Intelligent Alarm Processor

Principal Investigator: Prof. Mladen Kezunovic, Texas A&M University

Background: This proposal is written as an expansion of Task 2A in the description of the project titled *Use of synchronized sampling in substations and system-wide applications*

Problem to be solved : ERCOT control center is equipped with an alarm processor that helps operators deal with various operating contingencies. Handling of the alarms may need improvements when operators get overwhelmed with amount of information presented for some complex contingencies. As a result, operators may not rely on the alarm processor but on direct contacts with TO's operators for figuring out details of the contingency situations. Since this may be a time consuming effort, the operators may not be able to respond to the unfolding events in a timely manner. In addition, due to the lack of additional information, the alarm interpretations by the operators may be either wrong or inconclusive. The tendency in further development of alarm processors is to use more precise data from the filed to improve the ability to perform cause effect analysis automatically. Modern intelligent electronic devices (IEDs) such as digital protective relays, digital fault recorder and circuit breaker monitors have detailed data describing local events. If this data is automatically processed at substations and only the relevant information about contingencies is passed on to the alarm processor, the cause-effect analyses can be vastly enhanced and the speed of making conclusions what to do significantly improved.

Approach for solving the problem: Each time a circuit breaker gets operated manually or through an action of a relay, many substation IEDs make recordings of field data such as voltages, currents and circuit breaker status that got changed as the result of equipment operations. If the local IED data is aligned in time using GPS synchronization and combined into a substation data base, further analysis of the sequence of events, fault locations, and equipment performance may be easily assessed. This process may be automated using advanced expert system solutions. Once the cause-effect analysis is performed at substations, the conclusions may be transferred to the control center to inform operators of the exact reasons for various alarms. This way the alarms can be explained and traced to the causes, reducing the number of alarms and improving the understanding of what is the meaning of the alarms.

This project will relay on the software that performs automatic collection of local data from IEDs, its storage in the database and further analysis through the use of expert systems. The local substation data is correlated based on GPS time stamping so that each event seen by different IEDs can be fully understood and characterized by determining the correctness of the sequence of operations. Since this data represents improvement over the RTU data collected by the SCADA system, further enhancements in the alarm processor are feasible if this new data is incorporated in the EMS database. This project will determine how the local substation information obtained through automatic processing of IED data may be used to improve the alarm processor.

Software packages for automated analysis of data from digital protective relays, digital fault recorders and circuit breaker monitors are developed in different task of this overall project. Presently the information extracted by those software packages is used by protection engineers. The goal of the task proposed for ERCOT development is to make use of such information in the operating environment. This approach will require extraction of information of interest to ERCOT operators and use of appropriate user interfaces. In order to achieve this, several additional developments will have to result in:

- Algorithms for cause-effect analysis of various operating contingencies
- Communication procedures for transferring local substation data to the control center
- Data base design for storing additional data at the control center
- Graphical interface adjustments to be able to represent new information to the operators

Deliverables: As a result of this effort, several deliverables will be available:

- Description of how recordings from substation IEDs may be used to improve alarm processor
- Deployment strategies including description of interfaces between SCADA and IED data
- Software for alarm processing including interfaces to substation processing software
- Evaluation procedure for comparing performance of the new approach vs. existing solution

The deliverables will be specified in such a way that a clear understanding of what is needed to implement the outcomes of the project will be included. Any data interfaces and improvements in the operators' interfaces will be outlined. After the first year developments are completed, the software will be ready for deployment and evaluation in the following year.

Expected benefits to ERCOT: ERCOT may have multiple benefits from the new alarm processor:

- Operators' ability to analyze contingencies faster and with more confidence
- More redundant data to back up existing data and conclusions
- New ways of dealing with overwhelming amount of alarms by classifying them according to the causes
- Improved archiving of field data for future analysis of disturbances and related operator actions

Budget: This project will cover two graduate students and one month of PI's summer salary. The requested amount is $93,000.00.