

WIDE AREA MONITORING SYSTEM (WAMS) METEL

AIS spol. s r.o. company profile:

The AIS company was founded in 1990. Company employees are experienced workers in the field of development and implementation of control systems for power engineering. The main customers are companies in the field of power engineering, power transmission and distribution and local distribution operators.

Our company is focused to the support of power enterprises in the following fields:

- Systems for measurement, monitoring and control, especially Wide Area Monitoring systems,
- Communication in power enterprises, connection of systems using different communication protocols.

The company is also largely devoted to the research and development of new technologies for the management of power networks and methods for their operation and use. Our cooperators are university research centers and research institutes. AIS participates in national research and development projects in the roles of the main investigator or co-investigator.

At present, AIS is a solver in the proposal of several Science and Research projects within the European programs FP7 and HORIZON 2020.

The system WAM METEL is result of the national Science and Research project led by AIS. The qualities of the system were appreciated at the final opponency, where it won awards as the outstanding product of international importance.

The WAM system has been regularly reported by AIS experts at the national or international scientific conferences. AIS was the first that informed about principles and usage of WAMS for the control and operation of power networks in the world conference CIRED in Turino, 2005.

Since then, the company actively participates in regular conferences CIRED by the presentation and exhibition of its own products. At the main section of conference CIRED 2013 in Stockholm we presented a lecture *ADVANCED APPLICATIONS OF WAMS* concerning the features of our product METEL.

The AIS company has many years of experience in the field of WAM systems. Probably the first system in Europe implemented in 2000 was intended for monitoring of switching conditions and support of safe switching in the power network.

Five regional distribution companies in the CR are equipped with our systems and our PMUs are implemented in more than 140 switching and transforming substations, which represents more than 700 measuring inputs.

Spheres of business of the AIS company are first of all the following areas:

Systems of synchronous measurement WAM (Wide Area Monitoring)

- Development, programming and implementation of PMUs.
- Implementation of communication devices for data transfer.
- Development, programming and implementation of PDC central stations (Phasor Data Concentrator).
- Implementation of applications utilizing synchronous data.

Devices for industrial communication

- Development and programming of communication devices.
- Solution of communication concentrations and conversions of communication protocols.
- Measurement and automatization
 - Development and implementation of data collection systems in power engineering.
 - Project, parameterization and implementation of information and control systems for water supply, heat distribution, waste water cleaning stations and small water plants.
- Development and application of software
 - Development of software for client/server application.
 - Development of communication software.
 - Development of database applications including applications for intranet.
 - Development of user software for real time technology systems.
- Technical development
 - Design and realization of special digital or analog electronics according to the customer requirements.

Wide Area Measurement Systems (WAMS) :

The Wide Area Monitoring Systems (WAMS) represent a modern technology implemented about 15 years ago in the USA. The technology represents an advanced tool for the control, improved security and reliability of transmission and distribution networks. The quality of data obtained by these systems allows usage in the real operation and creation of expert systems for improvement of security of power networks and prevention of critical states like blackout. The significant benefit is also possibility to analyze quality of network components, evaluation of real transfer capacity of lines and analysis of real losses in the network.

WAM systems are intended for monitoring of wide networks by extensive distributed measurement of synchronous phasors in crucial network points. At the same time, WAM systems can cooperate with existing SCADA systems and represent their significant addition.

WAMS consist of network of GPS synchronized Phasor Measurement Units (PMUs), system of data transfer and collection using various types of communication similar to that of SCADA systems, data storage and processing and collection of applications performing on-line and off-line data presentation or consequent processing.

WAMS allows significantly improve precision of estimation calculations of the system state and consequent expert analysis (e.g. contingency analyses, load flow evaluation) in the cooperation with SCADA and EMS.

WAM system METEL scheme:



All WAMS levels architecture implementation:



System benefits:

- Functions and features:
 - Improved security of network manipulations
 - Decreased occurrence and duration of blackouts
 - Increased reliability of network operation
 - Well-time detection of approaching of critical state
 - Monitoring of actual line transfer capacity (ampacity)
 - Usage of real line ampacity with the potential to increase power transfer up to 40%
- SW and HW scalability
- System based on international standards
- Implementation of all WAMS levels
- Multiuser and multipurpose client application

Data collection	Compliance with standard IEEE C37.118	Method of measurement conforms the standard	~
		TVE <= 0.5	~
		Data transmission speed up to 50 telegrams per	~
		second using standard protocol	
	Possibility of data correction	Data correction for nonstandard frequencies	~
		Correction of input characteristics by nonlinear	 Image: A second s
		function Correction of MTU and MTU characteristics by	
		nonlinear function	✓
Automatic real time system	Multichannel communication by standard protocols	Communication with PMU (usually C37.118)	~
		Communication with control system (usually	
		IEC104)	~
		Communication with other TSOs and DSs (usually	~
		C37.118)	
	Real time data processing	Automatic data evaluation	 ✓
		Detection of nonstandard states	 ✓
		Parameterizable event-based actions, event log	 ✓
	Application modules	Monitoring of system state	✓
		Monitoring of angle difference	 ✓
		Analysis of frequency oscillations	 ✓
		Monitoring of static stability	✓
		Monitoring voltage stability	✓
		Detection of island operation	×
		Monitoring of line parameters	~
		Evaluation of line ampacity	✓
Archiving	Server	Standard database server with documented	 Image: A second s
			ļ
	Database Optimization	Optimization of database for processing of large	
		depth)	
		Optimization of response (units of seconds for	~
		newest data, units of minutes for archive data)	
Client program equipment with GUI	On-line monitoring (topical data) Off-line analysis (archive data)	Monitoring of system state	~
		Monitoring of angle difference	~
		Analysis of frequency oscillations	~
		Monitoring of static stability	~
		Monitoring voltage stability	~
		Detection of island operation	 Image: A set of the set of the
		Monitoring of line parameters	 Image: A second s
		Evaluation of line ampacity	 Image: A start of the start of
	Ways of data presentation	Tables	~
		Line graphs	 Image: A set of the set of the
		Polar vector graphs	 Image: A set of the set of the
		Survey maps	 Image: A second s
		Flags for detection of nonstandard states	 Image: A set of the set of the
		Event log	 Image: A second s
	Outputs	Print	 Image: A set of the set of the
		Export to MS Excel (xls and csv)	 Image: A set of the set of the
		Export to bitmap format	 Image: A set of the set of the
		Transfer of data to other applications using	 Image: A second s
		clipboard	

Client SW GUI samples:



Available functions and applications:

- Support safety switching in high voltage networks.
- Monitoring of complex voltages and currents (amplitudes and angles) in and between network nodes.
- Monitoring of frequency, detection and analysis of oscillations including modal frequency analysis.
- Detection of low reserve of static stability.
- Monitoring of voltage stability.
- More precision estimation of the system state in the cooperation with SCADA and EMS.
- Terminal Phasor Measurement Unit (PMU) specification:
- Stand-alone unit with in-place compute functions, storage option and remote parameterization.
- Fast parallel measurements typically 10 kHz.
- Various measurement inputs for range of instrument transformers.
- 8 inputs per terminal.
- GPS time synchronization phase precision
 < 0.1°, voltage and currents precisions < 1%.
- Wide range of communication options on physical layer (Ethernet, RS-232, GSM/GPRS) and standard protocols (e.g. IEC-68570-5-101/103/104, IEEE-C37.118) implemented.
- Conforms to EMC standards for industrial environment.



Detection of island operation

(identification of separated parts of

network and behavior in island,

On-line identification of actual line

 Monitoring and dynamic rating of actual line transfer capacity –

Other functions are being prepared

monitoring of conditions for

reconnection of islands).

parameters.

ampacity.

and tested.





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