Software Package for Measuring of Generators Temperatures

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***Abstract* – Description of a software package for the temperature monitoring in the generators and turbines of hydroelectric power plant is given in this paper. The proposed package and hardware configurations have been developed at the Faculty of Electronic Engineering in Niš and applied in HE "Vrla 2" in Surdulica, which is part of "Vlasinske hidroelektrane". The software receives data from the sensors and displays them in tables and diagrams on a PC screen. Exceeding in temperature of a certain measuring point is signalled to the operator in the command centre, by changing the colour chart and sound alarming. This software allows the archiving of data, generating and printing daily and periodic reports.**

***Keywords* – Software, Power plant, Temperature measuring**

I. INTRODUCTION

Temperature measuring and monitoring at key points of the generator is of great importance for the process of producing electrical energy. Normal values of temperature are a sign of the correctness of the generator, which with turbines are vital elements of the hydroelectric power plant. In certain areas of constructive parts of the generators and turbines, measuring elements (Pt 100) are installed and used to measure temperature [1-3]. The resistance of these elements changes with temperature (at 0°C the resistance is 100Ω and when temperature is increasing, the resistance value is also increasing). Software package of the system for temperature monitoring in the generators and turbines is used for data acquisition, archiving of measured data, numerical and graphic representation of data and alarm activation based on measured temperature values. Access to operating functions is allowed by user authorization system.

Software for Measuring of Temperature in Generators (SMTG2006) is developed for Windows XP operating system, [4] with installed MS Office package and InterBase 6.5 database server. New partition on the hard drive is created in order to improve efficiency of database. Data acquisition from measuring elements is enabled by multiplexer which is connected to serial PC computer port. Software package is realized by several modules described below:

- LMSU-SM-SMTG-06-0000 – Data acquisition module provides communication between PC terminal and hardware module for data acquisition via serial port. Module is operating independently and real-time processes are priorities.
- LMSU-SM-SMTG-06-0001 – Alarm control module monitors measured signals values. If these values are higher than allowed, the module sends request for sound and visual alarm activation. The module receives operator request for sound alarm activation. Visual alarm is activated until the cause of alarm activation is eliminated. Real-time process is priority in this case, also.
- LMSU-SM-SMTG-06-0002–Configuration system module manages system configuration database. This module provides hardware module acquisition data, module addresses acquisition, description of measured points, and graphic interface configuration for monitoring and alarm values.
- LMSU-SM-SMTG-06-0003 – User authorisation module manages authorized users database. This module is used for storage of user names, passwords and user access control data. Data coding before storing on hard drive and decoding during authorization are executed in this module.
- LMSU-SM-SMTG-06-0004 – Activity storing module receives systems activities, errors emergence, login and logout data and stores them to hard drive. Afterward review and generating of system reports are enabled.
- LMSU-SM-SMTG-06-0005 – Data archiving module receives measured data and sends them to archive on hard drive, monitors archive capacity and erases old data. Graphic representation of temperature values at measured points is allowed.
- LMSU-SM-SMTG-06-1000 – Graphic interface for monitoring allows representation of measured values, alarms and other system activities. User can intervene in the case the alarm is activated. The interface is connected to data acquisition module, alarm control module, activity storing module and data archiving module.
- LMSU-SM-SMTG-06-1001 – Graphic interface for configuration is graphic environment which provides hardware module configuration for data acquisition, graphic interface configuration for monitoring and setting of alarm values. Interface is connected to configuration system module.
- LMSU-SM-SMTG-06-1002 – Graphic interface for authorization is used for user authorization and database managing. This interface is connected to user authorisation module.

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• LMSU-SM-SMTG-06-1100 – Report generator creates graphic reports of temperature values in certain period and table report about registered activities. This generator is connected to data archiving and activity registration modules.

II. Operating Functions of SMTG 2006

Function key F9 displays following operating functions (Fig. 1):

1. MONITORING TEMPERATURE (Temperature history)
2. IZVEŠTAJI (Reports)
3. POSTAVLJANJE ALARMA (Alarm settings)
4. AUTORIZACIJA OPERATERA (User autorisation)
5. KONFIGURISANJE (Configuration)

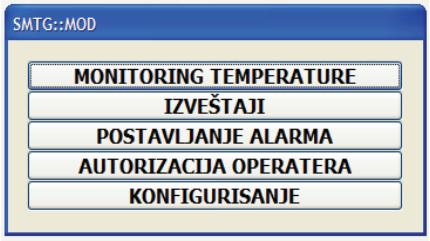

Fig. 1. Welcome screen with operating functions

A. Temperature Monitoring

Primary operating function of SMTG 2006 is temperature monitoring In generators (Fig. 2). Temperature monitoring screen consists of:

1. Screen heading
2. Table with current temperature values on generators
3. Activity listing
4. Status line

Fig. 2. Temperature monitoring screen

1. Screen heading includes the title and software package version, name of authorized user, working unit which the system is installed on and current date and time. If there is not authorized user, user name field is red.

2. Table with current temperature values for each generator is obtained by functional keys from F1 to F8. In the upper part of the table there is the sign “Fn: Generator n”. In the left part of the table below the picture of generator there are light indicators of correctness of communication with activation modules, where each module has its own light indicator. When computer starts communication with acquisition module, light indicator becomes yellow. If module answered according to protocol, light indicator is green. In the case when there is no response, or answer is not adequate to protocol, light indicator is red. Temperature values are shown as digital indicators for each measured point. Colour of the digital indicator corresponds to appropriate temperature range. Blue colour is for allowed range, yellow colour shows entry in risk temperature range and finally, red colour shows temperature values above allowed limit. On the left side of digital indicator there is a short name of appropriate measured point.

3. Activity listing includes a daily list of activities such as authorisation access to operating function, activation, acknowledgement and alarm stopping, errors emergence and other important system activities. Each group of activities has different colour in order to easier notice the group. Especially important activities are shown by red colour with short-timed sound signal.

4. Status line shows data such as: the name of current authorized user, login time, alarm information (the number of active and unacknowledged alarms) and finally the name of software package designer.

B. Temperature history

Composed data are stored in database each second. Precise temperature history graphic representation at selected point is available in this way (Fig. 3).

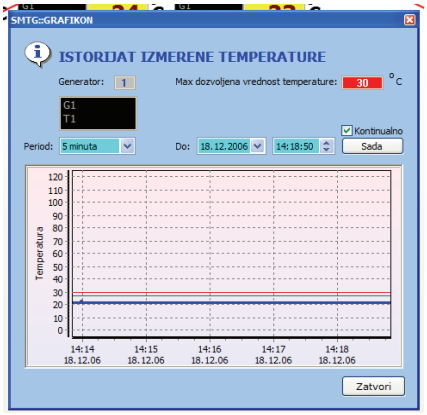

Fig. 3. Screen with temperature history

Temperature on the generator is presented by blue line; low limit of risk range is presented by green; and maximal allowed temperature is presented by red line on the chart.

Desired temperature history chart can be obtained from the list by choosing date and time period. Key “Sada” sets current date and time. If field „Kontinualno“ is checked the newest composed data for chosen period is being permanently presented.

C. Alarm Settings

The most important function of temperature monitoring in generators is alarm activation in the case of some monitored temperature value exceeds the allowed limit. This system incorporates warning subsystem. In the case that temperature enters to the risk area defined by warning temperature and alarming temperature, warning subsystem changes colour of digital indicator from blue to yellow.

If temperature of any measured point exceeds allowed limit, sound-visual alarm signalization will be activated, appropriate digital indicator becomes red and graphic temperature history at the measured point with warning is showed. Alarm activities data are being updated in status line. This activity is registered into activity listing. Computer starts to emit discontinuous sound signal. User separately acknowledges alarms for appropriate measured points by pressing the button „Potvrdi“. After acknowledgement of all alarm activities, alarm is deactivated, sound-visual signalization is turned off and the window with alarm warning and graphic temperature history is closed. Each acknowledgement is being recorded in activity listing.

If temperature value returns into allowed range, alarm will be deactivated for this point, even without user acknowledgement.

There is need to define warning and alarming temperature value to allow the system to operate (Fig. 4).

Fig. 4. Alarm settings

When we click on the button „ALARM“, the form for input of warning and alarming temperature values will be opened (Fig. 5).

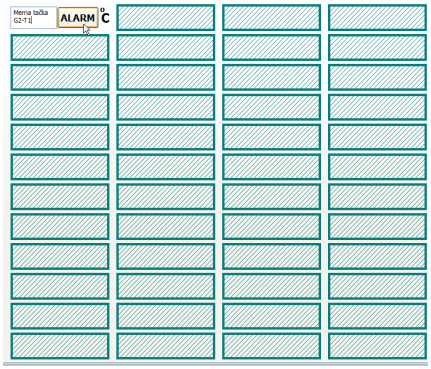

Fig. 5. Alarm values form

D. User Authorisation

Operating function access is determined by access control defined during user authorisation (Fig. 6). Authorisation system provides the services of adding new user deleting some users from database and changing access control data.

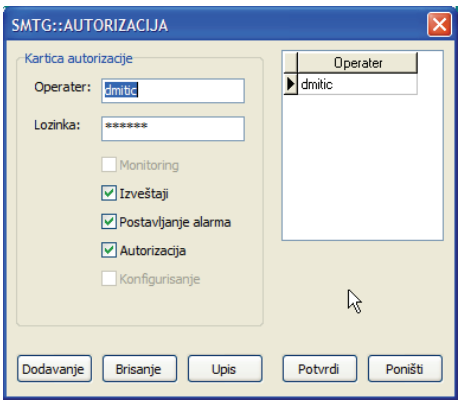

Fig. 6. User authorisation

If we want to create new user account we need to press button „Dodavanje“. In such a way new user card is created in database, then the name and password are entered and access control is being defined. After pressing the button „Upis“, these data are being recorded into database. If we want to access existing card, we need to click the name of user in users list. Button „Upis“ can be used for changing access control for some users and we can delete users by button „Brisanje“. Finally, all changes will be permanently written into database using button „Potvrdi“.

E. Reports

This function provides report generating (Fig. 10) which refers to:

- User login
- Alarm emergence

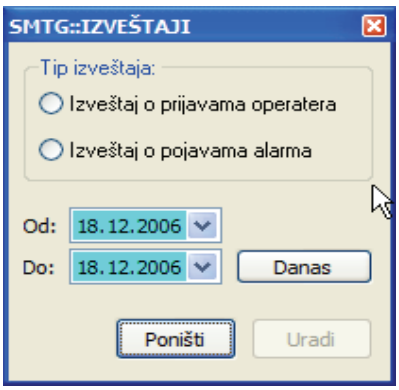

Fig. 7. Report settings

After choosing report type and time period, by pressing the button „Uradi“, report will be obtained as Microsoft Office Word document which can be viewed or printed. It is stored in document archive.

F. Configuration

Only specialized user, with high access level, may configure system. Communication serial port, active measured elements and its addresses are being defined during configuration process. Hardware connections for measured points and display positions could be mutually linked or unlinked. Each generator was given the chart with 48-fielded matrix for digital indicators (Fig. 8). Certain number of measured points is left for turbine. Each measured element has 6 slots with 8 ports each, for hardware connection with measured point. Current unlinked hardware connection is green and free positions have diagonal lines. We create link from hardware connection to free display position using „Drag and Drop“ method. Now, hardware connection is becoming red and two-rowed field for input of measured point description is appearing.

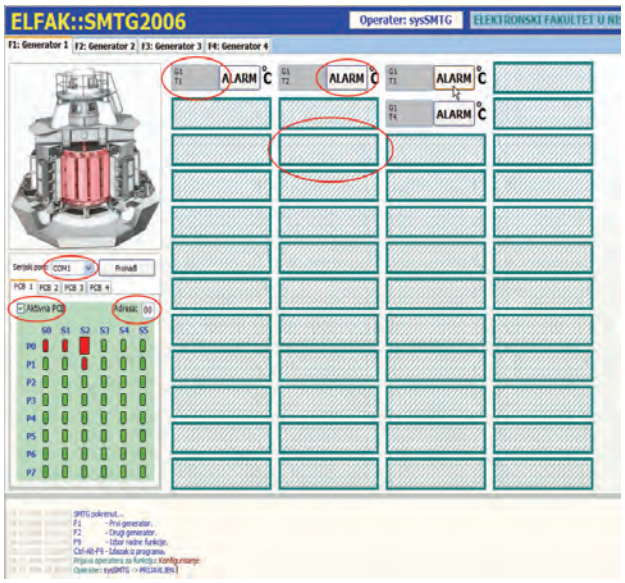

Fig. 8. Configuration system screen

Button „ALARM“ is also appearing. Warning and alarming temperature values for appropriate measured point are defined using this button.

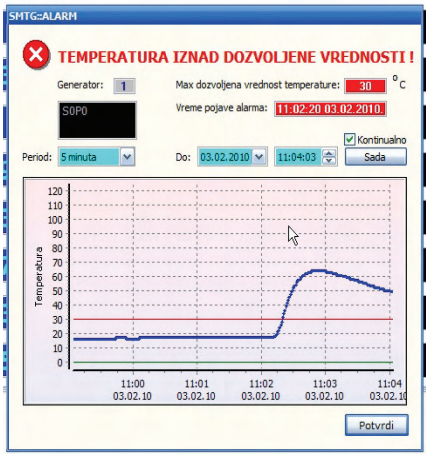

Fig. 9. Chart of current temperature values in generator

III. Conclusion

Described software package is not limited only to temperature measuring. It can be adapted for other measuring systems, for measuring of other physical quantities and parameters at different processes and objects. There is need for an adequate measuring converter for appropriate physical quantity with corresponding proportionality coefficient and creating appropriate sign for this quantity. Graphic and chart representation of measured values, alarm display, data archiving, report generating and printing are provided.

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References

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