

## ENERGY SAVING

## 7.4. Thermal imaging diagnostics of energy equipment

## 7.4.2. Application of thermal imaging devices at energy enterprises

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Generation of electric and thermal energy is concentrated at TPPs and NPPs. Thermal imaging technique allows to determine the deviations from the standard functioning of basic and auxiliary equipment of power plants for the on-time development of planned-prophylactic measures on elimination of the detected preemergency situations.

Normal operation of the basic equipment of electric facilities is not usually connected with release of large amount of extra heat. Heating of contact couples of switchgear, insulation failure, places with the raised leakage currents testify about the anomalous operation. Temperature control with detection of local overheating of separate parts and elements allows to detect the faults of equipment operation, in particular, operating irregularities of generators, power transformers, current and voltage transformers, high-voltage switches, inputs, connections etc.

Trouble-free operation of energy enterprises depends on the state of electrical substations and networks. So, the flammability risk depends on the state of cables, cable junctions (cable boxes and cable terminations) and cable ducts. Overheating of switching and cable equipment can result in inflammation of insulation, short current in electrical feed circuits of electric power plant auxiliaries. Just the thermal imaging technique allows carrying out the non-contact inspection of substation equipment, state of different power assemblies, elements, devices and lighting equipment being in the working condition. The increased temperature of ground bus ducts and constructions, connected with them, allows finding the places of current leakage to earth.

Trouble-free operation of energy enterprises also depends on successful operation of auxiliary equipment and computer-aided facilities. Thermal imaging technique allows controlling the relay state, installing the overheating of collector ring motors, bearings, controlling the state of pumps, electric drives and transducers. Due to it the defective units of relay protection devices and automatics can be also found. Determination of successful performance of thermal part is connected with controlling the state of boiler (reactor), where it is often necessary to evaluate the uniformity of heating on its surface. Overheating of elements testifies about faults in lining and thermal insulation.

Thermal imaging technique allows carrying out the search of thermal insulation failures in heating systems. At that the failures of thermal insulation of steam lines, air lines, pipelines for hot water supply can be determined.

Equipment of remote thermal control allows regulating the operation of heat-exchanging devices, the temperature distribution in heat exchangers, the temperature of pumps and drives. Devices of thermal control can be successfully used for controlling the operation of the forced and exhaust ventilation. Infrared imagers are used for the search of "bottlenecks" in the heating and cooling paths.

Thermal imagers showed themselves well in controlling the operational conditions of boiler and auxiliary themotechnical equipment. In this case the operative, non-invasive control can be used for monitoring the gas temperature in inlet sections of air input in combustion chambers, temperature of

the cooled parts of equipment.

Thermal imaging technique allows determining the faults in hermetic sealing of steam pipelines and water pipelines of hot and cold water, levels of liquids and oils in large tanks as well as can be used for detection of gas component leakage from the hermetic pressure vessels. Thermal imagers can be used for determination of the quality of heat flows supply paths as well as for analyzing the thermal loss with sewage discharge waters and operation of cooling towers at TPPs.

It is possible to apply the infrared devices for registration of radiation for *ecological monitoring*.

Infrared sensors can be used for determining the places of unauthorized heat release as a result of decomposition, smoldering, inflammation and burning or in cases of violation of processes.

Thermal imaging technique is used for monitoring the emission of solid substances into atmosphere, because in this case a heat capacity of waste gas is changed. Such control promotes to the determination of fuel combustion efficiency, control of treatment facilities (electrostatic precipitators) operation.

The cases of determining the places of drains of liquids and gases by means of thermal imagers are known. It is connected with the fact that the temperature is changed in the places of drains and leakages. In such a way the blowholes in gas, heating and oil pipelines, water main pipelines and drainage effluents can be found.

Methods of detecting the phase changes of gas components in aerosol phase by means of thermal imaging control are known (for example, transfer from  $\text{SO}_x$  to the drops of  $\text{H}_2\text{SO}_4$ ).

Thermal imaging control can be used for determining the efficiency of operating ventilation systems at the workplaces and rooms as well as for determining the operation of humidity systems. Sometimes this control is more efficient than the pointwise devices for controlling the hygiene and sanitary conditions on temperature, heat- and air exchange.

In some cases thermal imaging technique allows determining the places of electrical shock danger and the danger of burns occurred touching electrical devices and thermo-technical equipment.

It should be especially noted the necessity of infrared-control devices application for securing the reliability and *operating safety* of energy equipment and means of vital activity. Occurrence of pre-emergency and emergency conditions of equipment for power supply of objects of social and economical activity expressed in the appearance of seat of fire, breakings and leakages of liquid and gaseous substances and vapors, the unauthorized environmental discharges of harmful substances can be prevented by means of thermal imaging technique depending on the change of heat release and the control of changing thermal fields.

*Energy saving* is another sphere of thermal imaging technique application. Saving of energy resources represents the additional source of saving of cash resources. Therefore, the problem of rooms heating doesn't result only in solving the problem on accounting heat supply in rooms for creation of

comfort conditions, but also in the reduction of heat loss. Thermal losses in buildings appears because of defects in building envelopes, loose-fitting windows, bad thermal insulation and its damage under effect of different factors. When the thermal losses are determined for buildings and structures, it is possible to orient on the measurement of temperature fields inside and outside the surfaces. The gradients of temperature fields allow determining the places of thermal insulation defects location.

A practice of using the infrared devices allows noting the following advantages of thermal imaging control, which make this method perfectly suitable for solving the problem on diagnosis of the state of public functions and housing stock buildings:

- detection of failures in thermal insulation of buildings at the early stage of their development;
- non-invasive nondestructive control;
- appearance of special methods for determining the thermal losses by means of the results of thermal fields detection.

Non-invasive control of the temperature of solid (loose) substances, gas jets and melts of different materials is carried out by means of infrared devices, using the native thermal radiation of these materials.

A sufficiently large amount of devices for converting infrared radiation into visible image currently exists. Let us consider the family of serial devices, which are produced and can be used for thermal imaging control of energy equipment.