ABSTRAK

Kawasan Cagar Budaya Laswi Heritage di Kota Bandung merupakan kompleks 21 bangunan bersejarah dengan total beban terpasang yang signifikan, yang saat ini sedang direvitalisasi menjadi area komersial. Sistem distribusi konvensional 380V yang mengandalkan satu transformator terpusat dengan panjang kabel tegangan rendah yang ekstensif menimbulkan permasalahan teknis berupa jatuh tegangan yang melampaui batas standar serta rugi daya yang tinggi. Kondisi ini mendorong perlunya kajian terhadap alternatif sistem distribusi yang lebih optimal dengan tetap mempertimbangkan batasan pelestarian kawasan.

Penelitian ini bertujuan untuk membandingkan kinerja sistem distribusi konvensional dengan sistem berbasis teknologi TM/TR-Package 20kV pada aspek profil tegangan, rugi daya, dan keandalan sistem. Pendekatan studi kasus komparatif digunakan melalui simulasi *Load Flow* dan *Reliability Assessment* pada perangkat lunak ETAP 22.5 dengan metode Newton-Raphson. Dua skenario disimulasikan dan dievaluasi berdasarkan standar PUIL 2020 dan SPLN T6.001-2013.

Hasil penelitian menunjukkan bahwa penerapan sistem TM/TR-Package memberikan perbaikan yang sangat signifikan pada seluruh parameter kinerja sistem distribusi. Jatuh tegangan mengalami penurunan drastis sehingga seluruh bus beban memenuhi standar PUIL 2020, berbeda dengan kondisi konvensional yang sebagian besar busnya melanggar batas yang diizinkan. Rugi daya total berkurang secara substansial sehingga efisiensi penyaluran daya meningkat secara nyata. Dari aspek keandalan, indeks SAIDI membaik secara signifikan yang menunjukkan berkurangnya durasi pemadaman yang dialami pelanggan. Selain keunggulan teknis, teknologi ini juga terbukti selaras dengan prinsip pelestarian *heritage* berupa intervensi minimal, reversibilitas, dan kesesuaian estetika kawasan.

Penelitian ini memberikan kontribusi berupa kerangka analisis integratif untuk optimasi sistem distribusi pada kawasan cagar budaya, serta menjadi acuan teknis bagi pemangku kepentingan dalam perancangan infrastruktur kelistrikan yang efisien, andal, dan selaras dengan prinsip pelestarian.

Kata kunci: optimasi, sistem distribusi, *Load Flow*, TM/TR-Package, bangunan cagar budaya, SAIDI, SAIFI.

ABSTRACT

The Laswi Heritage Cultural Heritage District in Bandung comprises 21 historic buildings with a substantial total electrical load, currently undergoing revitalization into a commercial area. The existing conventional 380V distribution system, which relies on a single centralized transformer with an extensive low-voltage cable network, presents critical technical issues including voltage drops exceeding permissible standards and excessively high power losses. These conditions necessitate an investigation into a more optimal distribution system alternative while considering heritage preservation constraints.

This study aims to compare the performance of the conventional distribution system with a TM/TR-Package 20kV-based system in terms of voltage profiles, power losses, and system reliability. A comparative case study approach was employed through load flow simulation and reliability assessment using ETAP 22.5 software with the Newton-Raphson method. Two scenarios were simulated and evaluated in accordance with PUIL 2020 and SPLN T6.001-2013 standards.

The results demonstrate that the implementation of the TM/TR-Package system yields remarkably significant improvements across all distribution system performance parameters. Voltage drops were drastically reduced, enabling full compliance of all load buses with PUIL 2020 standards, in contrast to the conventional system where the majority of buses exceeded permissible limits. Total power losses were substantially decreased, resulting in a notable enhancement in power delivery efficiency. In terms of reliability, the SAIDI index improved significantly, indicating a considerable reduction in outage duration experienced by customers. Beyond its technical superiority, this technology also proves to be compatible with heritage preservation principles, including minimal intervention, reversibility, and aesthetic compatibility.

This study contributes an integrative analytical framework for distribution system optimization in cultural heritage districts and serves as a technical reference for stakeholders in designing efficient, reliable electrical infrastructure aligned with preservation principles.

Keywords: optimization, distribution system, load flow, TM/TR-Package, cultural heritage building, SAIDI, SAIFI.