

Start-up Analysis of 125MW Steam Turbine at Different Condition

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ABSTRACT: One major challenge in today's traditional power generation technology lies in meeting the rapidly changing yardsticks of economics and environmental guidelines. Turbine is very sensitive part of power plant and also very costly, so require taking care about it very essential. A long and trouble-free operation of modern turbine groups, is for the mostly depend upon a proper start-up and shut down activity. In recent times, LP blades of a steam turbine are generally found to be more susceptible to failure than IP (intermediate pressure) and HP (high pressure) blades. In this paper, different startup condition of turbine and for that time taken by steam turbine is studied.

Keywords: Temperature, Pressure, Load, Time, Startup.

I. INTRODUCTION

Economics of power generation does not only require designing of an efficient power plant, but also follows proper operation and maintenance (O&M) strategy[1,2]. A long and trouble-free operation of modern turbine groups is for the most part dependent upon a proper start-up and shut down activity. During start-up condition there are so many parameters which affects the operation of turbine groups[2]. Start-up of the turbine is affected by different parameters like maximum temperature, maximum pressure, limiting factors, thermal stress, vibrations, rotation speed etc. The maximum temperature and maximum pressure of steam that can be used is fixed from metallurgical considerations[3, 4].

II. METHODS FOR START-UP

It is necessary to warm up the steam lines before the turbine group is started. It is also necessary that the steam lines from boiler up to valve housings are drained, clean and given a warm-up. This can be achieved if the corresponding drain and warm-up valves are properly opened.

The starting conditions for turbine groups are as follows:

1. cold start
2. warm start
3. hot start

III. EXPERIMENTAL RESULTS FOR COLD START

A turbine is considered cold when the mean temperature value of the rotor metal of the HP or IP turbine is lower than 250 °C. Starting under cold condition occurs only when there is a shutdown for a certain length of time. Shutdown may be required for an accurate check of the plant. During the shutdown repairing work may have been done, during which valves and switches ordinarily not actuated, might have been moved from their settings. Conditions required of steam for cold start includes Superheating of live steam and reheat steam which must be by 20 °C as a minimum before the steam is admitted into the turbine[5].

On a cold start it is convenient that pressure and temperature at starting are low. But the value of it should not drop below the lowest values which are valid for the installation. Different parameters verses time taken for startup steam turbine from zero to full load condition is represent by different graph.

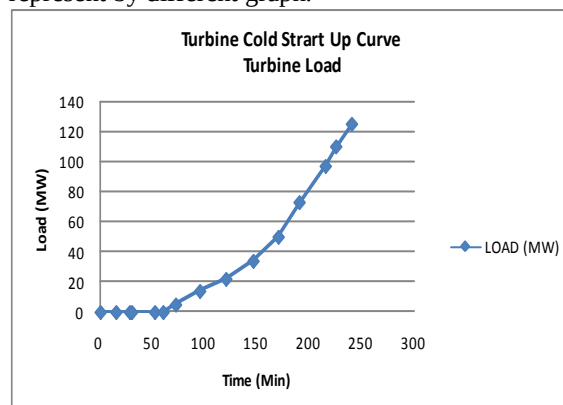


Fig.1.Cold starting of turbine Load –Time

When turbine start from cold condition it takes 240 minute to achieve full load 125 MW. Initially turbine does not take any load up to 60 minute then start to take load. During no load condition turbine attain 3000 rpm and warm-up with in 60 minute.

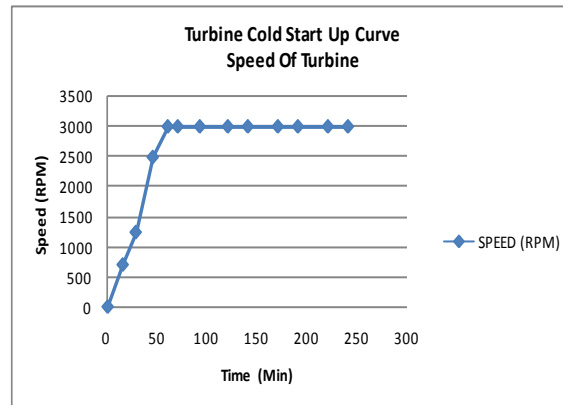


Fig.2.Cold starting of turbine Speed-Time

When turbine start from cold condition it takes 60 minute to achieve full speed 3000 rpm. During different speed interval it is require to cross critical speed very rapidly.

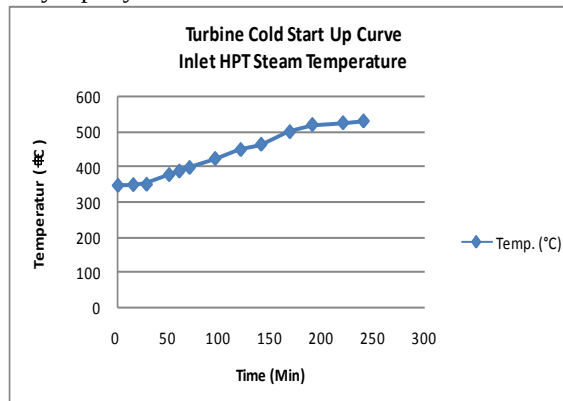


Fig.3.Cold starting of high pressure turbine Temperature-Time

High pressure turbine take a 240 minute to attain 530 °C. It stand steady to 15 minute at 350 °C and then start to raise temperature for regular time interval.

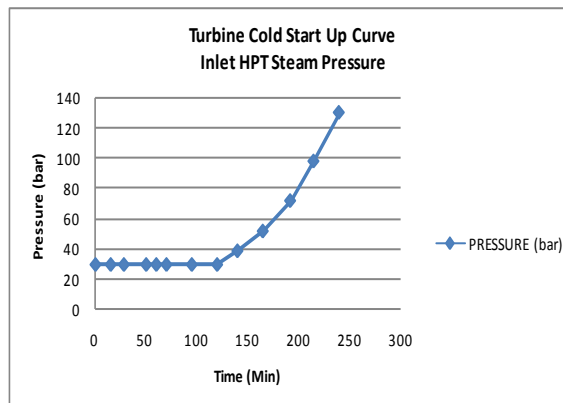


Fig.4.Cold starting of high pressure turbine Pressure-Time

High pressure turbine steady at 30 bar pressure for 120 minute then allow to raise steam pressure. It attain full load steam pressure 130 bar at 240 minute.

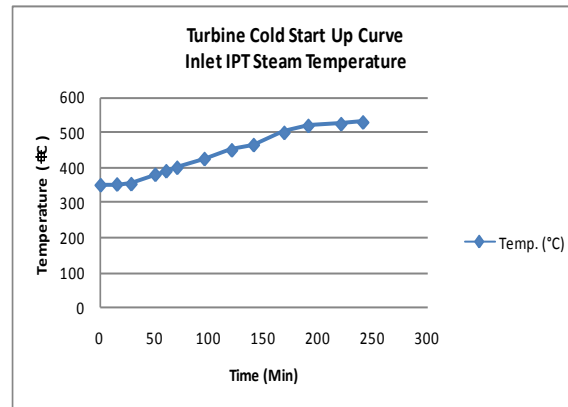


Fig.5.Cold starting of Intermediate pressure turbine Temperature-Time

Intermediate turbine also steady at 350 to 352 °C for 15 minute then increase during regular time interval. It takes 240 minute to attain 530°C.

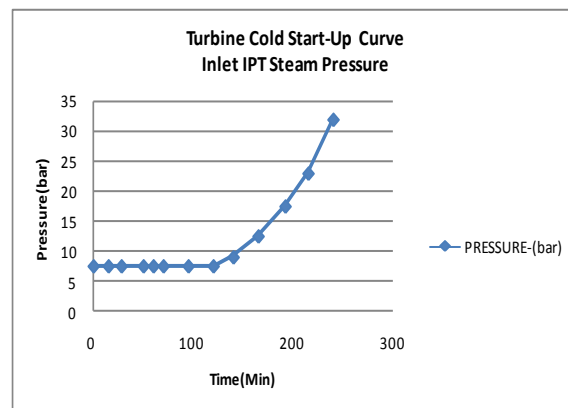


Fig.6.Cold starting of Intermediate pressure turbine Pressure-Time

Intermediate pressure turbine steady at 7.5 bar pressure for 120 minute then allow to increase its pressure. It takes 240 minute to attain 32 bar pressure.

IV EXPERIMENTAL RESULTS FOR WARM START

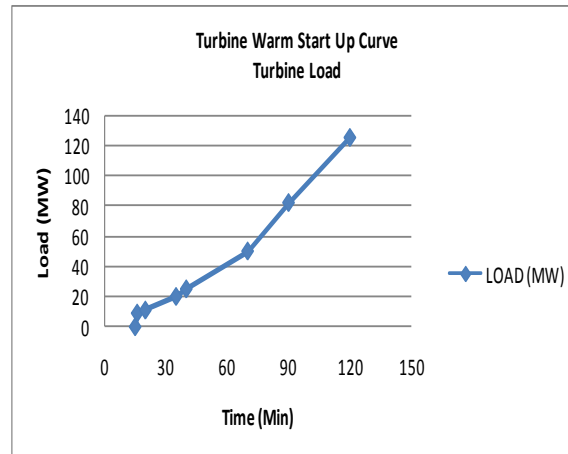


Fig.7.Warm starting of turbine Load-Time

When turbine start from warm condition it takes 120 minute to achieve full load 125 MW. Initially turbine does not take any load up to 15 minute then start to take load.

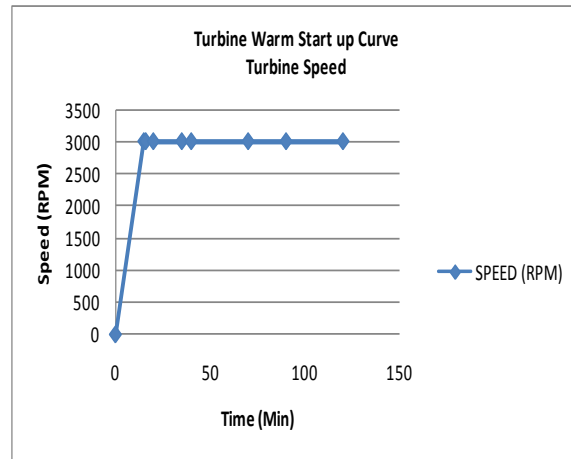


Fig.8. Warm starting of turbine Speed-Time

When turbine start from warm condition it takes 15 minute to achieve full speed 3000 rpm. It is desirable to start turbine from warm condition than cold condition.

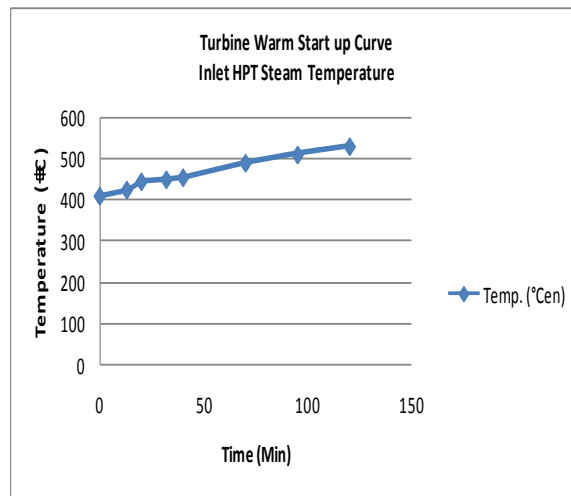


Fig.9. Warm starting of turbine Temperature-Time

High pressure turbine take a 120 minute to attain 530 °C. It stand steady to 12 minute at 410°C and then start to raise temperature for regular time interval.

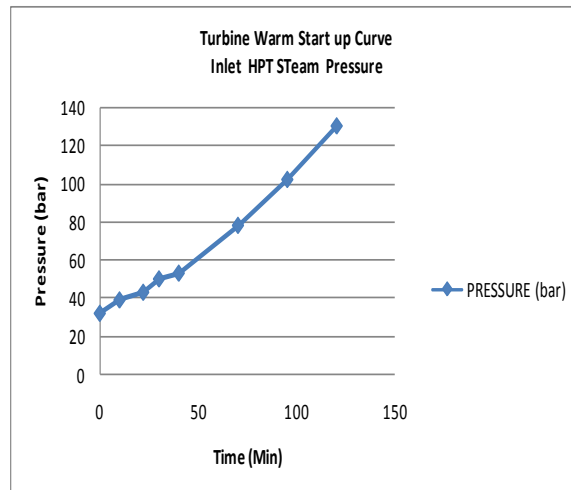


Fig.10. Warm starting of turbine Pressure-Time

High pressure turbine steady at 32 bar pressure for 10 minute then allow to raise steam pressure. It attain full load steam pressure 130 bar with in 120 minute.

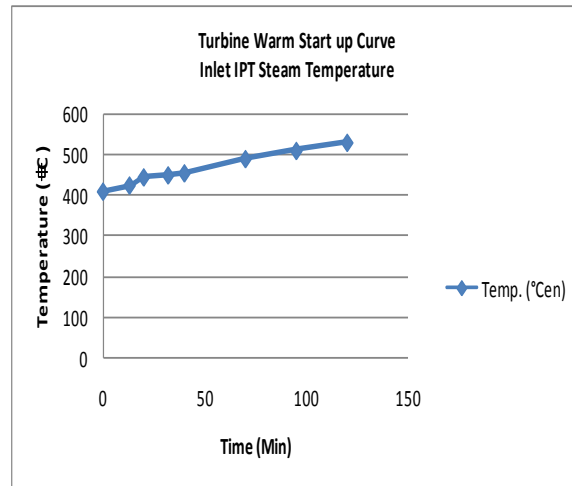


Fig.11. Warm starting of Intermediate pressure turbine Temperature-Time
 Intermediate turbine allow to raise its temperature from 410 to 530°C during the regular time interval between 0 to 120 minute.

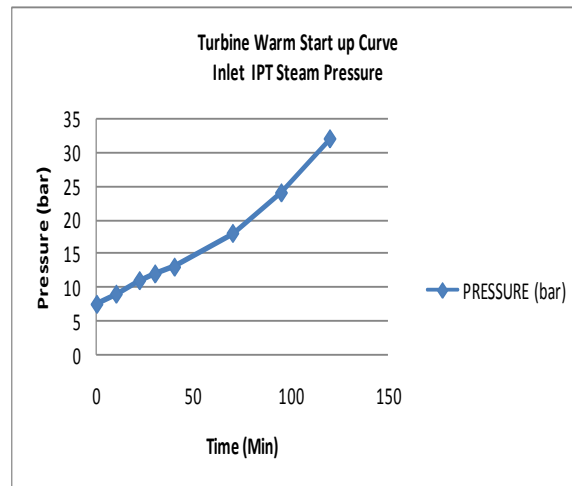


Fig.12. Warm starting of Intermediate pressure turbine Pressure-Time
 Intermediate pressure turbine allow to increase its pressure from 7.5 bar to 32 bar pressure during regular time interval 0 to 120 minute.

V. EXPERIMENTAL RESULTS HOT START

Different parameters verses time taken for startup steam turbine from zero to full load condition is represent by different graph.

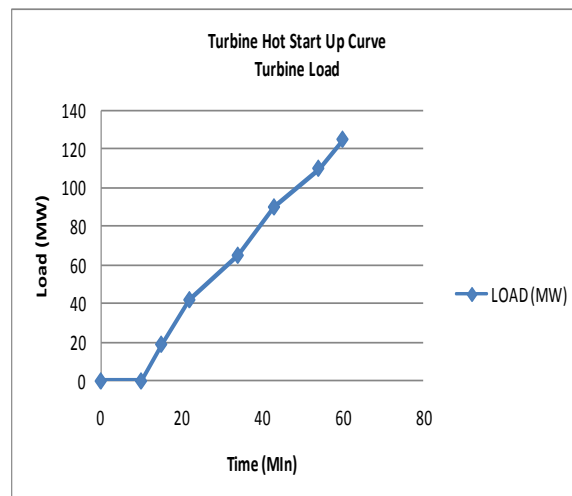


Fig.13. Hot starting of turbine Load-Time
 When turbine start from cold condition it takes 60 minute only to achieve full load 125 MW. Initially turbine does not take any load up to 10 minute then start to take load.

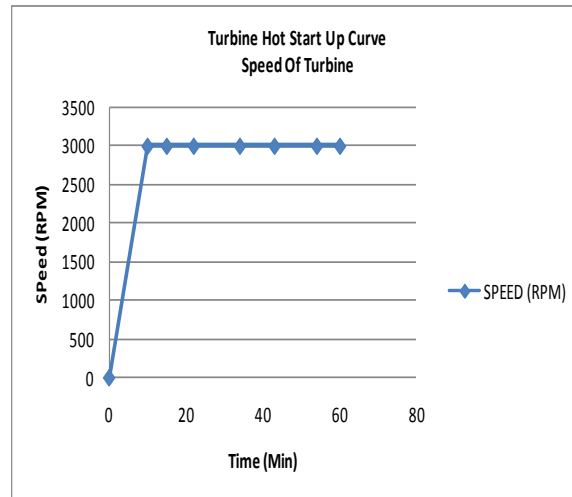


Fig.14.Hot starting of turbine Speed-Time

When turbine start from hot condition it takes 10 minute to achieve full speed 3000 rpm. It is desirable to start turbine from hot condition than cold condition or warm condition.

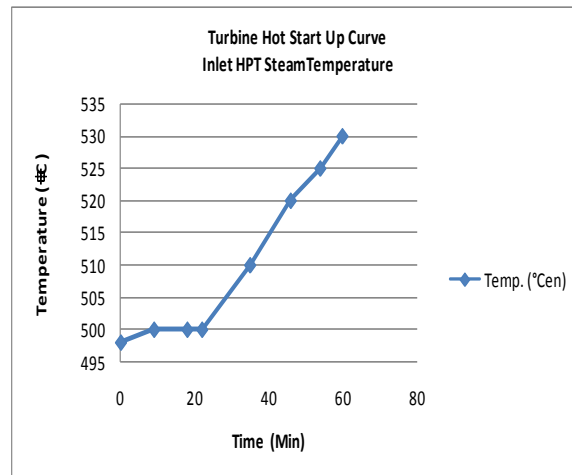


Fig.15.Hot starting of turbine Temperature-Time

High pressure turbine take only 60 minute to attain 530 °C. It stand steady to 12 minute at 500°C and then start to raise temperature gradually for regular time interval.

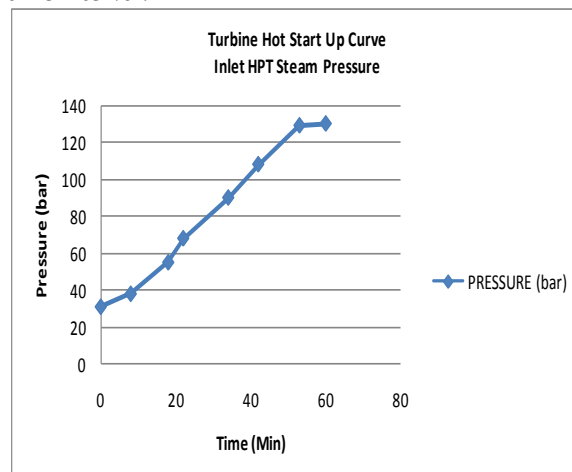


Fig.16.Hot starting of turbine Pressure-Time

High pressure turbine allow to raise steam pressure gradually from 31 to 130 bar during regular time interval 0 to 60 minute only.

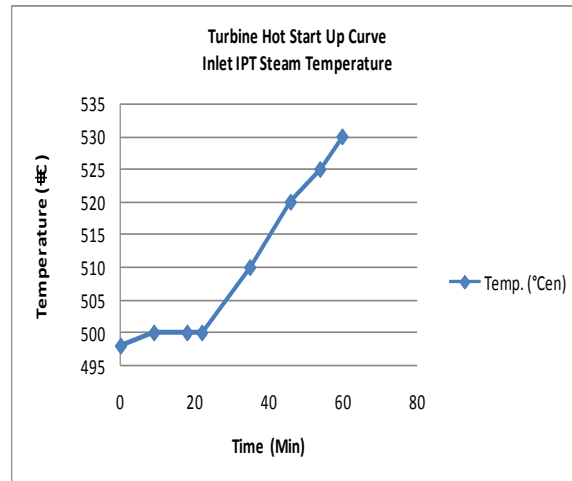


Fig.17. Hot starting of Intermediate pressure turbine Temperature-Time

Intermediate pressure turbine take only 60 minute to attain 530 °C. It stand steady to 12 minute at 500°C and then start to raise temperature gradually for regular time interval.

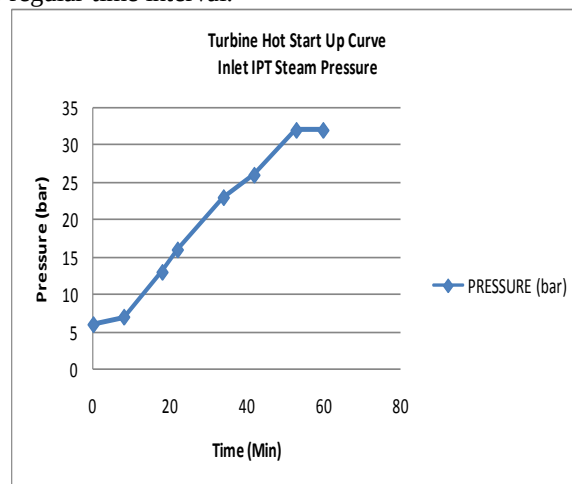


Fig.18. Hot starting of Intermediate pressure turbine Pressure-Time

Intermediate pressure turbine allow to raise steam pressure gradually from 6 to 32 bar during regular time interval 0 to 60 minute.

VI. ACCELERATION TO SYNCHRONIZATION SPEED

Normally the turbine group speed is raised to rated speed automatically via the turbine governor. To provide acceleration, after checking and ensuring that all operational and monitoring data are within allowable ranges, the automatic speed up process of the electronic turbine governor is switched on. Thus the turbine group speed is raised to the rated speed. The turbine group is raised in speed according to start-up curves. Determinant for a cold or warm/hot start is the mean HP and IP rotor metal temperature before starting up. Switch over temperature = 250°C. During the speed up time, a constant watch shall be held on possible vibrations. When vibrations are abnormal in some way, the speed is to be lowered momentarily to 500 RPM. Wait a little while and then try to speed up once again until a status is achieved where abnormal vibrations are absent. According to practice the most part of vibration problems suddenly arising, can be attributed to “rotor blade rubbing”. This is a very dangerous point which needs to be investigated. Critical speeds range:

800.....900 RPM
 1560.....1700 RPM
 2000.....2450 RPM

VII. CONCLUSION

Observation carried out on 125 MW steam turbine for cold, warm and hot start up show that during cold, warm and hot starting turbine taking 240, 120 and 60 min. to reach full load 125 MW respectively. Turbine speed attain zero to three thousand RPM for cold warm and hot condition are 60, 15 and 10 min. respectively. From above discussion it is better to start turbine from hot condition than warm condition while warm condition is better than cold condition. Also one more observation seen that cold startup applicable at $T_{\text{rotor metal}} < 150^{\circ}\text{C}$, warm startup $150^{\circ}\text{C} < T_{\text{rotor metal}} < 400^{\circ}\text{C}$ and hot startup $T_{\text{rotor metal}} > 400^{\circ}\text{C}$.

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