

The System Control Centre in Wendlingen

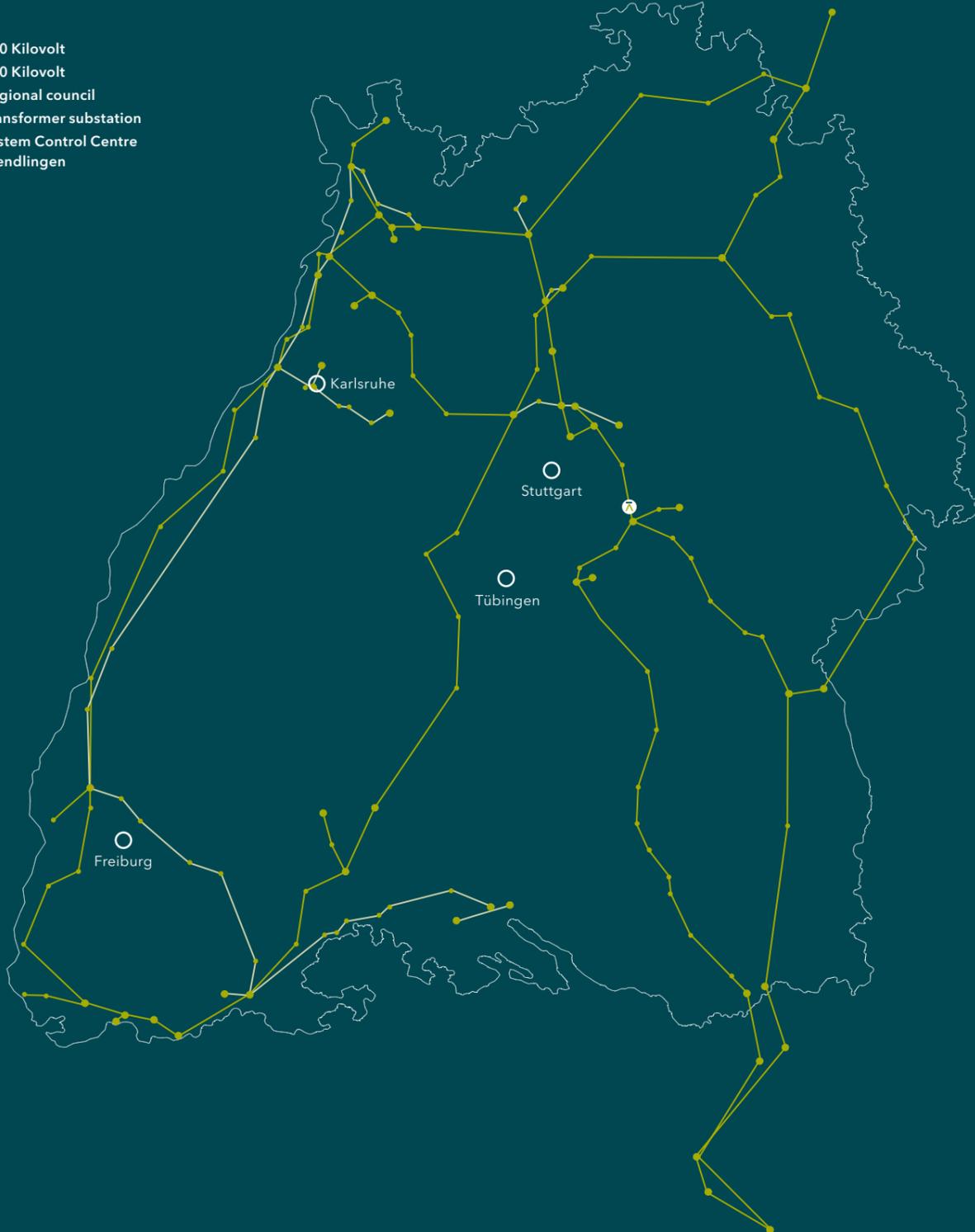
AT THE HEART OF THE TRANSMISSION SYSTEM



220 and 380 Kilovolt

OUR TRANSMISSION SYSTEM

- 220 Kilovolt
- 380 Kilovolt
- Regional council
- Transformer substation
- Ⓜ System Control Centre Wendlingen



01

4 About us: TransnetBW

BUILDING A NETWORK FOR THE FUTURE

02

6 The System Control Centre in Wendlingen

PROVIDING BETTER QUALITY OF LIFE TO OVER 11 MILLION PEOPLE

03

8 System operation

KEEPING TRACK OF THE ENERGY TRANSITION

04

14 The team

MAINTAINING MAXIMUM VOLTAGE 24/7

05

16 Development

EVERYTHING UNDER CONTROL - FOR MORE THAN 5 DECADES

01

About us: TransnetBW

BUILDING A NETWORK FOR THE FUTURE

Stable electricity grids are the prerequisite for a reliable supply of energy and the basis of a functioning economy and society. As transmission system operators, TransnetBW is responsible for the operation, maintenance, planning and expansion of the transmission system. We secure the supply of electricity to around eleven million people in Baden-Württemberg and make sure that this industrial region is equipped for manufacturing at all times. Our extra-high-voltage lines are connected with the downstream 110-kV distribution networks. We take the energy from the source of generation to the target location while integrating renewable energies into the supply system. Our control zone is interconnected with neighbouring transmission systems in Germany, France, Austria and Switzerland; we are part of the European network of transmission systems.

The energy transition is changing the way electricity is generated: in Germany, there is a growing focus on renewable energies such as wind and solar power. The electricity production process is shifting away from the main centres of consumption and becoming more volatile. Wind power plants are predominantly built in the windy northern regions of Germany; the electricity is needed in the high-consumption regions in the south. Patterns of consumption are also changing dramatically. Our digital society needs more electricity than ever before; new technologies lead to higher load peaks at certain times, such as in the evenings, when many people charge their electric vehicles.

With our transmission system, we are laying the foundations for the stable supply of electricity in Baden-Württemberg and beyond. From the System Control Centre in Wendlingen, our system control engineers manage load flows in the system and maintain the balance of electricity production and consumption. We have already started building the transmission system of the future, which will be prepared to respond reliably to prospective transmission issues.

Overview

ENERGY SUPPLY

34,600 km²

Area supplied with electricity

3,200 km

Electrical circuits of 220 kV and 380 kV

600

Employees

6.1 billion

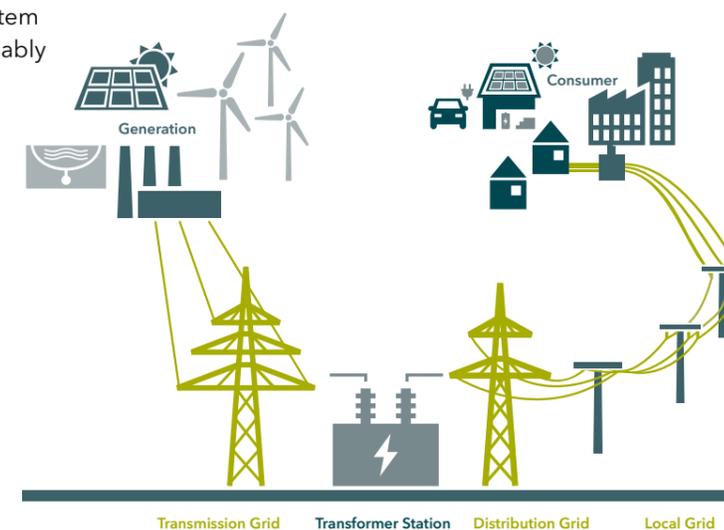
Revenue in 2016

8,500 MW

Installed capacity of subsidised renewable power plants in Baden-Württemberg

74 TWh

Annual gross electricity consumption in Baden-Württemberg



02

The System Control Centre in Wendlingen

PROVIDING BETTER QUALITY OF LIFE TO OVER 11 MILLION PEOPLE



The residents of Baden-Württemberg depend on a reliable energy supply. Our job is to guarantee this at all times. This means thinking ahead, responding quickly and practically in case of emergencies, and collaborating effectively with neighbouring countries. In order to command the necessary flexibility for the management of the transmission system, we need a control centre that fulfils demanding requirements: the System Control Centre in Wendlingen. This is the heart of our transmission system - and has been for over 50 years: the first load distribution operations at the Wendlingen facility commenced in 1962. In the following decades, the building was renovated several times and consistently upgraded with more advanced technology. To prepare the centre to control the network of the future more effectively, the facility was completely rebuilt in 2016.

The technical equipment installed at the System Control Centre ranks amongst the most advanced of its kind in Europe. The highly integrated network control system is capable of processing large quantities of information simultaneously. The data comes from transformer substations and power plants in our control zone as well as neighbouring regions. It includes measured values of currents, voltages, switching status and even transformer oil temperatures. The data is transmitted to the System Control Centre via our own data cables on our power lines. This gives our system control engineers all the information they need, directly on their monitors.

Control centre EQUIPPED FOR THE NETWORK OF THE FUTURE

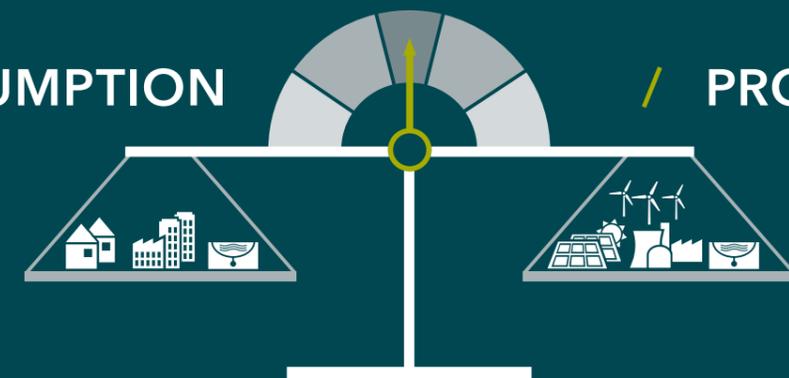
440 m ² Control room	95 Workspaces
65 m ² Large-screen laser projection	50 Million € Total investment
11 GW Annual peak load	50 Transformer substations

Production = Consumption
Network frequency = 50 Hertz

/ 50 Hertz

/ CONSUMPTION

/ PRODUCTION



03

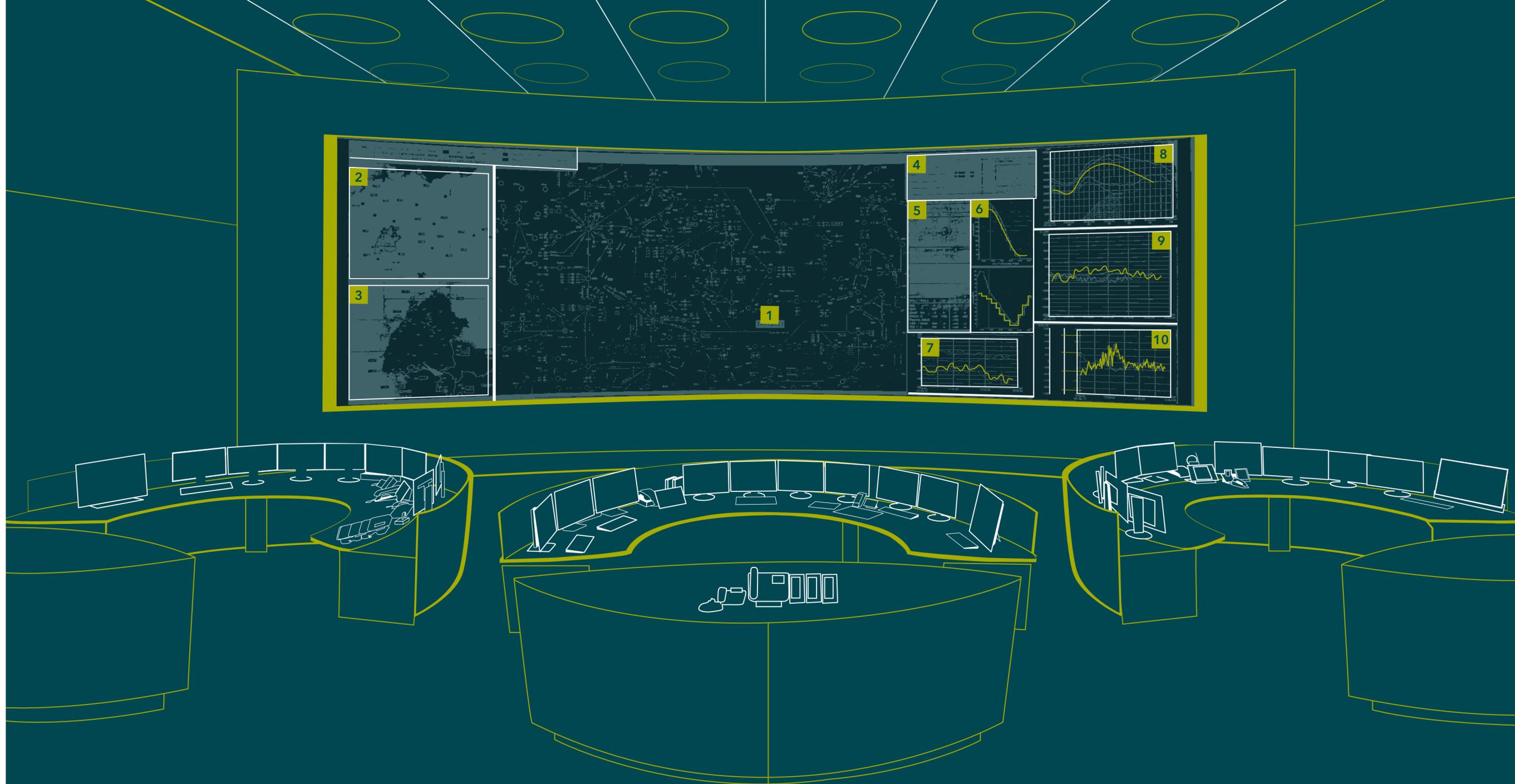
System operation

KEEPING TRACK OF THE ENERGY TRANSITION



Energy production and demand, malfunctions and outages - here at the control centre, our team of specialists in system control and IT have everything under control. They work 24-hour shifts to secure a stable electricity supply. On the left, **Operational Planning** is responsible for calculations and forecasts of the expected system status. In the middle, **System Control** manages and monitors the transmission system. **System Balance**, on the right, ensures that the balance between production and consumption is consistently maintained.

The **Network Operation Centre** (not pictured) makes sure that the communication links between the System Control Centre, the transformer substations and other partners function seamlessly.



Overview of System Control

SMART TOOLS FOR A STABLE SYSTEM

- 1 System overview**
This is our energy universe at a glance: here, we display and monitor information such as the switching status, voltage, power flows or system utilisation.
- 2 European Awareness System (EAS)**
EAS helps us collaborate effectively with other transmission system operators in Germany and neighbouring countries. This allows us to monitor the overall system status, observe the frequency and exchange capacities and identify emerging problems immediately.
- 3 Geographical map of Baden-Württemberg**
Geographical overview of our system, showing current exchange capacities with neighbouring transmission system operators in Germany and other countries.
- 4 System Balance**
Overview of the current status of the reference frequency, the exchange capacity, the reference exchange and the load of import/export in the control zone.
- 5 Power plant generation**
Analysis tool for the input of renewable energies in Germany and our control zone, as well as the active and reactive power fed in from conventional power plants.
- 6 Photovoltaic energy and wind energy input**
Overview of the forecast and the previous day's values.
- 7 Correction values from the International Grid Control Cooperation**
Chart of the correction values provided by the International Grid Control Cooperation (IGCC) and its European partner organisations.
- 8 Load curves**
Information about the control zone load, vertical grid load and decentralised input in our control zone - for the current day, the previous day and the previous week.
- 9 Grid Control Cooperation (NRV/IGCC)**
Display of the control band limits, the demand for secondary control power in Germany and the demand in our control zone.
- 10 Power frequency control**
Overview of the current frequency, the power deviation and grid control errors in our control zone.

04

The team

MAINTAINING MAXIMUM VOLTAGE 24/7



An exhibition area for visitors is located in the atrium of the System Control Centre

A highly qualified and dedicated team of experts work day and night to manage and control our transmission system. The responsibilities of the System Control Centre are shared between the sections of System Control, System Balance and Operational Planning, supported by the IT team at the Network Operation Centre.

The actual task of controlling the transmission system consists of the System Control and System Balance sections. The system control engineers switch workplaces every week to ensure that their knowledge in both areas is always current, as well as preparing them to provide optimal mutual support at any time. The specialist responsible for operational planning has to look into the future to some extent to plan the necessary measures to maintain balance in the transmission system.

/ SYSTEM CONTROL

The system control section manages and monitors the transmission system. In order to maintain security,

the team follows the principle of the “n - 1 criterion”. This determines that any random component of transmission system operation - such as a power line or a transformer - may malfunction at any time without causing a disruption of the supply or further expansion of the problem.

In addition, the system control section makes sure that there is no overload of the extra-high voltage transmission system. For this reason, they always coordinate switching plans with neighbouring transmission system operators. Grid reliability calculations and load flow forecasts are automatically generated every five minutes to assist our system control engineers in assessing the transmission system status.

/ SYSTEM BALANCE

The system balance section is responsible for the schedule management as well as the power-frequency control for the German grid control association. This involves the drafting of plans known as energy roadmaps, which define how individual control zones must interact in order to maintain the grid frequency of 50 Hertz.

These plans are based on forecasts by market participants and show the relationship between energy production and consumption in the control zones. The forecasts are updated regularly and the schedule is adjusted accordingly.

Bottleneck management is also one of the core tasks of the system balance section. Regardless of various forecasts and advance planning, there are still occasions when the transmission system is threatened with overload. This is when an efficient response is called for. In such an event, the experts contact all solution-relevant organisations such as power plants and transmission system operators. The central measure here is redispatching: the immediate adjustment of originally planned power plant utilisation to meet the current demands of the transmission system.

/ OPERATIONAL PLANNING

The operational planning section is responsible for the task of coordinating grid security, both within Germany and internationally. The primary tool for this purpose is an international association of transmission system operators. In close collaboration - yet with decentralised,

individual responsibilities - the members of the association supply a stable flow of electricity to around 185 million people in ten countries, spanning across a surface area of 1.13 million km².

To maintain the stability of the supply, the operational planning section also manages the coordination of transmission capacities in a national and international context.

/ NETWORK OPERATION CENTRE

The System Control Centre is equipped with a highly available IT system and cutting-edge technology. This includes our own communication network for transmitting data in separate directions by means of various channels. All information and signals from the power lines and transformer stations must be transmitted live to System Control at all times - even in the event of a sudden malfunction or outage.

The experts in the Network Operation Centre are responsible for this task. They monitor multiple network connections around the clock to guarantee their functionality.

05

Development

EVERYTHING UNDER CONTROL - FOR MORE THAN 5 DECADES

1961

The upswing in the economy is accompanied by a sharp rise in electricity consumption. The demands on load distribution start to change. For this reason, the then grid operator, Energieversorgung Schwaben, decides to build a new load distribution centre in Wendlingen.

1974

The grid is rapidly developing: the first subsection of the 380kV grid commences operation. This also requires the restructuring and automation of the grid control system. A new main grid control centre is planned for the facility in Wendlingen.

1980

After three years of renovations, the new main control centre commences operation on 23 May 1980. The load distribution section now starts to concentrate on the deployment of the Energieversorgung Schwaben power plants and control of the 220kV and 380kV grids.

1998-2001

Cutting-edge IT technology is installed. At the beginning of 2000, the new control room in Wendlingen commences operation. The data transfer from the main switching centre for Badenwerk AG in Daxlanden takes another one-and-a-half years. In addition, the centre assumes control of the Neckarwerke Stuttgart transmission grid.

1990

Commissioning of the power-frequency control by Energieversorgung Schwaben.

2015

Growing demands resulting from the energy transition and higher specifications for technical infrastructure and security can no longer be met with the existing main switching centre - it becomes necessary to build a completely new facility in Wendlingen.

1962

On 29 September, the first employees take up their tasks at the two workstations in the load distribution centre of the 110 and 220kV grids. The power plants and transformer substations are schematically represented then as now.

1977

In the process of modernisation, the load distribution centre is transferred to a provisional control room. To reduce the load on the main switching control centre during the renovations, smaller switching lines and control centres take over the task of controlling the 110kV grid.

1984

For the first time, a real-time data processing system is used to monitor switching status. This means that the high-voltage grid is now controlled remotely from Wendlingen via a data processing computer - as opposed to the previous method of telephoning the local switching stations.

1990-1998

Following the liberalisation of the electricity market, the main control centre in Wendlingen takes over the responsibility for system management and now monitors the electricity supply for the entire state of Baden-Württemberg. In addition, the system is switched from a key-controlled system to computer control with a graphical user interface.

2012

A third, permanent workstation for an operational planner is added to the control room in Wendlingen. The operational planner works at regional level to improve coordination in the partnerships between European transmission system operators.

2017

The new main switching centre is completed. Equipped with the latest technology, a secure electricity supply for Baden-Württemberg is guaranteed. Its day-to-day operation is characterised by close collaboration with German and international neighbours as well as frequent grid security interventions.

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