

PRODUCT NOTE - ABB AUSTRALIA

Synchronous condenser packages

Solving the challenges of renewable energy integration



Synchronous condensers

Supporting Australia's clean energy transformation

ABB is a global leader in power and automation technologies that enable utility and industry customers to improve their performance while lowering the environmental impact.

Synchronous condensers from ABB ensure efficient and reliable operation of power grids through reactive power compensation and additional short circuit power capacity.

Operating principles

A synchronous condenser is a device that supports network voltage by providing reactive power compensation and additional short circuit power capacity.

Fundamentally, a synchronous condenser is a synchronous generator operating without a prime mover. Generation or consumption of reactive power is achieved by regulating the excitation current.

An important benefit of a synchronous condenser is that it contributes to the overall short circuit capacity in the network node where it is installed. This, in turn, improves the chances that equipment connected to the network will be able to “ride through” network fault conditions.

A synchronous condenser is also well-suited to operating during overload duty for shorter or longer periods of time. Synchronous condensers can support the power system voltage during prolonged voltage sags by increasing the network inertia. They can therefore be utilized as VAR compensating devices in situations where voltage instability must be prevented at all cost.

Finley Solar Farm
Project

Supplied by:
John Laing and
ESCO Pacific



Dynamic properties

As with any synchronous motor or generator, the electrical dynamics of a synchronous condenser are largely determined by the reactants of the condenser and by the nature of its excitation system. Low transient reactants and comparably high rotor inertia ensure high transient stability margins and excellent fault ride-through capability.

Synchronous condensers from ABB are equipped with a brushless excitation system which allows for considerable over-excitation (field forcing) in case of network contingencies. Excitation control is performed by an AVR which is tuned to match the requirements of the specific application.

ABB modular synchronous condenser solutions

ABB offers module-based synchronous condenser solutions with active components designed according to project-specific needs. This allows for a flexible product as well as a short time to in-service.

ABB synchronous condenser modules are compact and fully functional units, with minimal footprint on site and minimal need for external auxiliary support.

The ABB Modular Systems team has extensive experience supplying packages inclusive of the: e-Houses (Transportable Substation Buildings), associated HV & LV equipment, SCADA. Specialising in delivering coordinated & cost-effective product package solutions.



Synchronous condensers

Components of the package

Synchronous condenser (SC)

A synchronous condenser is a large rotating machine which is erected on a heavy foundation. Refer to technical specification (TS) and dimension drawings for details. It is usually transported as two pieces (machine + cooler top section). The Main Terminal Box (MTB) is always separately handled. Sleeve bearings are used with jacking oil pumps assisting start up.

Main terminal box (MTB)

An MTB contains Current Transformers (CTs) and Potential Transformers (PTs), protection devices such as arresters and surge absorbing capacitors, plus Neutral Earthing Resistors (NER). It is a sealed IP55 enclosure with pressure relief openings. In larger sizes, NERs are located in a separate ventilated compartment. Line side and Neutral side equipment are separated inside and large openings aid inspections and maintenance. Connection options are from the cables beneath or from the side busbar.

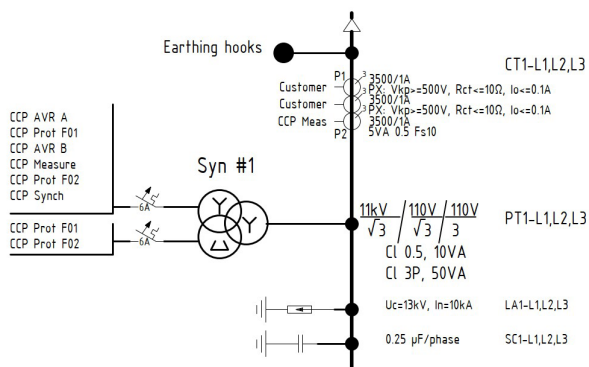


Fig.1 - MTB Line side (example values)

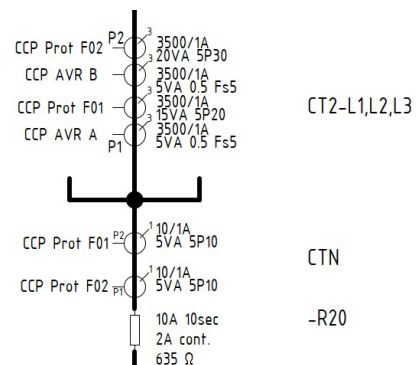


Fig.2 - MTB Neutral side (example values)

Pony motor (PM)

Synchronous condensers are started by a variable speed driven pony motor. It is directly coupled to the synchronous condenser shaft. Typical power ranges are approx. 200-1000kW depending on rotating masses. Coupling and coupling guards are included.



Frequency converter for pony motor (variable speed drive)

A variable speed drive assists in managing acceleration time and aids the seamless synchronisation to the network. A frequency converter can be a wall mounted or floor standing unit. It is fitted with a communication card for controlled synchronisation by a Condenser Control Panel (CCP). The converter needs to be installed indoors in a container or prefabricated building together with several motor control centres (MCCs).



Lube Oil Unit (LOU)

The lube oil unit should be located a few metres away from a synchronous condenser on a lower base. An oil return line must have a set slope of about 3 degrees. The unit may include an air cooler with an electric blower or a water cooling system. Redundant circulating pumps are always included with filters, temperature and flow monitoring.

ABB synchronous condensers

Control and protection

Condenser control panel (CCP)

A condenser control panel is the functional control unit of the synchronous condenser package. It is a floor standing cabinet which houses various instruments including:

- Automatic voltage regulators (AVRs) with full redundancy
- Protection relays (two different brands as per current requirements)
- A Programmable Logic Controller (PLC), which controls and monitors all the built-in measuring instruments, signals and interface with the upstream control.



**ABB AVR
(UNITROL 1020)**



**ABB PLC
(AC500)**



**ABB
PROTECTION RELAY
(REG670)**

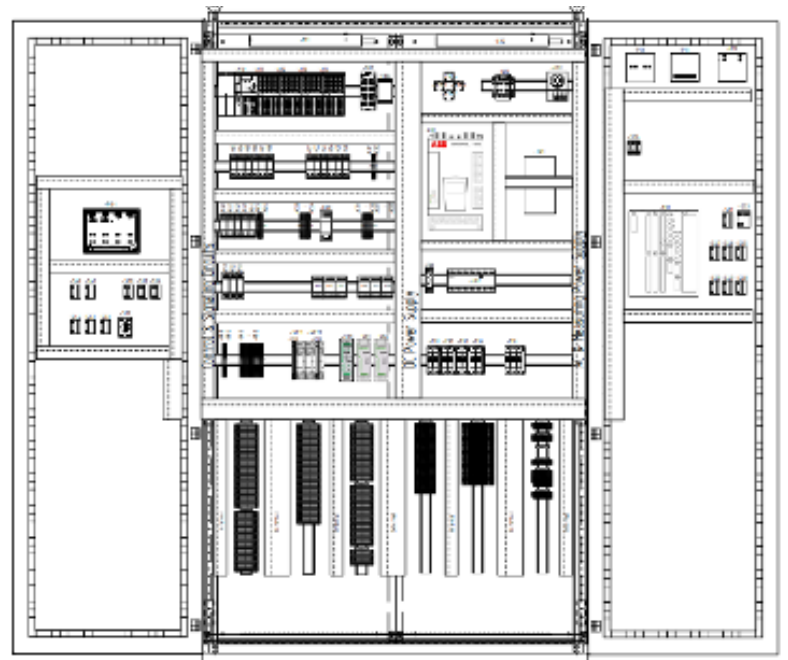


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Cooling options

Water cooled design

The most common cooling format is a machine with a top mounted air to water heat exchanger (CACW). This solution gives the highest power output. The heat exchanger is connected via external piping to the separate fin-fan cooler (FFC) unit as seen below.



Fin-fan cooler (FFC)

For outdoor installations in Australia a closed circuit water cooled synchronous condenser is the most common solution. The water is circulated between the radiator elements in the machine and the fin-fan cooler, where blowers are dissipating the heat to the surroundings. The blowers are PLC controlled subject to loading of the synchronous condenser.

Two versions are available. For smaller units the cooler is integrated on the top of the condenser (CAWA), which will save installation space. For larger units the FFC needs to be separate with its own control panel.



ABB synchronous condensers

Additional cooling options

Air to air cooling system – alternative design

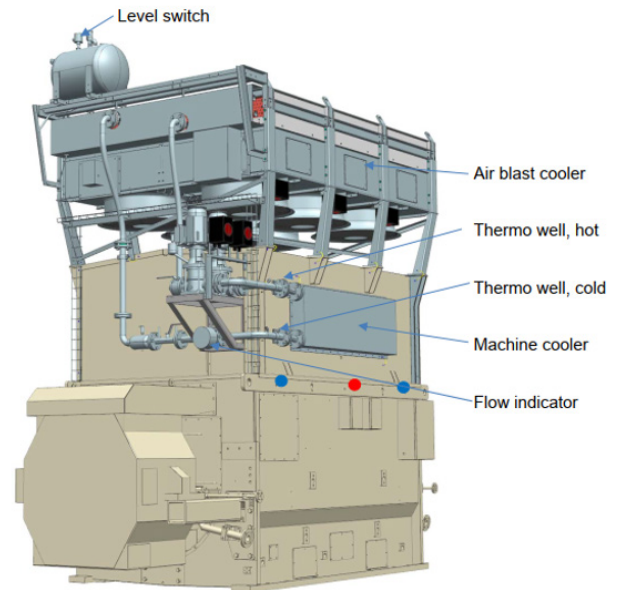
This machine mounted CACA (air to air cooler) with powerful blowers is speed controlled according to synchronous condenser loadings and cooling requirements.

This cooling format gives slightly less power output, but will result in a smaller footprint as no separate FFC unit is needed. The top mounted CACA cooler is larger than the actual machine body.



Integrated Water Cooler

This type of innovative cooler arrangement is an independent closed circuit cooling system (CAWA). This smart cooler concept uses a water-to-air cooler, integrated on the top of the condenser's air-to-water heat exchanger. It is designed specifically for the characteristics of the machine and offers a simple and compact solution resulting in significant space savings. This arrangement enables higher machine power compared with the CACA cooler system.



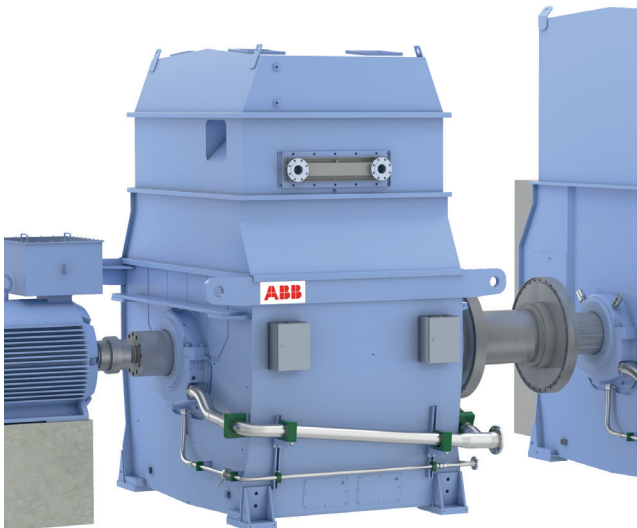
Additional package features and support

Flywheel and spare parts

Solution with flywheel with AFW1400

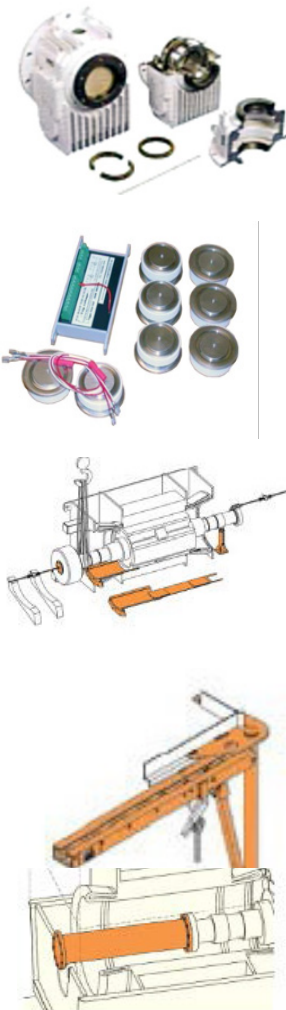
If very high levels of kinetic energy is needed, a Flywheel (FW) can be added to the largest condenser size (AMS1400). This system would provide kinetic reserves equivalent to a traditional synchronous power generator at about 300 MVA capacity. The result is a H factor* of about 6 seconds. This is an optional solution where very large kinetic support is required at the respective network node.

**H factor is indicating the ratio of kinetic energy in MWs (megawatt-seconds) and reactive power in MVAR (megavolt-ampere-reactive) available from the given plant or equipment, in this case synchronous condenser.*



Spare parts for commissioning, operation and special tools

Various items are included in this package including bearings, bearing parts, printed circuit boards, semi-conductors and lifting tools. ABB supplies parts that are subject to wear and tear or parts where availability is specifically important (e.g. diodes). Various tools are also available to ease maintenance and parts removal.



Additional package features and support

Modelling, installation and commissioning

From hardware equipment to modelling, ABB also provide the following services:

PSSE / PSCAD modelling support

A computer model of the synchronous condenser and AVR will enable the user to tune the AVR and PSS controllers, to run simulations and perform analytical studies of the power system. During early stages of a project ABB can provide OEM original PSSE/PCAD models and datasheets that are proposed and are available under NDA agreements. These modules are suitable to support the project from application to final grid code compliance.

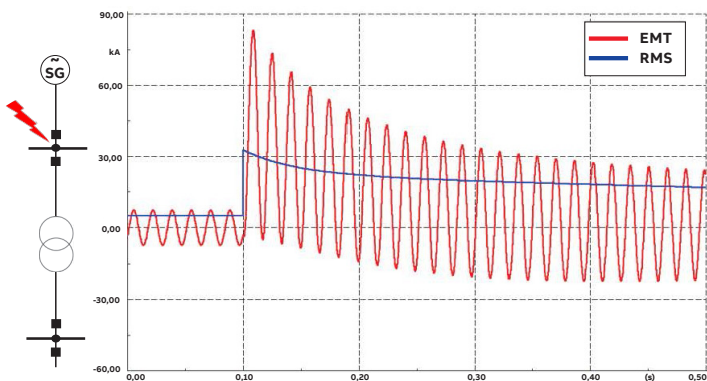
ABB has in-house support teams available that can be engaged on a consultancy basis tailored to the project needs.

Installation and commissioning support

ABB has experience in delivering synchronous condenser modular packages into all areas of Australia. We provide support for installation check points and for the commissioning of the synchronous condenser. This is inclusive of the auxiliary components of the synchronous condenser package. This service is provided on a consultancy basis allowing flexibility to meet the project needs in coordination with the entire project team.

Commissioning and site support via remote 4G wireless connection is available during the warranty period and beyond, where troubleshooting or changes in parameters and settings can be applied.

ABB has experienced in-country service engineers and well-equipped workshops dedicated to supporting customers throughout the lifetime operation of the complete synchronous condenser modular package.





Darlington Point
Solar Farm Project

Supplied by:
Edify Energy and
Octopus Investments

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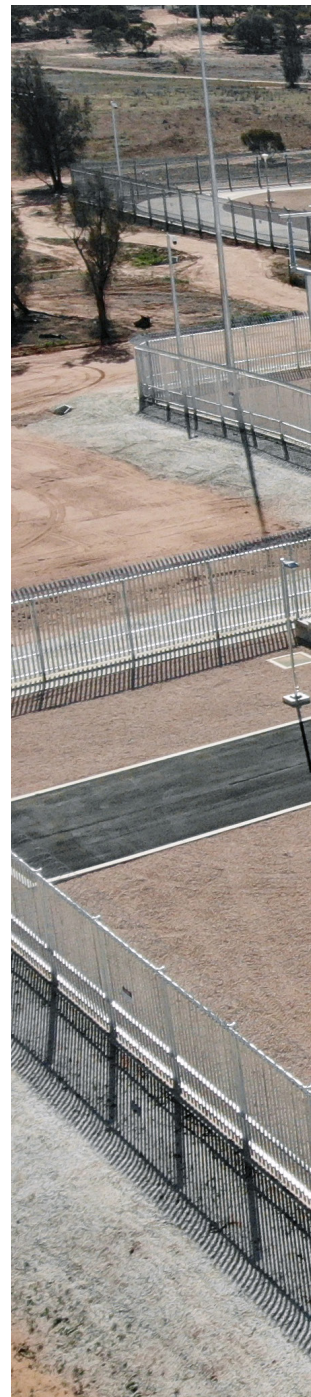
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www.new.abb.com/motors-generators/synchronous-condensers

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Darlington Point
Solar Farm Project

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