inem KONČAR

Končar - Electronics and Informatics Inc.

Reconstruction of the DC power supply system at TPP Rijeka

During the thirty years' period of exploitation power supply systems were exposed to significant changes due to which they had to be submitted to the project revision. To meet requirements of the new configuration, new loads and new regulations the substantial reconstruction of all power supply systems was necessary. The reconstruction allowed bringing the power supply quality and reliability of all critical loads of the power plant to the higher level corresponding to the facility significance.

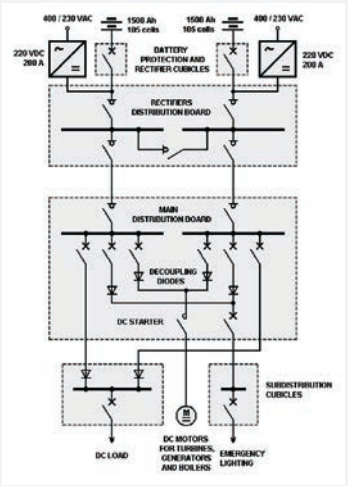
Rijeka thermal power plant (TPP) has the significant place in the electro-energetic system of the Republic of Croatia. It has been in operation since 1979. With 320 MW of installed power, with 900 GWh of the average annual electric energy production and with about 5000 operating hours on electrical grid, it is one of the biggest plants of Croatian electric power industry.
Because of the exceptional significance of TPP Rijeka all installed systems of uninterruptible DC power supply must be of the highest possible level of supply reliability. Namely, damages of a possible supply system failure could be extremely tremendous and disastrous for TPP itself.

Rijeka Thermal Power Plant

Very first systems of uninterruptible DC supply at TPP Rijeka were designed and performed according to principles and norms that were common thirty years ago. Their concept as well as performance was out of date, while batteries were about to expire.
Old rectifiers, as well as the complete DC power supply system were suitable for the power supply of old analogue equipment that in time relinquished to the new digital equipment, sensitive to power supply disturbances and voltage quality.
In time the system experienced many changes; partly because of maintenance processes and partly because of numerous adjustments due to changes of TPP itself. New DC power loads were added and modifications of TPP were made, so systems were not in accordance with the original project any more.
Fuses and circuit breakers in the distribution board were not selective and besides, dangerous and hard to detect isolation faults were becoming more frequent.
Considering the aforementioned it was necessary to redesign and replace old systems of uninterrupted DC power supply with the new, up-to-date equipment.
The complete reconstruction of all 220 V, 48 V and 24 V DC power supply systems had to be made. Prior to the reconstruction the preliminary design and the detailed design projects were made.

Particularities and challenges of reconstruction

Besides designing and production of the equipment the large-scale reconstruction consisted of various types of works and modifications of TPP itself. Among other things, the reconstruction included: replacement of existing batteries with the new ones, as well as the corresponding battery protection cabinets; replacement of existing rectifiers' cabinets and installation of the new ones; replacement of the rectifiers' distribution board, as well as the main distribution board.



Principal scheme of reconstructed 220 V system

Old equipment for starting and power supply of DC engines and pumps, placed in the main distribution board cabinets of the old 220 V power supply system, had to be modernized.
Prior to any works, in order to secure uninterrupted power supply of all loads during the reconstruction the detailed step-by-step elaborate was made. The elaborate provided the safe way of the performed works, in a very short period of time, with no breakdowns of power supply to load.
Before the reconstruction all cables in DC distribution boards were checked for current overload, permissible voltage drop and heating in conditions of short circuit. Cables not meeting the project requirements were replaced by the corresponding once. Additional cables providing two-sided power supply of loads were laid down. Cables were laid down within existing routes, but separately from alternating voltage cables. To ensure reliable power supply and selectivity of protection the necessary modifications in the existing sub-distribution boards were also made.
To provide selectivity of protection the new circuit breakers with the corresponding nominal current range had to be built in the distribution boards. Due to it a part of power supply cables had to be replaced, as well as wiring that had to be adjusted to the cross section of new power supply cables. This intervention went up to the end distribution board, i.e. to the third and fourth protection level.
Approximately 20 kilometers of new cables for DC loads' power supply were laid down and the special system for monitoring the cables insulation resistance was built in. Thus the precise detection of the existing and the new isolation faults that could

possibly occur during the facility operation was ensured.
Old DC motor starter cabinets for safety systems of the turbine, the generator and the boiler, were replaced. The complete startup automatic was solved with the new equipment enabling the local as well as the remote control, contributing to the higher security of TPP.

Basic characteristics of new systems

Using microprocessor technology, development of power electronics and new types of batteries contributed to the development of modern systems of uninterruptible DC power supply. All new systems of DC power supply are made as parallel redundant systems, to which all sub-distribution boards with the built in end level of protection are connected, and from which DC loads are supplied.

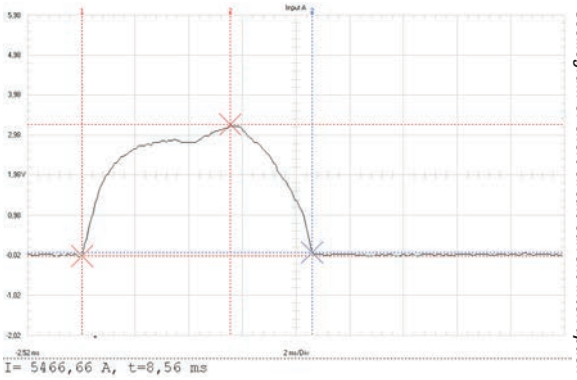
New modular rectifiers 220 VDC in the facility

All new cabinets, especially those of the main distribution boards, are made with the direct access to the circuit-breakers, with no doors, enabling instant view of the operation regime and quick handling. Circuit breakers are connected to isolated busbars by means of insulated wires, preventing thus any possibility of the inner short circuit and significantly enlarging the reliability of the supply system. The possibility of quick and efficiency maintenance from the front side has been ensured. All circuit breakers have been equipped with auxiliary contacts for tripping detection. Also, the complete selectivity of protection between circuit breakers of various protection levels has been provided.

Detail of new systems + 24 V

Loads are supplied from two sides, through two identical main distribution boards of corresponding DC voltage. The redundancy of supplying is provided with cables too. At the end of each cable there is a de-coupling diode or DC/DC converter providing supply redundancy without possibility of spreading failure from one system into another.

Monitoring and control of the new systems are realized locally, through a control panel mounted on the front of the DC system cabinets, but also remotely, through SCADA systems and PC/computers in the control center. For the remote monitoring and control via PC the program package ParaNap was delivered. It provides monitoring of all system's data: measuring, alarms, chronological list of events and parameterizing.



Oscillogram of short circuit current interruption

Inside the main distribution cabinets are built in special devices for monitoring and localization of insulation faults for all DC cables.

Reconstruction effect

The main function of all systems of uninterruptible DC power supply is to ensure the highest possible level of supply reliability. High level of reliability is based on the fact that failure of one power supply system can in no way influence the functioning of another power supply system which continues to uninterruptedly supply all connected loads, providing thus undisturbed functioning of TPP Rijeka.
Equipment and solutions built into TPP Rijeka are based on up-to-date concepts of integrated uninterruptible DC power supply systems. With the new equipment, with total of 43 cabinets, the highest level of reliability, corresponding to significance of loads supplied by these systems was achieved.
All measures undertaken significantly contributed to the higher level of reliability and availability of TPP Rijeka. The danger of a facility breakdown due to life-time expiration, poor functionality of DC power supply systems, or non-selective distribution board, possibly resulting in huge direct or indirect damages because of incapability of producing electric energy in critical moments, was eliminated.
By detailed examination during the taking over procedure the reliability of new uninterrupted direct voltage supply systems was proved, starting from the mains through distribution board up to the end consumers. Some of the tests performed are as follows: testing of the batteries capacity, short circuit and selectivity testing, testing with charged and discharged battery, as well as measuring and recording starting currents which occurs at starting of DC motors with new starters. With this way all checking was made to prove the results given by project calculations.
All testing results are documented in details. During tests all valid knowledge considering reliability, calculating of maximal and minimal short circuit currents, achieving the selectivity of protection between circuit breakers placed at several protection levels was used. Also, once again, our experience of performing complex works of reconstructing significant electro energetic facilities was confirmed.

340PR069E4015

inem KONČAR
Končar - Electronics and Informatics Inc.

Fallerovo šetalište 22, 10000 Zagreb, Hrvatska
Tel.: +385 1 3655 758
Fax.: +385 1 3655 550
E-mail: napajanja@koncar-inem.hr
www.koncar-inem.hr