RELIABILITY AND MAINTENANCE IN POWER SYSTEMS

by: Eng.ABDEL MONEM M.ABDEL HAMID
General Director,
Information Dept., E.E.A.

Reliability and Maintenance
in
POWER SYSTEMS

Power system

Local power system (isolated power stations) unified power system (connected power stations)

Types of power stations

(1) Hydro-electric power station

Cost of energy is composed of standing charges consist of interst on capital cost and depreciation , salaries and wages repairs and Maintenance Cost. No fuel cost .

(2) Thermal power station

a- Steam power station
b- Gas Turbine power station
c- Diesel power station

The standing charges is the same .
The running charges consist of fuel.
In fact Maintenance Cost is considerable amount, to increase the thermal efficiency the combined cycle is introduced .

The most important Factors controlling Generation of electric power are :-

1- Performance
2- availability
3- Reliabilty

This can be achieved by proper Maintenance.

EFFECTIVE MAINTENANCE

REQUIRES

A SYSTEMATIC APPROACH

IN

PLANNING

AND MAKING THE BEST USE OF

EXPERIENCE

RESULTING IN

INCREASED
OPERATIONAL
-RELIABILITY
-AVAILABILITY
-PERFORMANCE

AND IN THE LONG RUN

IMPROVED DESIGNS

THIS IN TURN GIVES RISE TO

INCREASED PRODUCTIVITY

INCREASED INCOME

AND

REDUCED MAINTENANCE REQUIREMENT
=
REDUCED COSTS

THAT IS TO SAY

INCREASED PROFITABILITY

AND

IMPROVED WORKING CONDITIONS	GREATER PERSONNEL SAFETY	FEWER STRESSES	LESS ENERGY CONSUMPTION

COSTS OF MAINTENANCE

In different activities there may be different views as to which costs are to be regarded as maintenance costs. In general, the following costs are considered under this heading:

WAGE COSTS	WAGE COSTS of the employees carrying out maintenance work.
MATERIAL COSTS	Costs of LUBRICATING OILS, PAINTS, PACKING MATERIAL and OTHER MATERIALS used in connection with maintenance work like spare parts.
ADMINISTRATIVE COSTS	ADMINISTRATIVE COSTS, i.e. costs of installing and servicing systems, follow-up systems, etc. required for maintenance purposes.
COSTS OF PREMISES AND EQUIPMENT	Costs of PREMISES, EQUIPMENT and AIDS used by the maintenance department.
PURCHASED SERVICES	PURCHASED SERVICES, i.e. costs of work carried out by outsiders (persons and companies).
CONVERSION COSTS	CONVERSION COSTS, i.e. costs of conversions intended to reduce, simplify or eliminate maintenance.
DIRECT MAINTENANCE COSTS	The above costs are what is generally meant by maintenance costs or DIRECT MAINTENANCE COSTS.
INDIRECT MAINTENANCE COSTS	Loss of income brought about by plant closures, etc. due to maintenance are often regarded as INDIRECT MAINTENANCE COSTS. A breakdown can in certain cases lead to enormous losses particularly in the process industries and ships. If a relatively large tanker loses a day, the losses can amount to well over £10,000. If a paper machine breaks down the costs.

may even reach over a thousand pounds per hour. Besides, breakdowns often entail high repair costs. Extensive dismantling may be necessary in order to deal with faults of a relatively simple nature.

THE MAINTENANCE CYCLE

The maintenance work should be so designed as to ensure that the organization, the systems and the working methods are efficient. The figure below illustrates the cycle according to which all maintenance should be carried out, in a readily understandable manner.

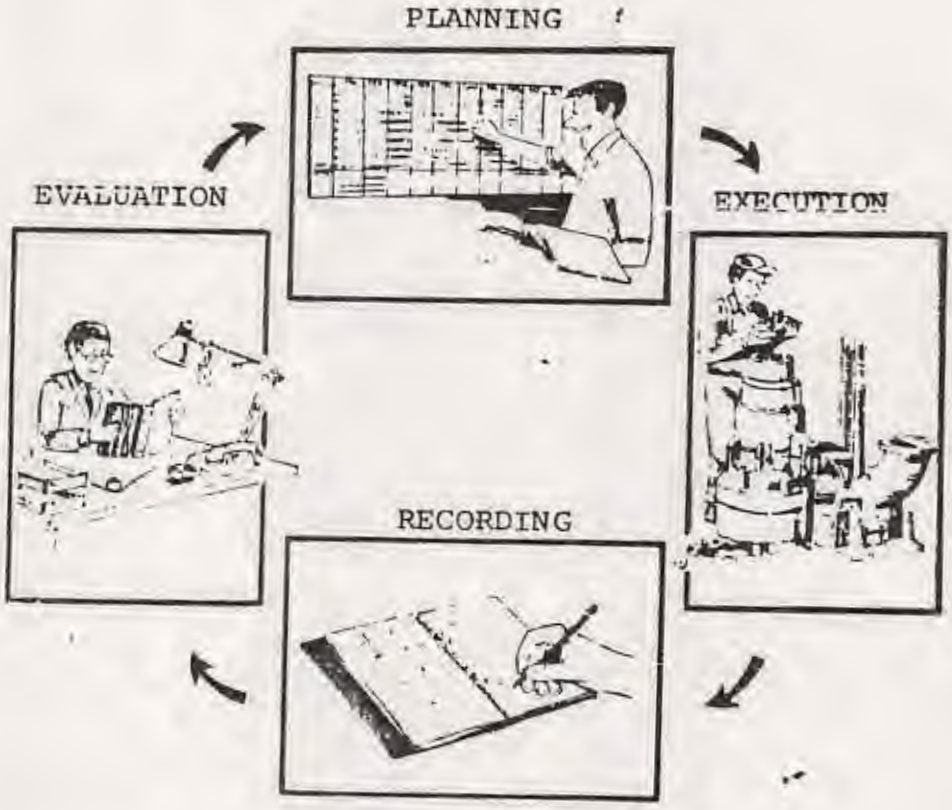


Fig. 1-2 The maintenance cycle

This cycle applies in all cases but it stands to reason that the methods of planning, execution, recording and evaluation may vary from case to case.

TYPES OF FAULT

Inspection can lead to considerable advantages but it should also be borne in mind that many fault arise under conditions or develop in such a way that they cannot be detected at a sufficient early stage by inspection.

RANDOM FAULTS

Faults may be RANDOM or REGULAR. RANDOM FAULT occur in such an irregular manner as to make their prediction impossible. A random fault may, for instance, be due to an unforeseen overhead.

OBSERVABLE RANDOM FAULTS

The OBSERVABLE RANDOM FAULTS take a certain time to develop, and provided that the intervals between inspections are shorter than this time such faults can often be discovered by inspection. If the time required for the development of the fault is short, it may be advisable, in the case of important components, etc., to provide for continuous supervision.

NON-OBSERVABLE RANDOM FAULTS

RANDOM FAULTS WHICH CANNOT BE OBSERVED not develop over a period of time, and it is therefore impossible to detect them by inspection. Only one thing can be done in order to prevent such fault from occurring again in future: they must be recorded and their causes must subsequently be analyzed with a view to improving the design or mounting of the machine concerned. Non-observable random faults may be to faulty materials, faulty control, out [illegible] etc.

REGULAR FAULTS

The REGULAR FAULTS develop in stages [illegible] with a known and/or recordable sequ[illegible] be due to wear, changes in material [illegible] tion, crystallization and other cause[illegible]

Also regular faults can be sub-divide[illegible] observable and non-observable faults.

OBSERVAB REGULAR FAULTS

OBSERVABLE REGULAR FAULTS can be detected by inspection since it is possible to ensure that the intervals between successive checks are not too long. The intervals between inspections are decided in accordance with the fault development time. Examples of observable regular faults are wear of runners and sealing rings of pumps, compressor valves, engine cylinders, etc. It is however relatively rare for a fault to develop in an absolutely regular manner. After all, even regular observable faults depend on variables such as lubricating oils, fuels and impurities.

NON-OBSERVABLE REGULAR FAULTS can only be prevented by programmed replacement or repair.

The figure below shows, in a simple way, the various types of fault and appropriate measures.

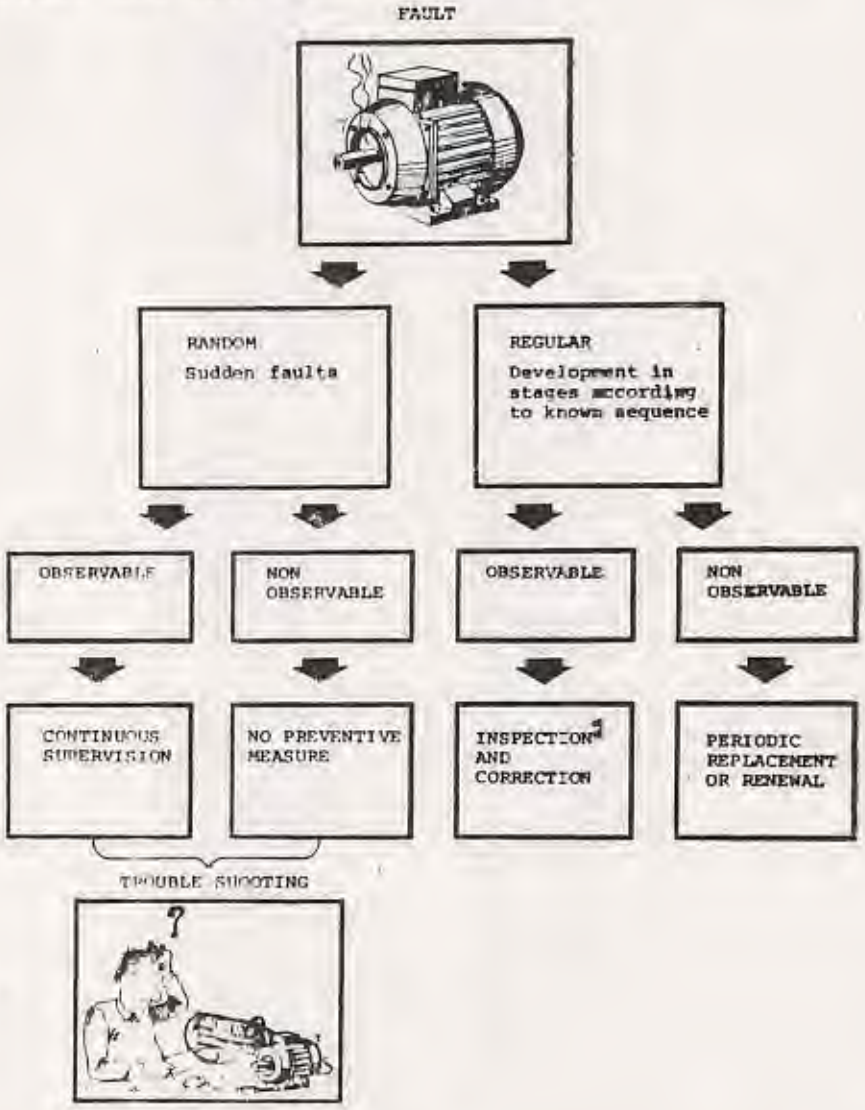
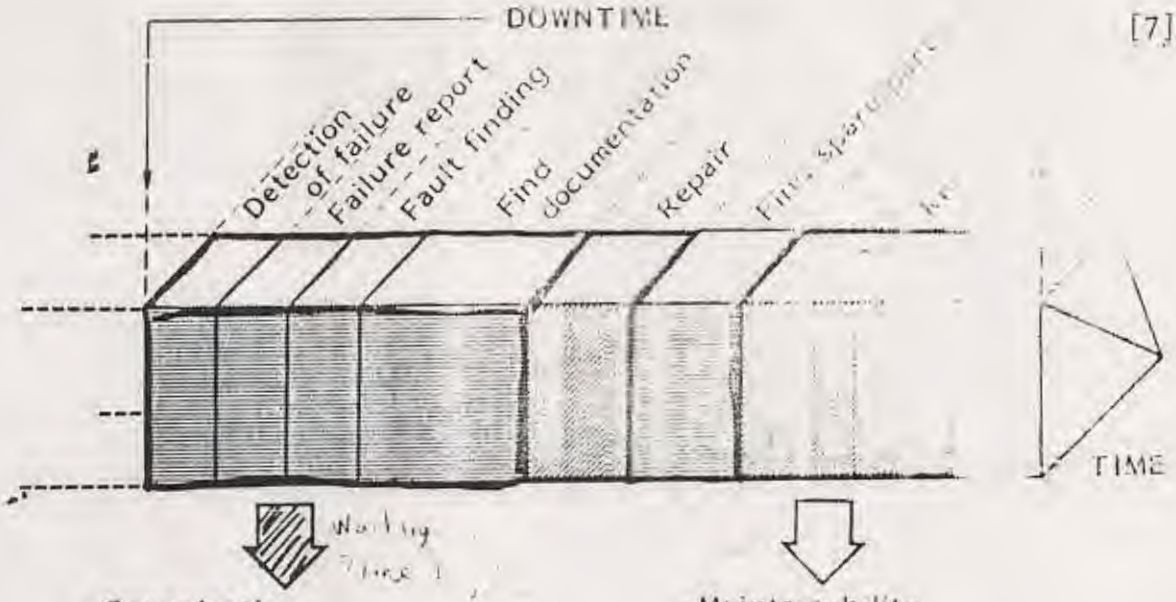
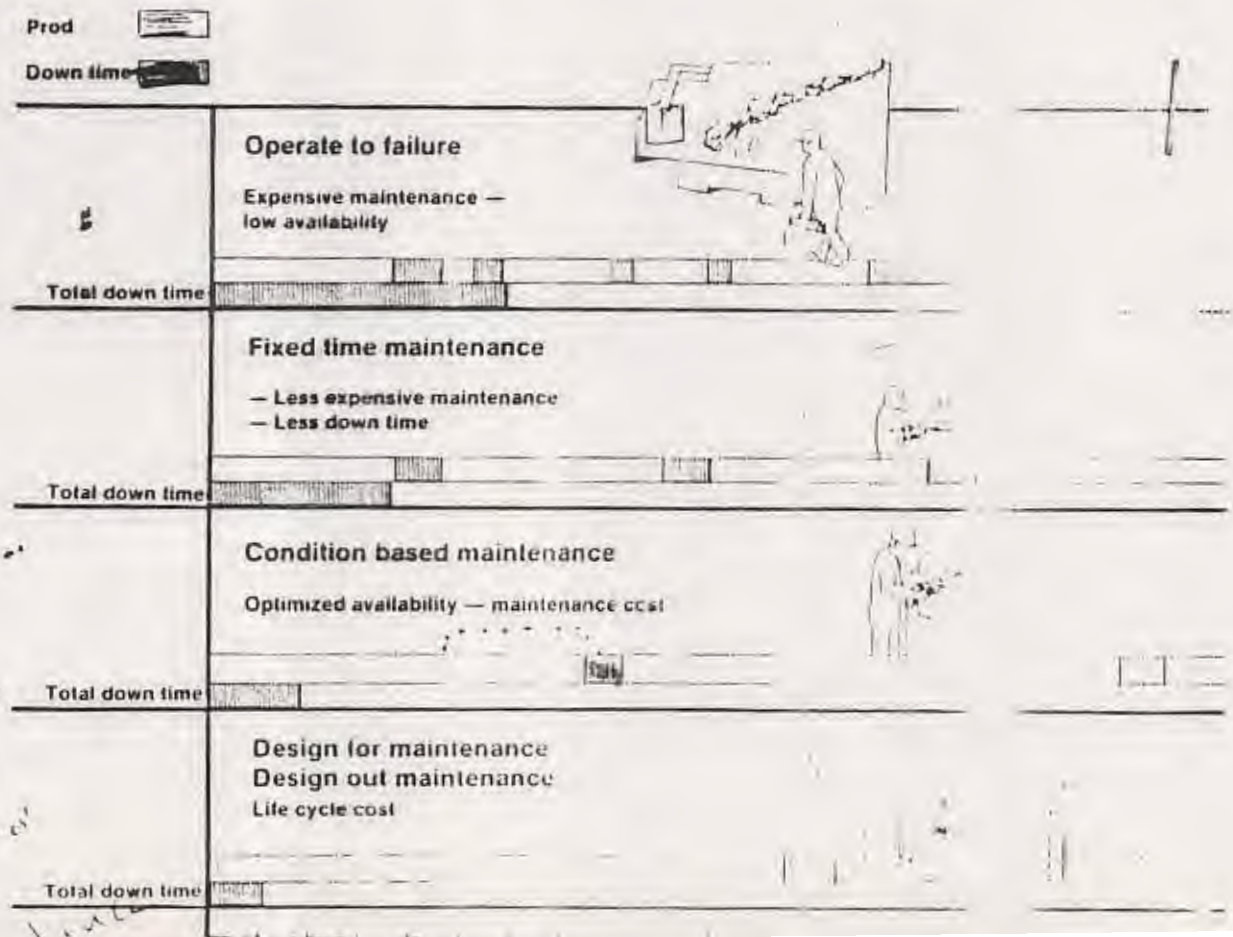


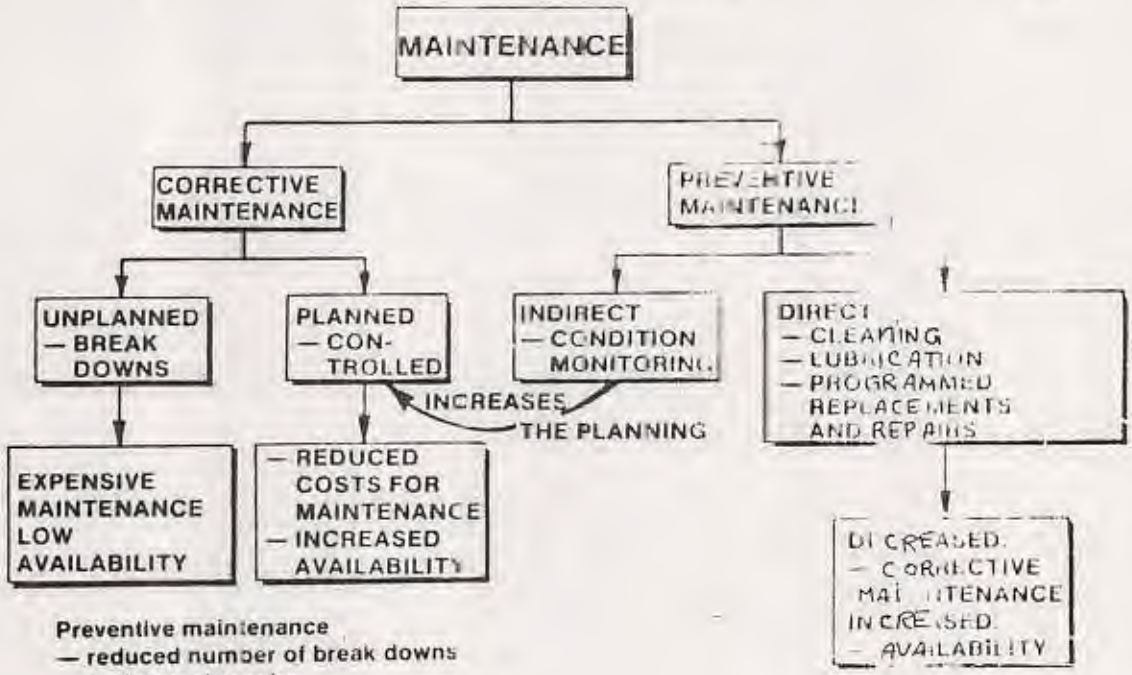
Fig. 2-7



-Organization
-Routines
-Trouble shooting chart
-Document record
-Inventory control system
-Unit record
-Training
etc

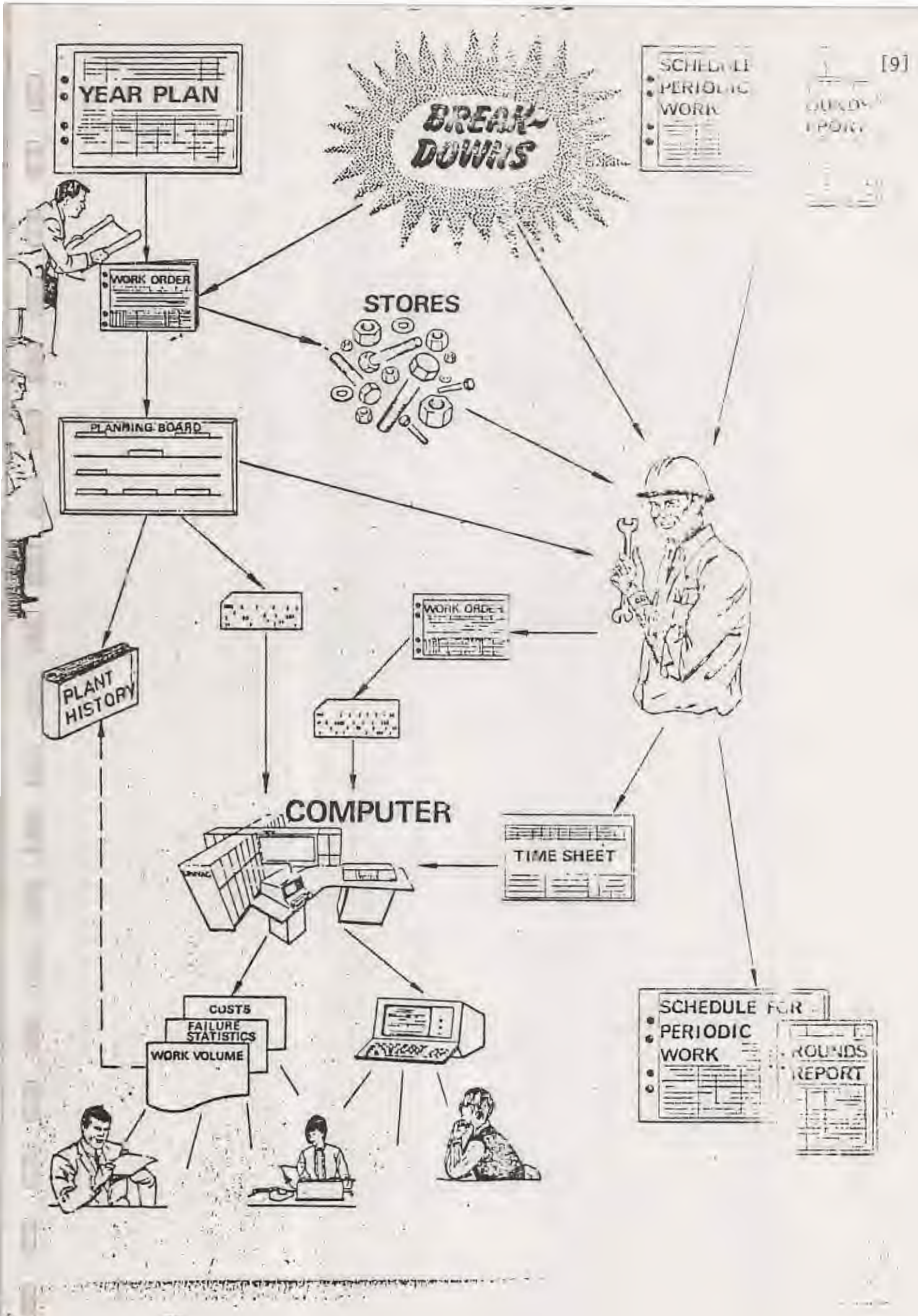
-Maintainability
-Tools
-Training
etc





Preventive maintenance
- **reduced number of break downs and urgent repairs**
- **more planning and control of corrective maintenance**

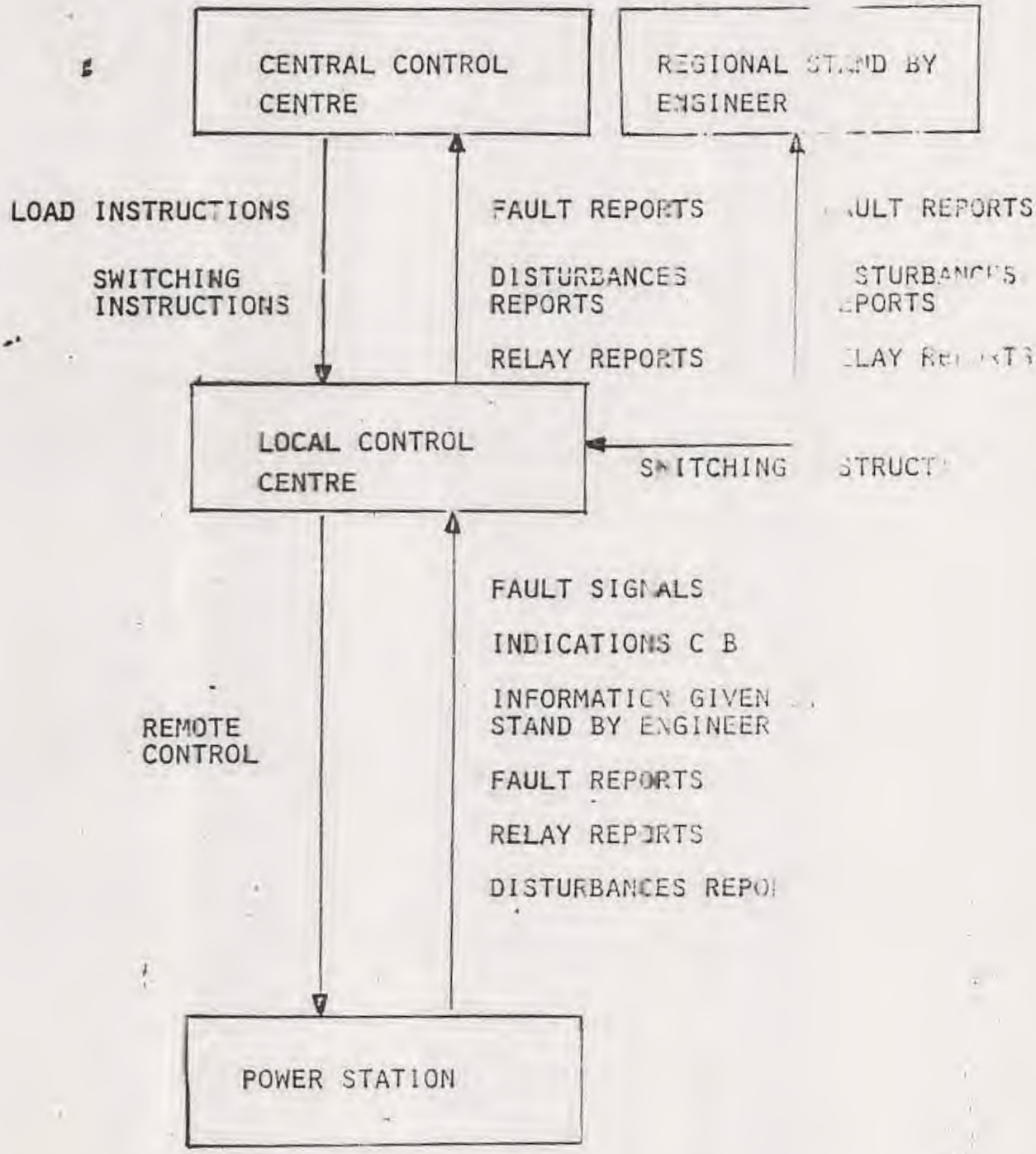
RESULT
- **INCREASED AVAILABILITY**
- **DECREASED COST FOR MAINTENANCE**


YEAR PLAN
BREAK-DOWNS
SCHEDULE
PERIODIC
WORK
WORK ORDER
STORES
PLANNING BOARD
WORK ORDER
PLANT HISTORY
COMPUTER
TIME SHEET
COSTS
FAILURE STATISTICS
WORK VOLUME
SCHEDULE FOR
PERIODIC
WORK
ROUNDS
REPORT

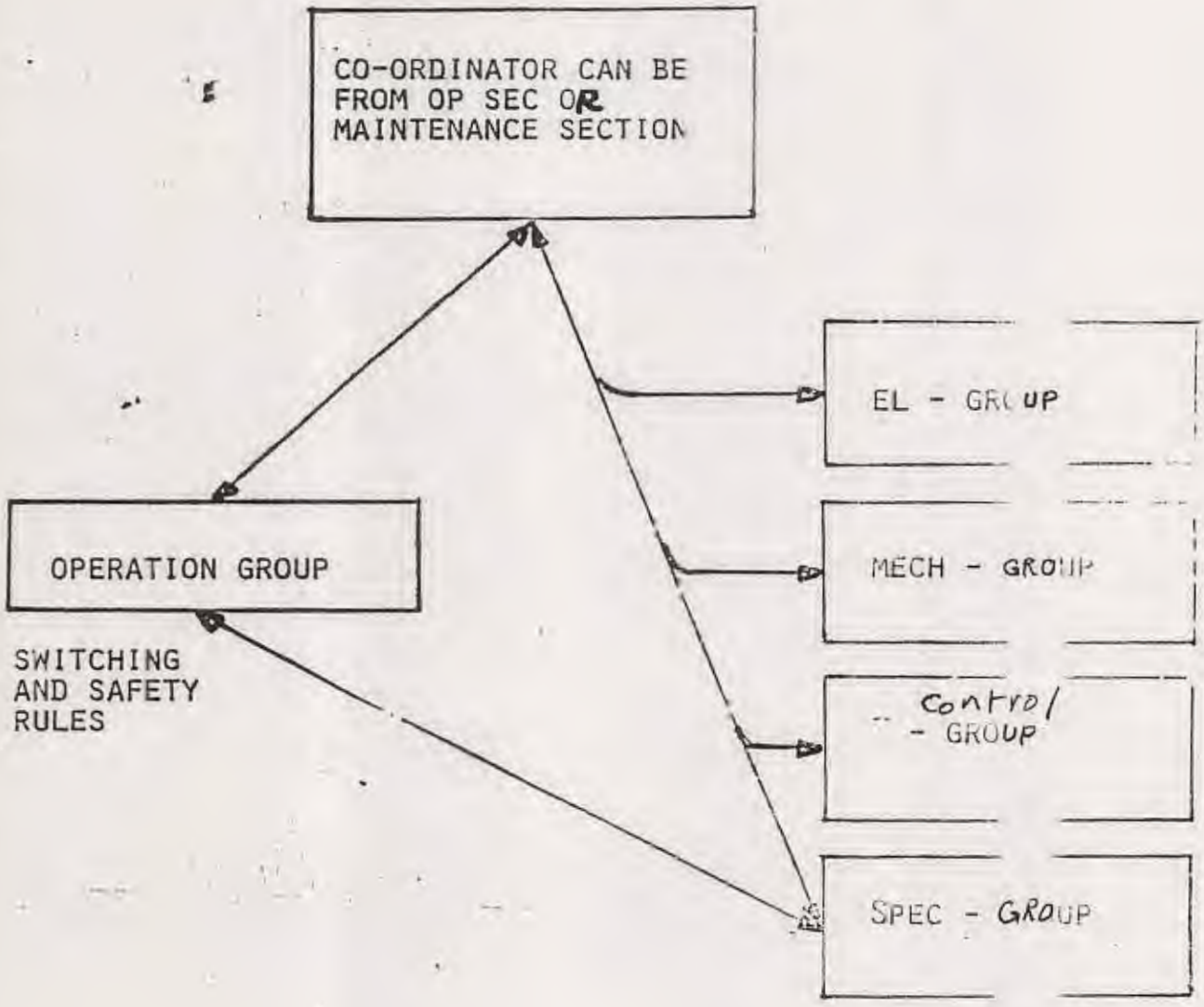
Maintenance Work

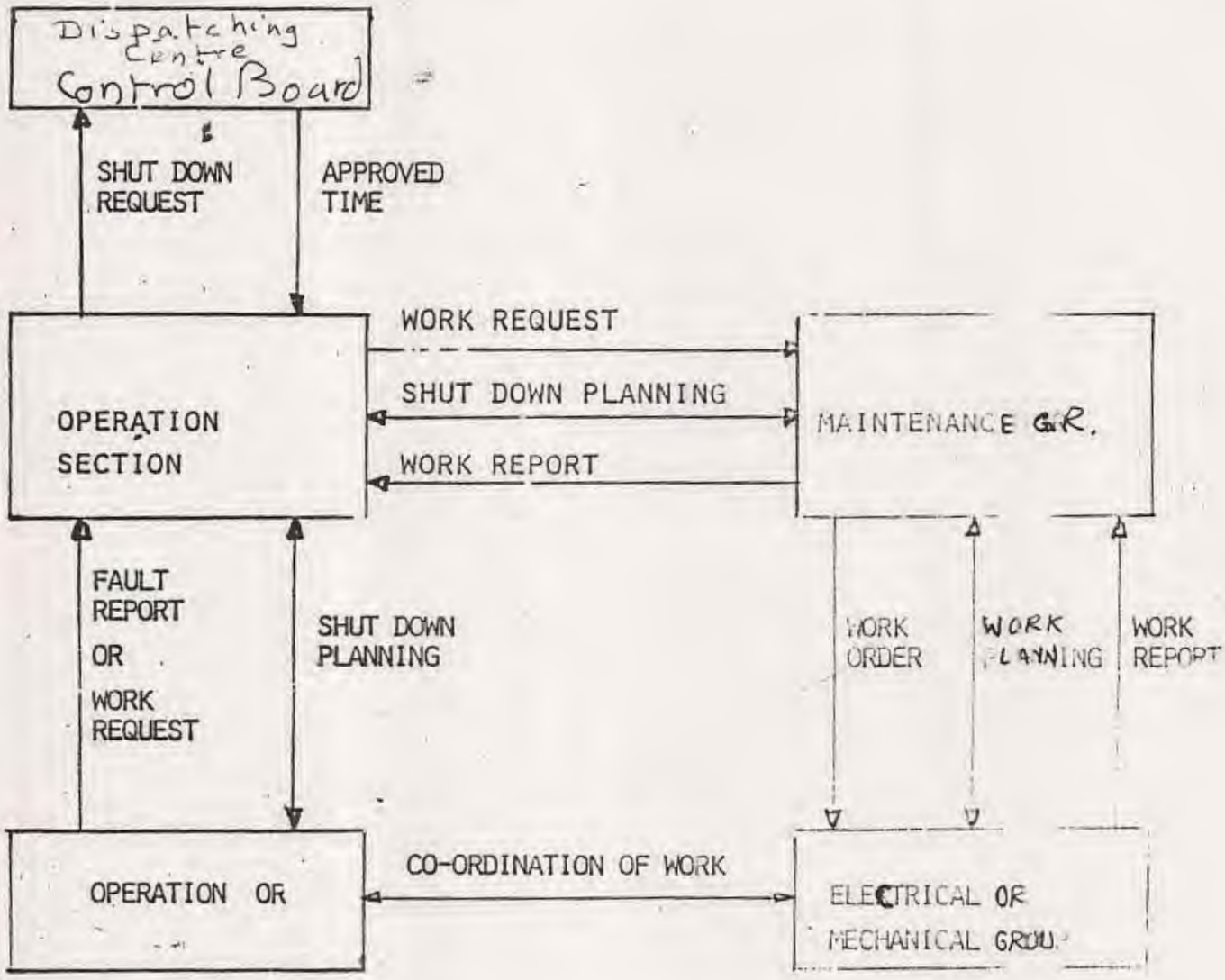
Work Sequance Routines

Clearing a Fault



Carrying out of Maintenance work In Power System



THE CO-OPERATION BETWEEN THE OPERATION GROUP AND THE C GROUP DUE TO THE SAFETY RULES AND THE FACT THE WORK CARRIED T CAN AFFECT OTHER PARTS IN THE PLANT ON BAR.

Power system Operation and Maintenance