



In the present era, electricity is an important raw material for socio-economic development of mankind. The per capita use of electrical energy of a country influences the standard of living index of the people to a great extent. It is difficult to conceive a comfortable and purposeful life style without electricity. Electricity has become a common essential day-to-day commodity for most people irrespective of position, place, time and field of work. It is, therefore, necessary to make a gateway for entry - of an efficient and effective management strategy - into the electrical sector with respect to planning, construction, production, maintenance, and utilization activities. Uninterrupted, reliable, and quality electrical power production in a system, mostly depends upon the performances of the generating sets available; and the performance of a generating set is largely affected by its maintenance schedule. In this paper the efficient and effective management strategy required and to be adopted during maintenance, especially during capital maintenance of large hydro generating sets has been discussed; although the short duration routine maintenance activities like daily/ weekly/ monthly maintenance, play a vital role to keep the set in good working condition.

Advantages of Maintenance

The maintenance of any machine/ equipment is necessary for:

- Rendering trouble-free/ reliable service;
- Minimizing forced shutdown period, thereby increasing production;
- Enhancement of life period of the equipment;

- Helping timely procurement of spare parts and consumables of good quality at competitive prices;
- Assessment of future behavior of the machine.

Categories of Maintenance Work

Considering the intervals taken for such work, the type of maintenance may be categorized as--

Daily/ Weekly:

This is usually called routine maintenance, which does not require shutdown of the machine;

Monthly/ Quarterly:

This type of maintenance work requires shutdown of the machine for a short period of about 3/5 days;

Yearly:

These three-or-five yearly maintenance work is required for overhauling/ repair/ special repair of the equipment, and a longer shutdown of the machine is required each time. Such maintenance work is usually styled as capital, special or major maintenance. In the forthcoming

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paragraphs, we shall be mainly dealing with the various aspects of capital maintenance pertaining to high capacity hydro generating sets.

Maintenance Planning

Before taking up such work, a maintenance planning programme is essential to achieve the target in satisfactory time. During the planning stage, the following activities have to be carried out:

- Collection of literatures, manuals, drawings standards etc. of the machine for which maintenance is programmed;
- Study of drawing manuals by qualified, and experienced technical personnel.
- Preparation of estimates, and arrangement of funds;
- Procurement of spare parts, consumables, tools and plants etc.
- Keeping readiness of the departmental workshop, and making necessary arrangements with outside agencies to meet the maintenance work schedule on time.
- Arranging for skilled, semi-skilled workmen, specialists, experts (from the manufacturers source whenever felt necessary).
- Identification of various activities, and preparation of work schedule/ programmes;
- Discussions with senior/ experienced executives, specialists, experts etc;
- Identification of critical activities.
- Appraisal/ Consultation regarding programme, methodology and procedure with skilled workmen, and allotment of works/

responsibility to workmen/supervisors.

- Co-ordination with other agencies, outside/ inside the organization for infrastructure requirements such as Power Supply/ Cranes/ Transport facilities etc.
- Arranging shut-down of the machine in consultation with SLDC/RLDC.

Sequence of Activities

The entire maintenance work of plant or machinery is required to be carried out in the following sequence :

Dismantling

This activity of dismantling of various parts and components of a plant or machinery considered for maintenance work, involves the following jobs:

- (i) Initial measurement of various parameters and recording them properly before dismantling;
- (ii) Identification and preservation of matching marks, signs etc. on the components of the plant/ machinery;
- (iii) Numbering of the components by punching or by some other means.
- (iv) Cleaning and storing of the components carefully, to avoid any distortion, damage or loss;
- (v) Special care for preserving the sophisticated, costly, and scarce items;
- (vi) Use of proper size/ capacity tools and tackles in the process of dismantling.

Repair and Maintenance Work

After dismantling is over, the repair and maintenance work of the

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plant/ machinery are taken up. This repair and maintenance work consists of cutting, grinding, scraping, welding, and replacement of spare parts etc. While carrying out the above work the following points require proper attention:

- (i) Use of superior quality and reputed make of consumables and spares;
- (ii) Application of appropriate technology/ methodology;
- (iii) Employment of skilled supervisors and workmen who have adequate experience and knowledge in the relevant filed;
- (iv) Use of proper size, quality, and capacity of tools.

Assembly and Stage-testing

This stage of activity is very important, and performance of the plant and machinery depends upon accuracy and care taken during the assembly of various components and sub-components.

During process of the assembly, the following few points may be observed:

- (i) The Assembly of the components should be done in proper sequence with respect

to the matching marks/ drawings.

- (ii) The accurate measurement of the various mechanical and electrical parameters should be taken and recorded during the process of trial assembly, as well as during final assembly of components and sub-components.
- (iii) Stage tests are to be carried out invariably after completion of each stage of assembly.
- (iv) The results of stage testing should be compared with the initial readings/ manufacturers' values/ standard values as the case may be.

Final testing

On completion of the assembly of the plant/ machine as a whole, the plant/ machine has to be finally tested to achieve desired results. The test results obtained during the final test process should be recorded in the permanent record maintained for the purpose. In this stage the satisfactory final test results are expected, and in case of minor departures of the test results from desired values, some minor adjustment of the components/ sub-components of the plant may be required. These minor adjustments are to be carried out to get desired values well within the tolerance limits.

Trial Run and Commissioning

After final testing of the plant/ machine is over, they may be put on trial run for a prescribed duration to stabilize the various dynamics, and operating parameters such as bearing temperature, oil pressure, etc. In this trial run, the machine is loaded gradually, by steps, to its rated

output. During this process of loading, the behavior of the machine has to be observed at each stage. Some tests on the machine are prescribed, which may be carried out during trial run when test results are recorded. On completion of the prescribed trial run period and stabilization of dynamic parameters, the machine is commissioned and put back in to its usual operational mode.

While carrying out the maintenance work of major plants and machineries, it is often required to handle heavy, sophisticated materials. While the area of work sometimes is critical and restricted. In such cases due attention should be given for taking adequate safety measures. The

lifting and handling devices should be checked and examined with respect to their capacity and suitability. The range of measuring equipments should be judged before they are put to work. Places of danger should be clearly marked, and necessary danger boards/ precaution notices should be put in appropriate areas. Personnel should be employed to watch the critical locations, whenever required

Adequate arrangements should be made to provide fresh air ventilation. Utmost care should be taken to prevent the adverse effect on workers in the places where there is a chance of being exposed to hazardous gases etc. The first-aid box should always be kept ready

with supervisors of each group of workmen.

The general awareness and alertness should be maintained by the workers as well as by the supervising staff, to take up rescue operations and to meet any un-toward situations. ■

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