A Case Study of Transmission Upgrade by Using ACCC Reconductor Approach for Connecting with The Hin Kong Power Plant Project

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The Hin Kong Power Plant is a key initiative aligned with the PDP. The Hin Kong Power Plant (1400 MW) replaces the retired TECO plant (700 MW). Upgraded transmission line needed to accommodate increased power capacity.
Traditional Grid Expansion vs Reconductoring

**Traditional Grid Expansion**

Building a completely new transmission line by dismantling the existing line.

- High costs and extended project timelines.
- Construction footprint has a significant impact on the community.

**Reconductoring**

Upgrading existing transmission line with higher capacity conductors.

- Minimize the risk of any uncertainty in the permission process.
- Minimize construction time.
- Lower cost compared to building a new line.
Minimize social & environmental impact, by avoiding 6,880 square meter land required to set up the tower foundation for the line reconstruction approach.
Building a new transmission line will not meet the Scheduled Energizing Date (SED) of the Hin Kong Power Plant.

Project Start: JAN, 2020

1. Approval process: 12M
2. ROW Compensation process: 12M
3. Bidding process: 12M
4. Construction: 12M
5. SED

2 Years & 5 Months

Reconductoring

Building a new line

Power Plant SCOD: 01/03/24
Conductors for High-Capacity Upgrades

Traditional High Temperature Conductors (Invar)

Invar core (Iron-nickel alloy) : low coefficient of thermal expansion.

Carbon fiber composite core (CFCC)

CFCC: higher strength, superior sag, lighter; this leads to lower resistance and higher ampacity.

Which Kind of Conductors have more benefits in term of power system security, efficiency, and environmental sustainability?
Invar vs. CFCC: A Technical Comparison

**Power system security**

**Invar**
- Maximum Conductor Size on Existing Tower: 2x456 mm$^2$
- Maximum Ampacity (Continuous): 2x1,886 (3,772A) @ 210C

**CFCC**
- Maximum Conductor Size on Existing Tower: 2x702 mm$^2$
- Maximum Ampacity (Continuous): 2x2,156 (4,312A) @ 180C

In case of an emergency (N-1), another circuit should carry a current **greater than 4134 A**.

Remark: 1/ Power Factor of the power plant is 0.85
Invar vs. CFCC: A Technical Comparison

**Efficiency (Transmission Loss ¹/²)**

- **Invar**
  - Transmission Line Loss on both Circuits: 7.34 MW (44.2 GWh/year)

- **CFCC**
  - Transmission Line Loss on both Circuits: 2.82 MW (17.0 GWh/year)

**Environmental sustainability (CO₂ Emission ²/²)**

- **Invar**
  - CO₂ emission from transmission Line Loss on each Year: 16.37 kton CO₂

- **CFCC**
  - CO₂ emission from transmission Line Loss on each Year: 6.29 kton CO₂

Remarks:

1/ Loss Factor = 0.3*Plant factor + 0.7*Plant factor² (Plant factor ≈ 80%)

2/ CO₂ emission ≈ 0.37 kg/kWh
Least Cost Analysis – CFCC vs. Invar

### Least cost alternative

**Capital Cost**
- Assumption: the CFCC conductor cost being equivalent to Invar

**Maintenance Cost**
- Assumption: the CFCC conductor cost being equivalent to Invar

**Cost of Transmission Loss**
- Assumption: Energy loss 3.111 THB/kWh

**Cost of CO₂ Emission**
- Assumption: Carbon credit price 108 THB/ton

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**NPV comparative cost analysis**

![Chart showing NPV comparative cost analysis for CFCC and Invar](chart.png)

- **NPV** (MTHB)
  - CFCC: 966 MTB
  - Invar: 2,206 MTB

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Assumption:
- 1/ NPV of total life cycle cost (25 years) & Using 4.96% discount rate.
- 2/ Overall life cycle costs
- 3/ Carbon credit pricing increases in accordance with Thailand's CPI every year.
Reconductoring, a process of replacing existing conductors with higher capacity ones, was chosen over building a new line. This saved time, costs, permits, and minimized environmental and social impacts.

CFCC technology reduces transmission losses (annual savings about 27.24 GWh/year), resulting in significant lower carbon footprint (annual savings about 10.08 kTON CO₂/year) compared to traditional INVAR conductors.

Potential for replicating this successful model across other projects in EGAT’s grid expansion to meet EGAT Carbon Neutrality by 2050.
Thank You