

Power Flow Controllers Implementation

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ESIG Spring Workshop



Technology Overview

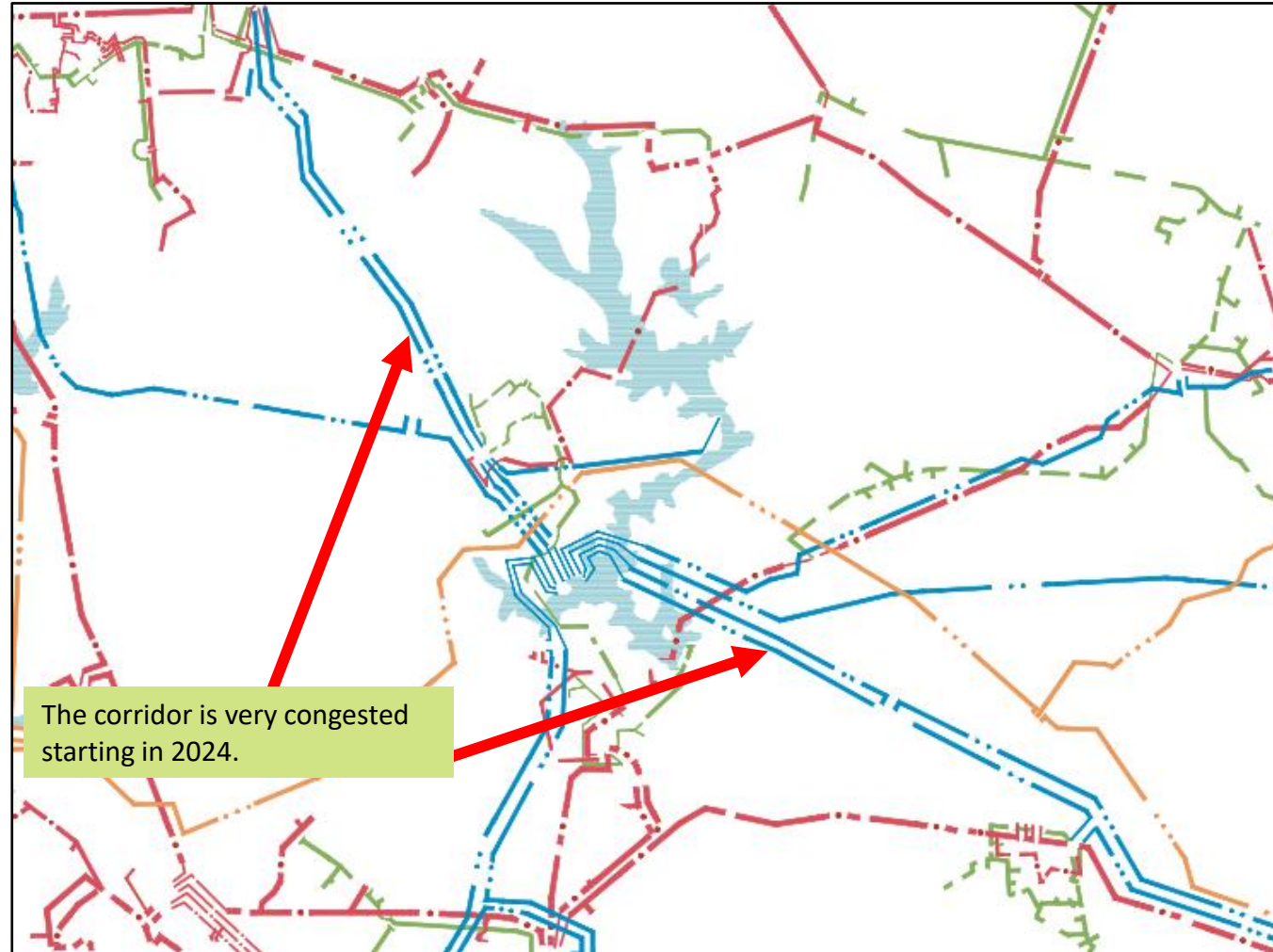
- **Advanced Power Flow Controllers (APFC)** are devices that can actively push and pull power by changing the reactance in the lines. They are useful for redistributing power flow in a mesh network to relieve congestion.
- A **Smart Valve** is a Static-Synchronous Series Compensators (SSSC) that injects a voltage in quadrature with the line current creating a capacitive or inductive reactance, that way increasing or decreasing the power flow in a circuit.



SmartValve Installation – ISA TRANSELCA, Colombia

Project Drivers and Information

- Addresses thermal overloads on 2-230kV transmission lines.
- In-Service Date: June 1st, 2025
- Testing Grid Enhancing Technology

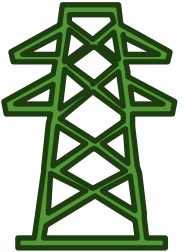


Alternatives Considered



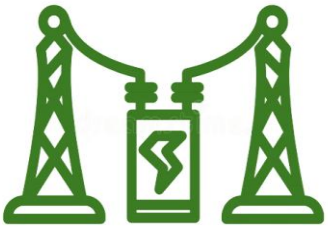
Line Upgrade

- Cost-Effectiveness



Line Rebuilds – Brute Force Projects

- Timelines
- Outages
- Cost



Series Reactors

- Supply Chain Delays
- System Losses
- Operational Flexibility

Project Roadmap

Summer 2023

- Internal Agreement
- Assessment by Smart Wires

Fall 2023

- Timeline and Conceptual Design Approval
- "GO/NO GO" Decision

Winter 2023

- Slot Reservation
- Engineering Estimates and Conceptual Design

Summer 2024

- Engineering SV & Substation
- Plant Quality Survey

Fall 2024

- Start of manufacturing
- QA first unit
- Delivery starts
- Finalize Maintenance Agreement

Winter 2024

- EMS Integration
- Engineering Completion
- Construction Start

Spring 2025

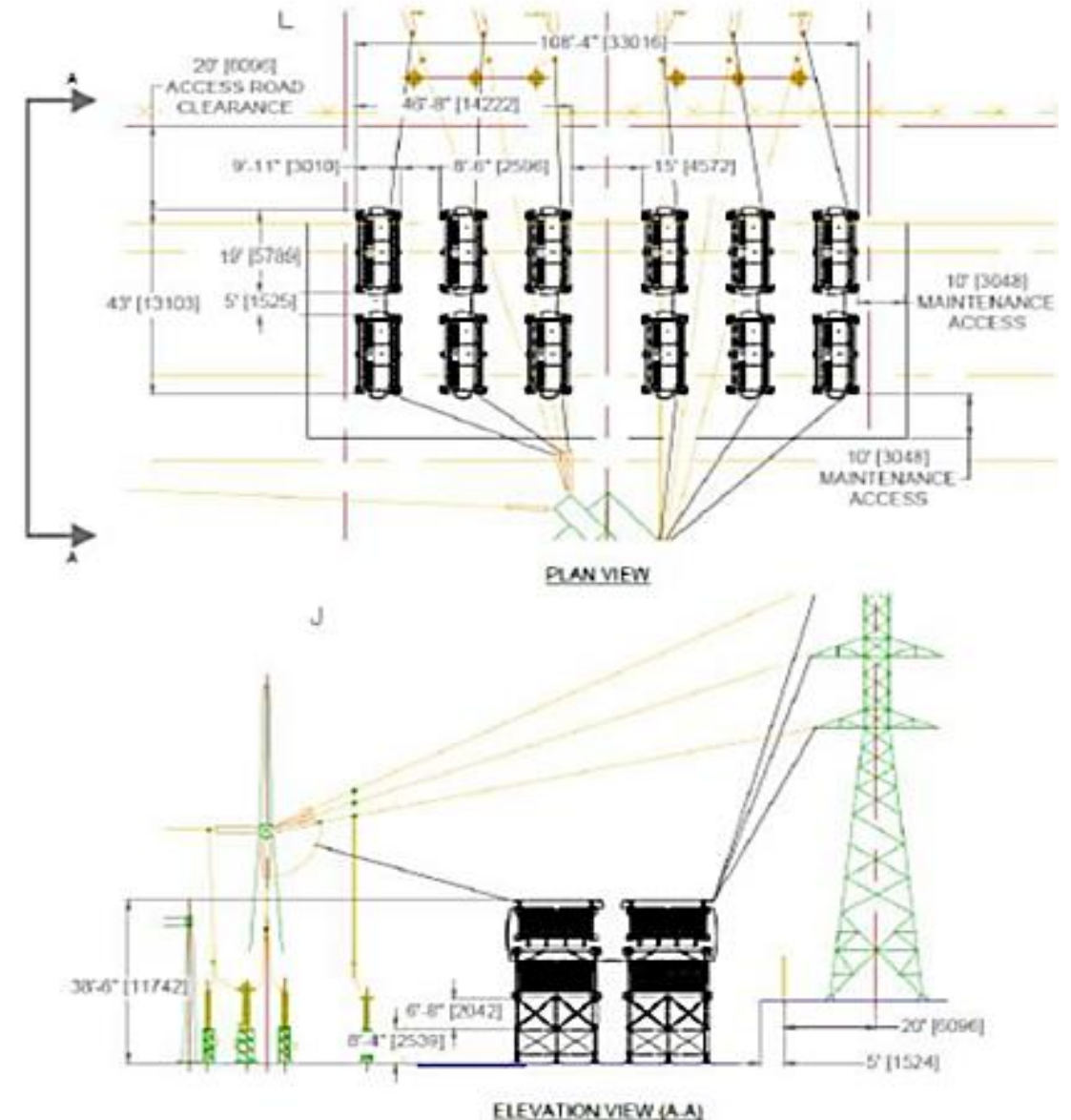
- Module Installation
- Testing

Summer 2025

- In-Service Date

Scope of Work

- Installation of 21 SmartValve modules
 - ✓ Substation expansion
 - ✓ Line work
 - ✓ Module Installation
 - ✓ Communication equipment
 - ✓ EMS Integration and Modelling
 - ✓ Training



Smart Valve Modes of Operation

Monitoring Mode

- The Smart Valves are bypassed, and the system is monitoring the line current.

Fixed Reactance Mode

- The Smart Valve is set to output a fixed reactance. The injected voltage varies with the line current to maintain the reactance at a set value.

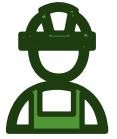
Fixed Voltage Mode

- The Smart Valve is set to output a fixed voltage output injection. The injected reactance will vary as the line current changes.

Current Control

- The Smart Valve is set to limit or boost the line current with respect to a fixed value. The injected voltage will vary to change the injected reactance and achieve the line current objective.

Challenges



Incorporation with Existing Infrastructure



Cost



Technical Knowledge



Integration

Substation Expansion



Foundations



Equipment

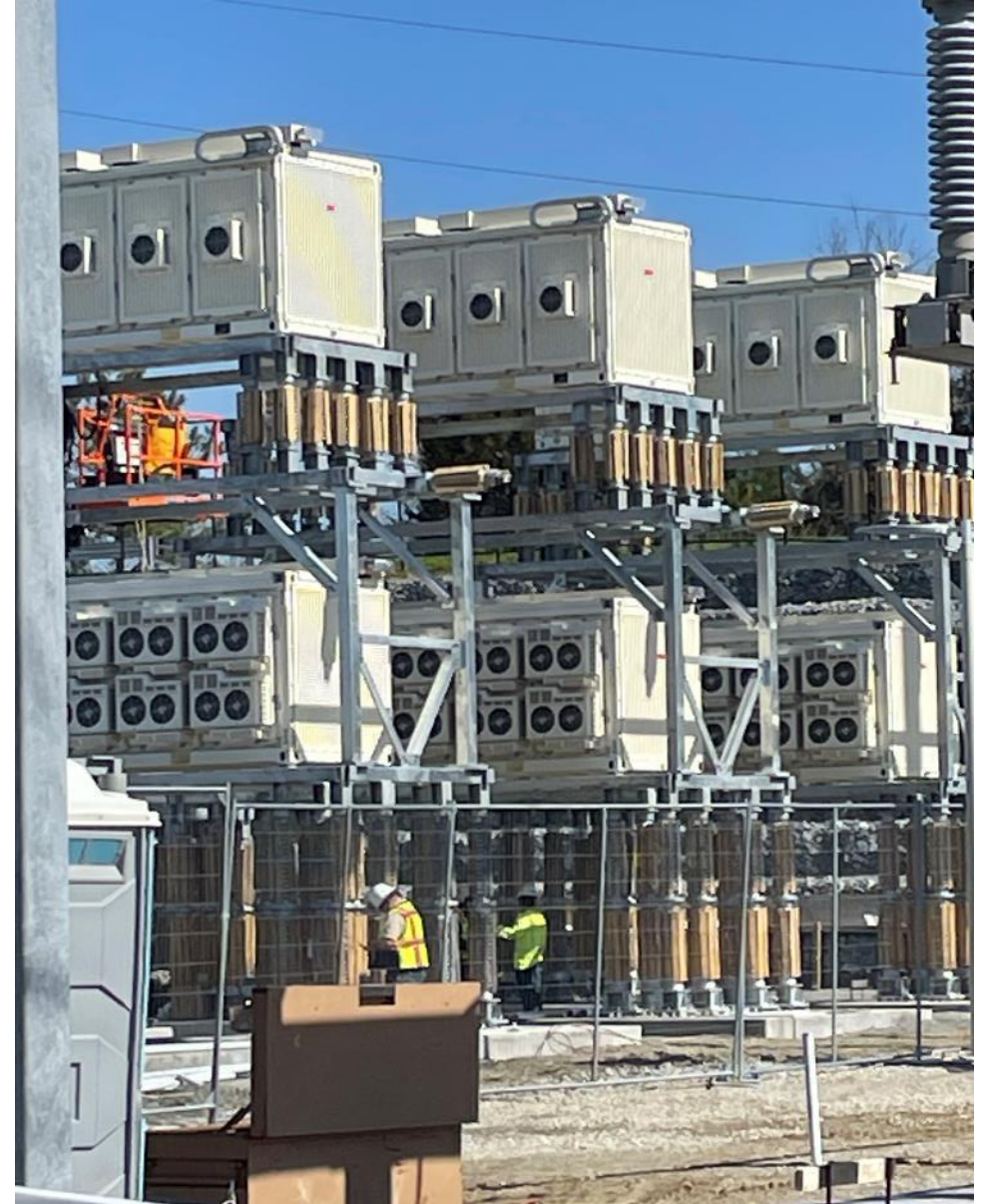


Installation





Installation





Southern
Company