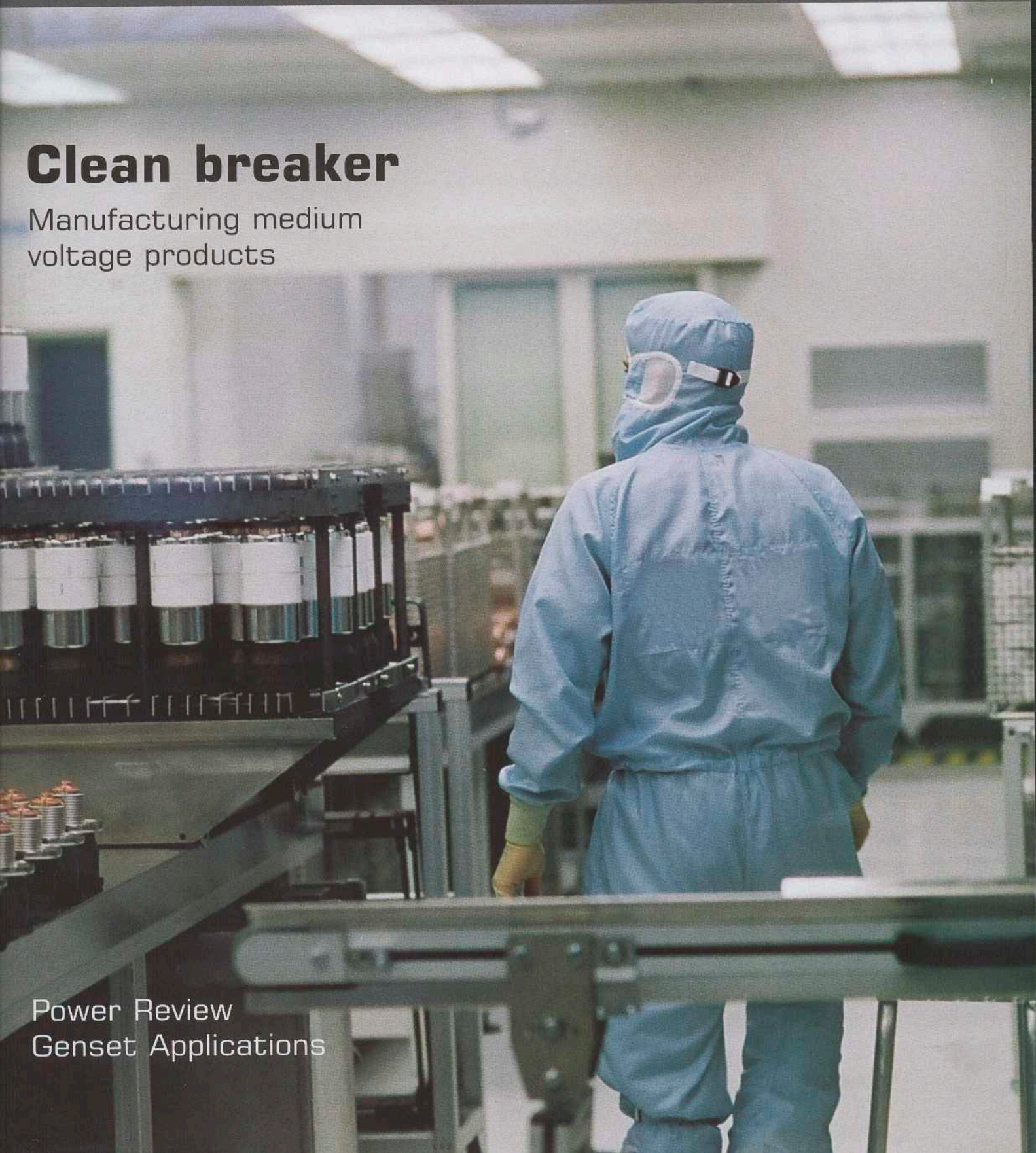


Clean breaker

Manufacturing medium
voltage products



Power Review
Genset Applications

**EDITORIAL****Editor**

JAMES LUCKEY
james.luckey@nexusmedia.com

Online editor

ANDREW TUNNICLIFFE

Editorial fax:

+44 (0) 1322 616378

ADVERTISING**Advertisement executive**

LUCY PIERCE
lucy.pierce@nexusmedia.com

Group sales manager

MATT COLVAN

Advertising fax:

+44 (0) 1322 616378

US sales representative

CLIVE BULLARD
Tel: +1 845 231 0846
Fax: +1 845 265 9695
Email: cbullards@cs.com

PRODUCTION**Production executive**

DEAN TURNER

Circulation

RACHEL HART

Managing editor

SVETLANA JOSIFOVSKA

Business sector manager

MARK SKELTON

Publishing director

TONY GREVILLE

Printing HEADLEY BROTHERS LTD

Published by

NEXUS MEDIA COMMUNICATIONS

Media House

Azalea Drive

Swanley, Kent BR8 8HY, UK.

Tel: +44 (0) 1322 660070

Fax: +44 (0) 1322 616378

E-mail: ipg@nexusmedia.com

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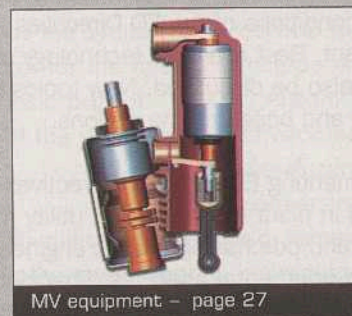
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PAGE 27 – Convincing experienced switchgear users that GIS gives significant advantages over traditional AIS can be an arduous task for OEMs. But sometimes the technology can do the talking. James Luckey visits ABB's Global Focused Feeder Factory in Ratingen, Germany.



Clean room at ABB's Ratingen factory.

GIS technology does the talking

Convincing experienced switchgear users that GIS gives significant advantages over traditional AIS can be an arduous task for OEMs. But sometimes the technology can do the talking. James Luckey visits ABB's Global Focused Feeder Factory in Ratingen, Germany.

Inside the clean room used to manufacture the vacuum interrupter.

Availability and reliability are two prerequisites for any equipment manufacturer. For OEMs in the business of power protection and safety this is absolutely essential.

Switchgear and its components are a vital link in the transmission and distribution chain. Gas insulated switchgear (GIS) using sulphur hexafluoride (SF₆) has been in use since the 1960s, at high voltage (HV) application first, and medium voltage (MV) much later. Air is also used for insulation but SF₆ has significant property advantages, notably its dielectric and arc quenching strengths.

At medium voltage level (generally accepted as between 1-52kV) demand for GIS is increasing, yet OEMs still find that convincing potential customers of its merits over air insulated switchgear (AIS) can be a difficult challenge.

The continued use of AIS is down to customer preference and those that perhaps don't take whole lifetime costs into consideration, says Karsten Hauck, product marketing for GIS at ABB Calor Emag MV Products. "The perception is that you can do more inspection and maintenance on AIS but the real benefit is provided only if MV live parts are maintenance free for the entire service life, as is the case with GIS. I believe GIS offers the better solution in nearly every application."

At its Global Focused Feeder Factory in Ratingen, Germany, ABB produces MV switchgear and related components such as vacuum interrupters, embedded poles, and

circuit breakers. It is the component market that makes up the bulk of the company's business (50 per cent of all orders), meaning it is both product supplier and switchgear manufacturer.

For MV applications, ABB has its ZX family of compact, modular and metal-clad GIS. It is used at primary distribution level in industry, utility and infrastructure projects. The ZX range covers single busbar (ZX0 and ZX1.2) and double busbar (ZX2) configurations, with rated voltages from 12-40.5kV, rated short circuit currents up to 31.5kA (40kA for the ZX2) and rated currents up to 4,000A.

The design within each panel depends on model but there are uniform sections. Each panel has compartments for circuit breaker, busbar, cable termination, pressure relief duct and low voltage section. SF₆ gas is used within the circuit breaker and busbar compartments, although there are no gas connections between the two.

Hermetically sealed

These compartments are hermetically sealed according to IEC standards, using laser cutting and welding on the tanks during production; once sealed and filled there is just a slight overpressure SF₆ inside.

To allow multiple panels to be fitted together with ease and without gas handling or screw coupling, ABB uses a plug-in socket technique for the busbar connection. A socket is built into the existing panel, there is a connecting link and insulation tube and the next panel can be plugged in. "It saves time

on installation and allows the factory to fill it with SF₆ and deliver it with factory tested quality, so that the properties remain unaffected by any severe site conditions," says Hauck.

The plug-in technique is used for attaching the power cables in the panel and can also secure a voltage transformer, surge arrester, blanking plug and test plug.

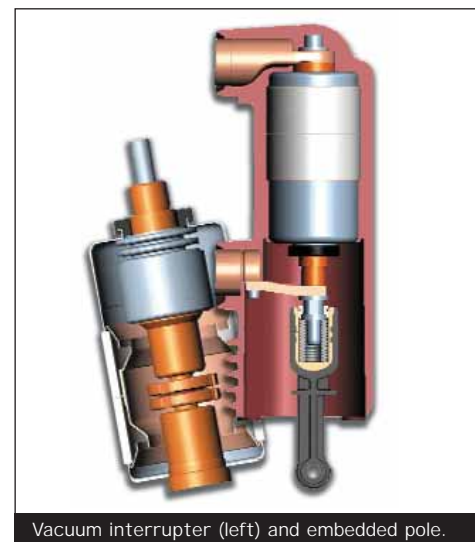
The circuit breaker compartment includes cable and test plug sockets as well as the vacuum circuit breaker poles.

The breakers are three phase switching devices arranged horizontally, with an operating mechanism (stored energy spring type) outside the gas compartment and embedded pole parts containing the switching element, the vacuum interrupter. "In ZX switchgear we use SF₆ for insulation. Switching is done with vacuum interrupters, totally independent from the isolating medium SF₆. The vacuum interrupters offer a very high operational life without the need for any inspection or maintenance."

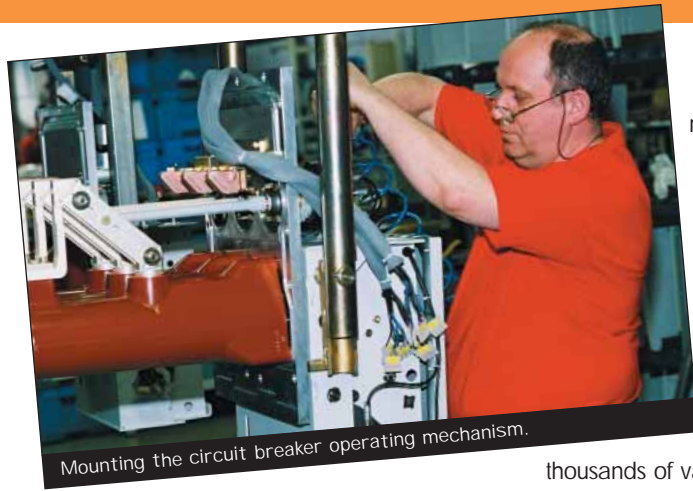
Clean room

The outer casing of the vacuum interrupter is a ceramic insulator, surrounding the copper/chromium contacts inside. The component is assembled in a clean room to ensure there is no contamination inside the interrupter, and evacuation and brazing are done in one process to achieve the best vacuum.

The circuit breaker pole is embedded in an epoxy resin together with terminals and push rod. The pole has a high dielectric strength and means the interrupter is not exposed to any outside damaging influences such as moisture or dust.



Vacuum interrupter (left) and embedded pole.



range voltage measurement.

“The same Rogowski coil can be used for whatever application or whatever ratio. When you specify CTs, there are different ratings regarding short circuit, different ratings for primary currents, and different ratings for secondary currents –

thousands of variations in fact for CTs. If you use a Rogowski coil – it’s just one.

“Imagine the effort needed when you find out in five or ten year’s time that the load or the intake of your switchboard will change. You may end up having to change all your current transformers because the characteristics don’t match any longer. You don’t have this problem with a Rogowski coil, because its output is linear over the entire range. Just set the protection relay in a different way in order tell it that e.g. 200mV should no longer be the stage for an over-current tripping, but the new stage is now 250mV.

“The Rogowski coil is commonly used, and is not a special technology but people cannot get rid of CTs, and yet it is cheaper than a CT.”

Control of the switchgear panel can be done through the integrated bay control unit REF542plus. It is a highly flexible system to allow quick changes; within minutes functions can be added by software settings, instead of changing relays and instrument transformers.

For product testing and R&D, ABB’s Global Focused Feeder Factory has independently

accredited laboratories. There are facilities for high voltage, mechanical, material and calibration testing. Such is the highly equipped nature of the labs that third parties also use them. Every kind of product imaginable can be tested in these labs, and it is powered by a three-phase short circuit generator with 2,800MVA maximum short circuit power.

“One very important test that you have to pass is the internal arc test,” says Ralf Heinemeyer, local business unit manager of ABB MV products. It is also a very expensive test because you can’t use the housing any more afterwards. And if you need ten shots to have a successful test it means you have to burn ten of those panels. You have to perform an internal arc on every compartment of the panel. That means for example if you look at our double busbar ZX2 switchgear, we have to use three shots.”

Increased efficiency

Much has been done to improve the switchgear at ABB. Heinemeyer points to increased efficiency and economy. “I think on the primary part a lot has been done; the secondary part is the wiring compartment, there is a push for continuous improvement and that will be the focus for our future.”

For now the factory takes pride in its current MV product output. And although it does manufacture some AIS (mainly for the German market) the last words must go to the attempts to convert MV switchgear users to GIS.

“[In AIS] the ambient conditions have a direct influence on the insulation; dimensions and ageing behaviour depend on quality of insulation and therefore on the lifetime and availability of the equipment,” says Karsten Hauck. With GIS, he adds, the airless, sealed tank means none of these affect the panel or components.

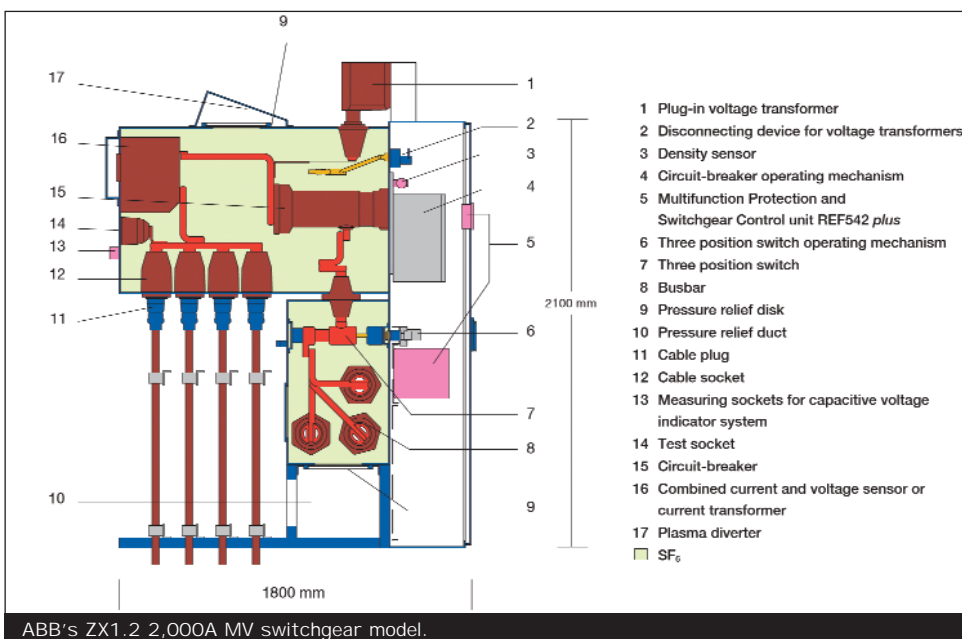
As the SF₆ does not age or deplete, operators do not need to top-up gas levels during the equipment’s lifetime, taken as 40 years. For that reason as well there is no need for maintenance on any component within the switchgear. AIS has humidity, dust, and altitude to contend with.

“Added to that the SF₆ gas allows smaller dimensions because the insulating properties are 2.5 times higher than air. You can save money on building costs as well, as a smaller switchboard takes less space.” **IPG**

The circuit breaker also has an earthing function says Hauck. “This means we don’t have a conventional earth switch but we use the CB in combination with an offload three-position switch. This combination is much more reliable because the CB is designed for switching short circuits – you can do this many times during its life. The three-position switch is either in busbar connection or in earthing connection.” The three switch positions – connecting, disconnecting and earthing – are clearly defined operations. Simultaneous connection and earthing is therefore not possible.

Detection of current and voltage can be done via conventional current transformer (CT) or, as Hauck is keen to point out, a combined sensor. “It is a compact design and uses quite a well known technique – a Rogowski coil.”

A Rogowski coil has an air core rather than an iron core, so it has a low inductance and can respond to fast-changing currents. As there is no iron core to saturate, it is highly linear even when subjected to large currents. It can be used within the ZX switchgear, together with an Ohmic divider for wide



ABB's ZX1.2 2,000A MV switchgear model.