by Dirk Sovonja, Kries Energietechnik, Caesar Budenbender, EnBW Regional AG, and Klaus Jotz, OMICRON electronics, Germany

The Challenge of Asset Management

Asset Management in practice: TransnetBW is the transmission system operator in Baden-Württemberg, Germany. Based in Stuttgart, the company is responsible for the operation, maintenance, planning, and expansion of the transmission grid in line with demand, and guarantees the safe and reliable supply to around eleven million people. The TransnetBW transmission grid covers an area of 34,600 km² and its 220 kV and 380 kV power lines cover approximately 3200 km. More than 80 transformers are connected to the regional 110 kV distribution grids with 600 staff members managing the 47 substations covered by TransnetBW GmbH.

Dirk Sovonja studied electrical engineering, specializing in electrical power engineering, at the Cooperative State University Mannheim in cooperation with EnBW Regional AG. From 2008 until 2012 he was employed as an engineer for protection technology at EnBW Regional AG. He then moved to TransnetBW where he was responsible for secondary technology, including protection and metering technology, and later for installation technology with a focus on secondary technology. Since September 2017 he has been working for Kries Energietechnik as a key account manager.

1 Management

Each power grid expansion needs a high quality asset management

2 Substations installations

Substations are complex installations with a large number of protection, automation and control (pac) assets

Implementing the energy transition constantly presents TransnetBW with new challenges. In order to reliably transport the increasing amount of electricity from renewable sources to consumers with transmission paths constantly being extended, the network must be continuously adapted.

The projects needed to achieve this are prepared in conjunction with the other transmission grid operators in the network development plan. Prior to implementation, all projects go through a legally defined series of approval procedures during which the individual measures are closely examined.

23 people in the protection, control and automation (pac) division operate from two locations (Karlsruhe and Wendlingen) and manage all assets covered by TransnetBW in the pac area. This includes 67 substations with a total of 2500 protection relays, consisting of approximately 200 different types, and 7500 data connections. The PAC division itself is divided into subareas: protective and metering point operation, and information technology.

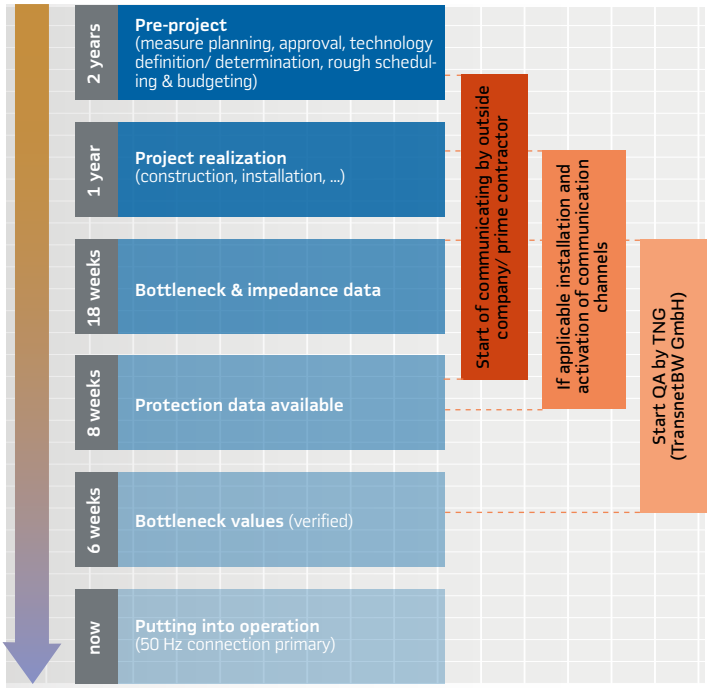
Requirements Drive the Need

The legal guidelines require full documentation of all work carried out in the substations. Furthermore, to ensure smooth day-to-day operations, all data such as manuals, test procedures, or basic settings must always be present and in the latest version.

The range of tasks of the PAC division includes periodic maintenance of the protection devices being used and any replacements in the event of a fault. In addition, this division is also responsible for implementing projects during the course of extension or alteration work in the substations.

3 Project at TransnetBW

Performing a project at TransnetBW is divided into clear sub-processes using a clear time schedule



The protection concept always includes a main and backup protection system, consisting of line differential protection and distance protection in each case provided by two different vendors.

The protection concept always includes a main and backup protection system, consisting of line differential protection and distance protection, in each case provided by two different vendors. Line differential protection also integrates distance protection and an emergency definite time-overcurrent-time relay. All protection relays are equipped with communication to the remote end in order to ensure 100% protection of the line.

Since the line data also usually changes during extension and alteration projects, the protection devices must be given new configuration parameters.

If a project like this is initiated, then the power system planning division provides the PAC division with all the relevant data for the equipment in question (lines, transformers, busbars, etc.). This data is forwarded using a form that also includes details of the maximum values of the respective equipment. This forms the basis of the short-circuit current calculations that the PAC division then commissions at the grid planning stage and that are fundamental for setting up the relevant protection systems.

This configuration data is specific to the electric circuit and is entered into a worksheet that always contains the values for both devices.

In addition to this, there is a configuration file in the manufacturer's format for every device that contains the typical basic settings and which are rarely subject to changes. These describe, amongst other things, the start process and actions in the event of a malfunction. This basic configuration file is then simply completed with the 30 – 40 values from the worksheet that are specific to the electric circuit and loaded into the device.

Caesar Budenbender has been working as an electrical engineer for secondary technology at TransnetBW since 2012, focussing on protection technology. Following his apprenticeship as an energy system specialist, he studied electrical engineering at the University of Applied Sciences in Dortmund, specializing in energy supply. Between 2010 and 2012 he worked in the field of protection technology at EnBW Regional AG.

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Complexity does not Serve

A system that was easy to use was needed for such processes. The environment previously used was made up of different IT systems that did not offer optimum functionality to meet requirements.

The operational system used throughout the company also manages many technical devices and components, however, due to its very commercial orientation, it focusses predominantly on condition assessment or depreciation. Fields like these should be completed or excluded so that no error message is generated when a device is added. The PAC division, however, is also faced with a very different problem: File types for test procedures and configuration files are not accepted and cannot, therefore, be integrated there. This also affects the relevant technical data. For meters, this includes, for example, transformer transmission ratios, metering code, and the like. The corporate ERP system cannot provide any of this unless it is via a costly auxiliary module.

This is no different when using an office IT environment. There are also problems here with the file types, but at a different level. The office IT security systems do not recognize the types of files used in the pac technology and are therefore also not able to check them. This is why the IT-administration does not accept them either. There is even a danger that the files would be deleted or rendered unusable by a virus scanner due to the identification of a potential risk.

This is why it is a very good idea to separate the critical infrastructure from the office IT environment. The process network of the PAC division was created in response to these requirements, it runs in parallel to the office IT and is adapted to the requirements of the PAC division. It is a self-administered network storage solution (with NAS as a backup) that directly recovers the data in case of server failure. Among other things, the server also covers the databases and the user access rights. From mid-2017, administration shall be handed over to an IT service provider who will run the servers at external and separate locations.

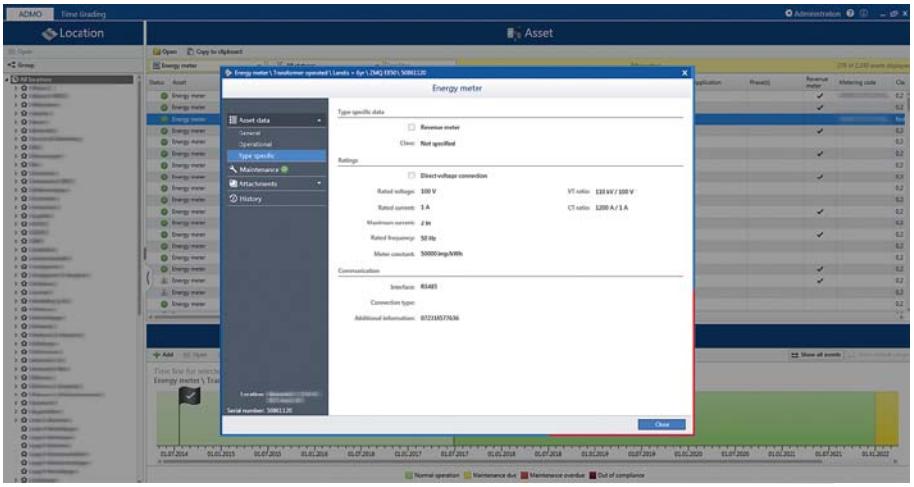
Asset Management by Data Base System

For the centralized and uniform storage and provision of data and information, the TransnetBW pac division preferred using a database system solution. It offers the possibility of providing specific evaluations in standardized formats and the necessary interfaces to other programs and databases, thereby enabling data to be exchanged automatically. An additional benefit is the protection against data loss as a result of back-ups and the safeguarding of raw data without the need for additional software. Strictly controlled rights management to protect the data against manipulation, but which also permits traceability or the ability to correct changes to data, does however constitute the main criterion, since this is the only means by which the legal certification requirements can be fulfilled. This kind of database system must, however, also fulfill the special requirements of the PAC division. This includes, for example, saving and providing data from protection devices and meters, as well as device documentation. In addition to this, there should also be the option to carry out evaluations, in particular for the relay loadability (current value for a feeder that must not lead to a protection trip), safety concepts, and meter information. It must be possible to create test cycles and export data into the corporate ERP database system of TransnetBW. The same applies to the export of evaluations into standardized formats (for example, Excel spreadsheets) and stand-by equipment management. The main criteria however are the secure archiving of protection test documents in compliance with DIN VDE 0109, the secure control of around 2000 datasets with attachments, and the simple planning of calibration cycles and test cycles.

> It is a very good idea to separate the critical infrastructure from the office IT environment.

Klaus Jotz studied electrical engineering at the Georg-Simon-Ohm TH in Nuremberg, specializing in electrical energy technology, after which he completed additional training as an energy manager. He has worked in the field of technical marketing for many years as well as working as a specialized journalist and specialist instructor. He has been working at OMICRON electronics since 2014 as a marketing communications engineer.

4 Getting an insight to the needed data of each asset



Since none of the database systems used by the company were able to meet all the special requirements of the PAC division the decision was made, after extensive market research, to opt for ADMO - a Protection System Maintenance tool (PSMT) from OMICRON electronics. It already contained all the required functionalities, which in turn makes customizing redundant. Clarity and comparatively easy handling are additional factors that contributed to the decision.

The introduction phase of development of the protection system maintenance tool was completed using a standalone version on a laptop. The initial import of data from the database to be superseded was realized using the integrated import function and associated XML template. In order to accurately identify the assets, PSMT uses the serial number of the respective device as a unique identification feature. After the protection devices were imported, the test operation started and the first practical findings in protection technology were gathered. The metering group started with a separate, second PSMT standalone version. To make subsequent merging easier, only device data (without attachments) was processed to begin with.

After this initial test operation, the changeover to the client-server version followed. The supplier provided assistance with both the server specification (hardware and software) and with setting up the SQL server database, the installation of the PSMT server, and merging of both databases of the standalone laptops in the PSMT server. In order to do this, the device data of the meter technology was imported into the protection database.

PSMT now runs as an asset test database in the parameterization environment, together with the configuration programs and test universe software. This ensures that the information is up-to-date and correct.

For the final expansion to be realized in the near future, in accordance with ISO 27000, the parameterization environment should run on its own servers, with a separate backend, separate VLAN, and full data backup on tape drives, fully administered by an external partner. Until then, the settings for the respective devices shall continue to be saved via the office IT in order to guarantee 24/7 access.

The current parameterization environment does of course also already permit controlled and secure operation. The maintenance of central data in the PSMT such as, for example, the definition of device types, the storage and allocation of manuals, management of basic configuration files, and determination of test cycles, is the responsibility of the relevant key user and is completed centrally in conjunction with the protection engineers in the office.

In the run-up to a project or alteration work, the system manager creates the data for the substation, for the fields and transformers, as well as for the protection devices and meters, all directly in the PSMT. The data is then synchronized with the end device or end devices. This mechanism ensures that the data is up-to-date at all times. Such unidirectional synchronization (from server to client) has a significantly lower error rate than bidirectional synchronization.

Asset management provides devices with all technical information. This includes the software and firmware version, and the order number.

The situation is somewhat different when a new test is set up or during commissioning. It is completed offline and on site by the relevant technician who then loads the data into the server database via return synchronization as soon there is access to the parameterization environment.

Today, TransnetBW uses PSMT in five areas of the PAC division, in particular for the data storage of protection technology and meter technology: asset management, test management, document management, evaluations and data exchange, as well as tripping scheduling.

Asset Management

Asset management provides devices with all technical information. This includes the software and firmware version,

5 The needed maintenance schedule

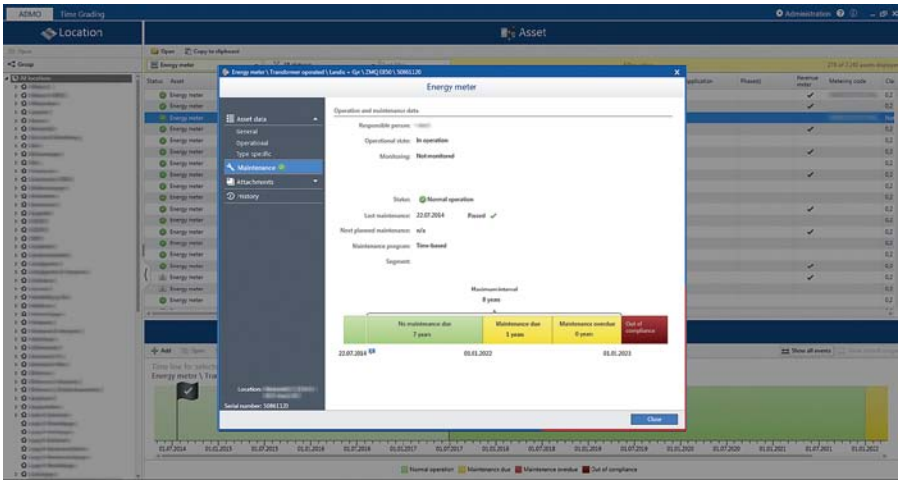


Figure 5: The asset management system shows the needed maintenance schedule.

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and the order number. These are used to quickly and easily identify devices that are affected by batch errors. This is especially crucial when it comes to the subject of IT security, since in future it will be vital to be able to react quickly to firmware updates from manufacturers when security problems are uncovered.

The requirement for stand-by equipment is determined using an overview of the types installed and the number thereof. For meter technology, key meter data is also forwarded to the remote meter read-out, such as nominal values, transmission ratios of current and voltage transformers, meter constants, and communication connections.

Test Management

For test management, TransnetBW defines the test cycles centrally, dependent on the equipment technology. The devices to be tested during the calendar year can be directly included in the budget plan via the PSMT fields "Asset System Code" and "Device ID." Using the same Excel spreadsheet, the devices to be tested should be imported into the annual switching planning tool (TBT) as soon as the TBT interface is ready. The test templates provided in the PSMT are used for the actual function test. Data is output or input manually, not via the automatic import/export function for the protection devices. This prevents any parameters that might be incorrect from being loaded, which would then be stored in both systems and would be difficult to locate. Furthermore, once the process has finished, the whole procedure must be assessed by the responsible technician, another reason for not using an automated system. In this way, the logic of problematic settings can be checked more easily. The subsequent archiving of test certificates is also realized in the PSMT.

Document Management

The purpose of document management is primarily to make technical information available from a central point. This includes manuals, descriptions of special cases, and other technical documents.

Evaluations and data exchange

PSMT is used to centrally carry out evaluations for data exchange, for example, for protection concepts with the main switch line or protective limiting currents with the system management. This information is then forwarded using an Excel spreadsheet. Guest access for other fields and departments also provides exclusive read-access to relevant PSMT data. In this way, device data relating to technology and year of manufacture can be used to plan renewal strategies.

For test management, TransnetBW defines the test cycles centrally, dependent on the equipment technology.

Time Grading for Distance Protection

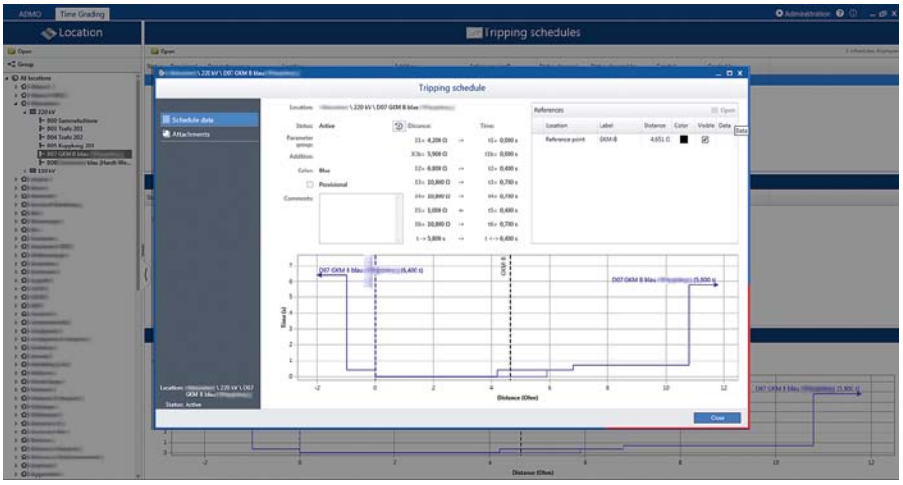
Until the PSMT was extended with the time grading module, TransnetBW worked with a program that it created itself. Maintaining this program as an everyday process was extremely time-consuming, which is why the PSMT time grading tool was integrated. It simplifies the creation of tripping characteristics by entering the primary X- and t-values and checking the selectivity. The characteristics of additional relays can be easily loaded as well, whereby possible overlaps are very quickly identified. Any dependencies between individual tripping schedules and possible intermediate feeds are also shown. Once tripping schedules have been created, they can very easily be reused, and even after copying and changing tripping schedules, it is always obvious what version is currently active.

An overall view shows all tripping schedules that are available, which makes it very easy to manage them. This made it possible to meet the requirements to display tripping schedules. The corresponding status for the relevant project can also be entered: In Planning, Provided, Active, Archived. The system automatically saves all data and this can be tracked in the history.

It is currently being considered what other processes could be usefully depicted with PSMT, since every extension of the system offers more potential. Company-wide dependencies with other processes should be taken into consideration here, where a possible shift and coordination of responsibilities and fields must be taken into account, which in turn can

Figure 6: The time grading tool shows exactly the set tripping schedule.

6 The set tripping schedule



bring about the need for new or extended access authorizations. A solution in a PSMT for calibration work would also be welcome.

Using the PSMT has given TransnetBW a number of advantages. The clear layout and standardized presentation of just the key equipment information made it easy to use with a clear overview. Furthermore, the processes have been significantly simplified when it comes to database management, especially with regard to the option to specify standard test cycles, document management, and the import and export functions from and to standardized formats. When it comes to the legal certainty and obligation to produce proof, the structured and traceable archiving of the test certificates, as well as the easy and secure traceability of changes to data within the PSMT via the automatic history, are paramount.

At a Glance: The Benefit of an Asset Management System

Proper functioning of the protection system has a major impact on the reliability of the bulk electricity system, which is why operating resources must undergo regular testing and maintenance. And of course protection relays protect costly electrical assets like generators or power transformers.

On the other hand malfunctions in the protection system can often be attributed to errors during the setup or configuration of assets. This is one of the impressive outcomes of the NERC Misoperations Report 2013.

Thus it is essential that the relevant test documents are accessible at any time, not only because of legal requirements. Therefore, whenever a utility undertakes asset management with a holistic view and according to the principles of ISO 55000 standard, it will address the protection system, for example, to effectively manage risks.

The ISO 55000 defines asset management as a coordinated activity of an organization to realize value from assets. But, asset management comprises more than just listing the existing resources of a utility. It also includes maintenance planning, asset evaluation, setting data for protection systems or disturbance analysis. Furthermore, the ISO/TC251 explains that assets have always been managed, for example, a protection engineer who sets or tests a protection device manages this asset. If this is done within the context of organizational purpose and strategy that steers this activity, it becomes asset management.

The Challenge of Managing Asset Data

In practice, it is often difficult to maintain an overview of the maintenance plans, test data, and associated documentation. For example, documents such as test plans, data sheets, and test reports are often stored in different locations. This results in greater organizational costs and makes the documents more difficult to access and consult for further research and analysis. As an example, consider the maintenance management. An efficient system should provide quick access to the required information and documentation as well as some important answers about the assets condition.

Because a utility handles a lot of assets, communication systems, control circuitry, current and voltage transformers, circuit breakers, station DC supplies, energy meters, and transformers should also be included on just one asset management system. The way of storing substantial information like locations, asset data, maintenance circles, associated test documents and even documentation from different external suppliers, is crucial for the efficiency of the asset management. Therefore, it is necessary to use a system that offers centralized planning and management capability for all testing and maintenance activities, and also allows on-site access for test technicians to the data they need at any time.

These demands require a team-minded system that gives a full overview of each asset and process to every user according to their access rights. Thus it simplifies the coordination within teams by supporting the maintenance activities, assignment of the responsible test technician or the development and distribution of test and settings templates. This will be a vital base for optimizing the maintenance strategy and complying with current standards for utilities as well as fulfilling their obligation to provide evidence of maintenance. ■

An efficient system should provide quick access to the required information and documentation as well as some important answers about the assets' condition.

7 The benefits of the system

Figure 7: Benefits using an Asset Management System that provides a holistic view.