DUTIES OF SHIFT PERSONEL AND REGULATIONS FOR OPTIMUM OPERATION OF SEVERAL ELECT . APPARATUS IN A POWER STATION.

by: Dr.SOLIMAN EL DEBIEKY

Ain Shams University,
Faculty of Engineering,
Cairo,

DUTIES OF SHIFT PERSONNEL

The notion of shift personnel of power systems, power stations, substations and networks embraces all workers servicing in shift production sections of a power system.

§ 1. Heads among the shift personnel during a shift are as follows :

a) Shift dispatcher of the Unified power system; (~~C.D.O.~~)

b) Shift dispatcher of a power system; (~~D.D.O.~~)

c) Shift dispatcher of a power network; (~~N.D.O.~~)

d) Shift engineer of a power staiton.

e) Shift engineer or attendant of a substation.

§ 2. The shift personnel shall work in accordance with an approved schedule; when necessary with permission of the management of a power station or substation, service or section of a network, one shift attendant may be replaced.

Two successive shifts for any shift attendant will be prohibited.

§ 3. Each shift attendant after arriving to work, shall take over the shift from the shift operator of the previous shift, and shall hand over the shift to the attendant, whose turn is next

It is prohibited to leave the work without handnig over the shift.

§ 4. When, in accordance with the shift schedule, taking over the shift, the shift attendant shall :

a) Acquaint himself with the state, scheme and conditions of the equipment operation in section by means of visual inspection, the volume of which is stated in the instructions.

b) Receive, from the attendant handing over the shift data on the equipment which is to be especially closely watched to prevent an accident or fault and on the equipment under repairs or in reserve.

c) Check and take over tools, materials, the keys to rooms, operative documentation and instructions.

d) Acquaint himself with all records and directions, which have been introduced after his previous shift.

e) Formally arrange the take-over of the shift by writting this down in the register or log-sheet, the person taking over the shift and the person handing over the shift must put their signatures in the register.

f) report to his direct-chief in the shift that he has taken over the shift and on the shortcomings noted by him when taking over the shift.

The shift attendant who has handed over the shift must report this to his immediate chief in the shift.

§ 5. Taking over and handing over a shift when eliminating an accident, carrying out of switchings or operations on connecting or disconnecting equipment will be prohibited. Taking over and handing over a shift during start-up or stoppage of equipment are allowed only with permission of a superior shift attendant or house (section) chief of a power station.

§ 6. Taking over and handing over a shift with boiler heating surfaces and ash and slag bunkers left uncleaned from stay and ash, and with the equipment in a state of dirtiness and the working place and serviced section untidy, are prohibited.

Take-over of a shift, with the equipment in bad repair or with its operation conditions being abnormal, will be permitted only with permission of :

a) chief of a house (section) or his deputy — for shift personnel of a power station house (section);

b) chief of a substation — for the shift attendant of a substation;

c) chief engineer of a power station — for the shift engineer of a power station;

d) chief engineer of a power network — for the shift dispatcher of a network;

7.

§ Every shift attendant during his shift is responsible for proper servicing and trouble-free operation of the equipment being under his supervision.

8.

§ The shift attendant must maintain the reliable and most economical operating conditions of the equipment in accordance with instructions, operating conditions charts and operating requirements of higher shift attendants.

9.

§ If the operating conditions of the equipment are disturbed or there is an accident or any damage to the equipment the shift attendant must independently and immediately take measures to restore normal operating conditions or eliminate the accident using the personnel under his authority and directly inform the chief of the shift of what happened.

10.

§ In the power system or in its individual parts accidents are eliminated under the control and responsibility of the power system dispatcher (or the unified power system dispatcher) or the dispatcher of network depending upon the scope of the accident.

At power stations and substations accidents are eliminated under the control and responsibility of the power station shift engineer and the substation shift attendant.

11.

§ The senior shift attendant of a power system, power station, substation or network regardless of presence of the higher administrative authorities is fully responsible for elimination of accidents taking decisions and measures to restore normal operating conditions on his own and following the instructions. If the actions of the shift personnel are wrong, a person from the higher technical administration (the chief dispatcher, chief engineer of power station or network) must interfere in the elimination of the accident, suspending, if necessary, omission

the shift attendant and taking personnel control of and respo sibility for further elimination of the accident.

12.

§ The shift personnel must make rounds and inspectio of the equipment and industrial premises being under their s pervision.

When going round the shift attendant must check opera ing conditions of the equipment as well as state and good r pair of the equipment, buildings, constructions and cleanne of working places and premises.

The schedule of rounds and inspections is drawn up by t chief engineer of power station or network considering the l cal conditions.

13.

§ The shift personnel must periodically test, in accorda ce with the local instructions, the apparatus of notifying, war ing and emergency signalling as well as check the clocks in talled at the power station and substation.

14.

§ The shift attendant may leave his working place carry out switching operations, to inspect the equipment, admit maintenance personnel etc. with the permission of a hig er shift attendant.

15.

§ The shift engineer of power station or network ma suspend a shift attendant man if the latter does not attend his duties.

16.

§ The shift personnel of power stations and substatio may be drawn in repairs while being released from their dut and if the safety rules requirements are observed.

GENERATORS AND SYNCHRONOUS CONDENSERS

§ 1. Generators and synchronous condensers shall be provided with relay protection and field suppression arrangements and control and measuring instruments for protection from internal damage and over current, as well as for control of generator start-up and operation.

§ 2. When operating generators and synchronous condensers the following shall be controlled : current and voltage of generator stator and field, active and reactive power for generators and reactive power fo synchronous condensers, pressure and, purity of hydrogen in the casing, pressure and temperature of hydrogen packing oil, resistance of insulation in the excitation circuits and bearings, temperature of stator winding and steel, bearings and thrust bearings and of cooling (of gas and liquid) at the inlet and outlet.

Non-symetry of stator currents will be controlled for generators and synchronous condensers with a capacity of 15 MVA and higher.

One of the ammeters shall have an over-current scale to control stator loading with current.

§ 3. Generators and synchronous condensers shall have relay for field forcing and automatic voltage regulators, hydrogenerators shall also have arrangements for quickly removing the excitation.

Automatic excitation regulation devices, as a rule, shall be kept connected and shall not be disconnected during the stoppage or starting of generators and synchronous condensers. Action of these devices shall be coordinated with the automatic voltage and reactive power regulators of the whole station.

4.

Excitation forcing devices shall be set in such a way that a maximum voltage of excitation would be obtained at voltage drops.

In separate cases, with the approval of system chief engineer, it is permitted to use lower excitation than the maximum excitation which can be obtained.

Apart from the devices automatically regulating excitation, — manual or remote — control regulation of the exciter voltage shall be provided in the excitation circuit of the exciter.

5.

§ Turbogenerators shall have reserve excitation, the scheme of which shall provide a change over from main to reserve excitation without disconnecting the generator from the network.

The necessity of having reserve excitation for turbogenerators with a capacity of 12 MW and less, is decided by system chief engineer.

6.

§ Each turbogenerator shall be equipped with a command apparatus to deliver instructions and notifications to the shift personnel at the control board and turbine section. Power stations which are run automatically or these with a single boiler single turbine scheme, which have no constant shift personnel in machine hall, are the exceptions.

7.

§ The generators and synchronous condensers, the insulation of the shaft end and cross-bars shall be so made as to enable its control to be exercised.

Resistance of insulation of bearings in generators, synchronous condensers and exciters with fully assembled oil pipelines shall be at least 1 Mohm. Megohmmeter for 1000 to 2500 V will be used for measuring the insulation resistance.

The condition of the insulation of the bearings in generators, synchronous condesers and exciters shall be checked periodically in accordance with local instructions.

8.

§ Generators with closed and running cooling systems,

except generators with hydrogen cooling, shall be with arrangements for fighting fire with water.

9.

§ Hydrogenerators and synchronous condensers with starting electric motors, and also turbogenerators directly connected to transformers, can be in emergency cases connected in parallel by self-synchronization.

When elimmating emergencies, all generators shall be connected for parallel operation by self-synchronization provided that the above mentioned test are satisfactorily carried out.

Chief engineer of power station, network and dispatching centre after appropriate calculation and tests have been made, will choose the main way of switching on turbogenerators connected to the generator voltage bus-bars.

10.

§ Speed of raising voltage in generators and synchronous cendensers and that of stator and rotor current increase is not limited. Speed of loading with active power depends on the turbine characteristics.

11.

§ Rated power of generators and synchronous condensers at nominal power factor remains unchanged in case of voltage changes within the limits ... 5%. The biggest rotor current within these voltage limits is the rotor rated current.

With the voltage on the generator or synchronous condensers being less than 95 percent, the nominal stator current shall not exceed 105 percent of the rated current.

The highest permissible temperatures of rotor and stator windings of generators and synchronous condensers at nominal parameters of the cooling agent (temperature, purity, pressure) and nominal values of current and voltage will be defined on the basis of thermal tests.

When the parameters of the cooling agent disagree with the nominal, permissible current of the rotor and stator winding will be changed correspondingly so that the temperature of windings would not exceed the highest permissible operating value. The current are increased only for a definite value of the cooling agent temperature decrease, this value being

dependent on the design and length of the unit and fixed in the manufacturer's instructions.

The highest operating voltage for all generators and synchronous condensers shall not exceed 110 per cent of the nominal, the maximum stator current is agreed upon with the manufacturer.

12.

§ Continuous overloading of generators and synchronous condensers, with currents higher than those permitted at a given temperature of the cooling agent, is prohibited. In emergencies, in the power systems short-time overloading of generators with surface cooling is permitted with stator and rotor currents being in the following limits, this overloading does not depend upon the cooling agent temperature.

Overcurrent in percentage to the rated.	10	15	20	25	30	40	50	100
Duration of over-loading minutes.	60.	15.	6.	5.	4.	3.	2.	1.

Duration and value of the overloading of generators with direct hydrogen or liquid cooling will be agreed upon with the manufacturer.

13.

§ Generators and synchronous condensers may operate with an earth fault in one phase in the generator voltage circuit for not more than 2 hours. During this time the personnel shall find out the place of the short circuit and disconnect the corresponding connection.

14.

§ When an earth fault occurs in the excitation circuit of a generator or synchronous condenser, the type and place of the disturbance shall be found out. In case of a stable metal earth fault, protection from double earth fault in excitation circuit is installed in the turbogenerator rotor winding operating for signal, in turbogenerators disconnection of which does not lead to power cuts and in turbogenerators which have set teeth in the rotor, wire bandages, rotor with salient poles etc., this protection shall serve as a tripping protection.

Turbogenerators in which a rotor winding earth fault has occured (apart from turbogenerators the rotor windings of which are earthed in accordance with their design) shall be taken out of service for maintenance at the first apportunity. If a second stable earth fault takes place, the generator shall be immediately unloaded and taken out of service for maintenance.

Hydrogenerators and synchronous condensers shall not, as a rule, operate with an earth fault in the excitation circuit, and protection from a double fault in the body is not provided. Earth leakage protection only is installed serving as a signalling protection.

15.

§ For generators and synchronous condensers, it is permissible to operate for a long period of time with currents in phases differing by not more than 10 per cent of the rated stator current for turbegenerators, and 20 per cent for hydrogenerators and synchronous condensers. In none of the phases the current shall exceed the rated value.

At lower loads, generators and synchronous condensers may operate for a long period of time with a bigger difference of currents in phases which is determined by special tests.

For generators with direct hydrogen and liquid cooling of windings the difference of currents in phases is agreed upon with the manufacturer.

16.

§ It is permissible for turbogenerators with air and surface hydrogen cooling to operate in asynchronous conditions without excitation during 30 minutes except when generators have rotors with wire bandages or set teeth. Values of the loading in asynchronous conditions is defined on the basis of tests.

17.

§ Operation of the generater as an electric motor is not restricted in time and is limited by turbine operating conditions.

18.

§ Continuous operation of generators as synchronous condensers with over-excitation will be permitted.

Operation of generators as synchronous condensers with underexcitation will be permitted after special tests.

§ 19. Resistance of insulation of the whole excitation circuit in generators and synchronous condensers in operation (except rotor winding which is earthed in accordance with its design), measured with a megaohmmeter for 500-1000V, shall be not less than 0.5 Mohm.

Operation of generators and synchronous condensers with the resistance of insulation of rotor winding less than 0.5 Mohm will be permitted after chief engineer of a power station or power network gives permission to this effect.

§ 20. Values of stator winding insulation resistances in operated generators and synchronous condensers will be compared with the results of earlier measurements at similar winding temperatures. In case the insulation resistance drops sharply (by 3 to 5 times), the cause of the trouble shall be found and eliminated.

§ 21. Generators and synchronous condensers in reserve, shall be inspected in the same way as operating units.

§ 22. Generators and synchronous condensers shall be periodically overhauled and maintained and tested.

Overhauling of generators and synchronous condensers is carried out one year after the unit was brought into operation, then once every 2 to 3 years, if their condition can secure continuous reliable operation.

Extraction of the rotor of a turbogenerator will be made after one year of operation, then once every 6 years. Rotors are extracted in hydrogenerators and synchronous condensers whenever necessity arises.

Maintenance of generators and synchronous condensers is carried out in accordance with a schedule made by chief engineer of a power station or network.

§ 23. Preventive testings of generators and synchronous condensers during overhauling are made in accordance with the instructions on volume and norms of testings of electrical equipment.

During maintenance, in cases of necessity, testings are carried out in the volume by chief engineer of a power station or network.

§ 24. Vibration (doubled vibration amplitude) of bearings in generators and synchronous condensers newly accepted and in operation (in vertically executed hydrogenerators vibration of the cross-bar with guiding bearings buried in it is measured) shall not exceed the following values :

Speed of rotation r.p.m.	3,000	1,500	1,000-500	375-214	187-625
Vibration value in mm	0.05	0.07	0.10	0.12	0.18

Besides, vibration of bearings in turbogenerators is assessed by the table given in § 291.

§ 25. After erection and overhauling, generators and synchronous condensers are put into operation, as a rule, without drying. When necessary, drying of generators and synchronous condensers is carried out in accordance with instructions in force.

§ 26. Newly erected generators and synchroous condensers shall be tested at the place of erection, the volume of tests being as specified in the technical conditions for delivery and instructions on volume and norms of testing of electrical equipment.

§ 27. Newly erected turbogenerators and synchronous condensers which were designed for operation with hydrogen cooling, shall be put into operation after erection with hydrogen cooling from the beginning. Automatic control of the gasoil system shall be provided.

§ 28. In power stations and substations which have no electro-

lysis plants centralized gas section with receivers shall be organised for supplying automatically generators and synchronous condensers with hydrogen.

29.
§ . Work shall be distributed among the houses and sections of a power station as follows, for the purpose of running and repairing turbogenerators with hydrogen and liquid cooling :

Electrical section — preparation and provision of normal operation of a turbogenerator with the entire auxiliary gasoil system of hydrogen cooling and liquid cooling system repair of the turbogenerator including end-type reals, gas pipelines gas coolers electric equipment of the whole system of hydrogen and liquid cooling change over of turbogenerator from hydrogen to air cooling and back, running and repair of electrolysis plants producing hydrogen with all their auxiliary arrangements including reserve tanks.

Turbine section — constant supervision of operation of the turbogenerator and all gas-oil system of hydrogen and liquid cooling, servicing and repair of the oil system of hydrogen cooling including oil seals of the ring-type shaft and oil supply units as well as equipment and distribution network of cooling water up to gas coolers.

Chemical section — controls and analysis of gases in the turbogenerator body, in balloons, and in the receivers of the electrolysis plant.

Automatics and Thermal Control Section (Laboratory) — servicing and repair of gas control instruments gas analysers, pressure guages, differential pressure guages, pressure relays, etc.

30.
§ Filling the turbogenerator with hydrogen and draining the hydrogen from the unit can be made both when the unit is in operation or is idle.

40.
§ At a power station (substation) which has turbogenerators (synchronous condensers) with hydrogen cooling, a stock hydrogen shall be available in a quantity sufficient for 10 days

of operation of the one-time filling ratio of gases — the biggest turbogenerator (synchronous condenser) as well as a stock of carbonic gas dioxide CO_2 sufficient for filling of the biggest turbogeneratro (synchronous condenser) three times.

41.
§ Pipe-lines of hydrogen cooling, oil pipelines, hydrogen and carbonic gas CO_2 pipelines and other pipelines shall have distinctive paint on them.

42.
§ The Percentage of hydrogen in electric hydrogen used for generators shall be not less than 99.5 per cent of the volume.

There shall be no hydrogen sulphide in the hydrogen.

EARTHING DEVICES

1.

§ In order to ensure the safety of personnel in installations with a voltage of up to 1000 V. and higher and in accordance with rules on erecting electrical installations, earthing devices shall be provided and metallic parts of electrical equipment and electrical installation which may become under tension owing to damaged insulation, shall be earthed. Operating conditions on the networks and protection of electrical equipment from overvoltages also necessitate the installation of such devices.

2.

§ When accepting an earthing device, the following documentation shall be submitted by the organization handing over the installation :

a) Executive drawings and schemes of the earthing device indicating location of underground — connections.

b) Certificates on undergrounds works carried out in device in conformity to the stipulations of the rules on arrangement of electrical installations.

3.

§ Every earthed element of an installation shall be connected to an earthing device or to an earthing main by means of a separate branching. Series connection of several earthed parts of installation to the earthing conductor is forbidden.

4.

§ Connection of earthing conductors to earthed parts, shall be made by welding, and to frames of machines, apparatus, etc. by welding or with reliable bolts. Connection of earthing conductors to the earthing device, and all other connections of the earthing system, sl be made by welding.

5.

§ Earthing conductors shall be protected from action of chemical substances.

Bare conductors openly laid, as well as strips of earthing system, shall have a distinctive colour. Earthing conductors laid indoors shall be accessi for inspection.

6.

§ Earting conductors shall not be used for other p poses, except for temporary connection of weld machines, when the cross-section of the earth conductors is sufficient. When earth fault protect with a zero sequence current transformer is availal connection of welding machines to earthing cond tors, shall be carried out after a preliminary ch king of the earthing circuits so as to avoid fa operation of the protection.

7.

§ In order to find out the condition of the earthi device, the following steps shall be taken :

a) Earthing device resistance shall be measured

b) Selective excavation of the soil shall be made inspect the earthing device elements buried the ground.

c) Continuity of the circuit between the earthi and the earthed elements shall be check absence of breaks of the circuit unsatisfacto contacts, etc.)

d) Breakdown fuses (in installations of up 1000 V.) shall be checked.

e) Reliability of natural earthing element conn tions shall be checked.

f) Specific resistance of the soil shall be check

8.

§ Earthing device resistance at power stations a

substations with selective excavation of soil, shall be measured during the first year after completion of erection works and after that, at least once every 6 years; as to the towers of over 1000 V. transmission lines — after the first 9 years of operation and then — once every 6 years.

The soil specific resistance shall be measured during the first year of operation; for transmission line towers.

Such measurements are carried out, if the tower earthing resistance exceeds 15 ohm.
Results of measurements are written down in certificates.

If considerable corrosion of earthing device elements is found, chief engineer of a power station or power network will decide what parts require replacement. Resistance of earthing elements affected by corrosion, shall be measured in shorter periods of time. Measurement periods are given by chief engineer of a power station or power network.

9-

Resistance of the earthing device shall not be more than :

a) For over 1000 V. installations with big earth currents (over 500) A — not more than 0.5 ohm, taking into account the natural earthing element resistance ; in this case, the artificial earthing device resistance shall not be more than 1 ohm.

b) For over 1000 V. installations with small earth currents (500 A and less): 125/I ohm for such an earthing device which is used for under 1000 1000 V. installations and 250/I for such an earthing device which is used for over 1000 V. installations only, where «I» is calculated earth current. In networks without compensation of capacitance currents, the earthing device resistance shall be not more than 10 ohm.

c) In under 1000 V. installations — 4 ohm.
When generators and transformers are of 100 KVA and less, the neutrals of which are connected to the earthing device — 10 ohm; resistance of the earthing device of each repeated earthing of the neutral — 10 ohm.

d) For towers of over 1000 V. transmission lines, resistance of the earthing device in summer time with the ground wire disconnected shall be not more than the following values :

Soil Specific Resistance in ohm/cm.	Resistance of Earthing Device in ohm.
Up to 1.0	UP to 10
More than 1.0 up to 5.10	Up to 15
More than 5.10 up to 10.10	Up to 20
More than 10.10	Up to 30

10-

§ Measuring the earthing device resistance, as well as the soil specific resistance, shall be carried out in the periods of the least conductivity of the soil, i.e. in summer — when its dryness is the highest.

11-

§ Unscheduled measurements of the earthing device resistance shall be made after their re-arrangement or overhaul.

12-

§ At power stations and substations, checking of the existance of the circuit between the earthing elements and earthed equipment, as well as of condition of breakdown fuses, shall be carried out every time the equipment is under repairs (maintenance and overhaul).

Checking the reliability of the natural earthing element connections is carried out after every repair.

13-

§ Portable earthing elements, used for earthing cur-

rent carrying parts of equipment under repairs, shall be made of bare copper wires and conductors, having a cross-section, which meets requirements of thermal stability at short-circuits, but at least 25 mm^2. In other respects they shall satisfy protection means requirements.

§14. A certificate, containing the earthing system scheme, its main technical data, data on results of earthing device condition checking, on the nature of repairs and changes made in the earthing system shall be drawn up for every operated earthing device of a power station or substation.

IV PERFORMANCE INDICES AND TECHNICAL ACCOUNTING

§ 1. Main production and technical indices of power station and system performance are the following :

a) amount of electric energy sent out;

b) full cost price of electric energy sent out by power system;

c) cost price of electric energy sent out by power station;

d) specific consumptions of conditional fuel for electric energy sent out;

e) specific water consumption for electric power sent out by hydro-power stations and water flow utilization factor (relation of hydroelectric power actually generated to electric power the generation of which is possible under existing hydrological conditions);

f) magnitude of losses in power networks in per cent to the power sent out to the network;

TECHNICAL CHARACTERISTICS

§ 2. Technical characteristics of boilers and turbo-generators, including their auxiliaries, as well as technical characteristics of equipment of hydro-power stations and networks are the basis for technical rating, planning and analyzing the performance indices of different units, power stations and power system as a whole.

§ 3. Every power station shall have technical characteristics establishing dependance of quantitative performance indices of the units and their loads.

In order to draw up technical characteristics of boilers and turbines the latter are tested together with their auxiliaries with in the range of possible operational loads.

§ 4. For various groups of equipment differing in steam

parameters as well as for power station as a whole the characteristics fixing dependance of total and specific heat consumption (net consumption) and other performance indices on the load shall be drawn o the basis of the unit technical characteristics.

Characteristics of a power station as a whole shall be approved by the power system chief engineer.

§ 5. Every year the technical characteristics of the equipment shall be reviewed and corrected reflecting the modifications made.

If considerable changes are introduced in operating conditions of the equipment (e.g. burning of other kind of fuel, modification of units, networks etc.) the technical characteristics shall be corrected (on the basis of tests) immediately after changes have been introduced.

TECHNICAL RATINGS

§ 6. On the basis of the technical characteristics, technically grounded ratings are set and approved by the power system chief engineer for power stations and networks and by the high er authorities for the power stations which do not belong to the power system.

The technical ratings shall be drawn up for specific consumption of conditional fuel for the electric energy sent out, specific water consumption for hydro-energy sent out by the hydro electric power stations, net efficiency of boiler and turbine units as well as intermediate technical indices (vacuum, feed water temperature, flue gases temperature, heat and power consumptions for auxiliaries etc.) insuring the efficiency ratings for boiler units.

The technical ratings shall be drawn up for the whole possible range of operational loads.

§ 7. The technical ratings shall reflect the effectiveness of the technical and organizational measures planned to be taken.

§ 8. The ratings of conditional fuel specific consumption for the energy sent out and for the net unit efficiencies are provided with the justified tolerances for deviations of actual performance parameters from those assumed in the technical characteristics which take place due to operational regulation- type deviations and wear and tear of the equipment during an inter-repair period.

The tolerance fixed by the power stations are approved by the power system chief engineer and for the power stations which do not belong to the power system by the higher authorities.

V ATTAINABLE ECONOMY LEVELS

§ 1. At every power station an attainable designed level shall be set of average yearly specific consumption of conditional fuel for sent out energy corresponding to the highest economy of the equipment installed at the power station and to the kind of fuel used at the station.

§ 2. At every hydro-power station an attainable average yearly level shall be set of water specific consumption for power, sent out insuring the maximum utilisation of the water flow and the equipment during periods when water is not spilled.

§ 3. The attainable economy level of the power station shall be based on normal operational conditions and normal technical conditions of the installed equipment. Effectiveness of technical improvements and modifications stipulated in the approved long-term plan shall also be taken into account.

The attainable economy levels of power stations are approved by the power system chief engineer, and for the power stations, not belonging to any power system, by the higher organizations.

The terms when the power stations have to obtain the designed ratings and specific conditional fuel consumption, corresponding to the actual electric loads of the power stations, shall not exceed: for serial units installed at power stations being extended — 6 month, for first new type units, and for the first units at new power stations — 1 year.

VI SECURING ECONOMICAL OPERATION OF EQUIPMENT

§ 1. Planned indices, technical characteristics and ratings as well as economical operating conditions of the equipment at various electric and thermal loads of a power station shall be brought to the notice of the personnel in the form of loading conditions charts and economical operating conditions schedules for all main and auxiliary equipment, instructions and tables.

The personnel of the power stations shall be instructed on how to achieve and maintain the economical operating conditions of the equipment.

§ 2. Electric and thermal loads shall be distributed among the units, power stations and power systems working in parallel the method of relative increases, with provision of maximum reliability and economy in operation of the power system as a whole.

Every power station shall have a fixed sequence of starting, stopping and loading the units depending on the aggregate load on the power station.

In the UPS, the distribution of loading is fixed by the CDS.

VII CONTROL AND ANALYSIS OF TECHNICAL AND ECONOMIC OF INDICES

§ 1. Systematical control and analysis of technical and economic indices of the performance of separate units, power stations and a power system as a whole shall be done systematically at power stations and in power systems.

§ 2. Chief of power stations, as well as heads of shift personnel shall systematically control the maintaining of the economic operation conditions of performace of main and auxiliary equipment, of correct load distribution among the units, and of equipment conditions taking measures to remove the short comings, which were noticed.

§ 3. When analysing technical and economical indices for a month, year or any other period of time the fulfilment of plans and efficiency of utilising fuel or water resources are checked, shortcomings are found in the state of equipment or in the fixed operation conditions the fulfilment of planned organizational and technical measures on improving operation is checked and reserves are sought for economising more fuel, electric energy and water resources.

§ 4. The assessment of the achieved main production indices, given in § 928 by the power stations and power systems is done on the basis of comparing the actual values to those given in the plans.

The utilisation of fuel at thermal power stations and of water resources at hydroelectric stations is analysed on the basis of comparing the actual specific fuel or water consumption values for the energy sent out to the rated indices corresponding to the optimum operation conditions for electrical and thermal loads and hydrological conditions which were actually observed earlien

The performance of electrical networks is analysed on the basis of comparing the actual values of losses in the networks to the electrical loads on the network actually observed earlier.

When making a general analysis of the performance of a power station of power system, it is also necessary to take into consideration other factors which affect the technical and economic indices, such as accidents, worsening of the technical condition of equipment, insufficient consumption of power by consumers, changes in conditions of power transfers.

XII RECORDS AND TECHNICAL ACCOUNTING (REPORTS)

§ 1. In a power system and at power enterprises indices of the performance of equipment shall be recorded which are necessary for controlling the efficiency of the performance of equipment and for compiling technical reports.

The management of power stations shall secure the control of the proper functioning of control measuring instruments and of proper state of records, striking of steam and water balance and accounts of other technical indices.

§ 2. Prescribed technical accounting (reports) shall be kept in power systems and at power enterprises.

Power stations shall draw every day and month reports in the fixed volume. Everyday reports with an analysis of the indices for the previous 24 hours shall be passed on to the chief engineer, shift engineers and chiefs of houses (sections) in the time selected by chief engineer.

3. Regular discussions with personnel of the results of work of duty shift, a house (section), the power station shall be held in the order set by the chief enginner of the station, at which experience of advanced shifts and individuals is propagated and short comings which were noticed are analysed.

Positive experience shall be made known and spread.

§ 4. Power systems and enterprises shall submit to the superior organizations required periodical reports with a technical analysis of operation in accordance with instructions in force.

IX REPAIR OF EQUIPMENT

§ 1. Periodicity of overhauls and maintenance (major and running repairs) is specified by the present Rules taking into consideration the state of equipment. The scope and schedules of repairs of the main equipment are determined by annual plans in accordance with § 858 — § 861.

Calendar schedules of preventive tests of electrical equipment and power station and network apparatus are approved by the chief engineer of a power station or electrical network.

§ 2. When carrying out overhauls the measures for increasing the length of continuous operation of the equipment, improving technical and economical parameters and modernisation of the equipment.

§ 3. Repair of auxiliary mechanism directly connected with units shall be carried out simultaneously with the repairs of the latter, if there is auxiliary mechanism capacity reserve, it is permitted to repair auxiliary mechanisms before the main unit is pat out of operation for overhaul. Repairs of the other auxiliary equipment (mechanisms, mazout facilities, water supply) and railways, buildings, constructions and sanitary installations are carried out according to yearly plans approved by the management of a power station or network.

§ 4. Power stations shall be equipped with lifting gear and other mechanisms and necessary arrangements and tools to mechanize labour-consuming works and to reduce the period of the equipment being idle during repairs.

Compressed air, acetylene oxygen pipelines and permanent electrical network for welding works shall be arranged.

§ 5. The following preparatory measures shall be taken before a unit is brought of operation for overhauling:

a) A scope of works and financial estimale are made (which is corrected after the unit is opened up and inspected);

b) A schedule of carrying out the repair works is drawn up;

c) A stock of materials and spare parts required are prepared in accordance with the scope of work lists.

d) Technical documentation for reconstruction works planned for the period of overhauling shall be composed and approved; materials and equipment for implementation of these works shall be repared;

e) Tools appliances, load handing arrangements and lifting and transport mechanisms shall be completed and in good condition;

f) Working places for repairs shall be prepared; the repairs ground shall be planned and places of parts and details shall be indicated.

g) Maintenance groups shall be completed and instructed.

§ 6. Documentation on overhauls of the equipment shall be approved by chief engineer of a power station or electrical network; if the repairs are centralized, the documentation shall be coordinated with the responsible chief of the repairing organization.

§ 7. The equipment installed at power stations and in networks, shall be provided with spare parts and stock of materials.

Spare equipment and large spare assemblies for the units of similar type (spare high voltage electrical motors, rotors of turbines and generators, diaphragms, sets of turbine blades, power transformer windings, cores of generator windings, exciter armatures etc) shall be kept under centralised management for one or several power systems.

There must be an accurate account of spare and spare equipment available at storehouses, shops and sections. Lists of spare parts and spare equipment shall be reviewed periodically by shop and section chiefs.

§ 8. When storing spare parts, spare equipment and materials, their safety from damage and proper utilisation according to their purpose shall be secured.

Bricking, thermal insulating and other materials which loose their properties when moistened shall be kept in roofed stores or under tents.

§ 9. Power stations shall have drawings necessary for ordering spare parts.

§ 10. Changes in construction of main equipment and changes of principal electric and thermal schemes, can be carried out only according to a project approved in an established order.

§ 11. When repairing main and auxiliary equipment, the results of centering and balancing, as well as values of all chims and other measurements which are necessitated by the wear and tear of parts and change of their conditions shall be registered in special sheets and data of works fuilfilled shall be put in a repairs register.

§ 12. In the course of unit repairs, the chief of shop or his deputy, senior foreman and the man responsible for the work shall accept separate assemblies and auxiliary mechanisms, the repairs of which were finished.

When the rotating mechanisms (mills, i.d fans, pumps, feeders, etc. are accepted by assemblies, they shall be inspected and tested running. Repaired assemblies are represented by the certificates of control clearances and measurements filled in and signed.

§ 13. Main equipment of thermal and hydro power stations after overhauls shall be accepted by a committee headed by

chief engineer of a power station, and after maintenance a committee headed by chief of a shop.

In electrical networks the equipment after repairs is accepted at substations by chief, engineer or foreman of substation service or section, or chief of a substation; at transmission lines chief engineer or foreman of T.L. service, repair centre or section.

§ 14. When taking over a unit after an overhaul, all the works enumerated in the list of scope of works, shall be checked, the quality of repairs shall be assessed preliminarily, appearance of the unit will be also inspected (insulation, cleanness, paint, platform and railing condition, etc).

The final assessment of the quality of the equipment overhauls will be given after the equipment has run on load for one month during this period, all necessary measurements and operation tests shall be made.

§ 15. The main equipment of power stations and substations after preliminary taking-over after repairs will be checked in operation during 24 hours. If there are no defects in its operation during this period, the equipment will be taken over for operation. If there are defects, the overhaul is not considered to be finished till the defects are eliminated and the unit is tested on load, during another 24 hours.

§ 16. All the works carried out during an overhaul of main equipment are taken over according to the protocol with technical documentation on repairs attached. Protocols with all supplements shall be kept in equipment certificates.

X TECHNICAL DOCUMENTATION.

§ 1. Each power station and electrical network shall have :

a) Documents on alliotting land for construction.

b) Geological and hydrogeolgical data on the territory with soil test results.

c) Protocols with foundation erection with hole sections

d) Certificates of examinaiton of buried structures and arrangements.

e) General lay out of the territory with all construction and underground facilities indicated.

f) Approved technical project or project report with all subsequent changes supported with appropriate documentation.

§ 2. Each power station and electrical network shall have.

a) Technical certificates of a power station and electrical network.

b) Executive drawings of each unit and structure drawings of all spare parts drawings.

c) Executive schemes of primary and secondary electrical connections.

d) Executive techological schemes.

e) Process and operation instructions on equipment and T.L. servicing.

§ 3. Books bound up and registered in Technical Inspection Office, shall be kept for vessels and steam pipelines, operating under pressure, gears and load lifting mechanisms.

§ 4. Manufacturers plates with rated parameters shall be ava lable on the main units of power stations and substatio (boilers, turbines, generators, transformers, as well as, on elec rical motors and other auxiliary equipment).

§ 5. All main and auxiliary units at power stations and sub tations, parallel pipelines, b.b. systems and sections. as well steam and water fittings, gas pipeline and air pipeline dampe shall be enumerated.

The main units shall have ordinal numbers, the auxilia ones shall have the number of the main unit with a letter (A,B etc). added.

§ 6. General schemes of technological sections (electric co nection schemes of power stations and substations, therm schemes of power stations etc). and schemes of separate asse blies (feed line schems etc). shall correspond to the fix settings and shall be revised at least once every two years.

All changes in units shall be registered in their schem and drawings immediately.

Titles and enumeration in scheme shall correspond to t real titles and enumeration.

§ 7. The schemes shall be hung out at conspicuous pla in the unit room.

A set of corresponding schemes shall be kept with the sh dispatcher of a power system and network, the shift engin of a power station, a shift shief of every shop, section or u and at a chief of a substation.

§ 8. A complete set of original schemes, drawings, instructi and other documents mentioned in this chapter, shall be k in technical archives of a plant and have the stamp « Do ments ».

§ 9. The instructions for servicing the equipment shall made in accordance with standard instructions on operat equipment, on the basis of Manufactors data and instructi

operation and antiaccident circulars and other directions, operation expierience of taking into account local conditions and the specific features of equipment; these instructions shall be approved by the chief engineer of the enterprise.

§ 9. The following shall be stated in the instructions for operating every installation and for every job :

a) Rights, duties and responsibilities of the servicing personnel.

b) Order of servicing the equipment in time of normal operation and accidents.

c) Order of admission for repairing the equipment.

d) Measures to provide safety rules and anti-fire measures.

§ 10. The instructions shall be revised at least once every three years taking into consideration all changes which were made in the schemes and equipment, newly issued circulars, standard instructions and other directions.

All changes and additions are introduced in the instructions immediately; workers who must know these instructions are informed.

§ 11. A list of the instructions required for every shop, substation and section, shall be made at every power station, dispatching office, in electrical network; all working places shall be provided with instructions.

§ 12. The following operation documentation according to the established form shall be kept at every power station, in electrical networks, and at dispatching centres.

Chief engineer of a power station or shift dispatcher of electrical network shall have :

a) Operation register-to write down all changes in the schemes state, working conditions and defects of the equipment as well as operative directions and orders of superior technical personnel in chronological order.

b) Application book for repairs and stoppage of the main equipment.

c) A book for taking equipment out of operation for which repairs dispatcher's permission is not required.

d) A book of directions — to write down directions of superior technical personnel, which are to be applied permanently or for over 24 hours.

e) Daily operative or mimic schemes of electrical connections and pipelines.

f) Relay protections and automatics register (for networks).

g) Chart of relay protection and automatics settings (for networks).

h) Defects and equipment disturbance register (for networks).

i) a register of trippings, earth faults and overcurrent protection operation (for networks).

Chiefs of shop or a section shifts at power stations and shift engineers of substations shall have :

a) Operative register-to write down in chronologiacl order all operations, switchings and other works carried out for a shift as well as automatic trippings, automation and protection operation, placing and removing earthings for repairs or blind flanges, damage or abnormal operation of equipment and operative directions and instructions received from superior technical personnel.

b) A book of orders-to write down the orders of superior technical personnel, which are to be applied permanently or for over 24 hours.

c) Register of defects and equipment disturbances-to write down defects and equipment disturbances found during the shift, which cannot be removed by the shift.

d) Daily operative or mimic scheme of electrical connections (for electric shops).

e) Register for relay protection, automatics and telemechanics (for electric shops and substations).

f) Relay protection and automatics settings chart (for electric shops and substations).

g) Register of trippings, earth faults and operation of overvoltage protection for power station electrical shops and substations.

The shift dispatcher of a power system shall have :

a) Operative register.

b) A register of applications for maintenance of equipment under the dispatcher's control.

c) A register of information on accidents and disturbances (including telemechanics arrangements).

d) Relay protections and automtics register.

e) Chart of relay protection and automatics settings.

f) Book of orders.

g) Operative or mimic schemes of electric connections of a power system.

§ 13. In power station shops, control board and dispatcher centres round-the clock registers according to the established forms shall be kept.

§ 14. Operative documentation shall be looked through by superior technical personnel every day and all necessary measures to remove defects and abnormalities found in the equipment operation and personnel work shall be taken.

XI DISPATCHING CONTROL

§ 1. In every power system dispatching of the interconnected operation of power stations (including those belonging to consumers) is exercised by means of twenty-four-hour dispatching control. The dispatching aims at :

a) Fulfillment of state plans for power generation and transmission and power supply to consumers, maximum economy in operation of a power system as a whole, while making the most efficient use of fuel and hydro-resources;

b) Uninterrupted power supply of consumers and reliable operation of both the whole unified power system and its individual parts;

c) Maintaining quality of power — frequency and voltage, according to the established standards.

§ 2. Operating conditions of power stations, substations and transmission lines are to be determined according to the requirements of the operating conditions of the power system as a whole considering technological features of individual power stations belonging to the system.

§ 3. The unified power system (UPS) shall have a central dispatching service (CDS) which is responsible for :

a) Twenty-four-hour operating control over coordinated interconnected operation of the individual power systems belonging to the Unified power system, which insures covering planned load schedules, uninterrupted supply of the consumers, appropriate power quality and economical operation of the whole Unified power system;

b) Elaboration of operating conditions of the unified power system, determination of normal electrical shemes in the networks of intersystem importance and, if necessary, intersystem power transfers, as well as fixing the order of frequency and voltage regulation, operation of the relay protections and elimination of accidents.

§ 4. Operating conditions of individual power systems shall be determined by the requirements of the operating conditions of the Unified power system and considering features of each power system and transmitting capacities of intersystem connections.

§ 5. The framework of the unified power system dispatching service shall be determined taking into account the complexity and administrative division of the system (UPS) capacities of interconnections and the scope of operating work in order to insure a quick and effective operating control. Beside the Central dispatching service the Unified power system may have local dispatching services (e.g. District dispatching office (DDO), network dispatching office (NDO) and city network dispatching office).

§ 6. The Central dispatching service exercises its operational functions through the dispatching offices directly subordinate to it and through other dispatching offices of individual power systems as well as through the personnel of the power schemes under the CDS operating control.

The Central dispatching service acts on the basis of the regulations approved by the Egyptian Electricity Corporation.

§ 7. The Central dispatching service of the Unified power system has a Central dispatching office (CDO) equipped with a control board, and necessary means of dispatching communication and telemechanics. The (CDO) operating personnel is on duty twenty four hours a day.

The Central dispatching service shall have an operating conditions group provided with necessary analysers and com-

puters as well as relay protection and automatics, and communication and telemechanics groups.

§ 8. The district power system shift dispatcher (DDO) during his shift is an operating chief of the power system. All main equipment of the power system securing power generation, transmission and distribution is under his supervision.

All the equipment, operations on which require coordinated actions of the shift personnel and agreed changes in the relay protections and automatics of several projects shall be under the power system dispatcher's operating control.

Power stations of small capacities may be placed under operating control of a network or main substation.

List of the equipment being under the DDO dispatcher's operating control and supervision and of the equipment being under local operating control is approved by the Director General of the Central Dispatching Service.

§ 9. The (CDO) shift dispatcher during his shift is operating chief of the (UPS) and has under his supervision: aggregate available capacity, reserve of the power systems, the most powerful power stations and transmission lines of intersystem importance. The biggest power stations of intersystem importance and important intersystem transmission lines may be under operating control of the (CDO).

A list of the power stations and transmission lines being under the (CDO) operating control and supervision is approved by the Director General of the (CDS).

§ 10. No element of the equipment being under the (CDO) dispatcher's operating control or supervision may be taken out of service or reserve without the dispatcher's permission except in case when there is an evident danger to the personnel or the equipment.

§ 11. The dispatcher shall give all instructions to the shift operating personnel directly subordinate to him.

§ 12. The dispatcher's instructions shall be fulfilled immediately and unconditionally, except those which expose to danger the personnel or the equipment.

Responsibility for a groundless delay in fulfilling the dispatcher's instructions is put upon the persons who failed to follow the instructions and upon the chiefs of power schemes who gave their sanctions not to fulfill the instructions.

§ 13. All instructions of the director or chief engineer of the power station or network as well as instructions of the power system chiefs on questions being in the dispatcher's competence shall be fulfilled by the operating personnel after obtaining the permission of the competent dispatcher.

WORKING OUT OPERATING CONDITIONS OF POWER SYSTEM.

§ 14. When working out power system operating conditions the CDs shall draw up :

a) Yearly schedule of power system daily load maximums;

b) Power stations available capacity schedul (taking into account seasonal changes in this capacity),

c) Programme of overhauls of main equipment (taking into consideration the necessity of covering daily load maximums and of providing reserve capacities in the power system).

d) Yearly power balances and daily maximum covering schedules.

e) Calculations of active and reactive power flows distribution in networks and of voltage levels in main points of power systems for maximum periods, summer time and, if necessary, for flood periods at hydropower stations.

f) Schemes of power system electrical connections and schemes of electrical connections for power stations and substations having many incoming and outgoing lines.

g) Daily dispatching schedules of active load and spinning reserve for power system and individual power stations,

h) Tables of economical load distribution among power stations.

§ 15. The yearly plan of overhauls is approved by the Chairman of the Corporation two months before the beginning of the year.

In the power systems belonging to the Unified Power System, the yearly calendar schedules for repairs of the main equipment of the power stations as well as the transmission lines and substations being under the CDS dispatcher's operating control or supervision, are approved by the chiefs of the UPS and the CDS one month before the beginning of the year.

It is prohibited to introduce any changes into the approved schedules of overhauls affecting the magnitude of the capacities being under repair without permission of the CDS.

§ 16. The monthly schedules for overhauls and current repairs of main equipment in the power systems and networks shall be drawn up by the central dispatching service (CDS) on the basis of the yearly plans for current repairs taking into account the standards of periodicity and duration of stoppage of the equipment for current repairs.

The monthly plans of main equipment overhauls are approved by the Head of the Power System and communicated to the power stations not later than the 25 th. of the previous month.

In the Unified power system the monthly plans of main equipment overhauls are approved by the CDS before the 25th. of the previous month.

§ 17. The Central Dispatching Service works out operating conditions of the Unified Power System on the basis of the data given by the individual power systems.

When working out operating conditions, the CDS shall draw up:

a) Yearly schedule of daily load maximum for the UPS.

b) UPS available capacity schedule (taking into account seasonal changes in this capacity).

c) Programme of overhauls on main equipment of power systems insuring coordination of overhaul schedules for individual power systems (taking into consideration possible power interchange and distribution of reserves).

d) Yearly power balances and daily maximum covering schedules (taking into account approved overhaul schedules of power systems);

e) Calculations of voltage levels in main points of the UPS and active and reactive power distribution among the power systems for yearly maximum period, for summer time and, if necessary, for flood period at hydro-power stations;

f) Scheme of electrical connections for the UPS main transmission system;

g) Dispatching daily schedules of active load and spinning reserve in the UPS and individual power systems.

h) Tables of economical load distribution among the power system;

SCHEME OF POWER SYSTEM ELECTRICAL CONNECTIONS

§ 18. In every power system a normal scheme of electrical connections shall be worked out and approved by the CDS Director General on the basis of power flow calculations and checking reliability of the power system and its individual elements.

§ 19. The schemes of electrical connections for next day is specified by the district dispatching office (DDO) on the basis of given operating conditions and approved applications for disconnection of the equipment and is approved by the district dispatching office (DDO) chief dispatcher.

§ 20. The power system scheme and operating conditions as well as relay protections and automatics shall secure :

a) Preservation of power system stability after clearing of short-circuits or tripping of the powerful generator, transformer or transmission line; in the cases when asynchronous running is permitted for a short period successfull resynchronization shall be insured.

b) Conformity of short-circuit levels with the equipment installed at power stations and in networks.

§ 21. Maximum permissible loads of the equipment and transmission lines shall be determined and revised periodically by the CDS and the relay protection service in accordance with the operating conditions and adjustment of the relay protections.

§ 22. The UPS dispatching daily load schedules as well as the spinning and cold reserve schedules for individual power stations shall be approved by central dispatching service (CDS) director general.

The dispatching active load schedules shall be given to the systems and stations in the terms defined by the local instructions.

§ 23. When giving load schedules to the hydro-power stations one shall secure the most advantageous operating conditions of the unified power system UPS as a whole, while satisfying the following conditions:

a) Discharge of planned quantity of water (basing on the available water flow and utilization of storage lake).

b) Demands of other branches of national economy (irrigation, navigation and fish breeding) in accordance with interdepartment agreements.

c) Covering of power system load maximum.

§ 24. The power stations must follow the given dispatching schedule of load and spinning reserve and the power stations, taking part in regulation of frequency and power, shall keep to

the given limits of regulation. The power station personnel shall immediately inform the power system dispatcher of forced deviations from the given schedule.

§ 25. At the request of the power system dispatcher the power stations shall raise load up to the value of full available capacity or to reduce it to the technical minimum. Speed of raise and reduction of load in normal and emergency conditions, time required for starting the units, and minimum loads of the equipment, shall be approved by the power system chief engineer.

§ 26. It is forbidden to operate the units at the thermal power stations with limiters when it is not specially requested by the dispatching district office (DDO), or, in the Unified Power system, — by the Central Dispatching Office. (CDO)

At the hydro-electrc power stations operation of the hydraulic units with limiters is permitted with the consent of the power system dispatcher in the cases mentioned in § 456.

§ 27. When the power system operating conditions deviate from the planned ones, the power system dispatcher may change the load of a power station in accordance with the economy requirements or for other reasons.

FREQUENCY REGULATION

§ 28. In the power systems frequency shall be constantly maintained at a level of 50 c.p.s. with deviations not more than + 0.2 c.p.s. The power system dispatcher shall control the normal frequency by the frequency meters at the CDO or DDO.

§ 29. When frequency in the power system drops below the limits stated above, the power system dispatcher should use available power reserves.

If the frequency in the power system continues to drop, while all available power reserves have been used up, the power system dispatcher shall immediately secure restoration

of normal frequency by limiting or shedding the consumers in accordance with the instructions on frequency regulation approved by the power system chief engineer. In the UPS, the instructions on frequency regulation are approved by the CDS.

§ 30. The dispatchers of the power systems and the UPS as well as the shift engineers of all power stations are equally responsible for maintaining the normal frequency. The responsibility for timely unloading of the power system is put upon the dispatching service, the Central dispatching office (CDO) and the network dispatching office (NDO).

§ 31. To prevent the spread of an accident, resulting from a sudden frequency drop caused by a loss of capacity, the dispatching offices of every power system (in the UPS on agreement with the CDS) shall fix the following:

a) Loads, connected to, and settings of, frequency lead shedding devices in the power system, distribution of these devices in individual parts of the system taking into account local power balances as well as loads and settings of automatic reclosers.

b) Distributions of devices that start automatically units of hydroelectric stations at frequency drops and their settings;

Regardless of availability of the frequency load shedding devices, every power system should have a schedule of emergency limitations and disconnections of the consumers approved by the power system chief engineer.

VOLTAGE REGULATION

§ 32. Voltage in the control points of the power system shall be maintained in accordance with given levels so as to provide the consummers with normal voltage.

When determining voltage levels and drawing up voltage schedules with indication of permissible deviations, account shall be taken of all regulation possibilities.

If the deviations go beyond the limits set in the schedule,

the power system dispatcher shall take measures to restore normal voltage level.

§ 33. The voltage schedules shall be given to all the substations having synchronous condensers or transformers with on-load tap-changers and to the power stations having local consumers. The schedule shall indicate the upper and lower permissible limits of voltage at various hours of the day.

§ 34. The voltage schedules shall be drawn up at least once every three months and approved by central dispatching service director general.

The shift personnel shall follow these schedules.

§ 35. The Central dispatching service shall exercise a daily control of voltage level in the system by checking voltages in the control points and at all stations and substations to which the schedules have been given.

It shall also control positions of tap-changers of transformers at power stations and substations and correct handling of reactive power of generators and condensers.

§ 36. For the control points, power stations and substations with synchronous condensers controlled by the power system dispatcher, the lower limits shall be set for emergency voltage reduction, which depends on the power system steady-state stability.

If the voltage there drops to the fixed limit, the personnel of the power stations and substations with synchronous condensers must maintain the voltage on their own, overloading the generators and condensers § (502); and the power system dispatcher shall immediately take measures to eliminate reactive power deficit by limiting or shedding, if necessary, the consumers in accordance with the instructions approved by the power system chief engineer.

XII WITHDRAWAL OF EQUIPMENT FROM OPERATION OR RESERVE.

§ 1. In order to withdraw the equipment from operation or reserve for repair or a test, an operating application shall be sent to the competent dispatching district office (DDO) irrespective of availability of an approved plan. The application shall be signed by the power station or network chief engineer.

Application for withdrawal of the equipment being under operating control or supervision of the CDO from operation or reserve for repair shall be sent to the CDO.

Terms for sending the applications and their approval are fixed in the power systems by the dispatching services and in the UPS by the CDS.

§ 2. Application for carrying out tests and withdrawal of the equipment from operation or reserve involving complicated switching operations or significant changes in the power system operating conditions, shall be sent to the district dispatching office (DDO) or the CDS (respectively) three days before the beginning of the test (works).

Complex tests are carried out in accordance with the programmes agreed with the dispatching office. The programmes are approved by the districts despatching office (DDO) chief dispatcher and in the UPS by the CDO.

On transmission lines and switchgear, the works which do not require de-energizing may be carried out without applications to the power system shift dispatcher.

§ 3. In extraordinary cases the operating applications for emergency repair or repairs, not provided for by the plan, may be sent at any time of the day directly to the power system (DDO) dispatcher, and for equipment being under control and supervision of the CDO to the CDO dispatcher. The dispatcher has the right to permit the repair only within the period of his shift taking responsibility for it upon himself.

Permission for a longer period shall be given by the chief dispatcher.

§ 4. Permission for withdrawing the main equipment of power stations and main transmission lines for major overhauls is given by the Power system DDO chief dispatcher on the basis of the approved monthly programme of repairs.

In the Unified Power System permission for withdrawal of the power stations and transmission lines equipment, being under control or supervision of the CDS, for overhauls is given by the CDO dispatcher.

§ 5. Time of the equipment being under repair which is defined and permitted by the dispatching office is counted from the moment of disconnection of the equipment till the moment of its reconnection or putting into reserve.

The time spent for withdrawal of the equipment for repair or bringing it back into operation from repair as well as the time spent for starting the boilers and turbines is included in the time as permitted after the application has been accepted.

If, for any reason, the equipment supposed to be disconnected was not disconnected by the time fixed, the time given for repair is reduced correspondingly, while the time of reconnection is not changed. Extension of the repair time may be permitted by the power system (DDO) chief dispatcher, and for repairs approved by the CDS by the CDO chief dispatcher.

§ 6. Irrespective of availability of an approved application the equipment may be withdrawan from operation or reserve and tested only with the power system (UPS) dispatcher's permission given immediately before the withdrawal of the equipment from operation and reserve or before the tests.

§ 7. The dispatcher shall admit the personnel to work and permit them to reconnect the equipment of the power stations and networks being under the power system (UPS) dispatcher's control and supervision in accordance with the safety rules.

§ 8. The personnel of the power stations and networks have no right to make switching operations and tests on, or to change the settings of, the relay protections and automatics being under

supervision of the power system (UPS) dispatcher or network dispatcher without the dispatcher's permission.

These operations shall be done in accordance with an application of the relay protection service or in connection with application for disconnection or connection of power equipment preliminarily prepared and worked up by the local relay protection service of the corresponding power project.

For the relay protections being under operating supervision of the power system (UPS) dispatcher the above applications shall be approved by both the corresponding dispatching service and the Central relay protection service.

§ 9. The power system (UPS) dispatcher shall, while changing the scheme of electrical connections, keep the relay protections adjusted in accordance with the instructions of the Central relay protection service.

ORDER OF ELIMINATING ACCIDENTS IN POWER SYSTEM

§ 10. Elimination of accidents affecting operation of the power system shall be directed by the power system (DDO) dispatcher.

In the cases when it affects the UPS operation, the accident is eliminated under the CDO dispatcher's direction.

§ 11. Distribution of functions among the (CDO) dispatcher, power systems (DDO) dispachers and operating personnel of the power stations and networks in elimination of accidents shall be strictly regulated by the dispatching instructions on elimination of accidents. In order to speed up elimination of an accident the local personnel shall be given maximum possible independance.

§ 12. When eliminating an accident, it is permitted to energize a deenergized substation or part of network immediately without any notice.

XIII BOILER PLANTS

§ 1. Boilers shall be equipped with :

a) Blowing and other mechanized arrangement with remote control to keep heating surface from the gas side in the state of cleanliness, when using fuels, producing dense sticking deposits on the heating convection surface, the surfaces shall be cleaned with shots or other means. When shot cleaning is used, measures shall be taken to protect the economizer tube from damage caused by the shots falling down. For boilers with a capacity of 50 tons per hour and more, arrangements for cleaning external heating surfaces shall be automatically controlled in all operations, carried out after the arrangements have been put into operation.

b) Arrangements for taking samples of feed and boiler water, and superheater syeam.

c) Arrangements for taking samples of unburnt fuel from the flue gases (when operating on coal).

d) Observation holes and poke holes with doors which close tightly and reliably.

e) Systems of stairs and platforms providing access to all elements requiring servicing and systematic inspection, e.g. to the fittings, gates, dampers, primary instruments of thermal control and automatics. Arrangements for cleaning external heating surfaces; stairs and platforms shall meet the requirements of the safety rules.

§ 2. Newly commissioned boilers shall be adjusted for :

a) General and separate washing of superheaters; on the

line of water supply for cleaning, fittings and flange connection shall be erected enabling the line to be closed before starting the boiler.

b) Conservation.

c) For acid-alkaline washing (for boilers with a pressure of 100 ata and higher);

Good access shall be arranged to low collectors of superheaters and water economizer for internal insepction and cleaning.

Adequate equipment (tanks, pumps etc.), passages and arrangements for neutralizing the washing water, which is discharged, shall be provided in the boiler room for acid-alkaline washing.

§ 3. Boilers with natural circulation shall be equipped with the following arrangements :

a) For continious blow down from the drum section with the biggest salt concentration or from cyclone;

b) For periodical blow down from lower points of the boiler;

c) For blow down of the last collectors in the steam path and superheaters;

d) For emergency discharges of water from under the drum upper level while it is being refed.

Two valves shall be installed consecutively on every blowdown line, and, after blowdown valves on the main ring (collector), limiting washers are installed.

In the thermal scheme of the power station, complete utilization of blow-down steam and maximum use of blowdown water and its heat, as well as of steam for blowing down superheaters and steam pipeline when starting the boiler, shall be provided.

§ 4. Boilers with lower drums shall be equipped with a steam heating device, stopping and reverse valves shall be installed on the line through which steam is supplied to it.

§ 5. Boilers with natural circulation shall be equipped with arrangements placed inside the boiler, providing normal quality of steam when proper quality of feed water and fixed scope of blowdown are maintained.

§ 6. Boilers with a pressure of 30 ata and higher, shall have arrangements for regulation of superheated steam temperature

§ 7. Admixtures shall be added and measures shall be taken against corrosion at boilers where sulphurous mazouts are used.

§ 8. When chamber method of burning fuel is used, furnace and gas pipelines shall have explosion reilef safety valves erected in their highest point. Valves shall have branchings so that possibility of accidents is excluded.

§ 9. Induced and forced draft fans shall have arrangements so that their output can be regulated. Regulation with throttle dampers is prohibited.

§ 10. Induced draft fans in boilers, where pulverized fuel is used, shall be protected against wear and tear.

§ 11. When boiler has several induced draft fans operating in parallel, a uniform air supply to all section of the air preheater with any number of fans in operation, shall be secured. The air flow through a fan which is out of operation fan shall be prevented.

When a boiler has several i.d. fan operating in parallel uniform, suction of gases in the entire width of the unit with any number of operating i.d. fans shall be secured. Gas flow through an i.d. fan which is not in service shall be prevented.

§ 12. External surfaces of the boiler, pulverized fuel preparation plants and boiler room auxiliary equipment shall have thermal insulation. Maximum temperature of external surfaces of boiler plant bricking shall be specified on the basis of special norms.

§ 13. The following shall be installed on the boiler or unit control board to regulate:-

a) Amount of duel delivered to the furnace.

b) Draft, amount of air supplied by f. d. fans and amount of primary air supplied to the mills (in case of schemes with direct blowing-in).

c) Steam temperature after the primary and secondary superheaters, and after separate stages of the superheaters when necessary.

d) Amount of feed water.

§ 14. The following means shall be installed on the boiler or unit control board to control :

a) Main steam damper.

b) Starting and stoppage of i.d., f.d. and primary air fans. (In case of two or more similar arrangements).

c) Valves for blow down of superheater.

d) Valves for emergency water discharge from the drum.

e) One or two impulse safety valves for exploding them in case of non-operation.

f) Closing gate before starting (firing) throttle valves, quick acting fuel closing gate by-pass valves at limiting washers to feed boilers at firings and emergency discharge valves (for concurrent boilers).

§ 15. The control of the following regulation means shall be made from the boiler servicing platform:

a) Amount of primary and secondary air supplied to each burner, or air supplied to every zone of the chain grate.

b) Air temperature at air preheater inlets.

c) Valve of boiler continuous blow down.

§ 16. All boiler control means shall have designations stating their purpose and position indicators.

§ 17. Boilers shall be equipped with continuously operating indicating control-measuring instrumentes installed on the control board of a boiler or unit to measure :

a) Pressure in the steam part of the boiler drum and before the closing organ at the outlet of the concurrent boiler, the instrument shall have a red line on the points of the scale, indicating the highest pressure which is permitted.

b) Water level in the drum.

c) Feed water pressure before regulating organs, on single-boiler single-turbine units feed water pressure is measured in the collector after feed pump.

d) Boiler steam output and feed water consumption.

e) Steam temperature on each steam pipeline after the primary and secondary superheaters.

f) Vacuum in the top part of each furnace.

g) Gas temperature after the last boiler heating surface.

h) Content of O2 or CO2 in the flue gas pass with temperature of not more than 600 °C.

i) Liquid or gaseous fuel pressure after regulating valves.

Superheated steam temperature in parallel steam pipelines, may be measured with one indicating instrument with a rotary switch. The same goes for measuring the other valves in parallel gas pipelines from both sides of the boiler.

§ 18. Boilers shall be equipped with following indicating control measuring instruments installed on the boiler or unit control board operating on the «on-call» principle with the help of switches or other means, to measure:-

a) Steam temperature before and after regulating devices.

b) Water consumption per each direct contact desuperheater.

c) Gas temperature in the reversing chamber.

d) Water level in the measuring starting device in concurrent boilers (starting on changing parameters).

e) Pressure of primary air in the main box.

f) Draft in the air preheater or measuring devices at the suction of every f. d. fan.

g) Vacuum before ash catchers and i.d. fans. when the boiler is controlled from the central thermal board or from the unit board. The instruments indicating vacuum before ash catchers and i. d. fans can be installed on the board near the boiler.

h) Current of i. d., f. d. and primary air fan and pluverized fuel feeder motors.

§ 19. Boilers shall be equipped with control measuring instruments installed on the main servicing platform, on separate boiler elements or on control board near the boiler to measure:-

a) Superheaters steam temperature at loop outlets, measured by surface thermocouples, as well as outlets of the loops in the outlet part of screen superheaters. Thermocouples shall be installed at each front loop with a spacing of one meter and on every screen. Thermocouples shall be installed on the first boiler of every new type (at every power station) with a superheated steam temperature of 510 °C and higher.

b) Drum wall temperature in 6 points in a high pressure boiler.

c) Gas temperature before the air preheater (for boilers using solid fuel), as well as air temperature in the air preheater inlet and outlet.

d) Gas pressure in each branching from the gas pipeline to the boiler after the regulating gate and the chamber of each gas burner.

e) Consumption of water supplied to the surface desuperheater.

f) Steam temperature at the outlet of each stage of the steam superheaters as well as before and after the water economizer (only bushings are installed to enable periodic measurement to be made).

g) Primary and secondary air pressure before each burner.

h) Mazout pressure and temperature in each branching from the mains to the boiler (bushings are installed to measure the temperature).

i) Pressure of steam used for mazout dispersion.

k) Pulverized fuel temperature in the intermediate bunker (for explosive fuels).

l) Air pressure before each zone of chain grate.

m) Water level in the clean section of the drum (with one upper water indicating instrument a control one) and in each salt section of the boiler drum with stage evaporation, level indicators are connected through independent stubs specially arranged for this purpose, besides, each boiler shall have two independent lowered water-level indicators, connected to the clean section of the drum, one of them shall be hydraulic. When cyclones are arranged, installation of water indicating instruments on them is not obligatory.

n) Water level in the measuring vessels for concurrent boilers operating with steam washing.

o) Quality of saturated steam for periodical analyses of boilers with surface desuperheater (sampling points only shall be provided).

Б. Boilers with an output of 20 t/h and higher shall be equipped with self-recording instruments to measure:-

a) Steam pressure after the steam superheater (before the throttle organ of steam-meter).

b) Steam consumption after the primary steam superheater.

c) Feed water consumption.

d) Steam temperature in each pipeline after the primary steam superheater (for boilers with a steam temperature of 400 °C and higher) as well as in each pipeline after the secondary superheater.

e) Temperature of gases after the last heating surface of a boiler unit.

f) Feed water temperature, when a group of boilers is fed from one source, measuring of the feed water temperature can be done on the main feeding pipeline with one self recording instrument installed.

g) O2 or CO2 content in flue gas pass with a temperature of not more than 600 °C

h) Salt content in superheated steam of boilers, having desuperheaters of direct and indirect contact types.

i) Salt content of the feed water in concurrent boilers.

j) Salt content of the water supplied to direct contact desuperheaters.

k) Salt content of the boiler water (at boilers where stage evaporation is not available and chemically treated water on the boilers).

l) water level in the boiler drum.

l) Gas consumption on the gas pipeline of each boiler. For boilers with an output of under 20 t h, gas consumption can be calculated for the boiler as a whole or for a group of three to four boilers.

All self-recording consumption measuring instruments shall be equipped with counters.

When self-recording instruments have an indicating scale, installation of separate indicating instruments to measure the same values is not required, provided self-recording instruments are installed on the boiler control board.

§ 21. Counters for measuring mazout consumption shall be

installed at boilers with an output of 110 t/h and higher. For boilers with an output of under 110 t/h, the measurement of mazout consumption can be done for a boiler room as a whole or for a group of three to four boilers. In case of installation of burners, regulated by drainage, a counter shall be installed at the drainage line.

At boilers where mazout is used as a firing fuel, consumption from each tank is used to calculate the total consumption.

§ 22. Boilers shall be equipped with the following automatic regulators :

a) Of feeding.

b) Draft and burning process for boilers with chamber combustion.

c) Steam temperature after the primary desuperheater (for boilers with steam temperature of 400 °C and higher) and after the secondary superhearters, and after their separate stages, when necessary.

When different kinds of fuel are burnt in the boiler (solid, liquid and gaseous), the boiler regulation from one kind of fuel to another shall be changed from the control board of the boiler or unit.

§ 23. Boilers with an output of 50 t/h and higher shall have the following interlockings:

a) In case of emergency trippings of all operating induced draft fans, the forced draft fans, primary air fans (when these are available) mill fans, pulverized fuel feeders, raw fuel feeders and mills shall be tripped, when gas or mazout is burnt, regulating organs shall be closed on the pipelines through which gas or mazout is supplied to the boiler.

b) In case of emergency trippings of all operating f. d. fans, pulverized fuel feeders, mill fans, primary air fans (when available in the scheme), raw fuel feeders and mills shall be tripped if gas or mazout are burnt,

the corresponding regulating organs on the gas or mazout pipeline shall be closed.

c) In case of emergency trippings of both mill fans (in a scheme with a primary air common collector) or one of them when the other is under repairs, all pulverized fuel feeders, raw fuel feeders and mills shall be tripped, in a scheme with separate primary air boxes having a separating screen or gates, in case of emergency trippings of one mill fan, the corresponding groups of pulverized fuel feeders, raw fuel feeders and mill shall be tripped, when pulverized fuel is transported by hot air, tripping of pulverized fuel feeders, when mill fans are tripped, is not done, in scheme with primary air fans pulverized fuel feeders shall be tripped.

d) When a mill or mill fan is tripped, the corresponding raw fuel feeder shall be tripped and the valve on the drying agent pipeline to the mill shall be closed.

e) When hammer or medium speed mill is over loaded, raw fuel feeder shall be tripped. At boilers operating on gas interlocking for stopping gas supply after i. d. fans or f. d. fans stop shall be provided irrespective of the boiler output.

§ 24. Boilers with an output of 50 t/h and higher shall have the following protections :

a) In case of load rejection-protection operating from an impulse of increased pressure in the boiler; which correspondingly decreases fuel supply to the combustion chamber.

b) In case the highest permissible level of water in the drum has been exceeded-protection operating after the level goes up, which opens valves on emergency discharge of water from the drum. If the level continue to rise, this protection must stop the boiler, with induced draft fans left in operation.

c) In case of water reaching the superheater-protection operating from an impulse of sharp decrease of the

superheatered steam, steam temperature in the intermediate point of the superheater, which decrease fuel supply to the furnace and opens the valves for blowing down of the superheater. If the steam temperature falls below the permitted value, this protection shall stop the boiler, with i. d. fans remaining in service.

d) At short water level drop in the boiler drum-protection operating from an impulse of water level in the boiler falling lower below the permissible value, speficied by the manufacturer, which stops all boilers auxiliary equipment, except i.d. fan, and shuts down the boiler.

e) Tubes of the economizer, transition zone, lower radiant section and in the rest of the water-steam section of a concurrent boiler protection, stopping the boiler.

f) When the feed water supply to concurrent boilers is reduced-protection operating from an impulse of feed water supply drop to 20% confirmed by pressure dropping after the regulating valve with a time delay of 30 sec. which stops boiler.

g) When flame stability is distribued (at coal dust boilers) protection, switching on mazout burners, when the flame is lost the protection shall trip (with a time delay) f. d. fans automatically, other interlocking shall then disconnect all auxiliaries, except i. d. fans.

§ 25. Boilers shall have the following signalling systems on the boiler or unit control board:-

a) Of highest and lowest permissible water levels in the drum.

b) Of feed water pressure drop in the boiler room (or in the unit).

c) Of minimum permissible temperature of superheated steam.

d) Of maximum permissible temperature of superheated

steam (for boilers with a steam superheating of 540°C and higher).

e) Of disappeared level in measuring vessels of concurrent boilers.

f) Of gas pressure drop in the boiler rooms, where gas is used as the main fuel.

BOILER ROOM OPERATION

§ 26. Boiler room equipment shall be operated in accordance with local instructions.

§ 27. Newly commissioned boilers with natural circulation with a pressure under 100 ata. shall be washed with alkaline with a further internal inspection and cleaning. Boilers with a pressure of 100 ata and higher, irrespective of their type, shall be washed by alkaline-acid or hydrazine-acid before commissioning, with a further internal inspection and cleaning.

Protection of boiler elements made of austenite steel shall be secured.

Internal inspection of a boiler shall be stated in a protocol after chemical washing and alkaline washing.

§ 28. Before firing, the boiler unit and the pipelines belonging to it, shall be inspected to check their condition, a stand-by boiler shall be kept ready for firing and inspected once every shift.

§ 29. Mechanical mazout burners shall be checked on a testing platform with water before installed in order to check the quality of spraying.

§ 30. Before firing, the water level in the boiler drum shall be at the lowest mark of the water-indicating gauge. Air valves shall be opened at the upper points of the boiler.

When a high pressure boiler, which has not cooled down is being filled, the temperature of the water after the water economizer shall not differ much from temperature of the boiler drum body.

Before firing, the blow down system of the superheater shall be opened.

§ 31. Control of the water level in the drum shall be carried out from the start of the firing. Blowdown of the upper water-indicating gauges shall be carried out as follows :

— For medium pressure boilers, when the pressure in the boiler is about 1.0 ata., a second blow down is made before connecting them to the main steam pipeline.

— For high pressure boilers, when the pressure in the boiler is about 3. ata., a second blowdown is made when the pressure reaches 15 to 30 ata.

Switching over to control of the water level in the drum by lowered level indicators is carried out only after their readings coincide with those of water level gauges.

§ 32. Before firing, the fuel gas pass of the boiler shall be ventilated with i. d. and f. d. fans for at least 10 min, when using gas and mazout. Ventilation of gas passes when other fuels are used, is made with an i. d. fan only for at least 5 min.

§ 33. When a boiler, using gas, is being prepared for firing connected section of the gas pipeline shall be blown down through a vent line.

§ 34. When boilers operating on gas or mazout are being fired induced and forced draft fans shall be in service from the start of the firing.

§ 35. Period between the beginning of the cold start up and the moment when the boiler is connected to the steam main, shall be specified in instructions for a given boiler, with specific features of equipment design taken into account.

§ 36. When a boiler is started from cold, thermal displacement of drums and collectors shall be observed from the installed bench marks.

Boiler firing shall be carried out in such a way that the heating surfaces located in the surface would be heated uniformly.

Water walls shall be blown down through lower points when a boiler is fired or shut down.

§ 37. In case certain works were made in the boiler prior to its start-up, in which flange connections and manholes were disassembled, the bolted joints shall be tightened at a pressure of 3 to 5 ati. Bolt tightening at higher pressure is prohibited.

§ 38. Boilers shall be connected to the main steam pipeline only after through warming up and draining of the connecting steam pipeline. Pressure in the boiler drum at the time of connection shall be approximately equal to that of the main steam pipeline.

Warming up of high pressure steam pipelines, made of perlite and austenite steel, shall be done in accordance with special instructions.

§ 39. When the operating pressure is reached, the boiler unit shall be insperted so that possible leackage, steaming and other visible defects could be detected, special attention shall be paid to the tightness of draining and blowdown fittings.

§ 40. When a boiler operating on gas, is stopped, the gas pipeline of the boiler shall be disconnected from the gas mains, after all burners have been closed, blowdown line at the outlet shall be open, furnace, gas passes and air supply lines shall be ventilated.

§ 41. When steam is not longer supplied from a boiler with natural circulation, it shall be disconnected from the superheated steam pipeline and after the pressure is brought down, it shall also be disconnected from the auxiliaries steampipeline. Simultaneously with the boiler disconnected from the main steam pipeline, superheater blowdown system shall be opened so that it would cool down. Order of disconnection of the boiler and steam pipeline and period of the blowdown is specified

in instructions for a given boiler. It is prohibited to keep a non operating boiler connected to the steam main.

§ 42. Drain of water from the boiler, it is stopped, is permitted if the water temperature does not exceed 70° to 80°C, if there are no rolled joints draining of water from the boiler is permitted only after the pressure in the boiler is equal to the atmospheric pressure.

§ 43. When boiler is stopped and withdrawn for reserve (when it operates on gas and after furnace, gas passes and air supply lines), all gates, man-holes and guide apparatus of induced and forced draft mechanisms shall be closed tightly to keep heat losses to a minimum.

§ 44. When the boiler is taken out of operation, measures to protect it from corrosion shall be taken. Selection of anticorrosion protection methods will be specified in the instructions in which account is taken of local conditions.

§ 45. After a concurrent boiler has been stopped and has cooled down, it shall be washed with water.

When a boiler is stopped for purposes other than repairs, the boiler shall be filled with the deaerated water and conserved after its washing.

When the boiler is stopped for repairs and the water is drained, boiler conservation shall be practised so that a protective film on the internal surface of the boiler would be deposited.

Boiler washing and conservation shall be carried out in accordance with instructions for a given boiler.

§ 46. It is prohibited to have a boiler unit without supervision before the pressure drops down completely and electric motors are deenergised.

§ 47. If there are two feed mains in the boiler room, both of them shall be under pressure.

If there are two feed lines between the mains and boiler, one of them shall be used for feeding, the second being in reserve under pressure, control valve being closed, all closing organs of the reserve line shall be opened compeletely. Water passage through the closed regulating feed valve shall not exceed 10% of rated load of the boiler. When there is only one feed line, a valve of small diameter with a set of limiting washers, to feed boiler at the time of firing, shall be installed on the feed line in parallel to the main regulating valve.

There shall be provided the possibility of quickly bringing the reserve feed line into service from the operator's working place.

§ 48. Blowing off, shot cleaning, removal of slag and other operations to clean the heating surfaces of a boiler unit from the gas side, shall be carried out in accordance with instructions for a given plant.

§ 49. If there are deposits on the internal heating surfaces of drained, boiler conservation shall be practised so that a protec- a boiler unit, they shall be removed mechanically or chemically.

Whether a boiler is in a state of dirtiness will be decided on the basis of periodical inspections of the internal heating surfaces, with sample cuts made. Method and time of cleanings depends in each particular case on the boiler design, nature of deposits, etc.

§ 50. Permitted steam temperature at the outlet from each stage of the primary and intermediate superheaters at the time of firing and boiler operation shall be given in the instructions for a given installation on the absis of the manufacturing data or results of calculations and tests.

§ 51. Temperature of the air, when boilers operate on sulphurous fuel, at the entrance to the main airheater shall be kept at the level, at which heated surfaces are protected from corrosion and ash choking up. This temperature is based on the corrosion characteristics of flue gases of a given fuel.

§ 52. Air suction in the gas path between the outlet from superheater (at a point with a temperature of not more than 600°C)and the outlet from the induced draft fan for plants having no ash catchers, shall not exceed the following values (in percentage to the quantity of air theoretically required) for boilers with an output of.

— up to 75 t/h	12 per cent
— between 75 and 230 t/h	8 per cent
— over 230 t/h	5 per cent.

For boilers having ash catchers, the air suction corespondingly increases :

By 10 per cent (absolute) when electric filters or two — stage ash catchers are installed.

By 5 per cent (absolute) when cyclones or on ash satchers are installed.

§ 53. Control of the air sucked to the gas path of a boiler unit, shall be exercised by inspecting the installation when taking over the shift and by means of control gas analyses made at least once a month, as well as before and after maintenance and overhauling.

Elimination of untight spots in the furnace and gas path, shall be carried on with the boiler in operation (wherever possible), and when the boiler is shutdown.

§ 54. The tubes of superheaters operating at a temperature of 450°C and higher shall be checked periodically for residual deformation growth in conformity with existing instructions.

§ 55. The upper limit of the water level in the boiler drum (which, if exceded at rated load and adopted salt content limits, will lead to a deterioration of the steam quality) is determined on the basis of operation experience and tests. The lowest level is specified by the Manufacturers.

§ 56. The boiler shall be stopped immediately (if the protections are not available or failed to operate) in the following cases :-

a) If the water level drops lower than that required for reliability of the boiler and if it rapidly goes down, although the boiler is fed.

b) When the water level increases to the second fixed limit and when it is impossible to decrease the level quickly by opening the emergency discharge valves, as well as when the water reaches the steam superheater, which causes a sharp drop of temperature below the permitted value.

c) When a wall or generating tube bursts, the feeding of the damaged boiler shall be stopped.

d) If a steam pipeline, or feeding pipeline bursts,

e) When frame supporting beams are heated to red heat, bricking up collapses or other damage dangerous for the personnel or equipment occurs.

f) When a fire starts in the rear areas of the flue gas pass, which is indicated by abnormal increase of outgoing flue gases. temperature.

g) When all water gauges have failed.

h) When all feeding pumps have failed.

i) When induced circulation pumps for boiler water have failed.

§ 57. The boiler shall be stopped if the following faults are discovered :

a) Leaks in rivet and flange connections.

b) Leaks in rolled joints of tubes of the boiler water walls, water economiser, and surface overheating regulators.

c) Leaks in tubes and welded joints of the boiler, transitional zone, superheater, and water economiser.

d) Collapse of insulation from tubes, collectors and drums

heated by furnaces gases, collapse of insulation from steam pipelines made of austenite steel.

e) Cracks in steam pipelines.

f) Higher temperature of the cutlet part of concurrent boiler heating surface loops than otherwis statedin instructions for a given installation, if the temperature of the these loops cannot be brought down by changing the conditions of the boiler furnace or boiler feeding

g) If deviations are found from the feed water quality norms specified by instructions for a given installation. The period of outage is determined by station chief engineer.

§ 57: Boiler operation conditions shall correspond to the loading conditions chart based on test results.

§ 58. The most efficient distribution of the power station load among operating boilers, shall be based on their economical characteristics. A sequence of starting and loading of separate boilers at different loads of a power station shall be established.

§ 59. The operation tests of the boiler shall be carried out in the following cases :

a) After a major overhaul.

b) After modifications are made or when switching over to another type of fuel.

c) When actual parameters deviate systematically from the normal ones, the causes of this phenomena requiring clarification.

The scope and programme of the tests shall be approved by station chief engineer. Modified loading conditions charts shall be made or changes in the available charts shall be made on the basis of the results of the tests.

Feed regulators shall be tested for load rejections and thrusts after major over hauls of the boiler.

Thermal protection shall be tested in the terms approved by station chief engineer.

MAINTENANCE OF BOILER ROOM EQUIPMENT

§ 61. Overhauls of the boiler unit shall be carried out once a year or every two years. The period between two overhauls can be increased with the permission of the system chief engineer, if the boiler in its present condition can secure reliable operation in future. Maintenance shall be carried out whenever required, but at least once a year.

Small defects revealed during the boiler unit operation (dusting, steaming, suckings, mechanism vibration, formation of slag in furnace etc), shall be eliminated while the unit is kept in operation, if the safety rules permit that. If the safety rules prohibit the execution of the above-mentioned works, the boiler shall be shut down for maintenance.

§ 62. Pressing of the boiler shall be done in accordanse with the corresponding rules of pressing before and after major overhauls as well as before and after maintenance requiring works on the boiler element operating under pressure.

§ 63. When works are carried out inside the boiler drum or in the concurrent boiler separator, all pipelines, steam pipelines feed and drain lines connecting the boiler with the other boilers or steam collectors, expanders and drain pipelines shall be closed with blind flanges.

High pressure boilers can be disconnected by two consecutive gates with the opening of the atmospheric valve between them with a diameter of at least 32 mm, gates and valves shall be locked with chains having locks, and posters « Do not switch on men at work» shall be placed on.

§ 64. If work is to be carried out inside the furnace, gas pass and air supply line of the boilers to which gas supply is connected, the gas line branchings to the boiler shall be closed, induced and forced draft fans shall be switched on for 20 minutes to secure reliable ventilation of the furnace, flue gas pathes, and

air supply line, other measures shall be taken in accordance with the Safety rules.

§ 65. 12 V. electrical bulbs shall be used as source of light when work is carried out inside the furnace, gas pathes, and air supply line.

§ 66. When carrying out major overhauls and maintenance of a boiler unit, the steam superheater, wall and economiser tubes shall be checked to prevent possible accidents due to residual deformation increase, different types of corrosion, deposits and ashtar. At the same time the furnace, gas pathes and air preheaters shall be tightened, the tightness shall then be checked, supporting constructions, suspension brackets and compensators