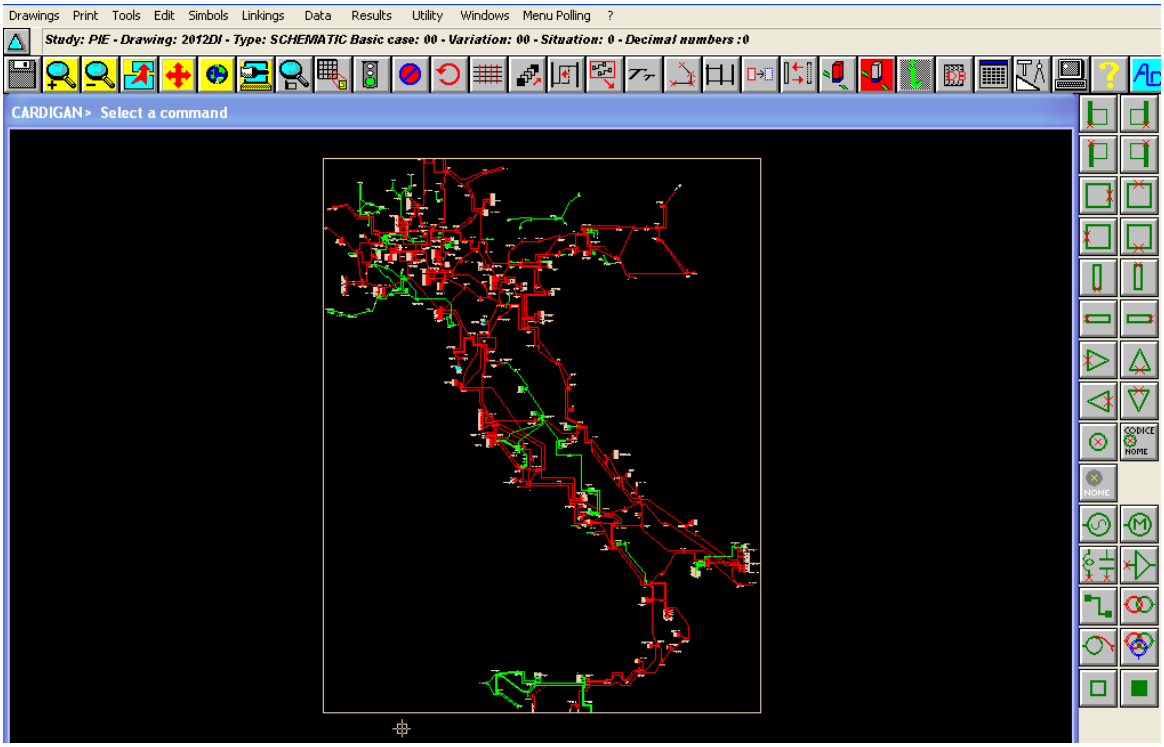

6.20.3 COMPUTATION PROGRAM

The various technical-economical facets are analyzed by means of specific computation programs that take parameters mostly affecting the investigated problem into due account.

- FLOWAC: for checking the a.c. load flow under normal operating conditions and with automatically-selected contingencies of network components (lines and transformers)
- CTINEW: for defining short circuit current levels at network nodes
- SIPARIO: For defining active and reactive optimisation (OPF) of the network with different objective functions
- GRARE: For adequacy analysis of transmission network with probabilistic and deterministic approach

The SPIRA system, moreover, allows specific network problems to be analyzed by means of specialistic computation programs such as:

- EQSTAR for the evaluation of network equivalents, or parts thereof, to be used in a.c. load flows and network adequacy probabilistic analysis computations
- EQUI for the evaluation of network equivalents, or parts thereof, when calculating short circuit currents
- DIFOAR for the appraisal of "flicker" disturbance caused by open arc furnaces at the various network nodes
- CORARM for investigating harmonics propagation into network in the presence of disturbing loads

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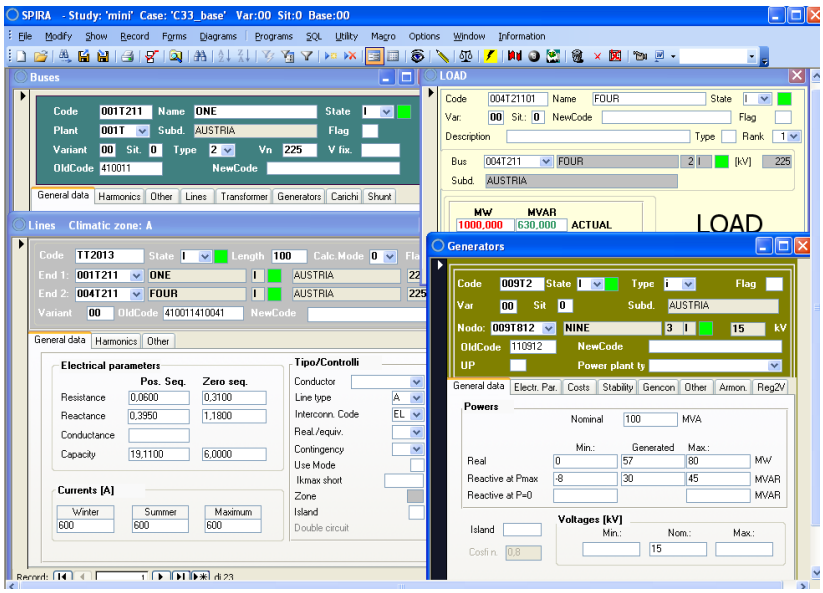
6.20.4 KEY FEATURES

The graphic man/machine interface (MMI) of the system enables :

- the network to be managed in a graphic mode
- external data bases to be activated
- computation programs to be activated
- active processes to be handled
- the data base to be queried and modified



- study results to be managed
- peripherals to be managed
- utility programs to be handled

CARDIGAN is the CAD interface enabling all graphic functions to be carried out that are needed for creating the network schemes

STUDY DB constitutes the data base of the network electric parameters that is shared by all applicative computation programs and holds the results of computations carried out by these applicative programs.

The access, gained through special menus and masks as well as by means of the graphic interface, enables variants to be introduced on the investigated network for a rapid check about possible network alternatives.

The STUDY DB data base, moreover, provides the user with a set of default parameters for such components as lines and transformers to be predominantly used in the planning stage when accurate parameters are still unavailable.

Thanks to the graphic interface, it is possible to create the network scheme layout.

Drawing set-up as well as modifications thereof are made easier by several graphic functions that can be activated by means of icons on the screen.

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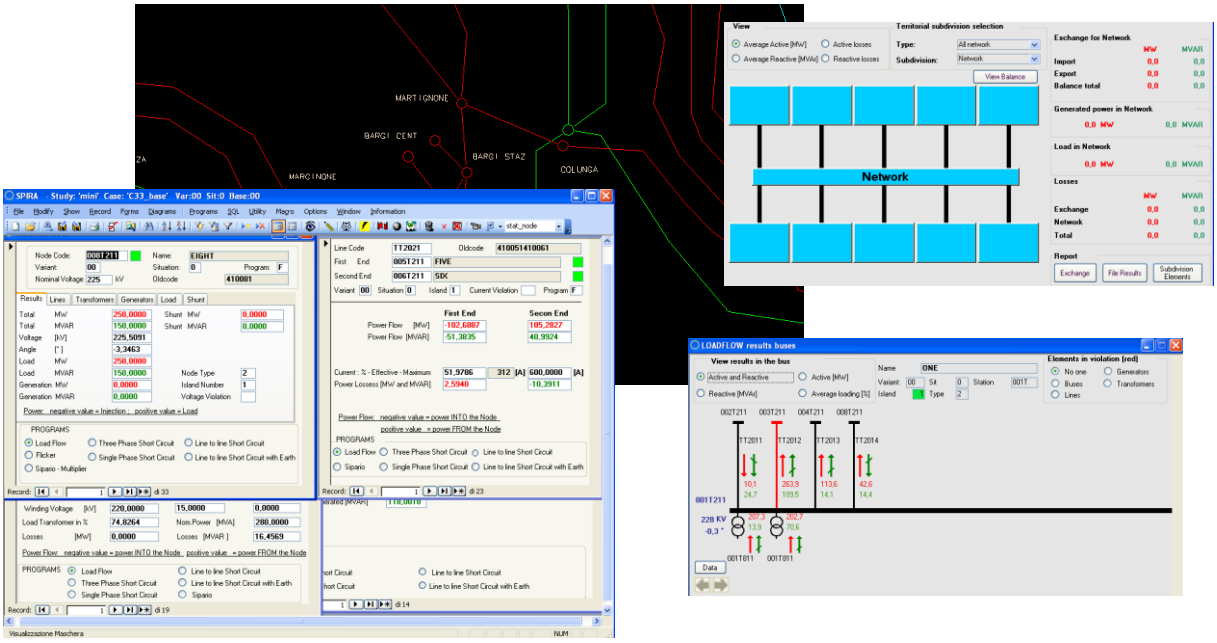

Besides, when drawing a network scheme layout, access can be gained to the data base for the automatic introduction of topologic-type alphameric information.

The results of studies that are more frequently carried out (load flow, short circuit current evaluations) can be displayed on the screen and on paper, but also on the network scheme in order to facilitate its analysis.

Graphic functions also enable the most interesting network sections to be selected for a graphic presentation of results that are to be included in study

6.20.5 MODULARITY AND OPEN-ENDED LAYOUT TO OTHER COMPUTATION SYSTEM

The SPIRA system features a modular structure enabling personalized versions to be made ready by embodying computation programs as needed to a customer’s specific requirements.

An overall open-ended layout to other computation systems is made easier by special interface programs for data exchange in order to facilitate the preparation of data files in a SPIRA environment.

Communication interfaces to other computation systems also make it possible to perform other types of studies about electrical systems. As an example, it is possible, by means of the SICRE simulator, to analyze the short-term and long-term system dynamics by taking into account, with the help of detailed models, the behaviour of control and protection equipment operating on the system itself at local, regional or national levels.

6.20.6 OTHER TOOLS LINKED TO SPIRA

No other projects related to.

6.20.7 EXPECTED CIM FUNCTIONALITIES

At the beginning of 2010 CESI starts to support the development of internationally unified data definition and data exchange mechanisms and is therefore committed to integrate and continuously update SPIRA in order to cover ENTSO-E needs and rules regarding the reliability of load-flow and short circuits results. Up to now the software is under development in order to be compliant with the models (rev1. and rev 2) used during the IOP tests.

CESI will continue supporting the development of CIM related standards and the innovations supplied with next releases.

6.21 TIBCO INTELLIEDGE FOR CIM

6.21.1 VENDOR PRESENTATION

Headquartered in Palo Alto, California, TIBCO Software Inc. (NASDAQ:TIBX) provides enterprise software that helps companies achieve service-oriented architecture (SOA), business process management (BPM) and Business Optimization success. With over 4,000 customers and offices in 40 countries, TIBCO has given leading organizations around the world better awareness and agility–what TIBCO calls The Power of Now®.

Markets and technologies are changing more quickly than ever, so the ability to adapt is becoming a key competitive advantage for large organizations, requiring:

- **Real-Time Visibility:** The power to see what is happening right now across your operations and marketplace.
- **Real-Time Understanding:** The power to make sense of it all so you can understand developing situations.
- **Real-Time Action:** The power to adapt immediately to seize opportunities, mitigate risks, and avoid threats.

Together, these capabilities add up to real-time business and give organizations what TIBCO calls The Power of Now®:

TIBCO's Future: Business Optimization - Enabling PREDICTIVE BUSINESS®

TIBCO is working toward enabling a future in which organizations will have such a complete and current understanding of their operations and markets that you can identify and address threats and opportunities before they impact your operations, customers or bottom line. This future involves the theory of Complex Events Processing (CEP) and the Master Data Management (MDM) within the enterprise. TIBCO has delivered on this vision by evolving the following capabilities.

- The ability to discern meaningful patterns among countless discrete events occurring throughout your enterprise and the markets you serve.
- The ability to seamlessly merge historical data with real-time information to aid in the identification and optimal resolution of situations that you've faced before.
- The ability to apply extremely sophisticated rules to automate that identification and resolution when human intervention shouldn't be required.
- The ability to manage data coming from all of your disparate systems and information sources.

6.21.2 TOOL DESCRIPTION - INTELLIEDGE FOR CIM

For many organizations, the ultimate goal is to create an integrated enterprise – what TIBCO calls the real-time enterprise. SOA connects people, processes, and information by integrating systems and providing a platform to develop new functionality while getting the most out of existing investments. Master Data Management provides the information management component – ensuring that critical information assets and foundation for other solutions, is aligned internally and across the value chain and delivered to people and systems alike in real time.

The combination of SOA and MDM allows organizations to be connected in real time at nearly every level, from processing day-to-day activities to making strategic decisions. Some organizations consider MDM to be a subset of the overall SOA strategy rather than a separate discipline, further reinforcing the role of MDM within an SOA. Regardless, SOA augmented with MDM provides IT organizations the tools to boost productivity and cut application development costs. More importantly, it gives them the ability to rapidly roll out new solutions that take advantage of accurate up-to-the-minute data about the company's products, customers, and vendors. It ensures that information is being properly managed and utilized throughout the organization to help the company achieve its business objectives.

Multi-Domain Platform

TIBCO provides a single platform to manage all types of master data (product, customer, vendor, asset, network equipment, network topologies, employee, etc.). In doing so, TIBCO provides a best-of-breed solution to address immediate requirements with the ability to gracefully scale the solution as needs evolve. Not only does a single platform provide a low total cost of ownership, but it allows customers to manage and view relationships across data domains such as different types of electrical network equipment and their topological connectivity within the network.

Process-Centric Approach

TIBCO takes a process-centric approach to managing master data by providing customizable processes to introduce, edit, and publish data – ensuring that clean data remains clean over time.

Service-Oriented Architecture

Through a loosely coupled architecture, pre-packaged web services, and 20+ years of experience in integration and distributed computing, TIBCO provides information alignment and consistency across systems so that business services and composite applications within an SOA have accurate, consistent, and timely information. The embedded distributed cache ensures that master data is served-up in a highly available manner via services to requesting application.

Real-Time and Event-Driven

TIBCO IntelliEDGE for CIM solution is built on a real-time event platform, allowing organizations to respond to business events in real-time to take advantage opportunities or avert problems before they escalate, through real-time notifications and automated corrective action.

Key Features of TIBCO IntelliEDGE for CIM

Information Management

- Master catalogue creation; aggregation from multiple data sources with survivorship; version control.
- Management of relationships and hierarchies including across data domains
- Matching and de-duplication through an advanced fuzzy match engine that uses human-similarity algorithms rather than rules to determine a match
- Images and unstructured information
- Metadata import and export from UI
- Structured and Google-type context-free search
- Role- and user-based access control

Business Collaboration

- User-configurable data quality and business rules
- Long-lived, stateful, cross-enterprise workflow
- Out-of-the-box workflow templates such as new equipment introduction
- Data stewardship and exception handling

Universal Data Connectivity

- Bus-based integration (including non-TIBCO)
- Mapping and transformation
- Web service API for real-time access to metadata, data, and application functionality

Business Intelligence and Analysis

- Process effectiveness visibility
- Detailed versioning, including version compare and roll back
- Full event history for data lineage tracking and auditing

Robust Architecture

- Real-time event-based architecture

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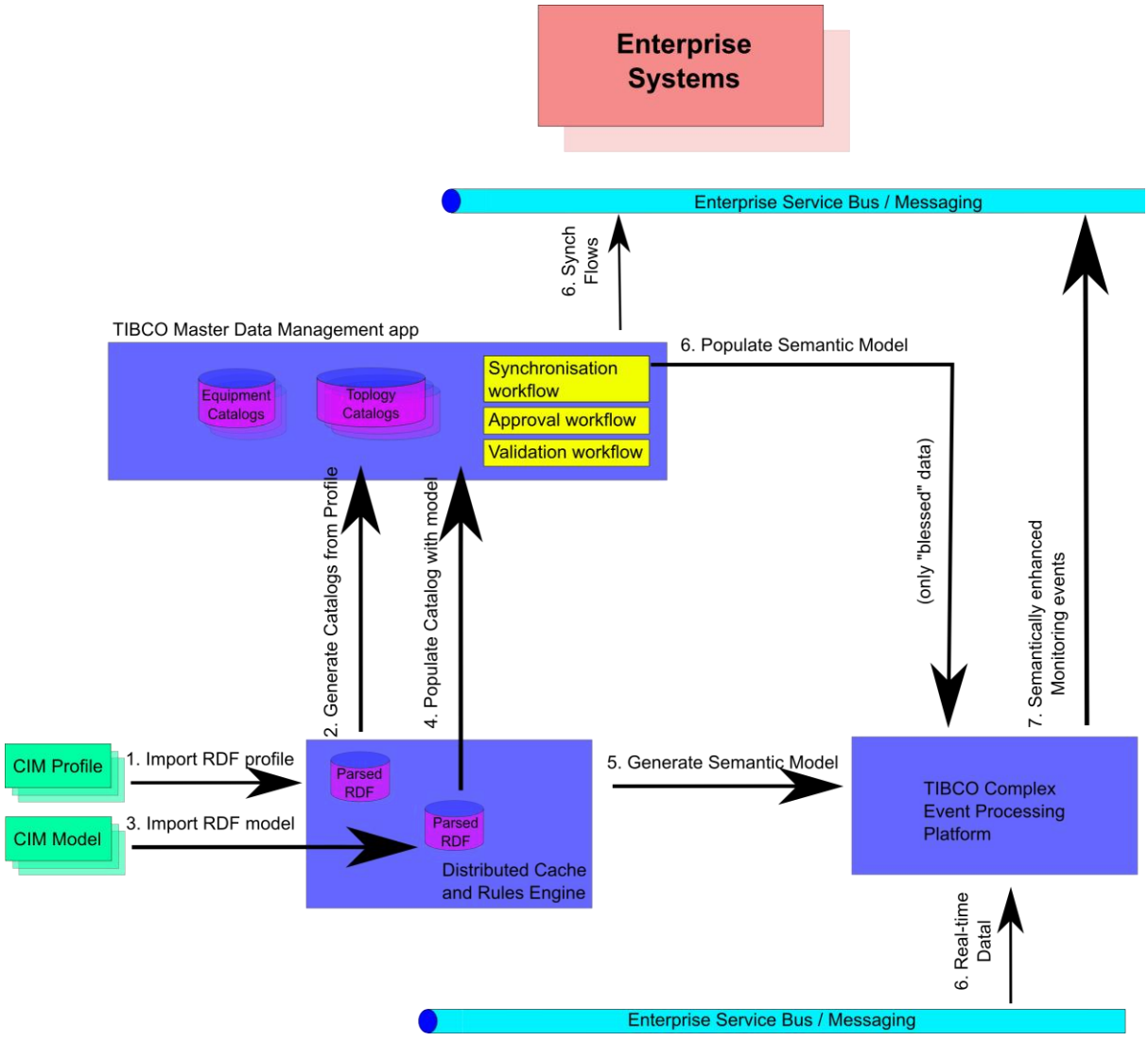
- Zero client footprint
- JMX-based monitoring
- Multi-threaded parallelization and caching for high performance access, loading, and workflow
- Distributed enterprise deployment
- Support for industry standard databases, operating systems, application servers, and EAI and B2B platforms

TIBCO IntelliEDGE for CIM

Equipment and network topology represent critical information assets for network operations in the utility industry. While many efforts are currently underway to implement distributed real-time infrastructure to support many smart grid initiatives, their success is largely dependent on ensuring that critical equipment assets information is aligned internally and across the value chain and delivered to people and systems alike in real time.

TIBCO IntelliEDGE for CIM solution manages the network equipment master data assets and supports the necessary processes, policies and procedures to ensure that clean data stays clean.



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In order to accelerate the implementation of a network equipment master data management solution, TIBCO IntelliEDGE for CIM provides the capabilities to quickly create and maintain:

- Master catalogue creation for all equipment types as defined within the CIM data model, generated from CIM Profile definitions. The creation of such catalogues can be aggregated from multiple CIM Profile definitions that describe different characteristics of the same equipment types.
- With the Master catalogue creation, also validation rules and initialization rules are generated based on constraint definitions as captured in the CIM Profile definitions.
- Creation of relationships and hierarchies between equipment modules, representing electrical connectivity and topology as derived from the corresponding CIM Profile definitions.
- Creation of batch import definitions for each of the equipment types, facilitating out of the box import of equipment model data into the TIBCO catalogues by reading the RDF representations of both Equipment and Topology data in CIM format.
- Creation of relationship mappings for the batch import definitions, to facilitate the management of relationships between equipment elements when importing Equipment and Topology profiles in CIM RDF format.

6.21.3 OTHER TOOLS LINKED TO THE TIBCO INTELLIEDGE FOR CIM

The TIBCO IntelliEDGE for CIM framework leverages the CIM data model as a Common Data Model to accelerate the creation of real-time integrated and event-driven operations environment for utility system operators. Within this framework the TIBCO solution works seamlessly together with:

- **TIBCO ActiveMatrix BusinessWorks™** is one of the leading service creation, orchestration, and integration products on the market. It has been deployed by over 1,000 companies worldwide and is the foundation for several of the largest mission critical service-oriented business applications in production today. Built entirely on open standards, ActiveMatrix BusinessWorks enables companies to expose existing systems as services, build new services, and orchestrate and assemble services into applications with little or no coding. This is the core of TIBCO’s SOA/ESB product suite.
- **TIBCO BusinessEvents™** helps companies identify and quantify the impact of events and notify people and systems about meaningful events so processes can be adapted on-the-fly and people can take action to capitalize on opportunities and remediate threats. BusinessEvents uses a unique model-driven approach to collect, filter, and correlate events and deliver real-time operational insight and is TIBCO’s solution for Complex Events Processing (CEP).

6.21.4 EXPECTED CIM FUNCTIONALITIES

TIBCO IntelliEDGE for CIM provides a real-time event driven integration and management environment, which delivers new levels of timely visibility and intelligence with respect to operational exceptions and exception management for system operators in the utility industry.

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The solution framework facilitates real time intelligence on operations optimization, addressing the costs of time and money associated with sub-optimal business activities in pursuit of asset condition management and process execution efficiency associated with system operator's core business model. This business functionality will be delivered through the marketing leading capability of TIBCO's Complex Event Processing (CEP) Platform in conjunction with the wider TIBCO technology suite. The solution framework leverages the CIM data model as a Common Data Model to accelerate the creation of a real-time integrated and event-driven operations environment for utility system operators.
As part of the development of the TIBCO IntelliEDGE for CIM, TIBCO expects to further leverage the CIM data model in order to:

- Implement both import- and export-functionalities, as well as event-driven integration of equipment and topology data within the data life-cycle management workflows of TIBCO Collaborative Information Manager to automatically integrate with transactional systems based on a CIM derived common data model
- Further develop the solution based template to maintain the semantic data model based on CIM including entities and relations.
- Develop event based (synchronous and asynchronous) routing and filtering, implemented in TIBCO BusinessEvents based on a CIM derived common data model. It is the responsibility of the routing and filtering subcomponent to introspect incoming requests, queries or other events and route them to the appropriate endpoint, i.e. back end system or client application. The solution works closely with cached semantic model, meta data, subscription management and subcomponent for transformation and validation.
- Develop CIM based situational awareness applications built with TIBCO BusinessEvents which delivers new levels of timely visibility and intelligence with respect to operational exceptions and exception management for system operators in the utility industry.

6.22 TNA

6.22.1 VENDOR PRESENTATION

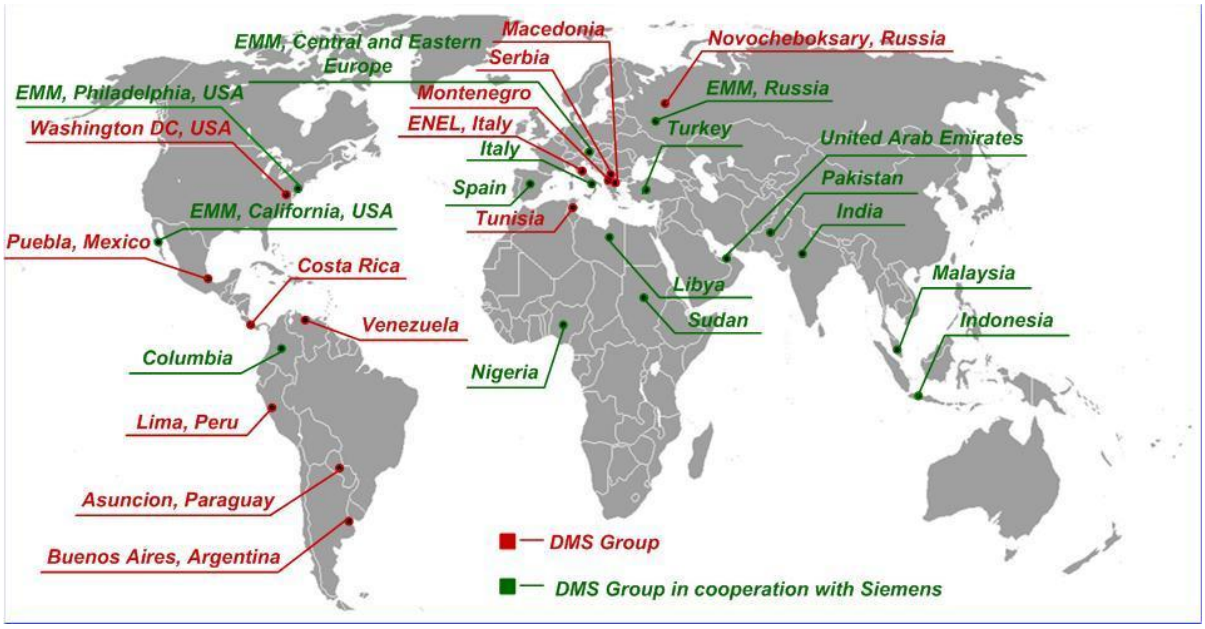
"DMS Group" LLC Novi Sad
Sremska 4
21000 Novi Sad, Serbia
www.dmsgroup.rs

Electricity Coordinating Center Ltd.
PO Box 50
11040 Belgrade 33, Serbia
www.ekc-ltd.com

DMS GROUP Ltd. is the private software engineering company for research, development and software engineering in electrical power systems, specially devoted to Distribution Management

Systems (DMS), but also experienced in Energy Management Systems (EMS) and Energy Market Management (EMM).
DMS Group, supported by a large team of expert engineers and development staff, provides services in development as well as in tender/proposal phase, installation, engineering, commissioning, and training for system use. Our team has proved itself extremely efficient in system customization according to customers' requirements. Expert resources of DMS Group, besides exceptional qualification, motivation and working discipline also have a very competitive price.

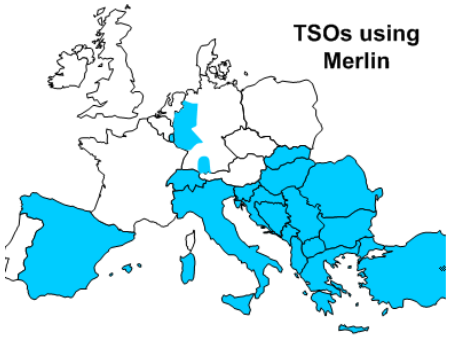
- DMS Group has numerous installations of DMS software worldwide.



Electricity Coordinating Center (EKC) Belgrade provides consulting and software services in the area of electric power systems, transmission and distribution systems and power generation. It is consulting company with great experience and well-known and recognized in Continental Europe, especially in South Eastern and Central Eastern Europe, as well as in the Middle East and Central Asia. It provides a full range of incorporated strategic advisory services, technical consultancy, developing state-of-art solutions, models and methodologies in the energy sector. Its services and tools are based on obligation to provide neutral, objective and expert advices that can guide clients to success.
EKC employs highly skilled and experienced staff, all of them fluent in English and other languages too (German, French, Russian…), educated and trained to fulfil any task given. Its employees have a solid reputation for delivering high quality services on time, even under time pressure. Together with its partners and outside experts worldwide, EKC can resolve any problem and give solutions that will lead its clients to successes.
EKC's experts use worldwide known professional software tools (PSSE™, GTMax, WASP…) and also, application software developed by its own experts. At the beginning, these tools have been developed for internal purposes, in order to speed-up and improve quality of work and results. After successfully usage of the software on several projects these software tools are used wide in the SEE region and Europe as well.
Also, it provides technical know-how for the development of professional software covering different fields of TSOs and electricity market operation.
In addition to consultant services, EKC also share its knowledge through organizing educational and professional trainings through EKC's special department for Education.

DMS and EKC have a lengthy cooperation in a field of software solutions for TSOs.

- **Merlin Conversion & Merging Utility Software:**

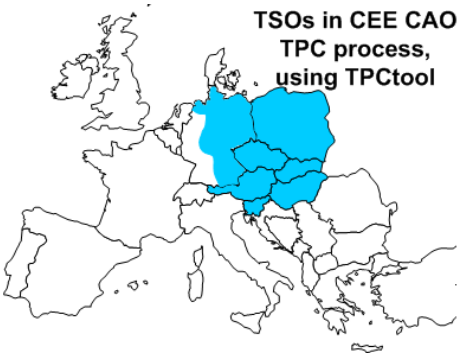


Merlin CMU is a software used by more than half TSOs of the Continental Europe (and by ENTSO-E (UCTE) secretariat), for two-directional conversion between UCT and PTI RAW data formats as well as for validation and merging the UCT/PTI datasets. Merlin is officially recommended by UCTE Secretariat (2007) for standard usage. It was also used as official converter in the UCTE–IPS/UPS (former SSSR) connection project.

- **PSA software for DACF, NTC and PTDF/MF:**

Our Load-flow tool Power System Analyzer is widely used in SEE region for DACF, NTC and PTDF/MF calculations. As a standard DACF load flow software PSA is used by the TSOs of Serbia and Albania, as well as for offline DACF analyses by the TSOs of Montenegro, Macedonia and Bosnia-Herzegovina.

- **CEE CAO IT Freising/TPC Tool**:



The highlight project where we are involved is the provision of complete IT support for CEE CAO Freising (coordinating the capacity auctions for the TSOs of Austria, Czech Republic, Slovenia, Hungary, Poland, Slovakia and two TSOs from Germany). Our role is to provide tools for:

- merging & data adjustment (data validation, data replacements, total exchanges-adjustment,) of network models and other data for D/M/Y coordinated flow-based auctions. There the automatic validation, replacements, adjustment and merging of 24 hours models for the whole Europe is performed in an automatic sequence
- the Load Flow tool for standard load flow operations (AC and DC load flow, contingency analyses, scaling, OTDF…) and for PTDF/MF calculation

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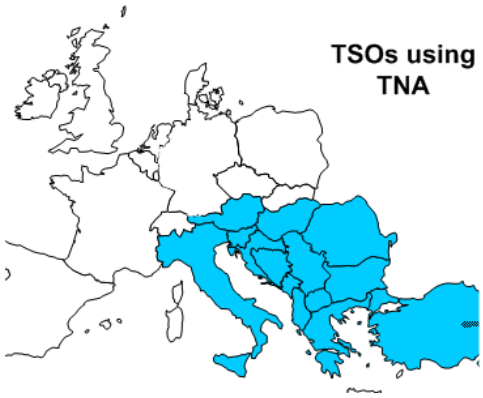
- **TNA software:**



Transmission Network Analyzer is a Standalone Tool developed jointly by EKC and DMS group, for SEE TSOs, and recently also used in CEE region. TNA software comprises the experience of previous software, and is provided for load flow, PTDF/MaxFlow, models validation/ fixing/ merging, UCT-CIM conversion and short circuit analyses.

6.22.2 TOOL DESCRIPTION

TNA – *Transmission Network Analyzer* (hereinafter: TNA Application) represents the entire application for design, calculation and analysis of electricity transmission networks. The Application is focused on the functionality development used for the purposes of setting the network models, analyses of transmission network and calculation of transfer capacities, as segments of procedures related to the open electricity market.

TNA is standalone application intended for working on a single computer. As for architecture, it is realized as a server – client set to operate on a single computer. In the further development, depending on clients' needs, it is possible to make a classification into server and client part. The Application was created on the basis of mutual efforts made by DMS Group Novi Sad and EKC Belgrade.

The Transmission Network Analyzer (TNA) main functions are:

- Validating, fixing and merging of the network models
- static load flow calculations and related contingency and sensitivity analyses
- Technical Parameters Calculation - PTDF/MF calculation, according to the Flow-based Coordinated Auctions principles in the regions of SEE and CEE
- Short-circuit analyses
- CIM XML – UCT conversion

It supports working with UCT and CIM XML formats.

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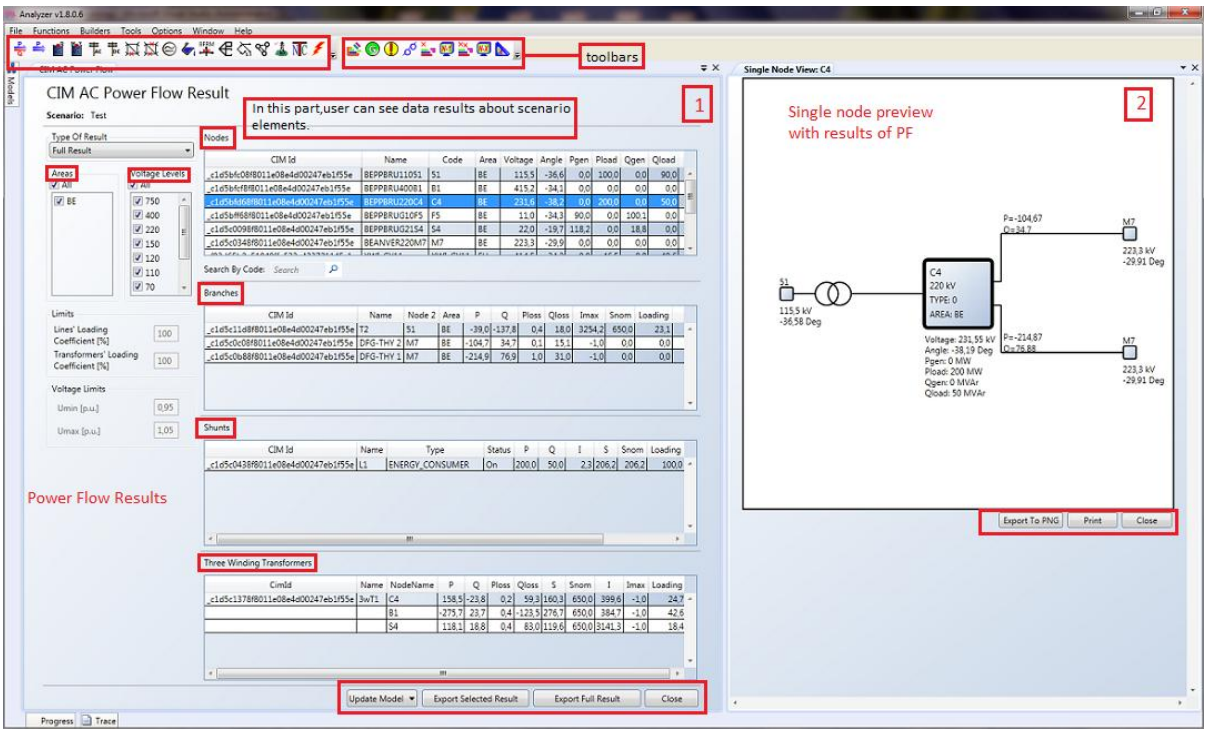

Figure 1 – TNA Load Flow Results with Single Node View

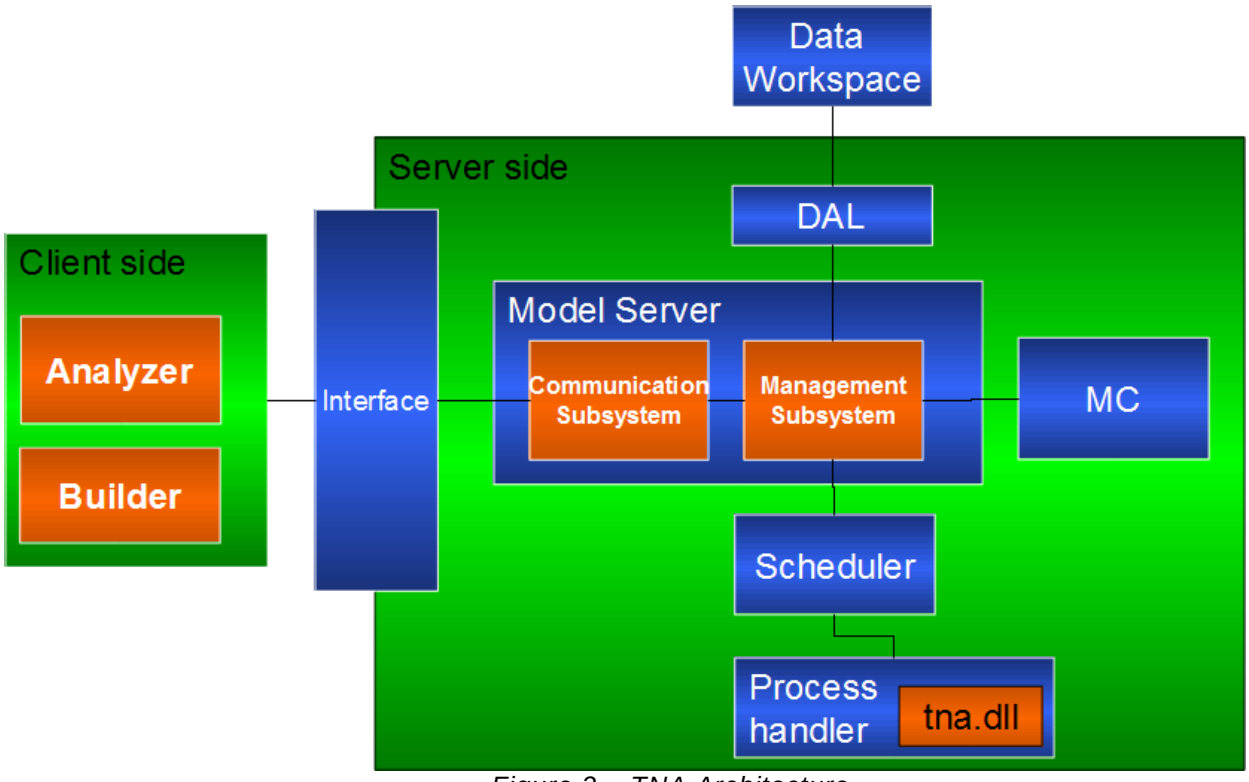

Figure 2 – TNA Architecture

The TNA Application contains four components:

- *Builder (client).*
- *Analyzer (client).*
- *Actualizer (server).*
- *Data Workspace.*

Server-client architecture is used in the creation of the TNA Application. Server application is represented by the *Actualizer* responsible for running of all calculations and communication between client and server, as well as direct communication between clients and *Data Workspace* module.

The client side is represented by *Analyzer* and *Builder* applications.

In the creation of the TNA Application, *.NET* technology is used with the associated *.NET 3.5sp1 Framework.* The clients are entirely written in *WRF*, server side is written in C# and C++. The libraries of power functions are written in C++ in order to obtain maximum efficiency of the calculation. The communication between the client and server is realized by using the *WCF* technology.

TNA – Functional units in the software

The TNA Application is functionally composed of three functional components:

- *Builder,*
- *Functions,*
- *TNA tools*
- *CIMedy Tools*

Builder component enables forming, modification and saving of scenarios (list of input data and results of functions), as well as running of the existing scenarios of models of transmission networks with associated types of files: *UCT, CBCO, BCE, AATR, AANT, GSK* and *TSO.* Also, a single manual or automatic validation of entered files is enabled.

Builder is also used for design and modification of *OTDF, N-1, N-X Contingency & Monitoring* lists, *CBCO* lists, as well as for modification of the existing *UCT* files. Builders are written in C# by applying MS WPF and WCF technologies.

Functions represent a group of applications intended for offline (planning) analysis of transmission networks. The following main groups of functions are comprised in TNA:

- ***AC/DC Load Flow****.*
- ***Maxflow-related functions: PTDF/MF, BFRM …***
- ***Post Auction Contingency Analysis***
- ***OTDF***
- ***N-1 and N-x contingency analyses***
- ***Net Transfer Capacity (NTC) calculation***
- ***Short Circuit calculation***

TNA Tools is a group of tools used for validation of input models, connection of national transmission networks and generation of reports on occurring problems.

- **Model Tool** is used for validation, verification of convergence and merging of UCT models of transmission network.
- **CBCO Tool** is used for validation of CBCO lists that are the input for PTDF/MaxFlow calculation.
- **CIM Tool** is used for for conversion between CIM and UCT models.
- **CIMedy tool** is a tool for viewing and manipulating with CIM models. It allows edit,

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create and delete elements from CIM models with nice and intuitive display.

Five main views are:

- CIM view - insight into all elements based on CIM design
- Power view - elements filtered by geographical location and substations
- Graphical view - draws graphical presentation of substations with closest neighbours
- Diagram view - draws diagrams with ability to change and elements positions
- Slack selection - allows manual selection of slack node for Load Flow and Fault calculation

In following picture there is a window with line segment view. It is possible to see all characteristics of each element using this CIMedy tool.

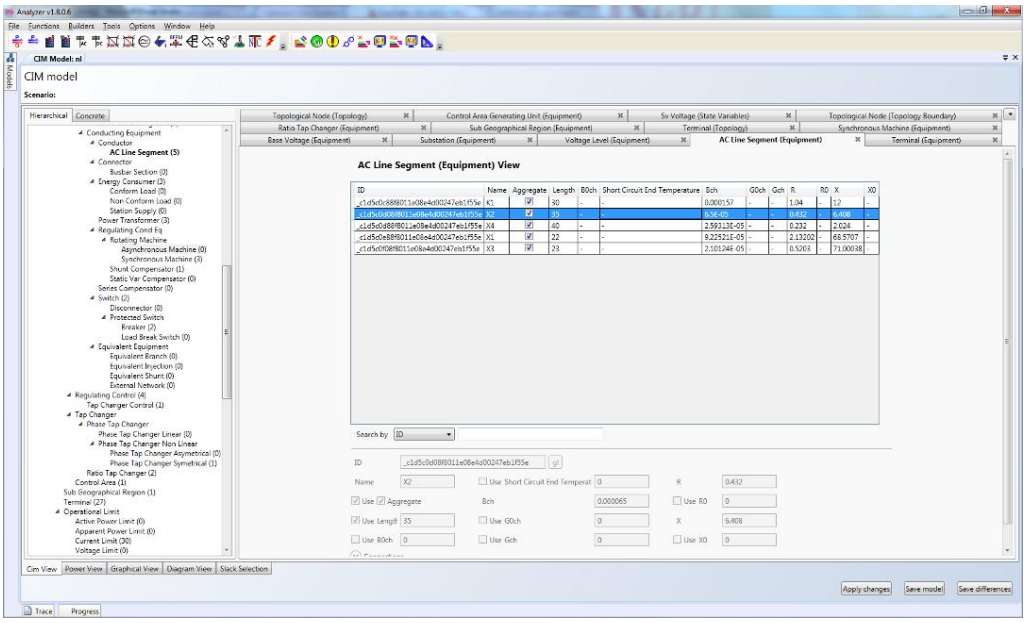

Figure 3 – CIMedy Tool (Line segment preview)

In the picture below, there is a picture of graphical view for one single substation.

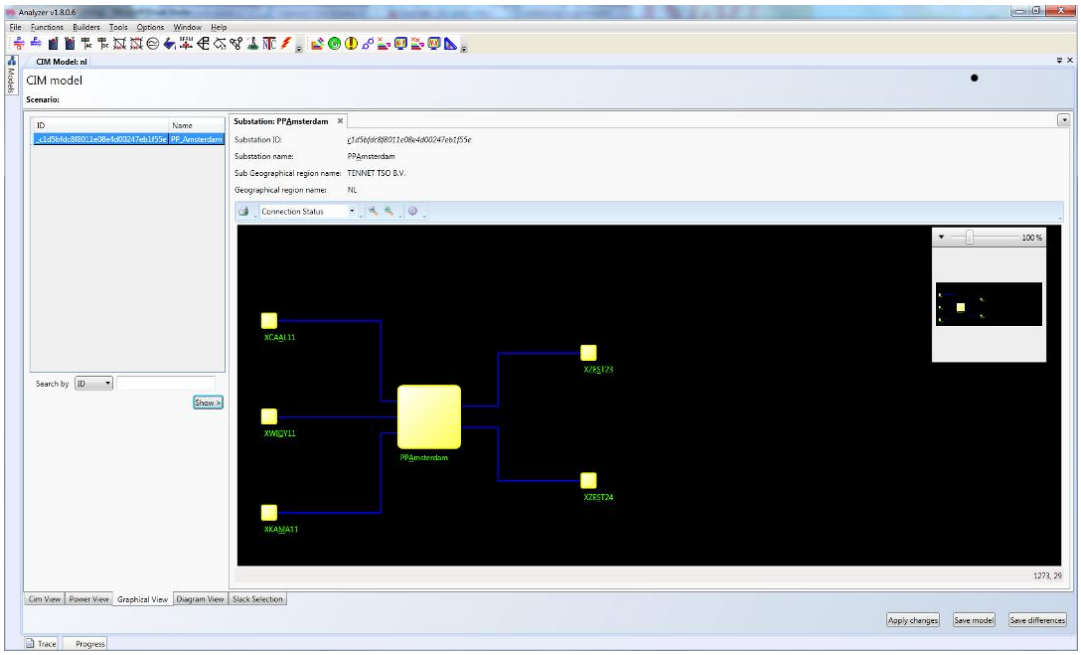

Figure 4 – CIMedy Tool (Graphical view of single node)

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6.22.3 EXPECTED CIM FUNCTIONALITIES

1) Transmission Network Analyzer supports functions for Transmission Networks. Currently Transmission Network Analyzer supports different functions for UCT models for example: Load Flow, PTDF, OTDF, Contingency Analysis, Area Interchange, NTC....; On the other side, currently TNA supports Load Flow and Fault Calculation for EntsoE CIM profiles (14 and 15).
2) TNA works with different models and it supports conversion from one model to another. TNA imports and exports CIM models, it is accurate in all calculations. Also there is possibility of merging two models in one new model.

3) Graphical view of results is simple and comprehensive. It is possible to see single substation with neighbourhood view. If application uses XML, then it is possible to see diagram view.
4.) TNA Application does import and export CIM models that can be zipped/unzipped.

In the future further development power market functions, new functionalities based on fault calculation and support of dynamic simulations are expected. Implementation of full database support is also in plan. There is also a plan to develop all functions that work with UCT for now, for CIM models.

6.23 UIB ADAPTER FOR USE WITH THE OSISOFT PI SYSTEM

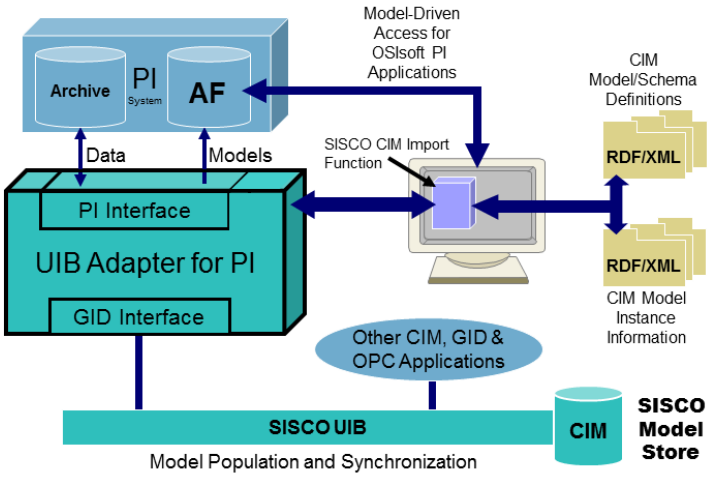
6.23.1 VENDOR PRESENTATION

SISCO (Systems Integration Specialists Company, Inc.) is a privately held company founded in 1983 and based in Michigan USA with resellers and OEM partners across the globe. SISCO is the global leader in standards-based communications and integration technologies for electric utilities, manufacturing and automation industries. SISCO software is used in a wide variety of applications from electrical power transmission, distribution and generation systems to manufacturing and postal automation equipment. SISCO works with all major OEMs by helping lower their cost to incorporate open standards enabling interoperable systems and lowering the cost to users. SISCO helps users with off-the-shelf connectors and adapters that leverage mainstream networking and middleware technology with support for electric utility industry standards like CIM, ICCP-TASE.2, IEC 61850, and other open international standards. SISCO has a proven track record of working effectively with OEMs and integrators that have contributed to the success of standards based solutions in the industries we serve. Working with SISCO allows our integrator partners to deliver more capabilities to our joint customers at a lower total cost of ownership and with lower technical risk. End users working with SISCO are assured that they have chosen a reliable supplier that can be counted on to work effectively with their suppliers to deliver a working solution.

Corporate Headquarters:	6605 19 1/2 Mile Road, Sterling Heights, MI 48314-1408, USA
Main Telephone Number:	+1-586-254-0020
Main Fax Number:	+1-586-254-0053
E-Mail:	info@sisconet.com
Website:	http://www.sisconet.com

6.23.2 TOOL DESCRIPTION

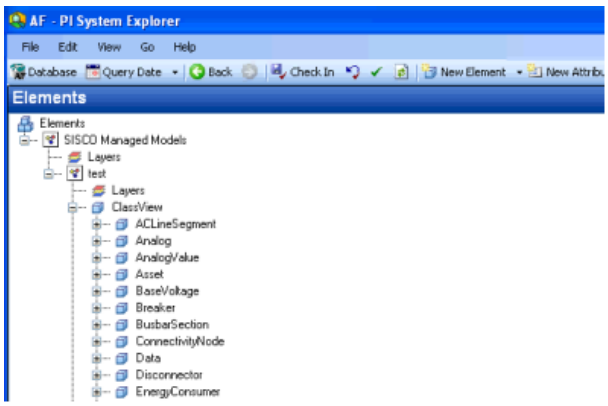
SISCO's Utility Integration Bus (UIB) adapter for use with the PI System (PI) from OSIsoft combines the power of the OSIsoft world-leading platform for real-time performance management with the application integration and common information exchange model capabilities of SISCO's UIB. The SISCO UIB PI Adapter receives modelling information, such as a network connectivity model typically maintained by a network modelling tool, EMS,DMS, or GIS system; and automatically configures the PI Analysis Framework (AF) for those points that are being historized by the PI Server. The SISCO UIB PI Adapter organizes the PI tags within the context of models familiar to the user such as IEC's Common Information Model (CIM), existing models from other applications like GIS or EMS, or a user-defined power system model. Changes made to the connectivity model are delivered via the UIB to the SISCO UIB PI Adapter, which automatically creates the PI AF entries, and PI configuration needed. The UIB and PI System provide a unique cost saving solution for electric utility users that minimizes manual reconfiguration.



BLOCK DIAGRAM OF SISCO UIB ADAPTER FOR OSISOFT PI SYSTEM

Features

- Works with customer defined models, models derived from applications, or industry standard models such as CIM, IEC61850, ISA, etc.
- Imports model definitions and network connectivity information into PI AF to enable PI applications with access to the CIM.
- Supports IEC CIM imports and procedures for:
  - Schema creation through the merging of CIM profile files.
  - Full model imports
  - Incremental Model Imports
  - Merging of Model Instance files through the use of Model Authorities and CIM Model File Headers
  - Built in validation of instance files versus schema/profiles.
- Supports model synchronization between the PI and the power system models in other systems to enable historization of these external model changes within the PI environment.
- Provides a Model Explorer interface that allows users to browse and edit the resulting models using a CIM context.



SCREEN SHOT ILLUSTRATING RESULT OF CIM IMPORT IN PI-AF

An additional capability, not tested at this IOP, is that the PI Adpater can auto-create PI tag names based upon the model definitions as well as integration with Enterprise Service Bus (ESB) technology for imports. This ESB capability also allows PI System information to be exposed to other applications, attached to the ESB, through the SISCO Utility Integration Bus layer.

For a complete data sheet, see: http://www.sisconet.com/downloads/MKTLit_UIB_PI.pdf

6.23.3 HANDLING. OTHER TOOLS LINKED TO THE UIB ADAPTER FOR USE WITH THE OSISOFT PI SYSTEM

The product is part of a family of products that integrate together through the SISCO Utility Integration Bus (UIB). The UIB provides application adapters, and programmatic interfaces, based upon the CIM based Generic Interface Definition (GID) abstract service definitions in the IEC 61970-40X standards. Through the proper deployment/integration of the UIB products, real-time data can be exchanged within the context of the CIM model over ESB and other SOA middleware systems using JMS such as IBM WebSphere, Tibco, Oracle, etc.

For more detailed information, see the following link: http://www.sisconet.com/uib.htm

6.23.4 EXPECTED CIM FUNCTIONALITIES

The adapter is a core product component from which other products/systems can be created. Its flexibility allows it to be used as a basis to:

- Send/Receive IEC 61968 CIM messages
- Model-driven Condition Based Maintenance Applications
- Wide Area protection schemes
- Synchrophasor processing applications
- User custom applications

6.24 UTILITY INTEGRATION BUS (UIB) SISCO MODEL STORE (SMS)

6.24.1 VENDOR PRESENTATION

SISCO (Systems Integration Specialists Company, Inc.) is a privately held company founded in 1983 and based in Michigan USA with resellers and OEM partners across the globe. SISCO is the global leader in standards-based communications and integration technologies for electric utilities, manufacturing and automation industries. SISCO software is used in a wide variety of applications from electrical power transmission, distribution and generation systems to manufacturing and postal automation equipment. SISCO works with all major OEMs by helping lower their cost to incorporate open standards enabling interoperable systems and lowering the cost to users. SISCO helps users with off-the-shelf connectors and adapters that leverage mainstream networking and middleware technology with support for electric utility industry standards like CIM, ICCP-TASE.2, IEC 61850, and other open international standards. SISCO has a proven track record of working effectively with OEMs and integrators that have contributed to the success of standards based solutions in the industries we serve. Working with SISCO allows our integrator partners to deliver more capabilities to our joint customers at a lower total cost of ownership and with lower technical risk. End users working with SISCO are assured that they have chosen a reliable supplier that can be counted on to work effectively with their suppliers to deliver a working solution.

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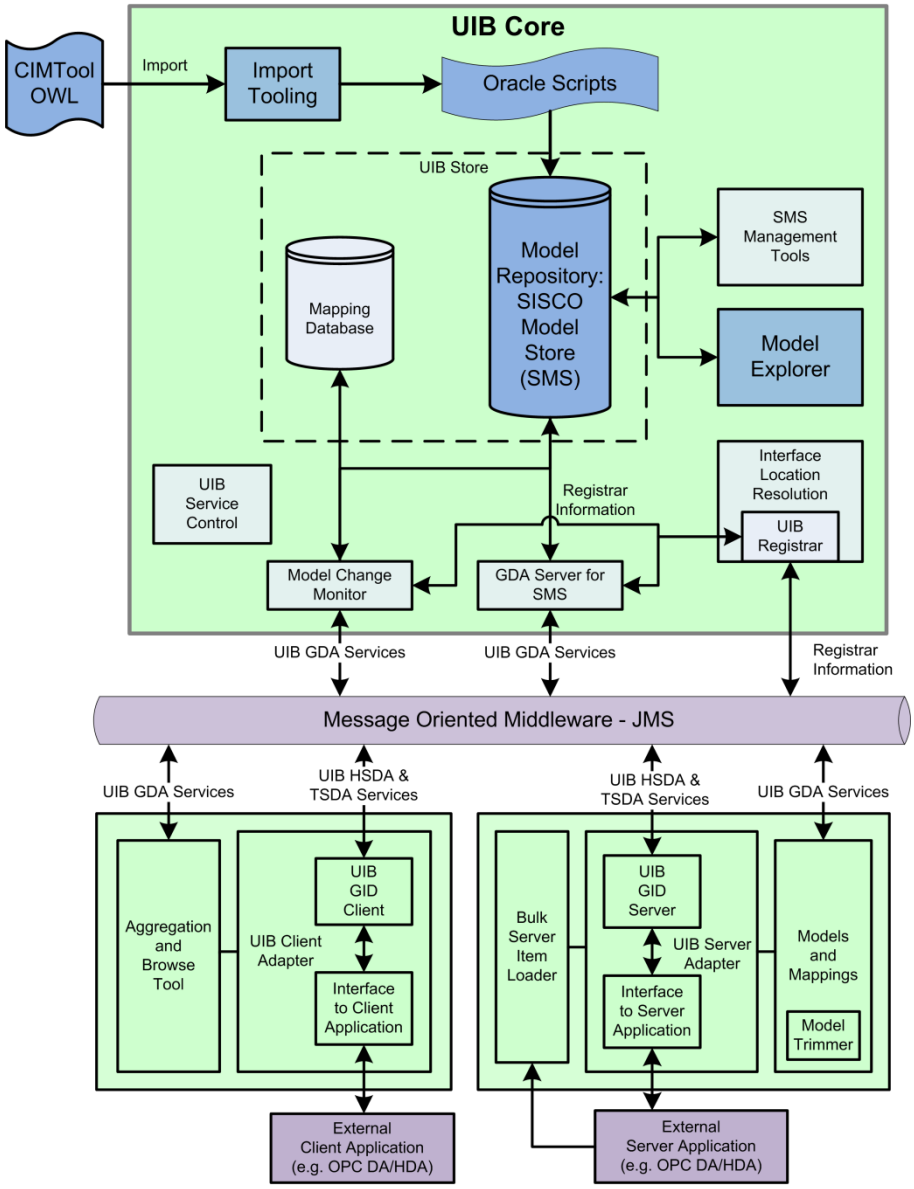
Website:	http://www.sisconet.com

6.24.2 TOOL DESCRIPTION

The SISCO Model Store (SMS) for the Utility Integration Bus (UIB) provides a model repository for UIB applications that supports an environment in which a common data exchange model for application integration can be stored and distributed across an enterprise service bus. Data stored in legacy applications are normally represented using proprietary methods that are unique to each application. Any external application that needs this data must either be programmed to understand these proprietary conventions or must use data transformation tools that transform the data for each application-to-application data path that exists in the system. As the system changes over time due to new data points being added, data moving from one application to another, or new applications being added, each individual data transformation mapping must be continuously maintained to reflect the changes in the underlying application data representations. With the common model-driven approach supported by SISCO's UIB, applications exchange data in the context of a unified model (e.g. CIM via IEC 61970 and IEC 61968) that hides the details of how data is stored internally in each application. The use of CIM as a common model allows data from multiple applications to be merged into a unified enterprise level view of data. Even if the model changes, as long as the relationships between objects in the model remain consistent, applications can still find the data they need by examining the model. Users benefit because they no longer need to maintain proprietary arcane tag naming conventions and separate transformations for each application-to-application data path. And, by using the standardized CIM for data exchange users have access to off-the-shelf

applications instead of having to write their own or pay vendors to customize their applications to accommodate proprietary data conventions. A block diagram of the UIB architecture is shown below. Only the elements in blue were tested at this IOP.



BLOCK DIAGRAM OF SISCO UIB SISCO MODEL STORE (BLUE COMPONENTS TESTED)

Features

- Supports a common data exchange model based on CIM for application integration over an ESB supporting JMS.
- Provides Location Independence – Applications access data in context of the model
- Enables distribution of model information and automation of model updates
- Standardized interface services comply with the abstract definitions of the IEC 61970-40X Generic Interface Definition (GID)
    - Generic Data Access (GDA) for model access and management.
    - High Speed Data Access (HSDA) for real-time data access
    - Time Series Data Access (TSDA) for access to historical data

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- Common data exchange model minimizes data transformations and provides global context for information.
- Supports off-the-shelf adapters for OPC Data Access (DA) and Historical Data Access (HDA).
- Enables merging of application data to create unified views of utility operations.
- Eliminates application specific dependencies that isolate integration adapters from changes in other system components.
- Reduces integration configuration by enabling application adapters to discover data without requiring knowledge of each data source.
- Model neutral design uses schema file for configuration enabling off-the-shelf support for custom CIM profiles and support for other standards like ISA S.95 and ISO 15926.

For a complete data sheet, see: http://www.sisconet.com/downloads/uib.htm

6.24.3 HANDLING. OTHER TOOLS LINKED TO THE UIB SISCO MODEL STORE (SMS)

The product is part of a family of products that integrate together through the SISCO Utility Integration Bus (UIB). The UIB provides application adapters, and programmatic interfaces, based upon the CIM based Generic Interface Definition (GID) abstract service definitions in the IEC 61970-40X standards. Through the proper deployment/integration of the UIB products, real-time data can be exchanged within the context of the CIM model over ESB and other SOA middleware systems using JMS such as IBM WebSphere, Tibco, Oracle, etc.

For more detailed information, see the following link: http://www.sisconet.com/uib.htm

6.24.4 EXPECTED CIM FUNCTIONALITIES

The SISCO SMS for the UIB is a core product component of the UIB from which other products/systems can be integrated.

- Import CIM files per the latest Interop tested profiles for both IEC 61970 and IEC 61968.
- View class and instance information via a Java based model explorer.
- Supports model discovery, data access, and model management services over JMS using a CIM model for data exchange that is stored in the SMS.
- Model notification messages can be generated to keep applications updated as CIM model is updated in the SMS.

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