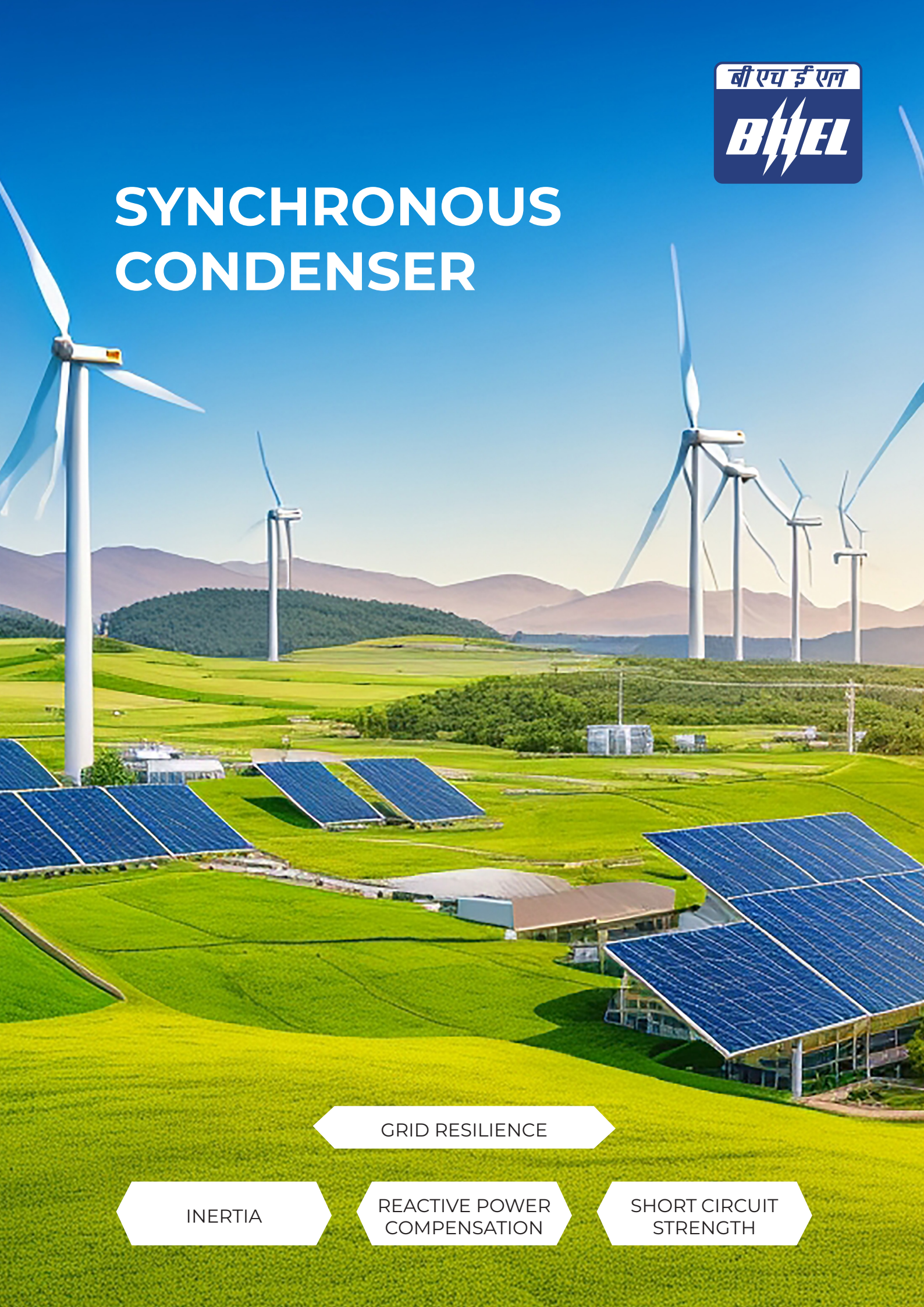
SYNCHRONOUS CONDENSER



GRID RESILIENCE

INERTIA

REACTIVE POWER COMPENSATION

SHORT CIRCUIT STRENGTH

SYNCHRONOUS CONDENSER

In conventional power systems, turbine-generator provides inertia, Short circuit strength and reactive power compensation. Large-scale **renewable energy (RE)** integration replaces these high-inertia systems with inverter-based resources (IBR), reducing short circuit current (SCC) and increasing grid instability. Further, this makes the grid more susceptible to blackouts during frequency excursions. While reactive power compensation from devices like SVCs and STATCOMs helps, their lack of rotating mass limits short circuit support.

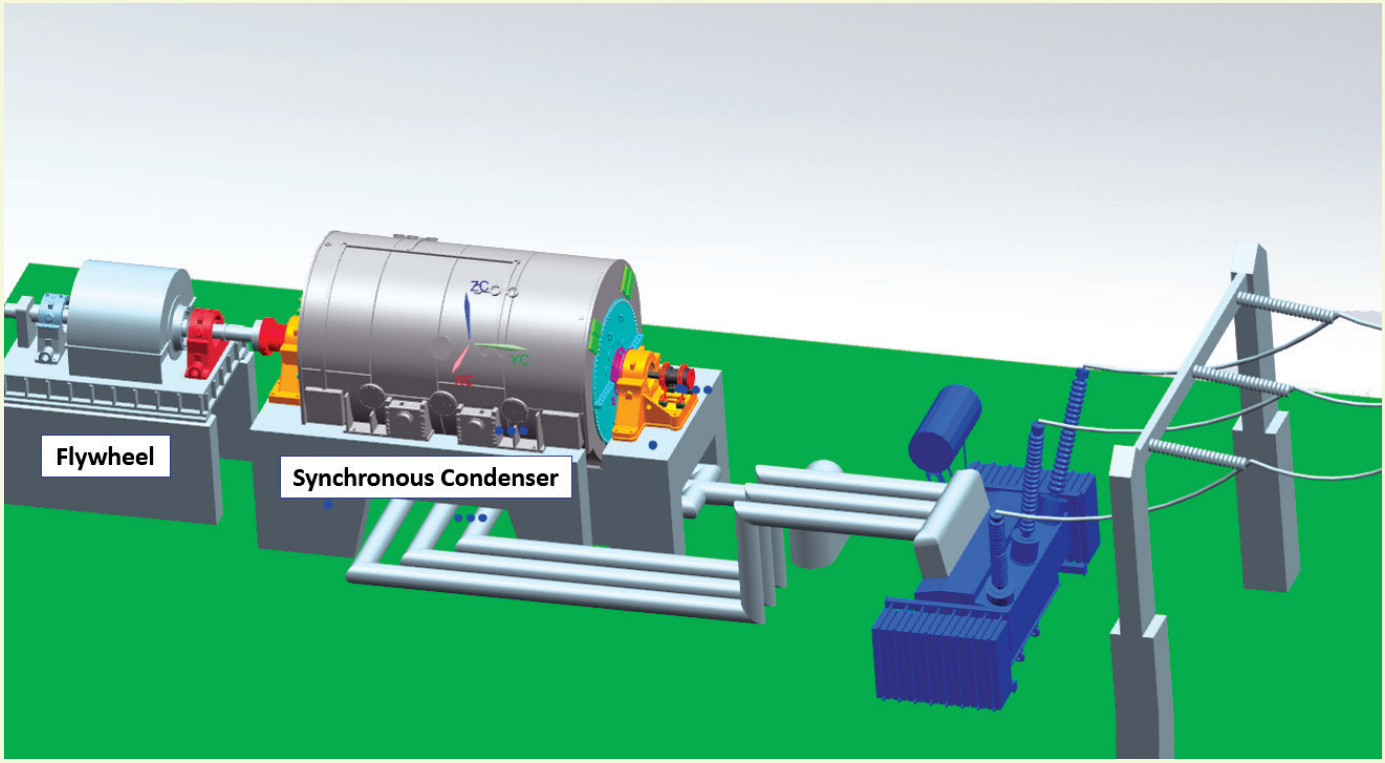
Synchronous Condensers (SC), strategically installed along the transmission system, serve as reliable grid stabilizers. They dynamically generate or absorb reactive power to maintain steady current flow and stabilize grid voltage. Additionally, they enhance short-circuit strength and provide inertia, contributing to overall frequency stability and grid resilience.

➢ Benefits

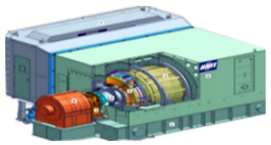
- Synchronous condenser (SC) can compensate for system reactive changes and maintain the required system voltage by varying excitation or the magnetic field strength of the condenser's field winding thus generating or absorbing **reactive power**
- Synchronous condenser (SC) along with Flywheel enhances system **inertia** in renewable-dominated grids
- Synchronous condensers (SC) provides **short circuit strength** to the grid by adding significant overload and fault ride through capability

BHEL SC Overview

- **Rating (each SC) :** Up to 300 MVAr
- **Rated Voltage :** Max. 21 kV
- **Inertia :** As required by grid
- **Excitation :** Static
- **Starting :** Static Frequency Converter (SFC)



Type of Synchronous Condensers

❖ **Cylindrical rotor generators** Upto 300MVAr	
❖ **Salient pole generators** Upto 300MVAr	

BHEL's offering for Synchronous Condenser Plant

1. Modular Package

BHEL is ready with the modular design and development of synchronous condenser plants to fit the needs of the customer. Our solutions focus on optimal functionality, quality, innovation, and high degree of customer satisfaction to meet the needs of customers looking for grid stabilization through reactive power compensation, enhanced inertia, and a strengthened power system, ensuring reliable and efficient performance.

Customer Benefits:

- **Grid Stabilization**
- **Soft start of synchronous condenser using static frequency converter**
- **Fast dynamic response**
- **Minimum maintenance**

2. REPURPOSING EXISTING POWER PLANTS AS SYNCHRONOUS CONSENDER

BHEL provides full support to repurpose existing or obsolescent power plants to synchronous condenser plant, adding new value to present assets. We can tailor the most suitable option according to Customer needs, thereby saving overall cost.

Customer Benefits:

- **Reutilisation of major equipment of existing plant**
  - Generator
  - Step-up Transformer.
  - Excitation system
  - Protection system etc.
- **Faster execution**
- **Cost Saving**

3. POWER PLANTS WITH SYNCHRONOUS CONDENSING CAPACITY

BHEL offers hydrogenator plants with synchronous condenser capabilities, combining hydroelectric generation with grid stabilization. This multi-functional system ensures efficient power generation, enhanced grid integration, and improved reliability, providing a stable, efficient, and sustainable energy solution for future grid challenges.

Customer Benefits:

- **Improved Grid Resilience:** Enhances stability and reliability.
- **Cost Savings:** Combines generation and reactive power support, reducing equipment needs.
- **Flexible Deployment:** Easily integrates with existing hydro facilities.

BHEL provides reactive power solutions for grid stability, including synchronous condensers, reactors, capacitor banks, and advanced FACTS devices like SVCs and STATCOMs. These technologies support voltage stability, inertia, and short-circuit strength, especially in renewable-dominated grids. BHEL also integrates reactive power management in HVDC and UHVAC projects, ensuring reliable and efficient power transmission. Through customized solutions and real-time automation, BHEL strengthens grid resilience and enables seamless renewable energy integration.

Bharat Heavy Electricals Limited

Regd. Office: BHEL House, Siri Fort, New Delhi - 110 049, India

Phone : 0120-6748137, 0120-6748503 **Mobile** : 9810523590, 9650026888

email : manoj.kumar@bhel.in, anand@bhel.in **Website** : www.bhel.com