THE ANTARA RS SYSTEM
AN ECONOMICAL REMOTE MONITORING SYSTEM USING THE TELEPHONE NETWORK

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SUMMARY

This paper describes a relatively simple and economical solution to monitor Ring Main Units in the distribution networks. Holec Medium Voltage is developing this system called ANTARA RS to reduce the outage time caused by failures in the network, by reducing the fault localisation time. The system will almost immediately indicate the location of the failure that has taken place in the network. For this purpose short-circuit indicators are placed on the medium voltage switchgear, being connected to the system by optical fibre cables. It is also possible to monitor all kinds of other alarms, for example: earth-faults, transformer temperature, Buchholz, protection relays, low voltage equipment, etc.
The telephone network is used for communication between the equipment in the switchgear rooms and the central computer, whether by PSTN lines or by GSM.
Also remote control is possible by activating two relays in each local unit.
Several Electricity Boards in the Netherlands and Belgium are testing the current model of Antara in their Medium Voltage networks.

1. INTRODUCTION

Social developments tend more and more to lean towards increasing dependence on a high quality electricity supply. Therefore the demands for an uninterrupted power supply will increase in the near future. Utilities in the Netherlands have already been confronted with claims due to failures in the network.

The distribution network in the Netherlands is principally ringshaped, and operated radially (in open rings). This creates an n-1 redundancy in the structure, but not in the operation mode (see figure 1). Cable faults in such a system lead to a failure of the power supply (figure 2), which can only be restored after a number of switching operations (figure 3).

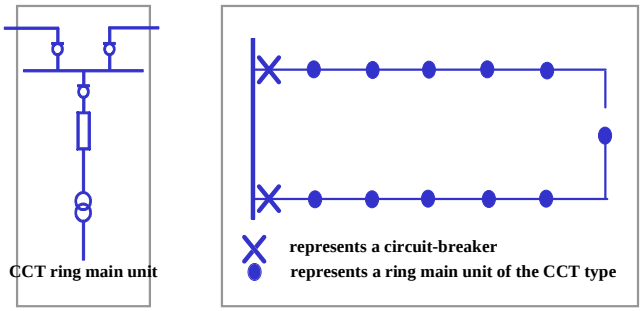


Figure 1: RMU and open ring

The average outage time as result of a Medium Voltage fault in the Netherlands is approximately 94 minutes. A large part of this outage time is spent on localising the fault. Nowadays this is done by a visual check of the short-circuit indicators on all the Ring Main Units in the interrupted (open) ring, starting at the substation with the circuit-breaker and downstream up to the RMU that has not registered the short-circuit current. It is estimated that approximately 40 minutes of the outage time is spent on fault localisation itself.

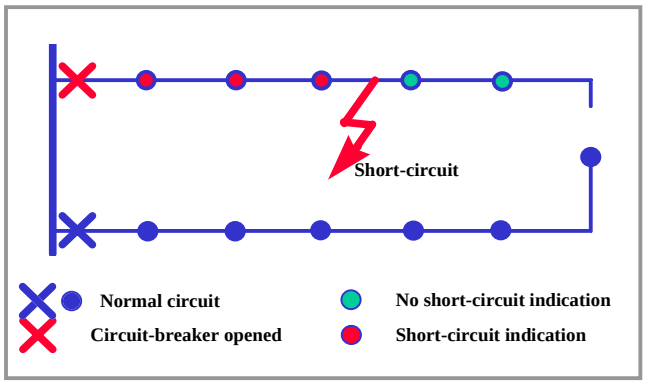


Figure 2: Fault in the ring

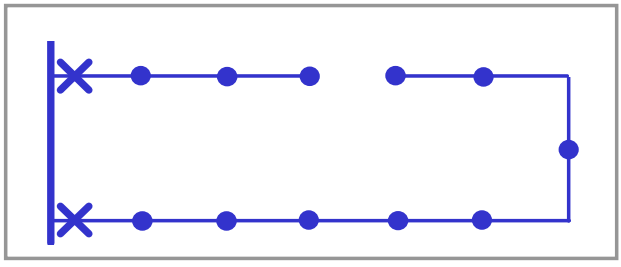


Figure 3: Power restored after fault.

Holec Medium Voltage has accepted the challenge to develop a cost-effective system that helps to reduce the outage time by reducing the fault localisation time. This has resulted in a system called ANTARA RS that almost real time indicates were the fault has occurred so that the switching procedure can be started immediately.

Figure 4: Picture of an Antara modem.

2. APPLICATION

The ANTARA RS system is developed for application in electrical switchgear rooms (transformer stations) to remotely monitor short-circuit indicators.
With this system it is also possible to monitor all kinds of other alarms. For example: earth-faults, transformer temperature, Buchholz, protection relays, smoke detectors, low voltage equipment, etc.
The principle of this system lies in the detection and communication of alarms to a central computer by means of the telephone network.

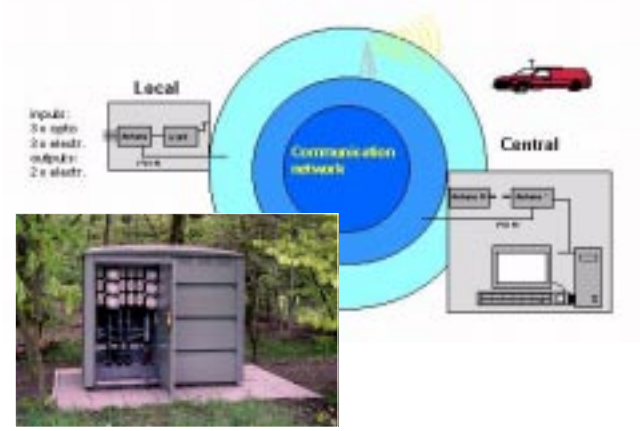


Figure 5: The Antara system

3. THE ANTARA RS SYSTEM

The Antara system consists of the following parts:

- Local modems (maximum 10.000).
- Sensors.
- Central modems.
- A central computer.
- Antara software running under Windows 95 using MS office ’97.

3.1. The local modem

Figure 6 shows the functional diagram of the local modem.

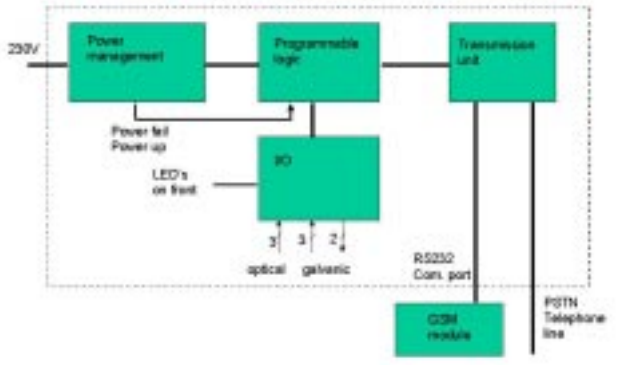


Figure 6: Functional diagram

3.1.1. Inputs and Outputs

Each unit has 3 optical inputs for the fibre optic cables coming from the short-circuit- and earth-fault indicators. There are also 3 inputs available for electrical alarm signals.
Each unit has two programmable outputs through the voltage free contacts of two built in relays. These outputs can be programmed to be activated as a direct response to an incoming alarm. The operator at the central computer has also the possibility to activate these outputs remotely at his command.

3.1.2. Programmable logic

The firmware of each individual local unit is programmable to a certain extent by means of the Antara database. The programming of each local unit can be done either locally by connecting a computer to the local unit through the RS232 interface, or remotely using the central computer updating each individual unit though the telephone line.
Output 1 can be programmed to react on an incoming alarm from one of the optic sensors.
Output 2 can be programmed to react on an alarm from one op the galvanic inputs.
Also the duration that these outputs are to be activated is programmable.

The messages to be displayed at the central computer on certain alarms are programmable for each individual local unit.

3.1.3. Transmission

The built-in modem in a local unit is designed to comply with the newest EU-standard TBR-21, so that this equipment is officially approved for application on analogue (PSTN) telephone lines in every country of the European Community.
If no PSTN telephone line is available, then Antara offers the possibility of using a GSM telephone, which can be connected to each local unit, by means of the RS 232 communication port.
The transmission of each local unit can be switched off, if desired.

3.1.4. Power management

The local units need a 230V/50Hz power supply. If the power fails the system automatically changes over to an internal battery backup of 3V DC to continue its monitoring and communication function. At the same time the power failure triggers an alarm that is communicated to the central computer. The battery backup has enough energy to supply the unit with power for several hours so that the monitoring and communication functions are guaranteed. Also the return of the mains will be detected and the system will automatically switch over from battery operation leaving a message for the operator at the central computer.

3.2. The sensors

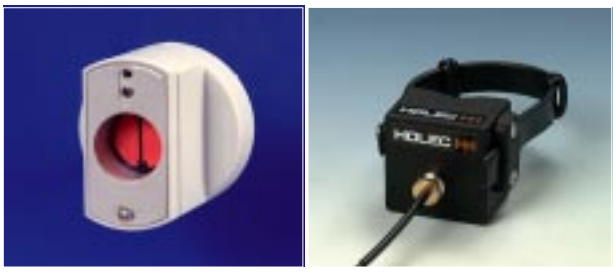
The system allows sensors that generate an optical input to the local unit as well as sensors that generate an electrical input.

3.2.1. Optical sensors

Short-circuits are indicated by devices that are specially designed to be mounted directly on the medium voltage switchgear. In case of a short-circuit these devices will give a flashlight by means of a built in LED. These short-circuit indicators are connected to the Antara system by fibre-optic cables. The application of fibre-optic cables is a safe way to connect the local modem to the medium voltage switchgear. These sensors are of the micro-electronic type that needs no battery.

The ANTARA system has already been fitted with two types of these sensors:
Type 1: Specially designed for switchgear type Magnefix. This device gives an optical indication by means of a red flag (mechanical) as well as a flashlight. It is self-resetting and powered from the voltage on the medium voltage switchgear.
Type 2: The universal type will generate only a flashlight. It is powered from the current through the medium voltage switchgear. This device can be used directly on non-insulated or insulated conductors.
There are two applications for this device:

- short-circuit indication
- earth-fault indication



Type 1 **Type 2**

Figure 7: Optical sensors

3.2.2. Electrical sensors

The local unit has 3 galvanic inputs available with which alarms are detected by means of voltages between 3 V and 24 V (AC/DC). This allows all kinds of other sensors, which can generate these electrical inputs, to be connected to the Antara system, for example: temperature sensors, gas detectors, door contacts, protection relays, auxiliary contacts on the MV switchgear indicating the status “open” or “closed”.

3.3. The central unit

The function of the central unit is simply to establish communication between the local units and the central computer.
In order to decrease the time to gather all information from the local modems, it is possible to attach several central units parallel to one central computer.
The central unit has also a programmable output, which will be activated on an incoming alarm and will be deactivated when all the incoming alarm(s) are acknowledged. This output offers the possibility to make a very simple connection to other systems in case of an alarm.

3.4. The Antara PC software

Antara is designed as a stand-alone system, although it is possible to make interfaces with other dispatch systems, including SCADA applications.
The Antara PC software runs under Windows 95 and uses the Access database of office 97.

If an alarm is generated at a local station it will be displayed on the screen of the central computer (figure 8). The systems draws the attention of the operator by making a bleeping sound and blinking of the alarm sign.
The display shows all the local stations that have reported an alarm. When a specific station has been selected, all relevant information like identification of the station and the nature of the alarm will be shown on the screen.
All the alarm messages are automatically registered in a separate database for statistical purposes.

Figure 8: Alarm screen

Bi-directional communication:
Communication between the central computer and the local units is bi-directional. The operator has the opportunity to make contact with each individual local unit to:

- Read the status on line.
- Activate the 2 output relays.
- Update the local unit with modified instructions.

Figure 9 shows the status display.

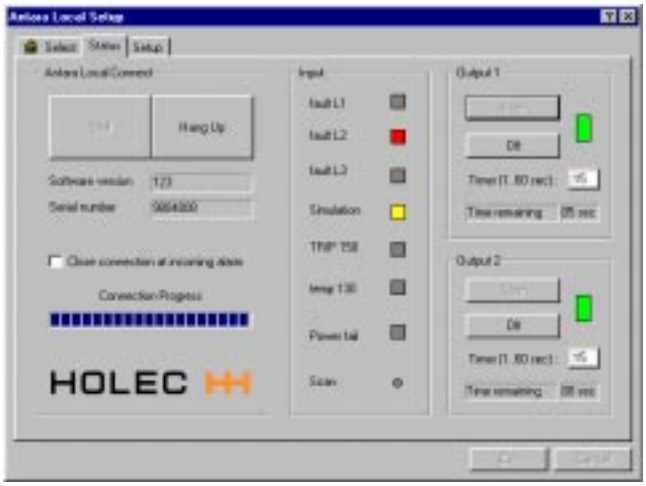


Figure 9: Status display.

4. PILOT PROJECTS

The current system is being used in several pilot projects with Electricity Boards in the Netherlands and Belgium. So far the feed back from these pilot projects is positive and has resulted in several improvements, already implemented in the system. The final evaluation will follow in due course.

5. IMPROVEMENTS

Due to the experiences gained in the pilot project several improvements have been implemented in the Antara system:

1. Direct indication of the fault location is one of the most important improvements implemented in the Antara system

2. It is now possible to use GSM as a transmission medium. The absence of PSTN connections in switchgear rooms is no longer a technical reason for not using Antara. It is easy to attach a GSM mobile unit to the local units to take care of the transmission. The use of GSM is gaining terrain in the communication market. It is expected that on the long term it will be even cheaper to use GSM for alarm reporting than using the conventional PSTN-lines for this purpose.

3. The universal type short-circuit indicator enlarges the applicability of the Antara system. The use of this system is no longer limited to Magnefix switchgear only. With this universal sensor it is now possible to apply Antara to all types of switchgear. This sensor makes is possible for all types of switchgear to indicate earth-faults.

4. Connection to other systems. The Antara system is able to give an alarm on the screens of the dispatch system to warn the operators that a fault is being reported by the Antara system. Still under development is a demonstration version that shows the possibility to integrate Antara in a dispatch system through a SCADA application.

5. The local units can be connected to other present systems in a switchgear room by means of the programmable outputs. If used for this purpose only the modem function can be shut down.

6. REFERENCES

‘Increasing the availability of the medium voltage network in the Netherlands’ by G. C. Schoonenberg, W.M.M. Menheere, F. Jansen. (Presented at CIRED 1997).