



GE VERNOVA

NALCO DRIVES GROWTH THROUGH TWO-PHASE EXPANSION OF ORISSA

New 220 kV conversion substation enables Indian National Aluminium Company to boost production

This document was originally created when the company was known as Alstom Grid. The company is now known as GE Vernova.

An entirely new substation converts the 220 kVac power supply to 195 kA - 1,200 Vdc, feeding potline 4. The turnkey solution comprises four groups including:

- 10 × 220 kV semi-pantograph disconnectors,
- 12 lightning arrestors,
- 4 regulating transformers (105 MVA),
- 4 rectifier transformers (2 × 52.5 MVA each),
- 8 rectifiers (37 kA – 1,200 Vdc),
- 8 LEM (40 kA),
- 2 LEM (225 kA),
- 16 DC switches
- and the necessary group and potline control system.

Customer profile

NALCO (National Aluminium Company Limited) is a state-owned business. It operates opencast mines, refines alumina and smelts aluminium in Orissa in East India, the mountainous state on the Bay of Bengal where bauxite deposits were discovered in 1981.

Business challenges

In support of continuous growth, NALCO launched plans to step up the production capacity of the smelters at Angul, Orissa from 345,000 to 460,000 tons per year.

Project objectives

Install a new 220 kV conversion substation in order to power the additional 240-pot, 115,000-ton capacity potline-4 within a very short time.

Finding the right partner

Alstom Grid's PEM unit in Massy, France, teamed up with Alstom Grid India to deliver indigenous equipment, civil works and installation. Alstom Grid Turkey (ATT) was chosen to manufacture the main power transformers and the 220 kV disconnectors were produced by Alstom Grid in Italy.

NEW ALUMINIUM INDUSTRY REFERENCE IN INDIA

When NALCO needed to ramp up the production of its smelters, Alstom Grid met the challenge. Working in close cooperation across two continents, the power electronics teams from Massy and Noida developed a tailor-made solution for the Orissa DC substation and potline power control system.

THE SITE - ORISSA SMELTER

New facilities brought online: the Angul smelter's potline 4 poured its first metal in December 2008. A major event for NALCO.



Manufacturing quality

The project called for specially developed switchgear, transformers, high current rectifiers and distribution boards to ensure the precise delivery of a constant power supply in the tough East Indian climate.

Alstom Grid brought experts from France, Italy and Gebze in Turkey together with the local team in Noida, India to meet the need. By 2007, their solutions had left the production line, passed the final factory tests and were ready to go.

A milestone reference for India

India is emerging as a global actor in the aluminium industry. Since energising the first group of the DC substation in mid-November 2008, NALCO has put 120 new pots into operation on potline 4. A further 120 are due to be brought online. When Phase II of the expansion is completed, the Orissa smelter's production capacity will reach 460,000 tons per year.

Strong local partnership

The team from Massy first got to know Orissa in the 1980s, when Cegelec powered the site's first potline. This time around, Alstom Grid India provided the local expertise required to ensure full technical compliance and a strong on-site presence throughout the two-year project. All of the team members from India were specially trained in France, where they spent a year helping to design and test the DC substation's control system.

Delivering the most competitive price

In 2006, NALCO's tender called for high quality and technical compliance at the lowest cost. Alstom Grid's team of global experts worked hand-in-hand to deliver:

- A tailor-made solution
- Field-proven high operational reliability
- Improved power quality
- Economical operation

KEY BENEFIT

All of the team members from India were specially trained in France.

KEY BENEFIT

The production capacity will reach 460,000 tons per year.



PRODUCT FOCUS



Regulating Transformers

Aluminium electrolysis requires a wide range of secondary voltage variations (up to 100%) to start the electrolysis potline from the beginning.

Specifications

Rated power	105 MVA
Primary voltage	220 kV
Secondary voltage	57.161 kV
Phase shifting	48-pulse. 4 equally-loaded units operating with on-load tap changer (OLTC)
Weight	170 T
Type of cooling	ODAF

Key customer benefits

- OLTC allows 0 to 100% voltage regulation for full electrolysis process from start-up
- Proven reliability at operating temperatures of up to 50°



Rectifier Groups

Each rectifier group consists of two half groups rated at 37 kA, 1200 Vdc. The two half groups are designed independently of each other with their own auxiliaries and cooling systems. Stacking the two water-cooled units of each half group produces a 6-phase assembly in which

the upper bridge corresponds to the positive polarity and the lower bridge corresponds to the negative.

Specifications

Output rating	2 × 37 kA continuous, 12 pulses
Rated voltage	1200 Vdc
Weight approx	2 × 5.5 T
Type of cooling	WFAF

Key customer benefits

- Innovative two-container design with built-in DC insulators facilitates transport and assembly
- Possibility to operate one half group at its full load when the other half group is under maintenance



Rectifier transformers

Phase shifting between the twin rectifier transformers and 12 saturable reactors allows a 70 Vdc voltage variation.

Specifications

Rated power	2 × 52.5 MVA
Primary voltage	57.161 kV
Secondary voltage	2 × 1,004 kV
Phase shifting	12-pulse. Star vs. delta on primary side
Weight	197 T
Type of cooling	OFAF

Key customer benefits

- Economical operation
- Improved power quality



Control System

PLC-based

HPC current regulator

Hardwired to control room back-up panel for emergency mode operation

Key customer benefits

- Precise current delivery accurate to ±0.1%

SCOPE OF SUPPLY

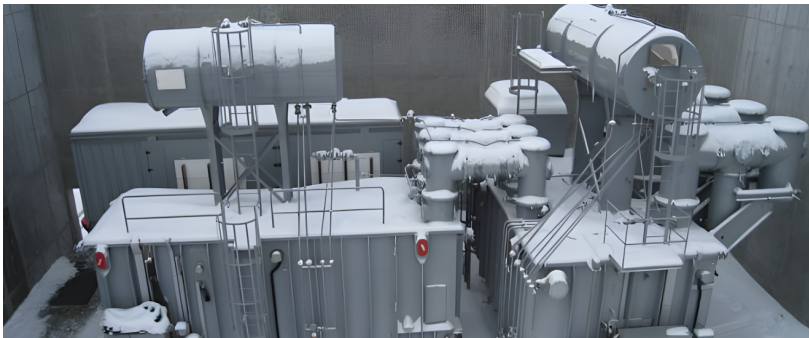
The contract awarded to Alstom Grid (France and Canada) called for the design, detailed engineering, supply, transportation, storage, installation, testing and commissioning of the AIS/GIS substation and AC/DC conversion groups comprising mainly:



- 6 x process loop compensation groups (102 kA, 42 Vdc)
- 7 x AC/DC conversion groups (95 kA, 1200 Vdc)
- 9 x filter banks for main conversion and process loop groups
- 161 kV gas-insulated/air-insulated switchgear
- 25 kV distribution switchboards

ACHIEVEMENTS AND CUSTOMER BENEFITS

AP60 technology focuses on energy efficiency and total cost reduction in the aluminium smelting process. Phase 1 of the AP60 plant, commissioned in 2013, has 38 pots and a production of 60,000 tons with expansion potential. If all the project phases are approved by Rio Tinto, the plant could reach a total of 272 cells installed with a production capacity of 460,000 tons of aluminium per year.



"This AP60 plant Phase 1 will use the most advanced aluminium smelting technology in the world and will become a platform for future AP technology development".

Jean Simon, President, Primary Metal - North America

-40 TO +35°C

operating temperature range for year-round reliability

38

 pots for Phase 1 production (60,000 tpy)

"Advancing Quebec's position as a global centre of expertise for the aluminium industry".

Extract from Rio Tinto Alcan press release

About GE Vernova's Power Conversion & Storage business

GE Vernova's Power Conversion & Storage business combines advanced energy conversion and storage systems to meet the electrification needs of utilities and industries. With a focus on power stability, energy storage, and industrial electrification solutions, Power Conversion & Storage empowers customers by addressing their most complex electrification challenges and accelerating their transition to a sustainable, decarbonized future.

For more information, please visit governova.com/power-conversion

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