

## RINGKASAN

PENGARUH POLA PEMELIHARAAN, *AVAILABILITY*, *RELIABILITY* TERHADAP  
EFISIENSI EKONOMIS PRODUKSI LISTRIK

## STUDI EMPIRIS PADA PT PEMBANGKITAN JAWA BALI

Aturan penawaran tenaga listrik (*bidding rules*) oleh Pusat Pengatur Pengelola Beban (P3B) menyebabkan kompetisi di sisi pembangkitan listrik semakin ketat. Kompetisi tersebut melalui suatu kompetisi harga energi dan kesiapan daya mampu pembangkit (proses *merit order* energi). Proses ini muncul sebagai salah satu akibat dikeluarkannya UU-No.20/2002 Ketenagalistrikan yaitu Pemerintah memberikan kesempatan kepada sektor swasta untuk bergerak dalam bisnis penyediaan tenaga listrik yang dimaksudkan untuk menghasilkan harga listrik yang wajar dan peluang investasi. Perusahaan industri pembangkitan listrik saling berkompetisi untuk memberikan *customer value* yang lebih dengan menjaga ketersediaan, keandalan dan efisiensi ekonomis biaya produksi listrik. Salah satu cara adalah dengan mengelola biaya pemeliharaan.

PT Pembangkitan Jawa Bali sebagai salah satu perusahaan industri pembangkitan listrik pemerintah, memiliki unit yang tersebar di Jawa-Madura-Bali. Biaya pemeliharaan menjadi biaya terbesar kedua setelah biaya bahan bakar yang harus dibebankan pada biaya pokok penyediaan Rp/kW produksi tenaga listrik. Biaya pemeliharaan unit pembangkit semakin meningkat dari tahun ke tahun, dengan pola pemeliharaan *predictive* (terencana) 1.98%, *preventive* (terencana) 34.09%, dan *corrective* (tidak terencana) sebesar 63.93% dari total biaya pemeliharaan selama kurun waktu 2002 s/d 2006. Hal ini kontradiksi dengan rata-rata biaya pemeliharaan yang diraih *Best Cost Producer*, yaitu *predictive* (terencana) 45-55%, *preventive* (terencana) 25-35%, dan *corrective* (tidak terencana) sebesar kurang dari 10%.

Penelitian ini akan mengkaji hubungan pola pemeliharaan, *availability*, *reliability* dan efisiensi ekonomis sebagai permasalahan manajemen dalam mengelola unit pembangkit secara optimal dan baik guna kompetitif dalam bisnis. Dasar teori menjelaskan bahwa semakin tinggi *availability* maka *corrective* dan *preventive cost* akan menurun sedangkan *predictive* dan *proactive cost* akan meningkat. Demikian pula dengan *reliability*, memonitoring nilai *reliability* dapat mengeliminasi peralatan rusak yang tidak diinginkan dan waktu proses yang menurun melalui *predictive maintenance* dan *proactive maintenance*, sehingga semakin tinggi nilai *reliability* akan semakin tinggi nilai biaya *preventive*, *predictive maintenance* dan semakin rendah biaya atas *corrective maintenance* sampai dengan titik optimum tertentu.

Hipotesis dalam penelitian ini adalah mencari pengaruh signifikansi masing-masing Pola Pemeliharaan *Preventive* (X1), *Predictive* (X2) dan *Corrective* (X3) berpengaruh langsung terhadap *Availability* (Y1) dan *Reliability* (Y2), serta pengaruh tidak langsung Pola Pemeliharaan *Preventive* (X1), *Predictive* (X2) dan *Corrective* (X3)

terhadap Efisiensi Ekonomis Produksi (Y3) melalui *Availability* (Y1) dan *Reliability* (Y2), dengan mengambil sampel pada PLTU, PLTG dan PLTGU Unit Pembangkit Gresik melalui model analisis koefisien jalur (*path analysis*) yang diolah dengan program AMOS 4.0.

Dari hasil pengolahan tersebut dapat dijelaskan bahwa Unit pembangkit Gresik memiliki pengaruh pola pemeliharaan *preventive*, *predictive* dan *corrective* terhadap *availability* sebesar 89,4%, pengaruh pola pemeliharaan *preventive*, *predictive* dan *corrective* terhadap *reliability* adalah 97,9% dan pengaruh *availability* dan *reliability* terhadap efisiensi ekonomis adalah 50,9%. Dari data tersebut akan ditinjau berdasarkan masing-masing jenis pembangkit yaitu: 1) PLTU dengan pengaruh pola pemeliharaan *preventive*, *predictive* dan *corrective* terhadap *availability* sebesar 99,3%, pengaruh pola pemeliharaan *preventive*, *predictive* dan *corrective* terhadap *reliability* sebesar 97,3% dan pengaruh *availability* dan *reliability* terhadap efisiensi ekonomis adalah 2,1%. 2) PLTG memiliki pengaruh pola pemeliharaan *preventive*, *predictive* dan *corrective* terhadap *availability* sebesar 98,5%, pengaruh pola pemeliharaan *preventive*, *predictive* dan *corrective* terhadap *reliability* adalah 99,4% dan pengaruh *availability* dan *reliability* terhadap efisiensi ekonomis sebesar 79,4%. 3) PLTGU dengan pengaruh pola pemeliharaan *preventive*, *predictive* dan *corrective* terhadap *availability* adalah 98,6%, pengaruh pola pemeliharaan *preventive*, *predictive* dan *corrective* terhadap *reliability* adalah 97,1% dan pengaruh *availability* dan *reliability* terhadap efisiensi ekonomis adalah 81,5%.

Pola pemeliharaan *preventive*, *predictive* dan *corrective* Unit Pembangkit Gresik yang terdiri dari jenis pembangkit PLTU, PLTG dan PLTGU berpengaruh signifikan terhadap efisiensi ekonomis melalui intervening *availability* dan *reliability*. Akan tetapi peningkatan *availability* dan *reliability* diikuti dengan peningkatan biaya dan aktivitas pola pemeliharaan *corrective* tidak dengan peningkatan pola pemeliharaan *predictive*. Sebagai saran penulis bagi manajemen Unit Pembangkit Gresik, pihak manajemen sebaiknya meninjau kembali proyeksi pola pemeliharaan yang dipilih dan tidak hanya fokus pada pencapaian kinerja *availability* dan *reliability* yang tinggi saja tetapi juga pengaruhnya terhadap efisiensi biaya pemeliharaan tersebut serta merubah *worker behaviour* yang belum *cost awarness*.

## SUMMARY

### THE EFFECT OF MAINTENANCE PATTERN, AVAILABILITY, RELIABILITY TO ECONOMIC EFFICIENCY ELECTRICAL PRODUCTION EMPERICAL STUDY IN PT PEMBANGKITAN JAWA BALI

Bidding rules by Pusat Pengatur Pengelola Beban (P3B) cause competition in electrical power generation becomes tight. That competition by process that we called merit order energy. This process as result UU-No.20/2002 Electrical rules, where Governmental give private sector opportunity to make a move in independence power producer intended to yield the fair competition electrics price and investments. Power generation plant industry want to make customer value by manage availability, reliability and economic efficiency with low cost price. One of manner by manage maintenance cost.

PT Pembangkitan Jawa Bali as one of government companies, have power plant generation unit scattered on Java-Madura-Bali. The maintenance cost become number two of total production cost after fuel cost have to load in Rp/kWh. Maintenance cost year to year becomes high, where *predictive* 1.98%, *preventive* 34.09%, *corrective* 63.93% from the total maintenance cost from 2002 until 2006. This is very contradiction with *Best Cost Producer*, where *predictive* 45-55%, *preventive* 25-35%%, and *corrective* 10%.

This research will be find the signification influence of relation maintenance pattern availability, reliability and economic efficiency as management problem in manage their power generation plant unit. Theoretically maintenance pattern will be economic efficient if availability increase and follow with the decreasing cost and preventive and corrective activities, but the contrary happened by the make-up expense and predictive activities. Also for reliability, with monitoring reliability value by predictive maintenance, it could be eliminating the equipment breakdown, when reliability value increase preventive, and predictive cost decrease but corrective cost increase until the optimum point.

Hypotesis on this research to find the signification of influence of direct relation maintenance pattern *Preventive (X1)*, *Predictive (X2)* and *Corrective (X3)* to availability (Y1) and reliability (Y2) also find the signification of influence of indirect relation maintenance pattern *Preventive (X1)*, *Predictive (X2)* and *Corrective (X3)* to economic efficiency with availability and reliability as intervening variable. The sample are PLTU, PLTG and PLTGU Gresik Power Plant Generation, and that model will be analyze by AMOS 4.0 Program.

As result by AMOS 4.0 that Gresik Power Plant Generation have influence maintenance pattern of preventive, predictive, and corrective to availability at 89.4%, to reliabiility 97.9% and influence of availability and reliability to economic efficiency at 50.9%. From that data, it would be breakdown to each type of Gresik Power Generation

which: 1) Steam Power Plant (PLTU) have influence maintenance pattern of preventive, predictive, and corrective to availability at 99.3%, to reliability 97.3% and influence of availability and reliability to economic efficiency at 2.1%. 2) Gas Turbine Power Plant (PLTG) have influence maintenance pattern of preventive, predictive, and corrective to availability at 98.5%, to reliability 99.4% and influence of availability and reliability to economic efficiency at 79.4%, and Combined Cycle Power Plant (PLTGU) have influence maintenance pattern of preventive, predictive, and corrective to availability at 98.6%, to reliability 97.1% and influence of availability and reliability to economic efficiency at 81.5% .

The Conclusion are maintenance pattern of preventive, predictive, and corrective in Gresik Power Generation have an significant effect to economic efficiency through intervening availability and reliability. However improvement of availability and reliability followed with the make-up expense and maintenance pattern of corrective activities don't followed with the increasing predictive maintenance pattern. As suggestion, management of Gresik Power Plant Generation have to calculate again the projection of maintenance project program and not only focus in getting good result in availability and reliability but also the effect in financial maintenance cost efficiency and changes worker behavior to cost awarness.

## ABSTRACT

Power energy demands in Indonesia to grow up with the fast improvement along with growing of industries utilize to support the economic growth rate. The excelsior of economics Activity will generate the increasing electrics consumption. According to UU-NO.20 / 2002 about Electricity Rules, Governmental give the opportunity to private sector to make a move in independence power producer intended to yield the fair competition electrics price and investments opportunity from every company. Pusat Pengatur Pengelola Beban (P3B) as a single customer of power applies the order of electric power offer (bidding rules). Bidding Rules represent the competition in power generation side through competition of energy price and readiness of generating energy based on energy merit order.

Power generation industry uses value chain to look for the strategic value for customer, one of them is how to manage Maintenance Pattern to keep of the availability and reliability with the economic efficient expense. Maintenance pattern consisted of three that are preventive, predictive, and corrective. Theoretically maintenance pattern will be economic efficient if availability and reliability increase and follow with the decreasing cost and preventive and corrective activities, but the contrary happened by the make-up expense and predictive activities. This research will be find the signification of influence of relation maintenance pattern to economic efficiency through availability and reliability as intervening variable by taking sample at Steam Power Plant (PLTU), Gas Turbine Power Plant (PLTG), and Combined Cycle Power Plant (PLTGU) of Gresik Power Generation. Because until now, Management Focus of Power generation more attention to reach attainment high performance of equivalent availability factor (EAF) and the low failure percentage where maintenance pattern not yet in line with economic efficiency attainment.

With the Path analysis which processed with the program of statistic AMOS 4.0 obtained result that maintenance pattern of preventive, predictive, and corrective of Gresik Power Generation which consist Steam Power Plant (PLTU), Gas Turbine Power Plant (PLTG), and Combined Cycle Power Plant (PLTGU) have an effect significant to economic efficiency through intervening availability and reliability. However improvement of availability and reliability followed with the make-up expense and maintenance pattern of corrective activities don't followed with the increasing predictive maintenance pattern. Predicted, one of factor cause it happened is inability of management power generation make projection the needed of maintenance pattern and also there're opinion that corrective maintenance can be industry cost saving.

**Keyword:** Maintenance pattern of Preventive, Predictive, Corrective, Availability, Reliability, Economic Efficiency