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FOREIGN TECHNOLOGY DIVISION

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By

Jacek Zwolinski and Stanislaw Mikolajczyk

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Man - digital Machine Conversational System Operating in Real Time

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Jacek Zwolinski and Stanislaw Mikolajczyk

Data Processing Center of EiEA

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In 1971, after the CDC 1700 machine was installed, the work started at the State Power Distribution with cooperation with the Electric Power Institute on the creation of on-line system, which would become the base for the automatic power control.

At the present time this system collects, processes, verifies and displays on-line the information on the power network status. The goal is the on-line power network control.

General System description

The on-line system consists of several programs with different applications. The basic group consists of I/O service programs for the analog and digital telemetry data. The incoming data are averaged in 20 seconds cycle and undergo the initial verification. Following that, they undergo the more detailed analysis, are scaled, and written out in the appropriate memory area. Such prepared data can now be used by all other programs providing the information to the power network dispatchers.

A separate group of programs in the on-line system, consists of programs allowing the dispatcher a direct dialog with the machine. Their role is to provide the information about the current status of the power

network. In the remainder of this paper these programs will be referred to as the dispatcher-machine conversational system, or short - the conversational system.

The conversational system satisfies the following requirements:

- currently informs the dispatcher about the status of the power network (line loading, voltage, frequency, condition of connections, etc.),

- supplies the information on request.

The first task is performed by an automatic display of messages about all the registered changes in the power network status (especially about exceeding the limit of the measured values or the status changes of the switching apparatus). Also the messages confirming the completion of the instructions issued by the dispatcher to the power plant.

The second task of the conversational system is performed by providing on request the information about the work of each power plant, status of the switching system in the selected sites, loading of lines, transformers, etc. This information can be presented, depending on the dispatcher requirements, in the form of tables, graphs, station diagrams or reports. The dispatcher, using the conversational system, can control entire on-line system, eg, enter the time corrections, control the information input to the computer from various measurement points in the power network.

The conversational system consists of several interacting programs. The general system diagram is shown in Fig 1.

Data Base

The conversational system uses constant and variable data.

The constant data set consists of information describing the in-

dividual elements of the power network (stations, lines, transformers), and also the parameters of these elements and the maximum allowable values. The constant data set is loaded into the computer memory and is changed only when the network elements change. The constant data set includes also the parameters describing the instrumentation.

The variable data set consists of information about the condition of power network, such as: measurement of generated power by the individual block and power plants, flow in the lines, loading of the transformers, information about the current status of stations (position of switches) etc. The variable data are sent from the individual measuring points cyclically to the computer, using the telemetry links.

The Formating Programs PIADM2 and MIKDEM

The transmission of the dispatcher instructions to the computer uses the PIADM2 and MIKDEM programs. The MIKDEM program allows the information about the power network to be presented in the form of graphs, station diagrams or certain tables on the graphic monitors.

The PIADM2 program allows to obtain a more detailed information on various peripheral devices (monitors, printers). Both programs are called by the operating system after the dispatcher issues the request, The request consists of four-character text, which is the mnemonic of the selected sub-program, and certain numerical values.

The PIADM2 program does the following:

- recognize the instruction mnemonics,
- decodes the numerical parameters,
- initiates the appropriate subprogram.

The instructions executed by PIADM2 can cause the changes of the entire on-line system work, control the telemetry data collection and provid the information about the power network. For example, the

instruction.

/ BLOK,p,q

causes the blocking out of the telemetry input from the measurement points from p to q. The blocking can be made if the instrument is malfunctioning. After the malfunction is removed, the telemtry input can be unblocked by

/ODBL,p,q

The instruction

/LIST,p,q,l

causes the listing to be printed on the peripheral device l, of the measurement points from p to q divided into the blocked ones by the dispatcher and the damaged ones. The list desn't include the measuring points that work correctly. This instruction allows for the control of the measuring system operation.

Other dispatcher instructions could for example, be the correction of the current time, if it was changed by the momentary malfunction of the on-line system, or change in the parameters describing the individual measuring points (for example because of the change in the allowed loadings). The dispatcher can issue the instruction to list the reports about exceeding the allowed values, connections, disconnections or malfunctions of the measuring system. Other instructions allow to print various reports and tables about the work of the power network.

The moodular program structure gives it a flexibility allowing for relatively easy audition of the new instruction or change of the existing ones. Individual instructions are executed by the PIADM2 subprograms, or, in the case of more complex task, the PIADM2 calls the separate program transferring the list of necessary parameters.

The MIKDEM program serves to provide the dispatcher the information about the system work in the graphic form. The program can be called

only from the graphic monitor. Its task is to prepare the list of parameters for the program displaying the diagrams of power plants, networks, tabulated data on the work of the power network (program PICTUR), or for the CURVAT program, displaying the time-variable graphs.

The dispatcher after issuing the appropriately coded instruction is able to obtain on the selected peripheral device:

a) a plot showing the measured value, eg. power, at the selected point for the last t hours (counting from the current hour),

b) station diagram, network diagram, tabulated data.

There is a possibility of displaying the pictures with the data describing the past behavior of the power network; the maximum retrospection time is about 100 minutes.

DRUKAL program

The incoming telemetry data are divided into three groups:

- information about the state of facilities
- information about the flow and loading
- information about malfunctions of measurement system.

The fourth group consists of telecommands.

Using the information from the first group in every measurement cycle, the current status is compared with the previous one. If the change is detected, a report is sent to the dispatcher, consisting of the following elements:

- current time,
- name of the facility in which the change occurred,
- name of the device and its now state.

For example, the report may look as follows

12:14 - R. JOACHIMOW - L.220kV ANIOLOW - ZAMKNIETO ODLACZNIK SYSTEMU 1.
(12:14 - R. JOACHIMOW - L. 220kV ANIOLOW - SYSTEM 1 SWITCH CLOSED).

Similarly, each measurement cycle the information from the second group is analyzed ie, measurements of flows and loading. They are compared with the allowed values, and in the case of exceeding them, an appropriate message is sent to the dispatcher. Also, if there is return to the normal situation the appropriate message is sent to the dispatcher, containing the following informations:

- current time,
- facility name,
- reason for the message - exceeding the allowed value or return to the normal state,
- measured quantity,
- allowed value.

For example, the message may have the following form:
19:27 - R. JANOW - TRANSF FOR 2.220/110kV *** OVERLOADING ***116MVA/100

The third group consists of information and reports on malfunction or correct function of measuring instruments. They are necessary, since the nonreported break in measurement, or worse, erroneous measurements, could distort the picture of the power network function. For example, the messages concerning the operation of measuring apparatus may look as follows:

19:26 - ZEDZ - SUM OF HEAT PWR PLANTS *** MALFUNCTION
19:35 - ZEDZ - SUM OF HEAT PWR PLANTS *** CORRECT MEASUREMENT

The forth group consists of teleinstructions. Part of the transmitted instructions from dispatcher to the power plant goes through the digital telecommand device (4). Its role is to simplify and increase the

dispatcher effectiveness. Every teleinstruction sent is recorded in the computer and confirmed in the form of the message displayed to the dispatcher. The message consists of the following elements:

- current time,
- name of the power plant to which the instruction was sent,
- text instruction.

For example, it may have the form:

17:20 - TELEINSTRUCTION TO THE DYCHOW PWR PLANT - START THE GENERATORS

17:22 - TELEINSTRUCTION TO THE TURÓW PWR PLANT - REGULATION CLASS 4

The messages are automatically displayed on the monitor, printed and stored on the disk. The messages on the monitor allow for indirect survey of the current network status, the printed messages allow for the analysis of network work at any time. In addition, the dispatcher is able to request that the chosen messages be displayed or printed.

CURVAT Program

The described conversational system allows the dispatcher to monitor the work at any chosen facility in the form of graph on the graphic monitor. The graph can include the time interval from 3 to 24 hours prior to the display time.

In order to obtain the required curve the dispatcher gives the number of chosen facility and the number of hours to be spanned by a graph. In that manner one can, for example, analyze the loading of electrical block or entire plant, line loading, loading of the pumping plant, water level.

The graphic presentation of the facilities work is performed by the CURVAT program. The data base for the program consists of the measurements collected and averaged in 15 minutes intervals. The plot consists of the broken line connecting the points representing the measurement

values. Each graph is described by the label containing: facility name, current measurement value, current time. The horizontal axis - the time - is scaled according to the requested number of hours, and the vertical axis according to the range of measured values.

In the case of temporary breaks in the measurements, the graph contains gaps or singular values only. If there is a suspicion that the measurement is in error, the question mark appears next to it.

Summary

The described dispatcher-computer conversational system is the part of the on-line system operating for the State Power Dispatch. The conversational system, continually improved, is simple in exploitation, easy to expand and is very reliable.

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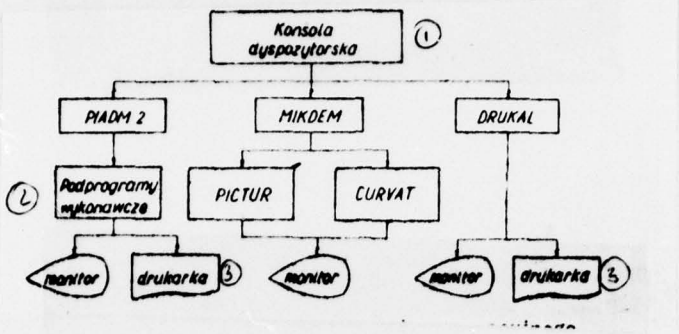
Fig 1. General diagram of the conversational system. 1 - operators console, 2 - execution subprograms, 3 - printers.



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