

ABSTRACT

This study aims to develop a decision-support framework for determining the replacement of excavator undercarriage components using a Conditional Group Replacement Strategy (CGRS). The research was conducted using historical failure data from Daily Maintenance Reports (DMR) of excavator units operating at PT ANTAM UBPN Maluku Utara. The analysis focuses on identifying recurring failure patterns, component dependency, and failure risk levels within the undercarriage system. Failure Mode and Effects Analysis (FMEA) was used to evaluate the risk of each component, while dependency analysis and recurring failure assessment were applied to understand the interaction between components within the system. In addition, reliability analysis was performed using Mean Time Between Failure (MTBF) and compared with spare part procurement lead time. The results indicate that failures in the undercarriage system are interconnected and tend to occur progressively. The integration of recurring failure analysis, dependency assessment, and FMEA produces a CGRS-based framework that supports binary decision-making (YES/NO) for ordering a complete undercarriage set. This approach helps reduce the risk of repeated downtime and supports more structured maintenance planning in remote mining operations.

Keywords: Undercarriage Excavator, Conditional Group Replacement Strategy, FMEA, Dependency Analysis, Maintenance Decision Support

INTISARI

Penelitian ini bertujuan untuk mengembangkan kerangka pengambilan keputusan pemesanan satu set *undercarriage excavator* menggunakan pendekatan *Conditional Group Replacement Strategy* (CGRS). Penelitian dilakukan menggunakan data kerusakan historis yang diperoleh dari *Daily Maintenance Report* (DMR) unit *excavator* di PT ANTAM UBPN Maluku Utara periode Januari 2024–Januari 2025. Analisis difokuskan pada identifikasi pola *recurring failure*, keterkaitan antar komponen (*dependency*), serta tingkat risiko kegagalan komponen dalam sistem *undercarriage*. Melalui metode *Failure Mode and Effects Analysis* (FMEA), analisis *dependency*, serta evaluasi *recurring failure*, dilakukan penyusunan kerangka keputusan berbasis kondisi sistem. Selain itu, analisis reliabilitas dilakukan menggunakan *Mean Time Between Failure* (MTBF) yang dibandingkan dengan *lead time* pengadaan suku cadang. Hasil penelitian menunjukkan bahwa kegagalan pada sistem *undercarriage* bersifat progresif dan saling memengaruhi antar komponen. Integrasi analisis *recurring failure*, *dependency*, dan FMEA menghasilkan kerangka keputusan berbasis CGRS yang dapat digunakan untuk menentukan kelayakan pemesanan satu set *undercarriage* secara biner (YES/NO). Pendekatan ini diharapkan mampu membantu perencanaan pemeliharaan yang lebih terstruktur, mengurangi risiko *downtime*, serta meningkatkan efektivitas pengelolaan pemeliharaan alat berat pada operasi pertambangan.

Kata kunci: *Undercarriage Excavator, Conditional Group Replacement Strategy, FMEA, Dependency Analysis, Maintenance Decision Support*