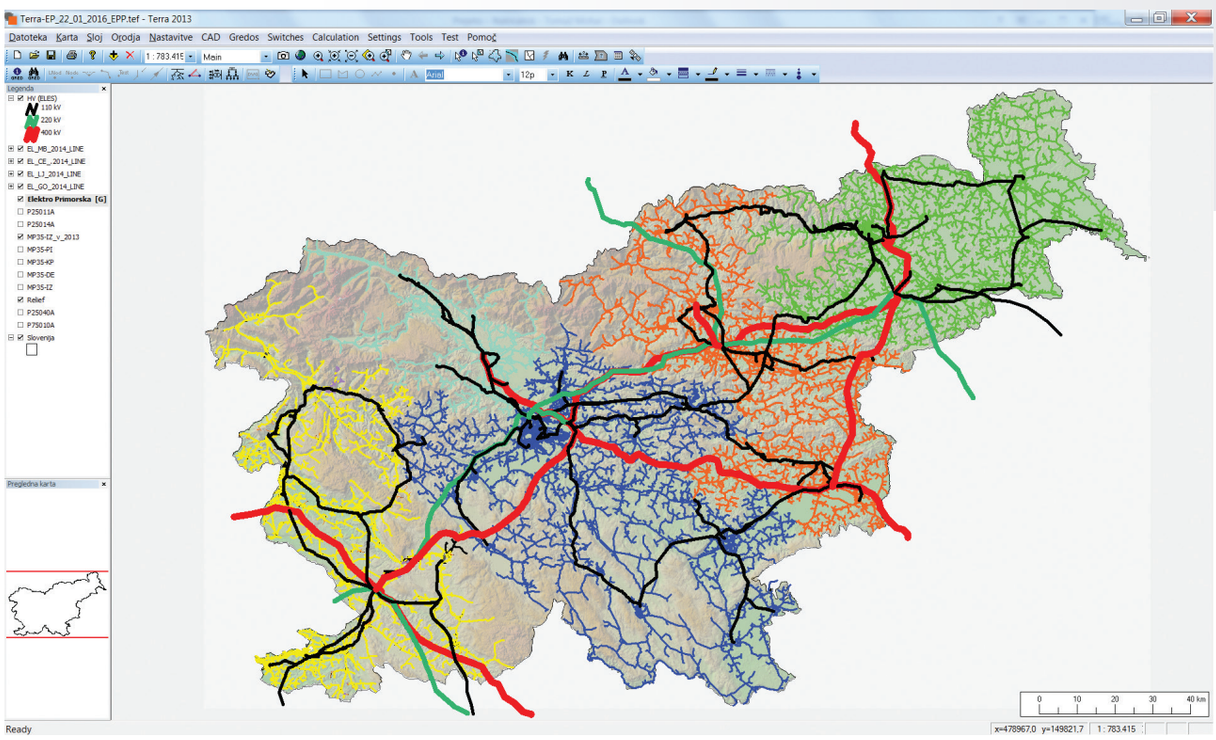
ENERGY AND POWER SYSTEM **PLANNING** DEPARTMENT

Gredos - distribution network analysis software:

- Power Flows (AC/DC)
- Optimal Re-switching (optimal losses, reliability)
- Optimal Back-up Supply
- Reliability Analyses
- Fault Calculation
- AMI Interface (Advanced Metering Infrastructure)
- DG Analysis Module (Dispersed Generation)
- Optimal Network Construction (Traveller Sales Man solver)
- GIS support (ESRI ShapeFile, MySQL)
- AutoCad DWG support (Taigha Open Design Aliance)

Operating platform: PC/MS Windows



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ENERGY AND POWER SYSTEM **PLANNING** DEPARTMENT

Gredos package (1996-2016) is network planning software used for analysing different network voltage levels with the same GIS user interface and different calculation modules.

2000: NS Windows, MS Access, OpenDwg, ESRI Map Object platform.

2005: Gredos software package for MV network analysis was completed by new calculation modules for LV network. The calculation model for Reliability calculation was essentially improved by the possibility to take into consideration the functionality of automated remote control switches. Significant progress was made at N-1 criterion checking where one corrective switch action was adopted as a new option for reserve supply assurance.

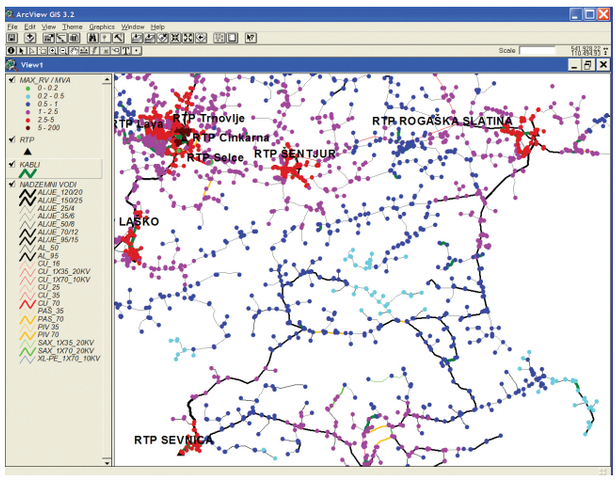
2007: The latest version of Gredos 10.0 software package gets a new feature: bulk transmission system analysis.

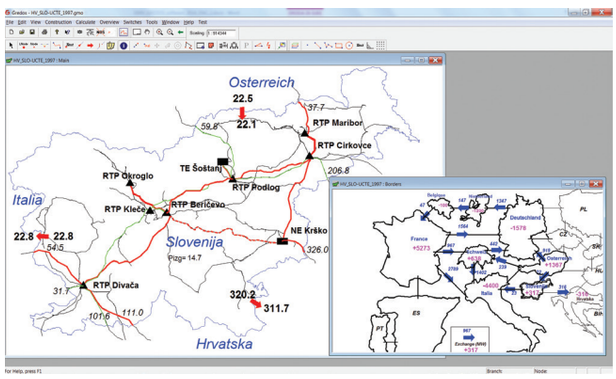
2009: Export of electrical power network topology and GIS data from Gredos MO software to SCALAR system. The export of GIS data from Gredos in the SCALAR system is easy, quick and effective, and it is possible to update and store the exported data via the internet.

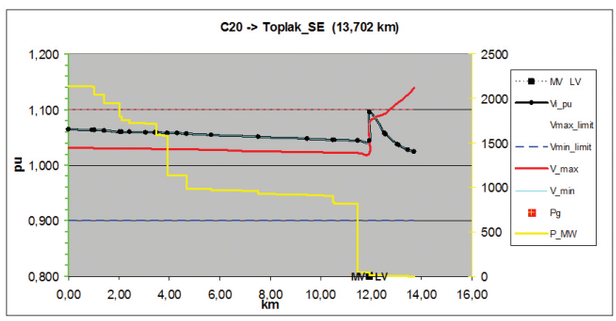
2011: 10 years of successful implementation of the Gredos programme as an independent GIS application based on the ESRI Map. The Gredos programme can be integrated as a COM network calculation object in various GIS/CAD applications with a professional graphics interface. There is a new innovative improvement for N-calculation module with automatic marking of the minimal set of branch candidates for back up supply testing at network failures.

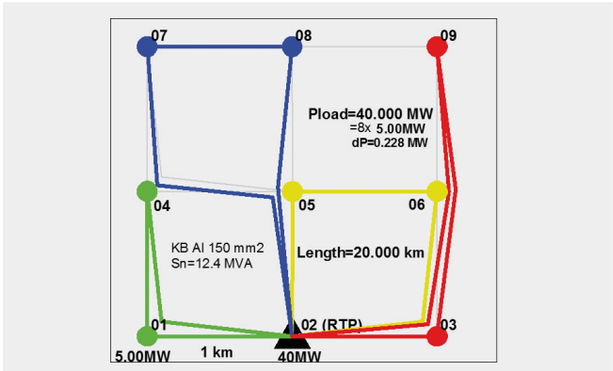
2013: After the redesign, the Gredos network analysis software package works with Terra2013 GIS software. The new interface enables the implementation of two new modules: AMI (Advanced Metering Infrastructure) and module DG (Dispersed Generation). The AMI module supports the transfer of leading data for transfomer station from the metering centre. The purpose of the DG module is the calculation of marginal voltage profiles with dispersed generators.

2015: A new LBM optimisation module has been added to Gredos network analysis software. The purpose of the new module is to build an optimal network from the point of minimum network costs while providing customers with the desired reliability. The module takes into account the criterion N-1, which means the creation of appropriate loops between transformer stations. Loop is modelled with binary variables in a way of a multiple traveling salesman problem.









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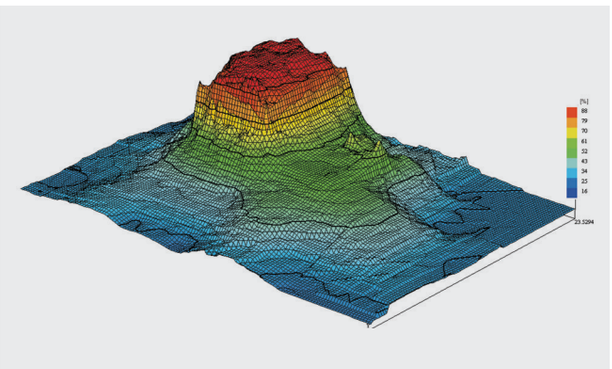
ELECTRIC POWER PLANTS AND FACILITIES ENVIRONMENTAL EFFECTS DEPARTMENT

The basic activity of the department is solving problems related to the impact of power facilities to nearby installations and the environment. The content of the work is tied to the research of specific problems related to the impact of electric power facilities on the environment and safety at work and applied activity, where research findings are used in everyday life. From the content of the work we perform various studies, papers, projects, reports, expert reviews and opinions. Department experts also participate in the preparation of various regulations, policies, standards and at the provision of legal requirements on the construction of electric power facilities. The department operates in the following areas: earthing, short circuit and protection, electromagnetic fields, electromagnetic compatibility (EMC), audible noise, the quality of the voltage, corrosion of buried structures, stray current corrosion, electric power facilities lighting installations and ambient light pollution, inductive effects of electrical power system devices on other systems in the environment, working environment and safety at work. The department is equipped with the necessary tools, instrumentation and mobile laboratories.

Earthing

- Research in effects and calculation of short circuits,
- calculation of line constants,
- calculation of distance protection, overcurrrent-time protection, and protection simulation,
- measurement of earth system resistance, touch and step voltage, ground potential rise, resistance continuity, lightning structures, electrical installations, specific resistance,
- grounding dimensioning,
- measurement of impendance to earth

  (Accredited by Slovenian Accrediatiton).



Measurements of touch and step voltage and ground potential rise

Electromagnetic compatibility (EMC)

- Transient overvoltages in secondary circuits of power plants and substations,
- radiofrequency interference of transmission and distribution power lines and switchyards,
- reducing electromagnetic interferences,
- in-situ measurement of over voltages on secondary circuit

  (Accredited by Slovenian Accrediatiton).

Measurements, analysis, research and consulting

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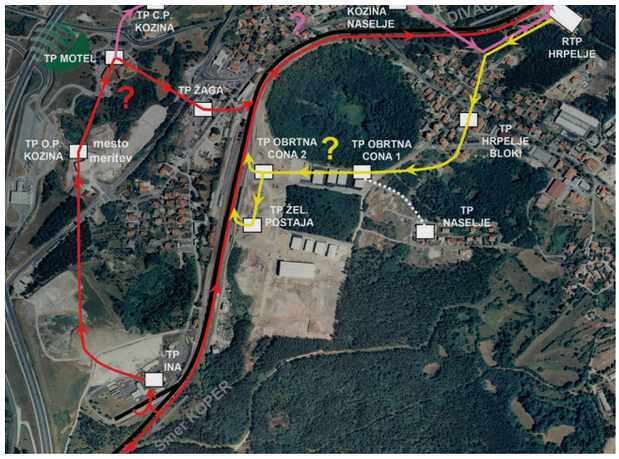
ELECTRIC POWER PLANTS AND FACILITIES ENVIRONMENTAL EFFECTS DEPARTMENT

Effects of power facilities on neighbouring metal installations and constructions and corrosion

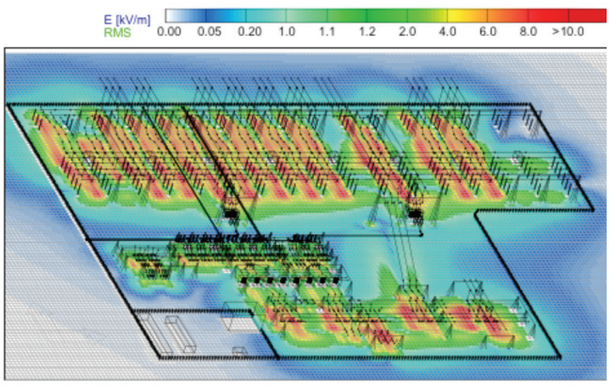
- Calculation of electromagnetic interference between transmission line and pipelines and telecommunication lines,
- protection of telecommunication lines and pipelines against transmission line electromagnetic interference,
- research in corrosion effects on grounding systems and metal structures,
- measurements of corrosion parameters,
- measurements of stray currents in DC electrified rail systems.



Measurements and analysis of DC stray currents of railway traction

Electromagnetic fields

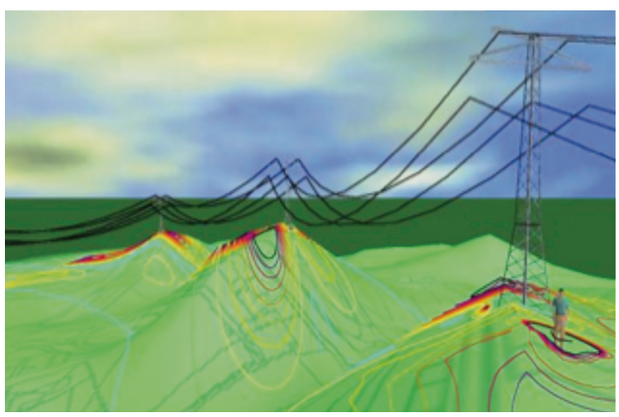
- Elaboration of environmental reports of electric and magnetic fields,
- measurements of electric and magnetic fields (Accredited by Slovenian Accreditation),
- 3-D Calculation of electric and magnetic fields (using detailed spatial data),
- research of electromagnetic fields of electric power facilities in the environment.



Calculation of electric field of transformer substation

Audible Noise

- Basic research in noise to determine noise algorithms for power equipment,
- measurements of noise caused by operation of power facilities (Accredited by Slovenian Accreditation),
- research of noise environmental effects.



Audible noise prediction model of overhead line caused by corona effect

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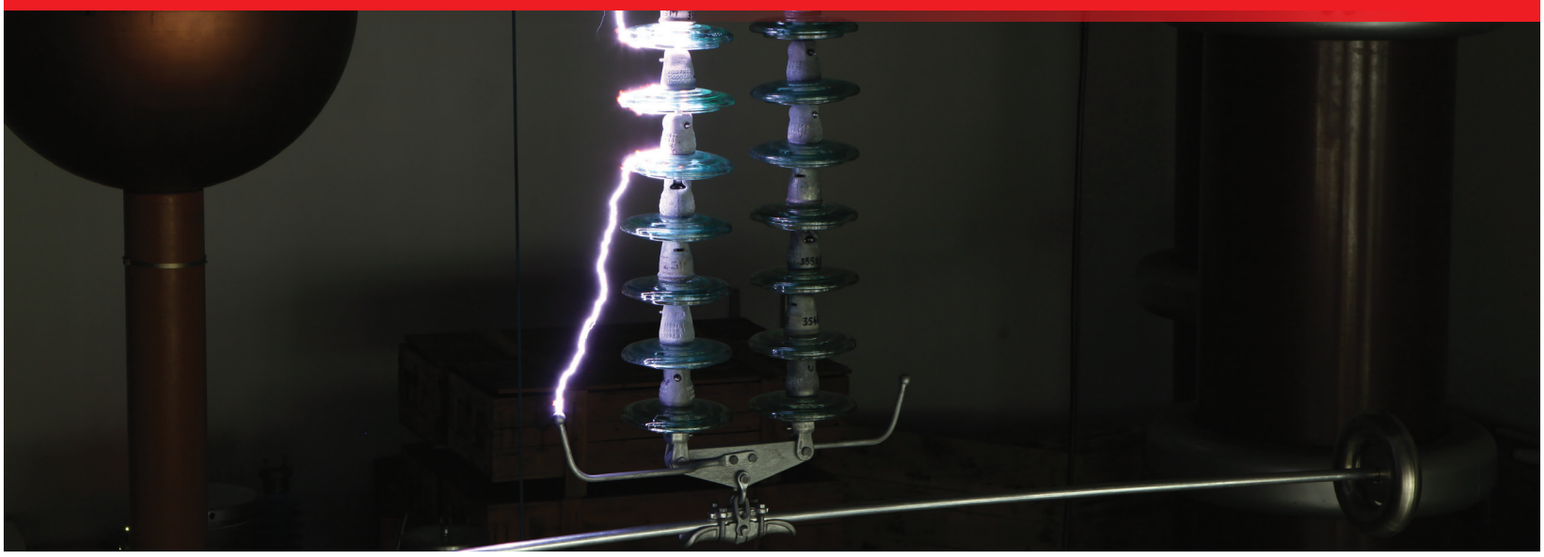
HIGH VOLTAGE AND ELECTRIC POWER PLANT DEPARTMENT



Basic High-Voltage and Power Plants Department activities are:

Research in power engineering

- Research in the field of power engineering and electrical industry,
- consulting services for generation, transmission and distribution utilities,
- computer simulations of electrical transients and FEM numeric analyses,
- over-voltage analyses and insulation co-ordination studies,
- dimensioning of protection systems against lightning strokes and designing of over-voltage protection,
- study towards solving operational issues of power plants (excitation, stability, protection),
- analysis of accident events and identification of causes of major damages and failures taking place on high-voltage equipment,
- new technologies (transformers, circuit breakers, arresters, GIS, cables, generators).

Tests and measurements on high-voltage equipment

- Tests and measurements (dielectric, current, thermal) in the high-voltage laboratory,
- insulation diagnostics (R_{ins}, tg δ, PD) of the high-voltage equipment and their components,
- in-service measurements of voltage and current transients in the system,
- verifying of the accuracy class of instrument transformers.

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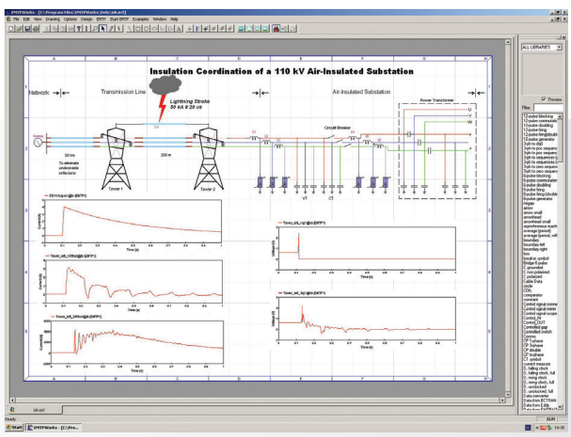
HIGH VOLTAGE AND ELECTRIC POWER PLANT DEPARTMENT

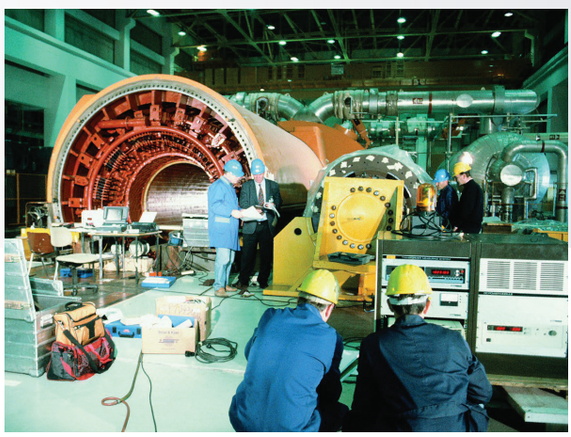
Electric power grid and power plants construction and maintenance (consulting, supervision)

- Consulting services in adoption of new technologies and providing solutions for a particular power system,
- participation in determination of appropriate technical parameters, selection and purchase of the high-voltage equipment,
- assessment of equipment and technical solution adequacy,
- electrical equipment acceptance procedures at the manufacturer's site,
- participation in design, construction and renovation of power plants and their components,
- examinations and expert opinions upon work completion,
- nuclear power plant maintenance (consulting, testing, QA procedures).

Miscellaneous (education, legislation, standardization)

- Providing support to governmental organisations in solving technical issues of power engineering,
- participation in the educational process of the Faculty of Electrical Engineering of the University of Ljubljana,
- participation in the preparation of legal documents for the area of power engineering,
- activity in technical committees in introduction of new technical standardisation,
- organisation and collaboration at professional conventions,
- membership in professional working bodies of domestic and foreign associations active in the area of power engineering,
- maintenance of contacts with similar organisations, societies and companies in the country and abroad.





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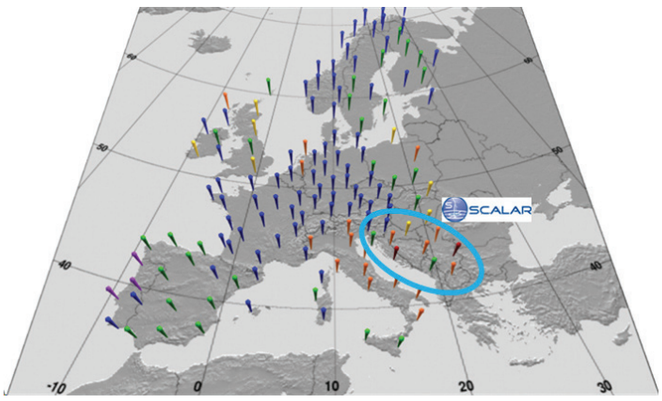
ELECTRIC POWER SYSTEM CONTROL AND OPERATION DEPARTMENT

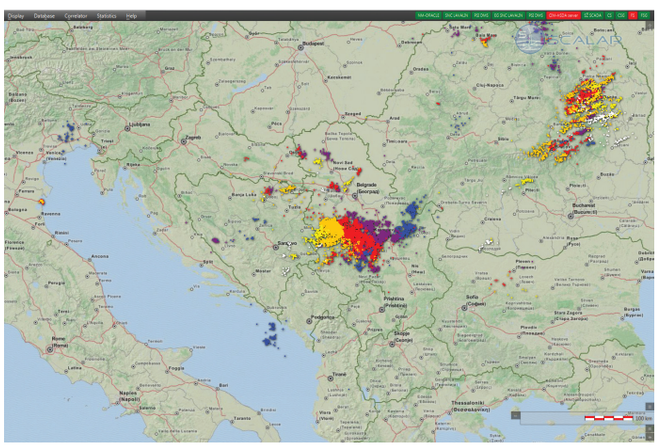
SCALAR

SCALAR is a lightning localization system, which has been operating since 1997. From the beginning, the system has been developed taking into account the needs of transmission and distribution system operators, especially in the field of power system operation, planning and maintenance. The users of the system have required a very high level of efficiency and availability of delivering lightning data and related services. Nowadays the system serves also users from other domains, such as transportation (railway, aviation), communications (broadcasting radio and television and telecommunication companies) and supports the insurance business.

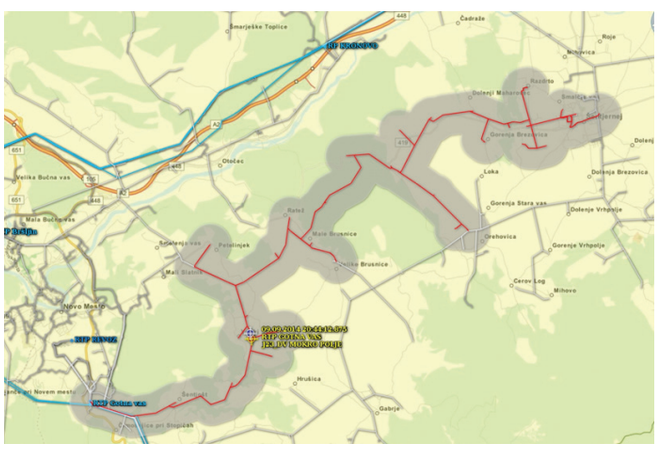
SCALAR is a part of EUCLID network consisting of European lightning detection system operators. More than 150 sensors are part of the EUCLID network, covering vast area all the way from Sicily to Nordkapp.



EUCLID and SCALAR network



Access to real-time and archive of lightning data



Real-time correlator of power line outages due to lightning

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ELECTRIC POWER SYSTEM CONTROL AND OPERATION DEPARTMENT

The core mission of the SCALAR system is the localisation of atmospheric discharges and providing related services. The following services are available:

Real-time observation of thunderstorm progress and access to archive data

Real-time correlation of object outages (overhead powerlines, electrified railway tracks, telephone exchanges, GSM base stations, etc.) and flash strokes

On-line access to long-term high-resolution flash density map

Flash density map and storm days map calculations for any specific area (rectangle, circle, areas defined as an area along a powerline, highway, railway, etc.)

An atmospheric discharges finder, where the location in question is determined via a house address

Real-time alarming that helps to increase public safety and mitigate damage incurred by flashes

Statistical analysis of flash stroke amplitudes, released charge, number of return strokes, etc.

Providing composite images of radar rainfall data (10 minute interval) and flash stroke locations

SCALAR has been developed, maintained and operated by the ELECTRIC POWER SYSTEM CONTROL AND OPERATION DEPARTMENT at the EIMV.
Additional information: **www.scalar.si.**

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ENVIRONMENTAL DEPARTMENT

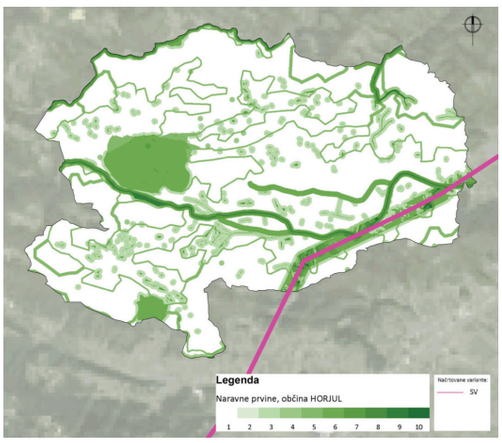
Specialised groups of experts perform analyses of environmental values for which they have developed in compliance with the applicable legislation and recommendations, accredited testing and control procedures based on EN ISO/IEC 17025 and EN ISO/IEC 17020. By adhering to established QA and QC procedures and by using services of their Environmental Information System, they guarantee adequacy of the measurement and calculations performed according to specifications of the adopted environmental rules and regulations.

Experts deal with:

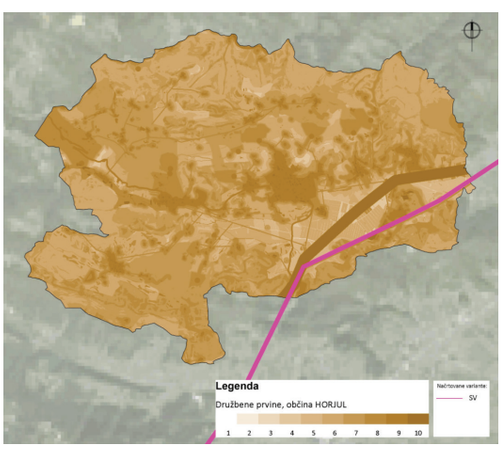
- the best available technologies,
- environmental sustainability assessment,
- environmental impact assessment and environmental studies,
- environmental performance analyses for asset management,
- technical consulting,
- equipment construction surveillance and
- development of new environmental protection strategies and assessment methodologies.

Environmental Impact Assesment

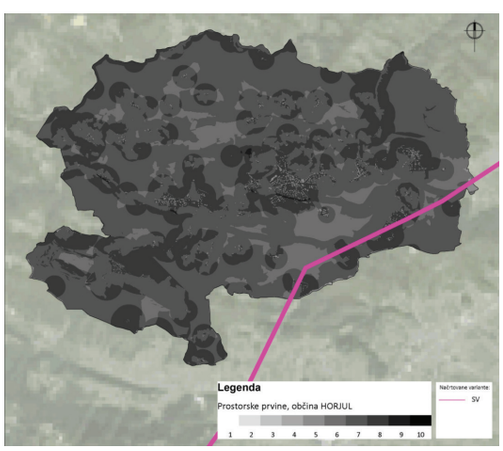
The existing knowledge on power lines' environmental impact was joined with data on important environmental values which are to be considered to the maximum extent. All basic environmental protection principles, arising from protection, sustainability and preservation are incorporated into the methodology. The proposed approach enables and ensures also the incorporation of the civil initiatives' point of view regarding sustainable spatial management.



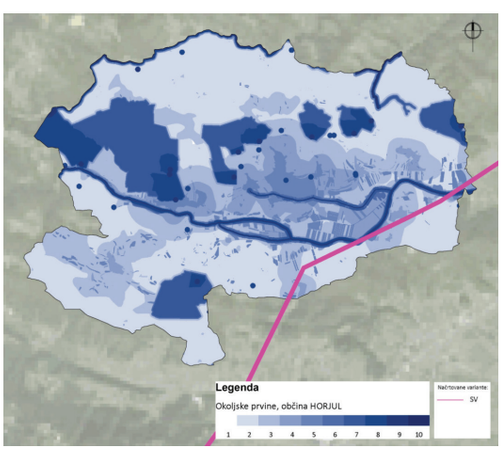
a) spatial management attributes



b) environmental protection attributes



c) nature protection attributes



d) social attributes

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ENVIRONMENTAL DEPARTMENT

Recommended EIA of power lines enables:

- recognizing and considering environmental risks (legislative and legitimate risks),
- assessing the risks and identifying the most significant potential environmental impacts,
- incorporating environmental risks in sensitivity models,
- identifying the most and the least sensitive areas for the realization of the spatial arrangement/projects and identifying conflict points,
- establishing dialogue among all stakeholders in a formal procedure and non-formal conversation,
- suggesting the alternatives with the least environmental risks or suggesting solutions that minimise conflict.

Open dialogue

Sincere thinking and ethnicity are virtues through which the importance of dialogue in conflict situations, which in spatial planning cannot always be avoided, can be more easily understood. It is important to respect and understand the opinion of all stakeholders in the process, which is a challenge tackled with significant emphathy for different standing points. Appropriate solutions can only be reached through dialogue that requires detailed field work.

Detected residential buildings within the 40 metres corridor of 400 kV transmission line at line tower no. 49

Legend:

--- observed area
— power line
● line towers
— field survey

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