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IEC 61850 Practical Application at Energy Facilities

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1 BACKGROUND

The given report covers practical implementation issues of data collection systems from IEC 61580-compliant relay protection and automatic equipment.

Industrial control system developers are now confronted with questions of how to obtain data from relay protection and automatic equipment via MMS and GOOSE protocols for sure.

Not only the complexity of the IEC 61580 standard but also different approaches to the implementation of standard protocols adopted by various producers are at the root of these questions. As a result, pieces of modern equipment produced by different manufacturers are not always interchangeable, software settings that is responsible for data collection is time-consuming and efficiency of such software is rarely enough to solve assigned tasks.

In this report, we describe the IEC 61850 standard, its advantages and disadvantages, and the scope of its application. The second part deals with the standard support provided by relay protection and automatic equipment manufacturers. A brief survey of data collection and transmission solutions will also be given. The third part concerns software produced by ReLab Software.

2 IEC 61580 STANDARD HISTORY

Since the advent of the first digital devices, new requirements to data transmission systems have been established. These requirements concerned reliability, productivity and compatibility of hardware-software solutions.

From the 1960's onwards, a lot of attempts to establish a system which would meet the requirements were made. However, technical complexities impeded the achievement of objectives.

Equipment manufacturers tried to achieve 100% reliability, compatibility and guaranteed delivery time not only by upgrading computer and communication systems but also by developing new data transmission protocols.

Each manufacturer built a system on the basis of those data transmission protocols that they considered the most suitable for solving one task or another. Different protocols such as 60870-101/103/104, MODBUS, DNP were used. Some of them have become more popular

than others but such a diversity of solutions led to incompatibility and interchangeability of equipment and made the system integration process more difficult.

The history of IEC 61580 creation began as far back as the 1980's in Detroit, USA. Assembly robots operated via MMS (Manufacturing Message Specification) protocol were installed at car assembly plants. The use of this protocol turned out to be successful enough and, in the 1990's, it provided the basis for UCA2 (Utility Communication Architecture), that was actively used in the European electric-power industry

Lastly, in 2003, the first version of the IEC standard appeared.

3 IEC 61580 STANDARD REVIEW

IEC 61850 was intended to be a universal standard which would allow to put in order separate solutions proposed by different manufacturers of relay protection and automatic equipment and data transmission systems used in power substations.

The standard turned out to be complicated enough due to its universality. It not only describes the way of data transmission but also fixes requirements to the description of electrical systems at all levels from the system level in whole to separate terminal configuration of relay protection and automatic equipment.

According to these requirements, the system is described in a clear and standardized form. All the configuration information is stored in files in different formats. It makes systems development on IEC 61580 basis simple and coherent.

Moreover, the requirements for electromagnetic compatibility, equipment interchangeability, etc are detailed in the standard.

A substantial part of the standard is devoted to data transmission protocols: MMS and GOOSE.

4 DATA TRANSMISSION WITHIN SYSTEMS BASED ON IEC 61580

Under IEC 61580 pieces of relay protection and automatic equipment are connected by the fieldbus through which pieces themselves exchange data with each other and transmit data to the upper level. Such architecture is convenient due to the fact that the use of a fieldbus considerably reduces the number of copper wires, thereby simplifying setup, engineering and maintenance of a system.

Data obtained from relay protection terminals can be transmitted through station fieldbus to the upper operator's level. Besides, regulatory bodies having appropriate level access are able to obtain live data from any substation and terminal of relay protection and automatic equipment. That information makes it possible to supervise the activity of subordinate services thereby improving reliability of energy facilities in whole.

It is the part of the standard devoted to data transmission that gave the ability of flexible configuration of dataflow.

According to the IEC 61580 standard, the main protocols of data transmission are MMS and GOOSE. MMS protocol is used for transmitting data from relay protection terminals into SCADA system for the further visualization while GOOSE is used for exchanging data between terminals. Guaranteed message delivery is a significant feature of the protocols. Moreover, MMS and GOOSE protocols have higher data transfer rate than other data transmission protocols. Besides, the standard makes it possible to use other protocols, but it is MMS and GOOSE realization that system operability depends on. The fact that systems satisfying the IEC 61580 standard provide higher data transfer rate and transmission security is the major advantage of systems based on this standard.

Standardization of data transmission protocols and strict requirements for equipment compatibility allow to achieve interchangeability between separate system components.

Systems built on the IEC 61580 standard are easy to maintain due to a reduction in the number of cable communication lines. It has a positive effect on system reliability in whole.

As a result of the intuitive nature of the system architecture, it takes developers and integrators less time to understand particular object architecture and, in consequence, the cost of engineering and integration is reduced.

It is easier to maintain such systems than standard ones, albeit staff experience requirements imposed by them are somewhat different.

The novelty and complexity of the standard can be considered as its disadvantages. The fact that developers and integrators have little experience in system engineering is another drawback.

There is one more disadvantage of the systems built on the IEC 61580 standard that consists in high cost of microprocessor-based relay protection and automatic equipment. However, the first thing to keep in mind is that the use of IEC 61580 provides a number of advantages. That is why the quantity of substations built on the IEC 61580 standard is growing all over the world.

5 DATA COLLECTION PERFORMED FROM RELAY PROTECTION AND AUTOMATIC EQUIPMENT

Today, all the main relay protection and automatic equipment manufacturers support IEC 61580.

Usually they are ABB, SIEMENS, AREVA, GE, SEL. Russian companies keep pace with European manufacturers and implement IEC 61580 support in their relay protection and automatic equipment. Each equipment manufacturer proposes its own solutions to data collection and processing; at the same time many system integrators prefer to use independent SCADA systems. It can be explained by the fact that independent SCADA systems are more multipurpose and system integrators can solve almost all problems using this kind of software.

On the other hand, most of universal SCADA systems manufacturers do not support IEC 61580 because of the standard protocols peculiarity and complexity. There are also independent solutions on the market which enable to integrate IEC 61580 support into almost any SCADA system.

Each of these variants, the use of manufacturers' or independent solutions, has its own advantages and disadvantages.

Although different manufacturers announce full IEC 61580 support their hardware and software are often incompatible with each other. Thus if AREVA terminal is added to a system built entirely by SEIMENS including upper level software there is every likelihood that technicians will face certain difficulties in integration of this terminal into SCADA system despite announced IEC 61580 support.

It is hundred-percent IEC 61580 support with due regard for a particular implementation of standard protocols by each equipment manufacturer that makes it possible for independent software solutions providers to support equipment produced by different manufacturers.

The fact that a system integrator has no need to search for an independent software solution is little advantage of the use of software produced by an equipment manufacturer. Such an extra organizational burden as well as a risk of running into a dishonest supplier forces companies to overpay for software applying to the very relay protection and automatic equipment manufacturers.

On the other hand, if you have already chosen an independent software solution provider and you have entered into cooperation with them these risks and inconveniences can be minimized.

Moreover, solutions from relay protection and automatic equipment cost more. The cost of software is built into the system price as if it melted into it. If the budget for system construction totals hundreds of thousands dollars rejection of such software will effect a saving of a good deal of money.

Owing to other advantages of the use of independent solutions, one can not only decrease the cost but also shorten the period for objects implementation.

Thus configuration flexibility, the price and the ease of the use are the main advantages of independent software solutions provider.

6 IEC 61850 OPC SERVER FROM RELAB SOFTWARE

ReLab Software LLC, the IEC-61580 OPC Server developer is one of the independent software solutions providers.

An OPC Server is a small software application invoked on a workstation that receives data from relay protection and automatic equipment and transmits data into a SCADA system. An OPC server is something like a translator making it possible for a SCADA system and a relay protection and automatic equipment to understand each other. An OPC Server satisfies completely the IEC 61580 standard and it is compatible with relay protection and automatic equipment produced by the main manufacturers.

To make sure that an equipment manufacturer has correctly provided IEC 61580 support for its equipment each device undergoes long-term testing to confirm compatibility with ReLab software under all possible conditions. As evidenced by working experience at hundreds of active facilities, such an approach excludes any contingency in the operation of tested equipment.

Data received from relay protection and automatic equipment produced by Russian manufacturers providing IEC 61580 support in its equipment also can be processed by ReLab software. On the other hand, a software product supports an OPC technology 100 percent. It means that ReLab software is compatible with all the key SCADA systems. For instance, a company modernizing a substation can independently chose equipment suppliers as well as a communication software provider and SCADA system. This approach will effect a saving of tens of thousands of dollars.

The high speed at which a system is configured is an advantage of ReLab software. While it can take other systems several days to configure one device all the necessary operations can be performed in several minutes by using ReLab OPC Server, thereby saving on both cost and time of a system setup.

The main feature of the software product is its efficiency. The OPC server loads a workstation to a very little degree. When processing the data received from 75 pieces of relay protection and automatic equipment by means of 1 GHz processor the load makes up 12 %. One workstation can receive information from more than 200 pieces of relay protection equipment.

Moreover, the ReLab OPC Server supplies all the data coming from the equipment with time markers. It occurs even in case the equipment does not provide such markers when transmitting data. Time markers are very important for data storage and further analysis of previous events.

The special thing about the ReLab OPC Server is that it makes it possible to configure offline, that is to say, without connecting to a real device. As a result, it takes less time to set up equipment. It is sufficient to download device configuration and make settings not on an object but in your office for that.

The price is a considerable advantage of the ReLab OPC Server. Moreover, in most cases one software license is enough to build data collection systems.

It should be mentioned that despite software complexity, any rejection connected with its malfunction has not yet been reported. The first OPC Server software licenses were sold some years ago and there have been no complaints about the product.

7 RELAB SOFTWARE IN RUSSIA

ReLab Software is an American company located in San Francisco, California. The company has been engaged in software development for the electric power industry for more than 7 years and nowadays, it numbers more than 500 customers throughout the world. Thus, ReLab Software LLC is one of the leading communication solutions providers.

ReLab's interests in Russia are represented by DC BARS company which not only sells software but also provides first line technical support. DC BARS has been in existence over 17 years. Its engineers develop and test software for avionics and nuclear power stations, as well as navigation software and so on. The company has four engineering centers situated in Moscow, Kaluga, Taganrog and Kursk.

Such companies as Honeywell, Liebherr, Rockwell Collins, Sukhoi Company are among the customers of DC BARS.

8 CONCLUSION

In conclusion, it should be noted that experience has shown that it is secure to implement IEC-61580 at energy facilities. Due to the fact that the standard is new enough and little understood by certain equipment manufacturers, sometimes there were particular problems. However, it is obvious that the more time passes the more reliable systems become and the more competent at micro technology maintenance staff are.

There is a high degree of certainty that the number of microprocessor-based relay protection and automatic equipment will grow in the future. The use of IEC 61580 will be not only a necessary but also convenient solution for organizations planning to modernize objects and build new ones.

The use of inexpensive and reliable solutions is a move to make the IEC 61580 standard a reliable and handy tool.