



INTISARI

Gas Insulated Switchgear (GIS) merupakan infrastruktur vital untuk distribusi tenaga listrik yang memerlukan efisiensi energi tinggi, terutama di kawasan tropis seperti Ibu Kota Nusantara (IKN). Tantangan utama dalam desain GIS mencakup efisiensi energi, keterbatasan tapak, dan tuntutan keberlanjutan lingkungan sesuai visi IKN sebagai kota hijau. Penelitian ini bertujuan mengoptimalkan desain GIS dengan mengintegrasikan strategi desain aktif dan pasif serta *Smart Control System*.

Metode penelitian meliputi analisis literatur, simulasi termal, dan evaluasi desain tapak menggunakan perangkat lunak IESVE. Berbagai skenario desain diuji untuk menilai pengaruhnya terhadap efisiensi energi, distribusi suhu, serta pengurangan emisi karbon. Strategi desain yang diuji meliputi ventilasi alami, isolasi termal (OTTV/RTTV), *shading*, pengelolaan vegetasi, serta sistem HVAC yang efisien.

Hasil penelitian menunjukkan bahwa penerapan strategi desain terpilih mampu menurunkan konsumsi energi hingga 31% dibandingkan *baseline* dan menghemat biaya operasional sebesar Rp130.031.000 per tahun dari total konsumsi listrik rata-rata per tahun sebesar Rp417.006.000. Setiap strategi dievaluasi berdasarkan kontribusinya terhadap pengurangan emisi karbon, dampak lingkungan, kemudahan implementasi, dan aspek teknoekonomi.

Penelitian ini memberikan kontribusi nyata dalam bentuk rekomendasi prioritas strategi desain untuk dokumen teknis GIS di lingkungan PLN dan mendukung sertifikasi bangunan gedung hijau serta akses *green financing*. Optimalisasi desain berkelanjutan pada GIS tidak hanya meningkatkan efisiensi energi, tetapi juga memperkuat daya saing infrastruktur kelistrikan nasional menuju pembangunan berkelanjutan di Indonesia.

Kata kunci: PLN, Bangunan Gedung Hijau, *Gas Insulated Switchgear*, Efisiensi Energi, Desain Berkelanjutan, Ibu Kota Nusantara



ABSTRACT

Gas Insulated Switchgear (GIS) is a critical infrastructure for reliable electricity distribution that demands high energy efficiency, especially in tropical regions like the new National Capital (IKN). The primary design challenges for GIS include energy optimization, limited site footprint, and environmental sustainability aligned with IKN's vision as a green city. This study aims to optimize GIS design by integrating both active and passive architectural strategies as well as a Smart Control System.

The research methodology comprised literature review, thermal simulations, and site design evaluation using IESVE software. Multiple design scenarios were tested to assess their impact on energy efficiency, temperature distribution, and carbon emission reductions. Evaluated strategies included natural ventilation, thermal insulation (OTTV/RTTV), shading devices, vegetation management, and efficient HVAC systems.

Results show that the selected design strategies can reduce energy consumption by up to 31% compared to the baseline, yielding operational cost savings of IDR 130,031,000 per year, out of an average annual electricity cost of IDR 417,006,000. Each approach was evaluated based on its carbon reduction potential, environmental impact, ease of implementation, and techno-economic viability.

This study presents practical recommendations for prioritizing design strategies in PLN's GIS technical guidelines, supports green building certification, and facilitates access to green financing. Sustainable design optimization for GIS not only improves energy efficiency, but also enhances the competitiveness of national electrical infrastructure within Indonesia's broader sustainable development objectives.

Keywords: PLN, Green Building, Gas Insulated Switchgear, Energy Efficiency, Sustainable Design, Ibu Kota Nusantara