Contents

1 VGB PowerTech

VGB PowerTech: Partner for Electricity Generation
Tasks and Structure of the VGB Secretariat 4

2 Results of VGB’s Activities

Nuclear Power Plants 7
Power Plant Technologies 16
Renewables and Distributed Generation 29
Environmental Technology, Chemistry, Safety and Health 36
Technical Services 44
R&D Activities and VGB RESEARCH FOUNDATION 46
KRAFTWERKSSCHULE e.V. 50
VGB: Events and Publications 51
Co-operation in Associations and Organisations 54

3 Power Plant Statistics

Power Plant Statistics 55

4 Association Structure

VGB Membership 59
Structure of Members 59
List of VGB Members 60
Board of Directors 66
Technical Advisory Board 66
Scientific Advisory Board 67
VGB RESEARCH FOUNDATION 68
Imprint 69
Preface

Dear ladies and gentlemen,

With the current Annual Report at hand, VGB PowerTech e.V. presents the results of its activities in the reporting period 2014|2015.

VGB PowerTech e.V., the European technical association for electricity and heat generation, bundles the issues and tasks related to electricity and heat generation that are of joint interest to the entire power industry. VGB PowerTech e.V. also coordinates relevant activities of member companies with government institutions and other partners in international cooperation all over the world.

The topics and key issues of the activities of VGB PowerTech e.V. and its associated institutions – Kraftwerksschule e.V., VGB Forschungsstiftung and VGB PowerTech Service GmbH – are detailed in the report at hand.

Challenge electricity generation

The various structural changes of electricity supply in Europe naturally have fundamental impact on power generation. The extension of renewables is progressing similar to decentral generation. This involves new general conditions for conventional generation. On the one hand, engineering issues are addressed: supply security and grid stability are again on the agenda, because conventional plants are balancing fluctuations at any time, thus securing a stable, efficient grid for 24 hours a day. And on the other hand, we are also facing economic challenges: market mechanisms and price building were nearly abandoned by regulatory interference. Economic plant operation is hardly possibly and the scope for necessary investments is being restricted.

This is only a rough sketch of today’s and tomorrow’s challenges. It is absolutely necessary that current change is shaped by suitable strategies, technologies and processes. When these measures call for efficiency, new technologies, increased cooperative partnership beyond the «borders» of individual sources of energy as well as synergies between the partners of our business, VGB PowerTech e.V. is the right address for cooperation and the exchange of experience. VGB PowerTech e.V. is still focusing on all power generation technologies with their broad capacity ranges and energy mix: from decentral small plants up to large-scale power plants and from hydropower and wind plants to fossil-fired generation.

Challenges for VGB PowerTech e.V.

VGB PowerTech e.V. is facing the challenges to be met by a technical association. Within the scope of the current project «Future VGB», the association is organising its structures and services to cope with the tasks ahead.

The move of VGB to «Deilbachtal Energy Campus», which took place during the period under report, is certainly among the most visible signs of the internal re-organisational and structural changes of VGB. The association is now able to make advantage of the joints infrastructure and new synergies resulting from the direct neighbourhood to its associated organisations Kraftwerksschule and KSG|GfS.

The modification and optimisation of VGB’s committee structure was among the major tasks on the agenda. The structure was adjusted to meet the future challenges in order to act and respond quickly and to enable sustainable and purposeful integration of existing and new topics. Besides, a special committee and a Tabcom were set up dealing with current administrative tasks.

During the reporting period, VGB continued exchanging experience in its committees and associated bodies and dealt with topics important to our members. On national as well as on the European stage VGB has accompanied, partly in cooperation with partner organisations like EURELECTRIC, legislation and regulation procedures by providing technical comments. More than 40 new VGB-standards, e.g. the RDS-PP® for wind energy plants, support construction and operation of electricity generation plants. With its important publications dealing with subjects of environmental protection like mercury, ultrafine particles, legionella, etc., VGB – as acknowledged platform – is bringing the necessary expertise into discussions. We also support our members in health and safety as well as material issues. VGB Technical Services and its laboratories for chemistry and materials are an important contact for our members to have their problems solved reliably and cost effectively.

VGB PowerTech is the top service provider for technical cooperation in power and heat generation in Europe and worldwide focusing on economic efficiency, safety and security, environmental compatibility as well as industrial safety and health protection upon the construction, operation and dismantling of plants.

The current tasks of power and heat generation are large and this also applies to the engineering tasks and thus to VGB PowerTech.

We hope you will enjoy reading the VGB Annual Report 2014|2015!

Dr Bernhard Fischer
Chairman of the VGB Board of Directors

Erland Christensen
VGB Executive Managing Director
VGB PowerTech e.V. is the European technical association for power and heat generation with international relationships. VGB’s 488 members from 34 countries represent a power plant capacity of 461,000 MW thus in 2014/2015 VGB achieved again a good result in terms of «members», «countries», and «power plant capacity». (Figure 1)

The VGB Essen-based Secretariat consists of the following Competence Centres (Figure 2):
- Nuclear Power Plants (CC1),
- Power Plant Technologies (CC2),
- Renewables and Distributed Generation (CC3),
- Environmental Technology, Chemistry, Safety and Health (CC4) and
- Technical Services (CC5).

These Competence Centres – supplemented by teams for Research, Controlling/IT, Marketing, and Administration – work through all issues concerning heat and power generation and associated environmental protection issues – in close collaboration with EURELECTRIC on European and e.g. BDEW (Bundesverband der Energie und Wasserwirtschaft, Berlin/Germany) on national level.

In order to fulfil the statutory tasks, honorary committees were set up by the VGB Board of Directors. The VGB Technical Advisory Board is responsible for allocating the committee members and determination of tasks. Currently committees are active in four fields with a large number of technical committees, technical groups and strategic forums. Three striking projects were realised during the reporting period:
- Re-organisation of the committee structure,
- Optimised working procedures to increase VGB’s efficiency and
- Move of VGB offices to the «Deibbachtal Energie Campus» in Essen-Kupferdreh.

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VGB represents a worldwide power plant capacity of 461,000 MW

**Fig. 1:** VGB memberships according to European countries. Outside of Europe, another 11 companies in 9 countries are VGB members.
During the year under review, the committees, groups and forums of VGB convened at over 180 meetings. All VGB members are informed about the results of these meetings through the bimonthly «VGB Newsletter» by e-mail, through the VGB Home Page, and via internet (closed user groups). Other interested parties can also obtain the VGB Newsletter free of charge by e-mail. Interested parties can register at www.vgb.org | Publications.

Apart from overseeing the activities of the committees, the VGB Secretariat also performs other tasks. In addition to working on the rules and regulations in form of VGB-Standards, VGB is also responsible for organisational support and coordination of joint research of power plant operators in the VGB-Forschungsstiftung (Research Foundation). The joint research supplements the company-specific research objectives. Furthermore, the VGB Offices organise seminars, symposia, conferences, and the annual Congress «Power Plants». These meetings are further platforms for the international exchange of experience within VGB PowerTech.

Against the background of the current challenges and the restructuring of European heat and electricity supply, VGB focuses on:

- continued internationalisation of VGB,
- renewables and the related technologies as well as synergies,
- technical issues related to future conventional generation,
- bundling of technical expertise and services for members companies in the fields of
  - power plant concepts
  - fuels and furnaces
  - steam generators
  - steam and gas turbines
  - electrical engineering, I&C, and IT
  - materials and civil engineering
  - operational, maintenance, and environmental management

including VGB’s technical services in the fields of:

- engineers’ consulting
- damage analysis and material test laboratory
- monitoring of construction and assembly/quality monitoring
- external chemical investigations

- Creation of technical Standards (no-official standards), in detail:
  - since August 2011 VGB Guidelines and VGB Instruction Sheets have been published as VGB-Standards
  - data bases and technical information in all fields of generation
  - coordination of projects and R&D measures
  - European networking with associations like EURELECTRIC, EUTurbines, Foratom, Euracoal and others.

- training and further vocational training of power plant personnel (at KWS and KSG/GfS)

Fig. 2: Structure of VGB PowerTech e.V., the European Technical Association for Electricity and Heat Generation.
Partner Companies of VGB

The VGB Executive Managing Director is, in the personnel union, also the Managing Director of VGB-Forschungsstiftung e.V., Kraftwerksschule e.V. and VGB PowerTech Service GmbH (Figure 3). He also has a close association with the Kraftwerksschule Gesellschaft (KSG) and the Gesellschaft für Simulatorschulung (GfS), which are responsible for training concerning nuclear technology. Furthermore, he coordinates the distribution of tasks amongst other sector associations with the managing directors of these associations.

KRAFTWERKSSCHULE and KSG|GfS

The competence of operating staff is, to a great extent, a determining factor in the security, cost-effectiveness and environmentally-friendly operation of power plants. Even in the current times of liberalisation, the contribution of personnel to the value of a company is decisive for its competitiveness.

The VGB members have long since realised the importance of training and further vocational training for their employees. Drawing up guidelines for the training of operating staff set the course for the qualification of power plant operators and shift supervisors, in particular, at an early stage. The Kraftwerksschule e.V. (KWS, PowerTech Training Center) was founded in 1957 and since then has trained and updated training for employees in member companies (Figure 4).

The personnel at nuclear power plants are trained in the Simulator Centre KSG|GfS in Essen-Kupferdreh/Germany. Simulator training for reactor operators began on Klinkerstraße in Essen in the VGB Offices as early as 1977. In 1987, the KSG (Kraftwerks-Simulator-Gesellschaft mbH) and GfS (Gesellschaft für Simulatorschulung mbH) companies were founded by 11 German and two international energy supply companies. KSG provides the simulators in the new Simulator Centre and the appropriate infrastructure which GfS uses to carry out its training (Figure 5).

VGB PowerTech Service GmbH

VGB PowerTech Service GmbH (PTS) is essentially responsible for collecting and distributing the existing know-how at VGB. It publishes the VGB PowerTech international journal as well as VGB-Standards guidelines, instruction sheets, conference proceedings, technical scientific reports, VGB books and brochures and KWS training manuals.

VGB FORSCHUNGSSTIFTUNG

The tasks of the VGB-Forschungsstiftung (VGB Research Foundation), founded in 1970, and the results achieved in the financial year concerned are described in chapter 2 of this report.
Nuclear Power Plants

Ludger Mohrbach

Nuclear power plants of VGB members worked nearly trouble-free in 2014 (with the exception of Belgium, see below). In several central European countries, nuclear power plants are increasingly providing grid services due to their excellent control features. 8.1% of German national primary energy consumption is covered by those nine German nuclear units still in operation.

In 2014, additional and larger hydrogen flake stacks – in the mm to cm range – were detected in the reactor pressure vessels of the Belgium Doel-3 and Tihange-2 nuclear power plants. All flake stacks are positioned in parallel to the surface and originate from the forging process, carried out in the 1970ies (manufacturer: Rotterdam’sche Droogdok Maatschappij; not existing any more). No crack growth has appeared. The operator Electrabel had launched an extensive investigation program in order to verify that material strength is still sufficient. Advanced irradiation of specimens in the Mol test reactor revealed unexpected results, which led to further investigations. In April 2015, an international expert conference took place which supported the planned restart of both units; however, in mid-2015 the Belgian regulator was still assessing the results. All other plants that might have also been potentially affected have carried out relevance checks; no other findings were reported until this report went to press (June 2015).

In the meantime, Belgium has postponed the planned shutdown date 2015 for Doel-1 and -2 to 2025 to make up for the power loss.

Final waste repository in Germany: «Back to Zero»

According to recent German lawmaking, a new commission «Disposal of High-Radioactive Waste» was established to (re-) select a final repository site. However, by the end of 2014, the commission was still in its constitution phase (and thus lagging behind schedule), because for the time being, formal matters and other issues occupied the agenda. The task is to agree on selection criteria for a new «grassroots» search for a repository site for heat-producing nuclear waste; Gorleben will remain in the selection process.

Intermediate storage

While the license for intermediate storage at the Brunsbüttel site was withdrawn for formal reasons, there is still no political consent about the storage of the still outstanding return casks from the French and British reprocessing plants. The federal government issued plans to distribute the casks over four utility storage buildings in four federal states, however, today the federal site Gorleben remains as the only storage site that is licensed to store waste from reprocessing plants.

Worldwide extension of nuclear power

After the Fukushima event in 2011, Germany remains – worldwide – as the only country that has – or will – prematurely shut down nuclear power plants. Instead, during the reporting period for example Hungary announced the construction start of 2 x 1,200 MW (PWR Russian design) at Paks, other new-build projects are underway in Finland (Hanhikivi-1), the UK (Hinkley Point C 1-2, Moorside 1-3, Wyllfa Newydd 1-2), Belarus (Ostrovets 1-2), Bulgaria (Kozloduy-7), Turkey (Akkuyu 1-4 and Sinop 1-4), Poland, Slovenia, the Czech and Slovak Republics and Russia (among others Kaliningrad 1-2).

China is currently commissioning new nuclear units nearly every six to eight weeks. In Japan applications for 22 re-commissions were filed, four have been approved yet, the first unit (Sendai-1) was restarted on August 11, 2015.
First permit for a repository for spent fuel in Europe

On February 18, 2015, the Finnish authority STUK informed the government that all safety criteria for the repository, which had been applied for to be erected at the Olkiluoto site, were met and thus no objections exist to prevent construction to be completed by 2020 (Figure 1). The next step will be a government decision on a building licence.

Project Management

Thomas Linnemann

According to the VGB mid-term budgeting 2014 to 2018, total expenditures of 12 M€ were expected for nuclear projects in 2014. With invoices of slightly more than 7 M€ and a transfer of planned payments of roughly 3 M€ to 2015 (liability), the total expenditures in 2014 amounted to some 10.4 M€, i.e. project management saved additionally some 1.6 M€ compared to the original budget planning.

26 new projects were launched in 2014. One was managed by the general committee, 12 by the Technical Committee «Engineered Safety» and 13 by the Technical Committee «Nuclear Power Plant Operation».

On January 1, 2015, 85 projects were under way. VGB project management assigns «traffic light» colours to each project, reflecting delays and/or cost overruns; none of the projects was «red», only few were «yellow», because final invoicing was delayed.

In December 2014, the general committee «Nuclear Power Plants» agreed on the VGB mid-term budgeting 2015 to 2019 that had been harmonised among all CC1 committees and panels. According to the new five-year planning, total costs amounting to some 11 M€ are being expected, 50 % are required by current and additionally forecasted projects (Figure 2).

When comparing last year’s with current mid-term budgeting, special emphasis has to be put on additional projects, i.e. particularly on the VGB- WANO (World Association of Nuclear Operators) membership, which was newly established at the beginning of 2015 and which will incur further costs for VGB of about 1 M€/a. However, at the same time it replaces individual membership costs of 1.6 M€/a for the operators involved.

The further course of the five-year period shows a clear decline in total expenditures for projects: In 2019, operators expect a reduced total budget of 4.6 M€ (58 %), 46 % of which will be earmarked for current and 54 % new projects.

The next mid-term budgeting will be established in the autumn of 2015.

New projects

The panels associated to the General Committee «Nuclear Power Plants» manage demand-driven research and development projects for nuclear power plants. The projects are 100 % financed by the nuclear power plant operators according to the shared cost principle of all plants involved. In 2014, 33 projects were awarded with a total funding of 2,666,272 €:

- one by the General Committee «Nuclear Power Plants» with 282,000 Euro,
- 21 by the Technical Committee «Nuclear Power Plant Operation» with 1,694,648 Euro,
- 12 by the Technical Committee «Engineered Safety» with 689,624 Euro.

Technical Committee

Engineered Safety

Ludger Mohrbach

The new technical committee, set up in 2013 in the course of the new organisation of CC1 (Figure 3), held in 2014 four meetings. Its main activities were the completion of the new working panel structure, the introduction of project management (including mid-term budgeting) and approval of the terms of reference for all associated panels.

These reported on a rotational basis to the technical committee, which also involved regularly the approval of project applications up to 250 k€ (higher amounts have to be approved by the general committee).

The technical committee dealt with:

- Re-evaluation of the membership costs for WANO, DIN (German Institute for Standardisation) and KTA (Federal Nuclear Regulatory Committee),
- Sump strainer performance under loss-of-coolant-conditions with zinc release,
- Determination of the remaining demand of the reliability data base ZEDB and adjustment of its contractual agreements,
- Discussion of the mid-term budget,
- Consequences from the amended SEWD- (protection against intrusive third-party actions) transport and IT-guidelines,
- Setting up a temporary working group on «Fuel assembly pivot pins»,
- Research funding,
- Material defects on fuel assembly flow restrictors,
- Guidance on periodic safety checks of interim storages,
- Organisation of the informative participation in external research projects (GRS, HALDEN, ISOE),
- Proposed transfer of the «QP database» (chemicals and other operating fluids) from AREVA to VGB,
- Selected topics of the Reactor Safety Commission (RSK).

Fig. 1: Final waste repository in Finland. Illustration of the repository for spent fuel after 4,000 years. (Courtesy: POSIVA).
The panel’s activities were still characterised by the discussions between operators and regulators about plant-specific “Post-Fukushima Measures” and current discussions about RSK recommendations, among others on the robustness of nuclear power plants. The panel also discussed:

- the future nuclear regulation framework drafted by KTA and DIN,
- consequences from regulatory requirements for restarts after the 2014 outages,
- fuel damage amount analysis (part of restart safety cases) for anticipated small (0.1F-) leaks of the primary cycle and
- residual ductility of fuel cladding in case of LOCA (loss of coolant accident) events.

Among others, the panel co-ordinated and approved:
- a generic report on the systematics of robustness analyses for BWRs,
- statements on the storage of emergency equipment,
- an evaluation of the potential of impaired reactor core cooling by zinc boron deposits at the sump strainers under LOCA conditions of extended duration and
- simplified “venting” procedures for the safety case “earthquake resistance of the filtered containment pressure relief system”.

Documents on the above-mentioned issues as well as additional concepts and papers are available on the VGB homepage (www.vgb.org), “Documents Approved” of the closed user group.

The panel also acts as interface between RSK and VGB offices and thus it coordinated inquiries on issues discussed in RSK committees and organised nine operator presentations in the period under review (Table 1).

For the time being, the panel decided to keep the six-week meeting intervals due to the still high work load and numerous tasks to deal with.

**Working Panel Component Integrity**

Jens Ganswind

The working panel focused on superior issues on securing integrity of mechanical components in boiling water (BWR) and pressurised water (PWR) reactors by taking into account mechanical, thermal, corrosive and radio-chemical boundary conditions.

The subjects resulted from:
- regulatory requirements of the Federal Supervisory Authorities (BMUB Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety),
- statements of the RSK,
- authority and expert requirements,
- requirements arising from the revision of KTA rules,
- notifiable GRS (German Expert Organisation for Plant and Reactor Safety) event reports, and
- events in external plants.

**Fig. 2:** VGB CC1 medium-term budgeting 2015 to 2019.
Therefore, the panel mainly dealt with the following subjects during the reporting period:

- event-based exchange of experience about damages and their transferability – if needed, drafting of joint concepts in order to derive remedial measures,
- securing of component integrity through the application of appropriate integrity concepts and fracture mechanical calculations,
- securing of component integrity through non-destructive testing (NDT) concepts, techniques and assessment methods,
- damage analysis and identification of corrective measures,
- damage prevention and safeguarding of component integrity,
- implementation of findings in plants,
- public relations as well as cooperation with external bodies (publications, lectures, national and European regulations).

**Assessment of damage cases**

Damage cases are basically analysed as follows:

- identification of the damage mechanism and reason,
- determination of corrective and repair measures in order to eliminate damage mechanism and reason,
- assessment of the transferability of the damage to other BWR and PWR plants represented in the panel,
- assessment whether new findings will emerge that helps to control plants.

**Working Panel Reactor Core**

Guido Vallana

Current projects are dealing with safety case issues of neutronic and thermo-hydraulic core design as well as layout and operating behavior of fuel assemblies and fuel rods.

Due to the phasing out of nuclear power in Germany, increasingly the panel has to deal with intermediate storage issues. During the reporting period, the panel held a total of five meetings on the following topics:

- consequences from the new nuclear safety requirements («new regulations»), among others with a view on reactivity transients and uncertainty analysis as well as shutdown margin safety,
- nuclear regulatory code: «Design of reactor cores of pressure and boiling water reactors, part 3: mechanical and thermal design»,
- fuel assembly bending and its reactivity consequences, especially the impact of corresponding water gaps,
- continuation and participation in international research projects like the HALDEN reactor project of OECD and undercriticality during fuel exchange processes.

The panel also identified requested «core issues» to be dealt with in the next four years. This part of «ahead» project management also involved the corresponding budgeting.

**Working Panel Impacts on Civil Structures**

Jens Ganswind

The focus of the Working Panel lies mainly on relevant civil engineering issues in the fields of seismic design, flooding, extreme weathers, explosions, fire protection and ageing management. The panel also performed co-ordination on new codes and rules and of general licensing issues, it further tracked the state of science and technology.

**Workshop on earthquake design**

In the late autumn of 2014, the panel conducted a Workshop «Relevant Innovation of KTA 2201» in order to highlight the major changes resulting from the revision of KTA 2201 «Design of Nuclear Power Plants against Seismic Events». The representatives of the relevant KTA working groups were invited in order to discuss the new aspects among the workshop participants.

**Technical Committee Nuclear Power Plant Operation**

Ludger Mohrbach

The technical committee forms the discussion forum for all nuclear power plant managers of VGB member companies. Apart from German plants, Swiss, Dutch, French, Belgian, Finnish, Spanish, Brazilian, Argentinian and (future) Polish operators are represented. The committee works bilingually in German and English, i.e. the plant reports in the committee’s minutes are regularly written in English.

The committee met four times during the reporting period. In addition to controlling its associated working panels and groups, the committee focused on exchange of experience in the plants,

- VGB-SBS system to assess safety culture,
- human performance tools,
- WANO reporting,
- project management and project budgeting,
- participation of Swissnuclear in the VGB «event evaluation» contract.

The following reports from the individual working panels comprise examples on the exchange of experience.
Working Panel Mechanical and Process Engineering

Heinrich Grimmelt

During the reporting period this new panel has met three times. Now the meetings cover regularly 1.5 days each, because operators in the post-operation phase demand increased exchange experience. The first day of each meeting is devoted to such issues. In the meantime the meetings are well attended. In this context, the panel concentrated on technical issues like:

- replacement of transformers by smaller, more efficient ones,
- replacement of auxiliary boilers by cogeneration plants,
- determination of power decay in storage pools,
- reduction of periodic testing.

The panel members exchange experience about special operational features, retrofit measures and plant modifications, revision results and event reports.

Following a WANO suggestion, the panel dealt with «Foreign Matter in the Fuel Assembly Storage Pool» and formulated a project draft for the Technical Committee «Nuclear Power Plant Operations», who approved the project. Figure 4 shows an example for securing a pencil for usage on the reactor floor.

The issue of scaffolding is another important subject frequently appearing on the agenda. The panel entrusted the associated Working Group «Maintenance in Nuclear Power Plants» to elaborate recommendations on erection legitimating, quality control including labelling and supervision.

For analysing unplanned situations on the reactor floor, the panel had set up working groups for PWRs and BWRs. In the meantime, the panel has decided not to review additional measures beyond the scope of the cases checked already, thus the working groups were dissolved again.

Impact of single-phase grid connection failures

On order of the German federal nuclear regulatory authority, its «Expert Organisation for Plant and Reactor Safety» GRS has drafted the message WLN 2013/05 «Events with unsymmetrical voltage supply caused by single-phase grid connection failures in foreign nuclear power plants».

A Working Group «Grid Issues», set up by the panel, was entrusted to investigate on single-phase events and to derive possible countermeasures. Yet the results gathered from simulations and measurements carried out in power plants’ auxiliary service supply systems have shown that the monitoring of negative sequence voltage in combination with measuring the three phase-to-phase voltages is one option to detect asymmetrical supply statuses in due time.

These activities were complemented by tests at the Fraunhofer Institut IWES Stuttgart. Here the focus was on investigating the behavior of running motors at suddenly occurring negative sequence voltage. Those tests have shown that the overpower protection devices and asymmetrical motor starting currents are the determining factors for the availability of electric motors.

Due to these findings, interim response threshold values were jointly determined. These values are to be verified by final motor investigations. Next project target is the identification of a «detection time» for a suitable motor with an associated protection relay, with the aid of further tests at Fraunhofer-Institut IWES.

Transformer monitoring

Following a request by the RSK Committee «Electrical Installations», the former VGB Working Group «Monitoring of Transformers» summarised and presented the experience made yet with the application of the VGB program to monitor operating parameters for oil-cooled transformers and for dry (emergency power) transformers. Thus, some anticipated transformer degradation damages could be detected in due time. However, none of the currently known measurements are able to reliably prevent instantaneous failures.

Working Panel Practical Radiation Protection

Lena Jentjens

Operational events and developments in operating plants and from dismantling activities are being discussed at the panel meetings that take place twice a year. Besides, the panel and its associated working groups further dealt with specific issues, some of which are mentioned below.

National/international rules

After finalisation of the EU «Basic Safety Standard for Protection against Ionising Radiation» (BSS) by the EU Council of Ministers in January 2014, the EU member states had a time frame of four years for the transposing of the standard into national law. In Germany this will involve comprehensive revision of the radiation protection and X-ray ordinances, and/or creation of a radiation protection act (by incorporating the X-ray ordinance).

The panel actively participated in the transposition, e.g. by providing written statements to the regulator on the issues of...
clearance of radioactive residues for further use and of harmonisation of qualification (for the training grades «Radiation Protection Officer»/«Radiation Protection Expert»).

The respective federal ministry (BMUB) also asked in writing for an estimation of the impacts of the tightened release values of the radiation protection guideline 2013/59/EURATOM (European Atomic Energy Community). The panel jointly responded together with the VGB Working Panel «Decommissioning» with the key message that the masses without clearance of a dismantled nuclear power plant would increase by 10 to 20 %. It also stressed that «purpose adjusted» releases (e.g., as shielding material) will remain essential.

DIN ISO 11929 «Calculation basis»
In addition to the existing KTA standard report, the panel drafted a VGB recommendation on the transposition of the DIN ISO 11929:2010 «Determination of the characteristic limits (decision threshold, detection limit and limits of the confidence interval) for measurements of ionising radiation – fundamentals and application». A working group established an evaluation and identification model for relevant and non-relevant parameters for the most important applications. The procedures for different applications can be often derived from that model. The recommendation was passed in March 2015 and will soon be available on the VGB homepage (www.vgb.org).

Radiation protection for non-destructive testing
During non-destructive material testing, radiation-relevant accidents are frequently happening worldwide. To give guiding advice, the panel formulated a VGB standard which was enforced in March 2015 and which is since available on www.vgb.org.

Qualifications in radiation protection
The working panel updated the VGB standards on training requirements for the grades of «Radiation Protection Technician» and «Radiation Protection Engineer». The recommendations were finalised in March 2015 and are also available on www.vgb.org.

Information system on occupational exposure ISOE of OECD-NEA
This network of radiation protection experts had been set up by OECD (Organisation for Economic Co-operation and Development) and IAEA (International Atomic Energy Agency) in 1992. Today, Germany is represented by one authority and two operator participants (from the working panel) at the bi-annual ISOE meeting. In the meantime, the working panel has recommended to abstain from participation in future ISOE programmes due to cost considerations. Decisions have not yet been taken.

The 2012 set-up ISOE working group «SAM» (Severe Accident Management) has now published a report on «Occupational Radiation Protection in Severe Accident Management» in January 2015.

Other interactions
The working panel is also co-operating with additional committees and panels, among others within the Technical Association for Radiation Protection («Fachverband Strahlenschutz»), the working group «Physicians in Nuclear Power Plants», the committee «Emergency Protection» of the Radiation Protection Commission (SSK) and of BGETE (Accident Prevention and Insurance Association). Examples for jointly published papers were the SSK general recommendation for planning of emergency measures by nuclear power plant operators (October 2014), and the «NPW» study on the cancer risk for staff professionally exposed to radiation (February 2014).

Working Panel Nuclear Power Plant Management Systems
Georg Schäfer
The panel is dealing with generic tasks of system- and product-related quality assurance issues and also with safety culture, this involves:

Exchange of experience on the practical implementation of management systems
The panel pointed out that management systems should be understood as tools. As such they should increasingly and comprehensively be supported and used by executives. Thus, in the sense of leadership any detected deviations from procedures and rules should be corrected immediately.

Adaptation of management systems to post-operation mode
Numerous organisational changes have to be organised in the transition phase from the end of power generation up to the start of dismantling activities. These require modified operational processes and thus adjustments of the management systems. Respective experience has been exchanged at the annual commissioners’ meetings for management systems.

Assessment of contractors according to KTA Rule 1401
The (nuclear) «VGB Contractor List» is currently comprising nearly 600 contractors who are regularly – every three years – subjected to the KTA 1401 assessment. More than 60 % of these contractors have decided to remain being presented in the
publicly accessible VGB database on the internet since autumn 2014. A total of 197 assessments were made in the period 2014/15.

The «VGB Contractor List» is a modern platform for German and foreign nuclear power plant operators to gather quick information about qualified suppliers with sound nuclear knowledge and long-term know-how for identifying optimum business partners (Figure 6).

Against the background of the nuclear phase-out in Germany, this platform also contributes to the extended promotion of the participating nuclear industry.

Training of particular nuclear knowledge for contractors and operator personnel in the field of mechanical engineering

VGB offers basic training for the administration and execution of nuclear procurements as well as three advanced trainings in the fields of pre-testing, supervision of civil engineering and construction, as well as their documentation. During the reporting period some 160 participants were trained in eight courses.

Nuclear procurement in the field of mechanical engineering

Due to the residual terms of German nuclear power plants, shortages in the supply of mechanical engineering equipment by domestic contractors cannot be excluded. The panel exchanged experience and discussing different recommendations of the ESK (Disposal Commission) and their impacts and implementation.

In summer 2014 the committee founded a Working Group «Periodic Safety Check (PSC) – Interim Storage». Within the scope of the pilot project «Periodic safety check for the Gorleben fuel assembly interim storage site”, the working group supported the contractor GNS (Gesellschaft für Nuklear-Service mbH) in drafting a revised version of the «PSC report» in compliance with ESK guidelines. Besides, the group developed a PSC Guideline «Waste Storage», which might serve as a base document for site-specific PSCs (Figure 7).

Safety culture – Assessments in plants

During the reporting period, a total of four safety culture assessments were conducted. In summary it was confirmed that there are no signs of declining motivation as regards of nuclear safety. There is still high demand for VGB assessments.

Working Panel Event Analyses

Guido Vallana

The panel routinely covers «holistic event analyses», «specific issues for nuclear safety commissioners» (kerntechnische Sicherheitsbeauftragte) and «assessments of safety culture» (for details see reports on «Management Systems» and «Human Factors»). In addition to the German, there are also Swiss, Dutch and Brazilian plants represented in this panel.

Holistic event analyses

Holistic event analyses in nuclear power plants are regularly carried out after events with human performance issues. They follow the so-called MTO- (Mensch-Technik- Organisation-) approach and are in the aftermath also regularly discussed by the panel. The underlying method (developed by Berlin University) is called «SOL» (safety through organisational learning).

Since April 2014, the panel has been cooperating with experts from the field of labour psychology to improve the SOL method and to adopt it to the state of the art. Apart from systemic models for event analyses, aspects of safety culture and safety management are also integrated into the analyses. The version SOL 3.0 has been available since the beginning of 2015.

The committee „Reactor Operation” of the Reactor Safety Commission has recently endorsed the VGB recommendation „Holistic Event Analyses”.

Human factor (HF) issues

Different examples were taken by the panel to discuss the transferability of events relevant to HF and the implementation of countermeasures. The panel also discussed the exchange of information with authorities and external experts on operators’ HF activities.

Specific issues for nuclear safety commissioners (kerntechnische Sicherheitsbeauftragte)

Routinely, the members of the panel intensively exchanged experience on reportable and non-reportable events, commented and interpreted national and international reporting criteria, assessed evaluation of experience and interpreted event reports to be passed on to the IRS (Incident Reporting System) of IAEA and to WANO. All participating nuclear power plants fully met their obligations to report regularly generic findings to WANO.

Technical Committee

Decommissioning and Disposal

Katrin van Bevern

During the reporting period the committee held three meetings, exchanging experience and discussing different recommendations of the ESK (Disposal Commission) and their impacts and implementation.

In summer 2014 the committee founded a Working Group «Periodic Safety Check (PSC) – Interim Storage». Within the scope of the pilot project «Periodic safety check for the Gorleben fuel assembly interim storage site”, the working group supported the contractor GNS (Gesellschaft für Nuklear-Service mbH) in drafting a revised version of June 10, 2013 of the «PSC report» in compliance with ESK guidelines. Besides, the group developed a PSC Guideline «Waste Storage», which might serve as a base document for site-specific PSCs (Figure 7).
Working Group Requirements on Interim Storage

As early as in 2013 the Technical Committee «Decommissioning and Disposal» had set up a Working Group «Requirements for the Storage of Nuclear Waste with Negligible Heat Development». The group was tasked to analyse the technical and licensing-related requirements from national rules and codes for the design of new interim storages. The group presented its findings in a report in 2013.

In 2014 the Technical Committee again called up the group for updating. After finalising its activities in 2014, the group ascertained that the plans for waste storages met the ESK requirements of June 10, 2013. Currently stores are planned at the Neckarwestheim, Brunsbüttel, Biblis, Philippsburg, Unterweser and Grafenrheinfeld (new) sites. The technical committee also dealt with the following tasks and topics:

- Reporting to the General Committee «Nuclear Power»,
- Cooperation with the EURATOM supply agency,
- Annual calculation of the average fuel cycle costs,
- Observation of the further development of «partitioning and transmutation»,
- Observation of the EU technology platform on final storage,
- Joint statement of VGB and DAtF (German Atomic Forum) on the 14th amendment of the German Atomic Energy Act and
- VGB/DAtF statement on the government’s national disposal «Programme for responsible, safe and secure disposal of irradiated fuel assemblies and radioactive wastes (NaPro)». The Federal Government will have to present NaPro by August 23, 2015 to the EU Commission.

Besides, the revised recommendation of the «Nuclear Waste Management Commission» (ESK) «Guidelines for the decommissioning of nuclear plants» has been available since March 2015. The VGB panel has analysed the paper and its amendments and has benchmarked the possible impacts on existing and future dismantling projects.

In addition to the above mentioned ESK-Guideline the «Guideline for decommissioning and dismantling of plants or plant parts (safe confinement)» according to §7 of the German Atomic Energy Act is also currently being revised.

Working Panel Interim Storage

Andre Seidel

The working panel deals with all generic issues concerning interim storage of spent fuel in casks, namely loading, transport and storage. As such the panel provides the exchange of experience as requested by the respective guideline of the «Nuclear Waste Management Commission» (ESK) and by the plant licenses.

Tracking of the activities of the «Federal Coordination Office for Information on Cask Handling» (KOBAF) is another topic of the working panel. KOBAF is operating databases and the BIBO platform (on-line authority information library) for mutual information of federal state supervisory authorities and their expert organisations. Status discussions are held regularly in order to reflect practical experience and operators’ benefit. Increased synergies could be achieved through extended utilisation of the databases and time could be saved within the frame of modification procedures requiring authority permission.

Working Panel Decommissioning

Katrin van Bevern

After the 13th amendment of the German Atomic Energy Act, which involved termination of the permission for power operation of eight nuclear power plants as well as additional plant shutdowns by 2023, the working panel guarantees regular exchange of experience among plants already decommissioned and plants to be decommissioned.

Experience has shown that disassembly of nuclear power plants is a technically solved task. In recent years operators, authorities and experts gained a wealth of experience when decommissioning and dismantling nuclear power plants. Decommission has progressed, mainly due to the disassembly of the Mülheim-Kärlich, Stade, Würgassen and Obrigheim nuclear power plants providing valuable engineering as well as organisational approaches.

Following the Fukushima event, seven out of eight units (at six sites) have applied for shutdown and decommissioning licenses according to §7.3 of the atomic law. The legally required public discussions have already taken place for Isar-1 and Biblis A+B in 2014, the ones for Neckarwestheim-1, Philippsburg-1, Unterweser and Brunsbüttel are planned for the summer of 2015.

Apart from the exchange of experience about decommissioning projects, the panel also exchanged detailed information about industrial safety and health related to decommissioning activities. It also kept track of the relevant international activities (e.g. the draft IAEA Safety Requirements «Decommissioning of Nuclear Installations»).

Answering to a request of the Federal Ministry, the VGB Working Panels «Practical Radiation Protection» and «Decommissioning» elaborated a joint statement on the release of slightly contaminated components.

Fig. 7: Inside an interim storage facility for fuel element casks.
The exchange of experience on the operation of site interim storages as well as issues of cask loading are also organised by a working group associated to the panel. Representatives of utilities’ head offices and from twelve utility site interim storages, plus from the state-owned interim storages Ahaus (TBL-A), Gorleben (TBL-G) and Greifswald (ZLN), as well as from ZWILAG (Switzerland) met with representatives of service providers (GNS Gesellschaft für Nuklear-Service mbH and AREVA Transnucleaire). Reports on particularities of storage operation (including domestic and foreign reportable events), site-specific utilisation concepts and experience made with the application of existing testing requirements and their adoption to changed general conditions were also on the agenda.

Based on the finalised project on Periodic Safety Checks (PSC) for the Gorleben and the Lingen interim storage sites, the Working Group «PSC-IS» developed a VGB concept, giving advice for the implementation of periodic safety checks and technical ageing management for interim storage sites.

**Working Panel Safeguards**

Katrin van Bevern

Keeping track of uranium and plutonium inventories through every step of the fuel chain in order to prevent diversion or misuse is the task of both EURATOM and IAEA. The VGB working panel exchanges safeguards experience from the utility installations involved, e.g. on the issues mentioned below.

**Sealing of fuel assembly casks by operators**

After having trained plant personnel how to handle seals and associated equipment, two casks were sealed in a pilot project at Unterweser for the first time by an operator in summer 2014, supervised by EURATOM and IAEA. Another two casks were sealed in July and October without on-site supervision. Continuity was ensured by video monitoring. All seals were checked and verified within the scope of the annual interim site inspection. The experience confirmed that indigenous operator sealing can ease the processing of loading fuel assembly casks, provided that the personnel is sufficiently trained. However, operators are still free to decide in coordination with EURATOM to seal the vessels themselves (with monitoring) or to have them sealed by the inspectorates. (Figure 8)

![Fig. 8: Refuelling, view into a spent fuel pool.](image)

**Application of the «Digital Cerenkov Viewing Device» (DCVD) for fuel assembly identification**

This new technology for the verification of fuel assembly identity in the spent fuel pool is an alternative to the existing «ION-Fork Measurement». First experience has confirmed that DCVD is advantageous for operators and inspectorates due to increased time flexibility. As the loading process largely depends on the varying time required for drying the inner atmosphere up to a specified residual moisture content, the time consuming coordination between EURATOM and operators can be dispensed with. After successful pilot application in Biblis in 2013, the new technique was now also applied successfully at Unterweser in 2014.

At the IAEA Safeguards Symposium 2014, IAEA also welcomed the application of DCVD as monitoring measure in Germany. Further national applications are planned for end 2015/early 2016 at another five sites. The panel has also been dealing with:

- cooperation with the working group «Supervision of Nuclear Material» of the federal IAEA support programme,
- observation and discussion with the government and the EURATOM and IAEA inspectorates on the creation of a comprehensive legal basis by adjusting «Facility Attachments» and «Particular Control Requirements»,
- assembly and disassembly of IT components in nuclear power plants and interim storage plants by the inspectorates,
- exchange of experience on current EURATOM and IAEA inspection practices; handling of safeguard systems that has remained on site and their transport,
- introduction of remote data transmission at the interim storage sites, and
- presentation of an encapsulation technology for damaged fuel rods for EURATOM.

(Figure 8)
Competence Centre Power Plant Technologies

Oliver Then

Within the scope of reorganising the VGB committee structure, the VGB general committees were dissolved. The last meeting of the general committee associated to the Competence Centre «Power Plant Technologies», took place in November 2014. Individual solutions were identified for the European members of that committee in order to create cooperation possibilities for them. In future, the VGB Technical Advisory Board is to increasingly deal with current topics from the country-specific viewpoint of all VGB members, the development of European general conditions and of national electricity markets as well as the consequences resulting from more flexible operation of conventional power plants. Besides, the VGB Technical Advisory Board, i.e. its committee, will also draft the conference programme of the VGB Conference «Generation in Competition» and will select the winners of the VGB Quality Award.

During the reporting period, the activities and cooperation with the German Association of Energy and Water Industries (BDEW) and the European Union of the Electricity Industry (EURELECTRIC) remained very intense, because on European level as well as in Germany a large number of initiatives, guidelines, acts and ordinances had to be revised and followed. In accordance and cooperation with BDEW, VGB made mainly technical comments on the coordination process in connection with the «Green books» (dealing with the future of the German power market) presented by BMWi (German Federal Ministry for Economic Affairs and Energy) by the end of 2014. The joint work on various network codes, like the «Requirements for Generators» (RfG) or «High-voltage Direct Current Transmission» (HVDC), was continued. The network code (RfG) is now in the comitology process probably not being terminated before the third quarter of 2015, after having been externally examined by DNV KEMA. The committee continued dealing with further processes like the BREF-LCP (European best available technique reference document on large combustion plants) or BREF for waste-to-energy plants as well as industrial cooling plants. Supported by VGB, EURELECTRIC published a paper on the relevance of thermal power plants stressing their importance for guaranteeing supply security with increasingly fluctuating instead of renewable energies. Details on these issues can be obtained from the VGB website.

Projects under the umbrella of COMTES+ developed differently. A final report was drafted for the ENCIO (European Network for Component Integration and Optimisation) project (aiming to the successful deployment of 700 °C technology in coal-fired power plants); however, final approval for funding is still pending. The project HWTII met its targets and was finalised with a workshop.

Within the scope of the 6th Indo-German Energy Forum (IGEF), which took place in New Delhi in February 2015 (Figure 1), VGB representatives met with experts of the National Thermal Power Corporation (NTPC), the Central Electricity Authority (CEA), the Central Power Research Institute and the Gujarat State Electricity Corporation, to present the study «Best Practices for Coal-based Power Plants in Germany». The 300-page study, financed by GIZ (German Society for International Cooperation GmbH), provides a comprehensive review on the construction, operation and maintenance of new coal-fired power plants in Germany and Europe.

After intensive discussions, a cooperation agreement between VGB PowerTech e.V. and eCl@ss e.V. (eCl@ss is the cross-industry product data standard for classification and clear description of products and services) could be signed at the Hanover Fair 2015. This cooperation will sensibly extend the VGB and eCl@ss portfolio in the field of multi-branch standards. Within the scope of this cooperation, the characteristics of components collected by VGB for definite identification are to be implemented in eCl@ss. Cooperation will produce a standard that will be internationally distributed and penetrate markets.
Manfred Freimark was honoured for his well-known quality. In Lübeck, Dr.-Ing. e.h. and highly topical issues and were ac-
eration» in Lübeck dealt with interesting and «Gas Turbines and Gas Turbine Op-
by State Secretary Rainer Baake (BMWi) Berlin (Figure 2) with a plenary lecture «Generation in Competition 2015» in

difficult economic situation of our indus-
tions – did not achieve the high levels of participants that – according to expecta-

Multiactivities between VGB committees of CC3 («Renewables») and CC2 are being continued. One recent example of closer cooperation is an oil workshop for wind power plants, which has been success-

Multi-activities between VGB committees of CC3 («Renewables») and CC2 are being continued. One recent example of closer cooperation is an oil workshop for wind power plants, which has been success-

Conventional Power Plants

Werner Hartwig

Conventional power plants have been suf-
ferring for quite some time from the impacts caused by the increasing share of non-pla-
nable renewable generation on the Ger-
money market. These are mainly decreasing numbers of full-load hours and continuously decreasing electricity prices that have been declining since 2010. However, highly fluctuating loads are perfectly met, but the resulting profits are not satisfactory for plant operators which increases cost pressure. Plant optimisation, co-combustion of different secondary fuels and further cost cuttings remain to be the only options. The introduction of a capac-

Future VGB Phase II

The project focused on the bundling of subjects thus reducing the committee structure by one level. In a first step, the number of committees was also reduced. This is to increase the flexibility and effi-
ciency of the exchange of experience and to reduce reporting. In future the Technical Advisory Board is to focus more on sub-

Technical Committee Steam Generation Plants

Technical Committee Conventional Power Plants

Werner Hartwig

Group members reported on very poor operating hours which partly do not cover plant costs. Only few power plants sum up noteworthy operating hours. Apart of the exchange of experience, the group dealt with current issues of new-built projects and quality problems of new plants and rehabilitation. Different techniques of boiler acid and heat treatment upon the appli-
cation of the new materials (Super 304 H and HR3C) were discussed.

The group also focused on the problems related to recirculation pumps in once-
through boilers. The Working Group «Boiler Recirculation Pumps» launched a research application which is to be car-
ried out by the Materials Testing Institute (MPA) of Stuttgart University, KSB, EnBW and VGB. Current investigations on life-
time in connection with flexible operation have focused on highly-stressed compo-
nents mainly in hot pressurised power plant components. Peripheral components have to be analysed in details in order to avoid damage and failure caused by these parts. Suitable methods have to be developed. In the project planned, such methods are to be developed and pre-

After having intensively dealt with the ma-
terial problems of T24 and HR3C, dam-
ages at boiler recirculation pumps were moved into the focus.

Different power plants are preparing to meet more stringent mercury threshold values. The committee decided to intensively discuss the possibilites of mercury reduction.

The PEPP (= Platform of Experience with Po-
erate events and damages at fossil-fired power plant components are to be collected in the PEPP database. The data contains «lessons learnt» for new designs and op-

Concerning multi-activities between VGB committees of CC3 («Renewables») and CC2 are being continued. One recent example of closer cooperation is an oil workshop for wind power plants, which has been success-

Regard events, we look back on a suc-

success year, however, with numbers of participants that – according to expecta-

The PEPP (= Platform of Experience with Power Plants) database has been activ-

The ad-hoc working group on process technology is concentrating on the mode of operation of recirculation pumps. The
different system states upon start-up, warm and cold start and shutdown were discussed. Improved instrumentation will improve analysis of temperature influences. Control characteristics support or even optimise assessment of loads in the Benson point. Group members will analyse critical system states in different operating modes.

**Standards**

The following standards are being revised or drafted:

- Revision of the VGB-Standard VGB-R 116 «Preservation of Power Plant Systems» in order to incorporate flue gas ducts and cleaning systems in addition to the boiler. Due to the scope, revision will not be finished before the autumn of 2015.

- Drafting of a new Standard «Insulation in Thermal Power Plants». Discussions were held with the «Association of the working group of the German industry» (AGI) in order to obtain rapidly a complete set of rules. AGI already drafted a standard on «Insulation in thermal power plants» (Q101) which exists in the German and English language. Since the AGI standard is to be revised, cooperation is possible. After termination of revision, VGB members can buy the standard like a VGB-Standard. The first working date was scheduled in Cologne for June 16/17, 2014. Further interested persons are invited for cooperation.

- An existing standard (VDI 4610) is also to be revised jointly with AGI. This standard deals with the important issue of heat bridges in insulations. Further interested persons are also invited for cooperation. A first working date was scheduled in Munich for June 24, 2015.

**Technical Group Fuel Technology/Firing Systems**

**Ludwig Müller**

The fourth meeting dealing with the research project «Low NOx Lignite-fired Boilers» of Brunswick University took place in Brunswick on October 28, 2014. Interim results were presented and discussed.

The «Platform of Experiences with Power Plants» (PEPP) was introduced to the participants, who recommended including the deflagration in a mill of Grosskraftwerk Mannheim (GKM) as a «case» into the PEPP database. The event had happened on November 1, 2012.

In the meantime the second meeting of the working group revising the VGB-Standard «Characterisation of Power Plant Coals» took place in the Tiefstack cogeneration plant/Hamburg on January 14, 2015.

As regards the general exchange of experience, reports were given on:

- Several boilers using coal blends made up of high-sulphur US coals mixed with low-sulphur South African, Colombian or Russian coals,
- The metal sheet packages of two air preheaters were cleaned with high-pressure water,
- Air staging as NOx primary measure was introduced at 500 MWth units,
- Ignition burners fired with dry lignite were commissioned in a lignite-fired power plant,
- Coal storage yards are monitored with thermographic cameras to identify smouldering fires and
- Minimum load reduction is continued to be set at several boilers.

Representatives of EnBW, GKM, COWI and RWE provided operating experience opening the thematic focus on safety measures for the operation of mills. The exchange of experience on the EMERGENCY OFF case will be dealt with at the forthcoming meetings.

**Technical Group Fluidised Bed Firing Systems**

**Ludwig Müller**

From the general exchange of experience it can be reported that:

- Severe boiler fouling was reported from one circulating fluidised bed combustion plant caused by firing secondary fuels. This also involved the release of larger amounts of hot bed ash due to a broken ash scraper.

- Due to plant failure, the ash bed in a fluidised bed chamber sintered immediately and could only be removed manually with mining techniques.

- Some plants fired with German hard coal were also switched to imported coal.

- Due to more stringent limit values for particulate emissions, it is checked to replace electrostatic precipitators (ESP) to bag filters.

- Damage of refractory lining was reported, i.e. after four years tiles had lost their pressure strength.

A working group is drafting a new VGB-Standard «Refractory Lining for Fluidised Bed Furnaces». The group met after the group meeting. The VGB-Standard was published in 2015.

**Technical Group Thermal Waste Utilisation**

**Andreas Wecker**

The kick-off meeting for the BREF-Waste Incineration took place in Seville in January. The EIPPC bureau suggested setting up three categories for air emissions which would reduce the number of data to be collected from reference plants. However, this procedure is criticised by the Federal Environment Agency (UBA). Currently member states are asked to identify so-called «Key Environmental Issues (KEI)» which are highly negatively impacting the environment. In this context UBA mentioned mercury. Currently a questionnaire for reference plants is being elaborated.

It was checked for waste-to-energy plants whether a legally more watertight organisation could exist which excluded civil and
Technical Group Industrial and Co-generation Stations

Werner Hartwig

Due to the large number of plant types and consequently different technical issues, the group members are mainly exchanging experiences. Currently the group comprises 71 members, with some 20 to 25 members taking part in the meetings.

In contrast to the other fields of conventional generation, industrial and co-generation stations are needed due to the booming economy and energy extraction. Therefore, several new-built projects are under way in the automobile, petrochemical and paper industry as well as at certain municipal utilities.

Currently VGB is doing consultancy work for five companies in different fields. Most of the companies optimised their plants in recent years and modified entire product lines. The emphasis was on co-combustion of pollutants and residues which are yielded. In the petrochemical industry old plants are modernised to receive authority approval.

Two new draft VGB-Standards dealing with grate firings and finned tubes were presented by VGB. Currently group members are needed for finalising these VGB-Standards.

The NOVALIS I research project was completed. It dealt with the development of a general, standardised validation method of optical-acoustical parameters in furnaces. After presentation of the final report, another one-day workshop was held at Salzgitter Flachstahl AG in January 2015 to discuss the measuring methods and results. It is planned to continue the project in order to elaborate necessary scientifically grounded assessment standards. The project partner DBI has already made a proposal which was approved by the Technical Committee «Conventional Plants» at its meeting on May 19/20, 2015 after it had been discussed by the Technical Groups «Industrial and Co-generation Stations» (project management) and «Fuel Technology/Firing Systems». According to current forecasts, the costs are to amount to about 75,000 Euro.

Technical Group Flue Gas Cleaning Technology

Andreas Wecker

All issues related to flue gas cleaning, like desulphurisation, denitrification and particulate removal are combined in the Technical Group «Flue Gas Cleaning Technology».

One research project was finalised during the reporting period: VGB Project No. 353: «Studies on the technique of flue gas desulphurisation with seawater focused on a simultaneous generation of electricity and drinking water».

In this project, the effects of the use of concentrates from the drinking water (brine) production on the absorption of SO2 in flue gas scrubbers and the oxidation in a downstream oxidation basin of seawater FGD were investigated. In determination of the data of chemical media for the absorption of SO2 in electrolyte systems, it was found and proved that in the liquid phase the complex SO2 Cl is formed whose consideration, when modelling the concentration of sulphur species in the liquid phase, is significantly more accurate than currently available data in literature. However, this accuracy decreases with increasing the complexity of the electrolyte system, as is the case with the use of seawater. Considering all the above conditions, a suitable model could be built to describe the reactions in the oxidation basin. It has been found that the use of brine results in an increase in the performance of the oxidation basin in particular due to an increase of the pH and temperature. With the model it is possible to optimise the place for addition of brine so that the maximum pH can be reached at the outlet of the oxidation basin. It was also shown that for dimensioning it has to be made sure that a good radial and only a small axial mixing should be achieved by the use of baffles. For modelling of the SO2 absorber the same simulation model as for the oxidation basin could be used, but the image of a drop of rain was used instead of bubble floating-up and the time step was reduced by a factor of 200 to consider the reduced residence time. Both, the dissociation of SO2 and the Henry coefficient were adversely affected, thus the rate of absorption decreases significantly. This can also not be compensated with the higher buffer capacity by the carbonate content of the added brine. As a result the brine leads not to an improvement of the performance of the absorber.
Technical Committee Machines
Technical Committee Mechanical and Civil Engineering

Peter Richter

The Technical Committee «Mechanical and Civil Engineering» and its associated six (former four) technical groups is dealing with current topics during their regular exchange of experience.

The problem of quality assurance is getting worse each year. The most negative examples are listed in the following:

- One non-OEM (original equipment manufacturer) did not mount the cone in a safety valve controlled by the medium in a steam turbine. The turbine was operated for about eight months without safety valve.
- In a new 150 MW turbine, the rotor was bladed with clockwise rotation and the guide blades with anti-clockwise rotation in the LP partial turbine.
- Again and again it can be observed that different sites within one company apply different standards as regards manufacturing and quality level.

Due to the numerous problems listed above, the technical committee is cooperating with other committees and groups, i.e. mainly with the Technical Committees «Materials and Quality Assurance», «Electrical Engineering, I&C and IT» and the Technical Group «Steam Generators».

During past months, the different technical groups elaborated and published the following VGB-Standards:
- VGB-S-016 DE+EN Turbine Internal Drains,
- VGB-S-036 DE+EN Preservation of Steam Turbine-Generator Sets,

Technical Group Steam Turbines

Current issues are discussed within the scope of the regular exchange of experience and documented in status reports:

Spare parts like casing joint bolts, steam strainers, oil pumps etc. could be lent from operator to operator through the existing network, thus avoiding long downtimes.

A Working Group «Pressure Equipment Directive (PED) at the Turbo Set» was set up. The discussion was triggered by the query about the necessity of revising the VGB/VDMA Information Sheet «Scope of the Pressure Equipment Directive (PED) with reference to steam turbines and their main components». The first meeting took place.

The oil workshop in Bremen took place on June 24/25, 2014. The maximum number of 50 participants had been achieved.

A new VGB Workshop on the issue of «Operation-dependent Maintenance of Industrial Steam Turbines» will take place in Ludwigshafen on September 11/12, 2015. In this workshop knowledge is to be provided on the planning, implementation, preparation and follow-up of steam turbine inspections from the viewpoint of VGB PowerTech e.V. and insurance companies.

The VGB Conference «Steam Turbines and Steam Turbine Operation 2016» will take place in Dresden on June 8/9, 2016.

The following VGB-Standards are being revised
- VGB-R 115 «Recommendation for the Inspection of Steam Turbines»
- VGB-R 503 «Guideline for the Internal Pipework of Turbo-Generator Sets»

Technical Group Gas Turbines

Peter Richter and Manfred Freimark

The technical group focuses on the exchange of experience and knowledge related to the operation, maintenance, modernisation, lifetime extension including the realisation of upgrade concepts and damage at gas turbine series and individual gas turbine models of different capacity.

Current topics like incipient cracks and fractures in the area of T-shaped lockings of compressor guide vanes, premature dissolving of thermal barrier (TBC) coatings at components of the hot gas path, damage caused by foreign objects (FOD), quality deficiencies upon inspection and repair etc. are regularly discussed and documented in status reports (Figure 4).

Changed operation modes involving frequent start-up procedures resulted in increased damage at the components of the hot gas path of heavy gas turbines, i.e. more creeping and fatigue.

The obvious consequences from the new German energy policy with less operating hours of combined cycle power, co-generation plants and back-up plants were still an issue on the group’s agenda. Against the background of decreasing revenues, the group members discussed the chances and options for utilising existing gas turbine plants by marketing grid services like secondary and minute reserves and by identifying new potentials to optimise generation and to cut costs.

Proven primary NOx reduction measures were discussed as regards the adoption of the NOx and CO emission behaviour of existing gas turbines with 300 or 1,500 OH/a to the more stringent requirements of the 13th Ordinance of the Federal Immission Control Act (13.BImSchV).

The group dealt with the issue of «Long-term conservation of stationary gas turbines due to changed market conditions – Discussion of requirements, concepts and experience».

The VGB-Standard VGB-S-121 «Supervision-, Limiting- and Protection Devices on Gas Turbine Systems» will be published by the end of 2015.

On May 06/07, 2015, the VGB Conference «Gas Turbines and Gas Turbine Operation 2015» took place in Lübeck. 39 cooperation partners supported the technical exhibition; a total of 250 participants attended the conference.
Technical Group Cooling Systems in Power Plants

Wolfgang Czolkoss

The group is dealing with possibilities for increasing efficiency of cooling systems, changes enforced by licensing procedures of future cooling tower types and investigation of microbiological risks related to the operation of cooling towers.

Different modifications of the cooling tower of the Gösgen and Leibstadt nuclear power plants and the efficiency improvements achieved were presented and discussed. The increase in efficiency due to aerodynamic improvement at the air intake was critically analysed.

The legionella outbreak in Jülich and the consequences for the Weisweiler power plant and the following activities by the responsible State Government of the German Federal State of North Rhine-Westphalia were on the agenda. The Project Group «Microbiology in Cooling Towers» that was jointly set up with the TG «Chemical Process Engineering» is intensively participating in the discussions triggered by the authorities. A statement on the problem of legionella was elaborated which is to replace the current VGB Guidelines 129 and 135 and which will also contain references on the discharge of cooling tower water etc.

An new VGB-Standard on the planning and operation of cooling towers is being elaborated which is to replace the current VGB Guidelines 129 and 135 and which will also contain references on the assessment of plume-free hybrid cooling towers.

Technical Committee Power Plant Concepts and Thermodynamics

Technical Group Power Plant Concepts

Hans-Joachim Meier

The committee was still focusing on the issue of «Flexibilisation of power plants». The joint research project «Partner steam power plant for the regenerative power generation» that is being managed by VGB was intensively attended and observed by the committee. The project was aiming at unconventional solutions in order to improve existing power plants to compensate the fluctuating supply from renewables. Existing thermal power plants are to secure grid stability until different, high-capacity power and or energy storage systems will be mature and readily available.

The current German situation is reflected in Figure 5. Today, Germany’s largest power accumulators only have a capacity of some 0.04 TWh. This capacity is represented by existing pump storage plants with an installed capacity of some 6,100 MW.

The figure is based on the assumption that renewables generation (wind and solar power) will completely fail in an e.g. calm winter week. If thermal power plants were no longer connected to the grid in such a situation, the entire electricity demand would have to be completely covered by power storage. The figure clearly outlines that the power demand of about 10 TWh is 250 times larger than the storage capacity currently available.

Therefore it can be anticipated that thermal power plants will remain indispensable for reliable electricity generation also in the forthcoming decades. Since the current market situation does not encourage investments into new flexible coal-fired power plants, retrofitting of existing plants, as focused by the research project «Partner Steam Power Plant», is rated highly.

The joint project was funded by BMWi within the framework of COORETEC (CO₂ reduction technologies) and covers a total of seven individual R&D projects investigating new and different flexibilisation options for coal-fired power plants.

The project, managed by VGB PowerTech e.V., is jointly conducted by the plant operators E.ON, RWE, STEAG and Vattenfall, the power plant manufacturers Mitsubishi Hitachi Power Systems Europe (MHPSE) and Siemens as well as the scientific institutions of Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR, national aeronautics and space research centre of the Federal Republic of Germany,), Energiewirtschaftliches Institut an der Universität zu Köln (EWI, Institute of Energy Economics of Cologne University) and the chair of environmental and plant engineering of Duisburg-Essen (LUAT) university as well as Rhein Ruhr Power e.V. (RRP).

Within the scope of the joint research project, the following working packages (sub-projects) were performed in separate research projects (responsible party in brackets):

- Simulation studies at two different reference plants as regards different strategies to enhance flexibility in terms of minimum load/start-up time/load following behaviour (LUAT-Uni. Duisburg),
- Requirements to be met by the future power plant park (EWI),
- Definition of reference power plants (STEAG),
- Reduction of minimum load of steam generators (MHPS),
- Reduction of start-up and shut-down times of steam turbines (Siemens),
- Integration of thermal storages in conventional power plants (DLR) and
- Synergy management for exchanging technical information between conventional and regenerative (renewables) plant engineering (RRP).

The joint research project was launched in September 2013 and will be finished in July 2015. All project partners will elaborate a joint final report by the end of 2015.

In March 2015, first results were already communicated on the Workshop «Flexible power plants for the energy transition» which had been organised by the Ministry for Innovation, Economy and Research of the German Federal State of North Rhine-Westphalia (NRW).

It is planned that the Technical Group Power Plant Concepts continues to deal intensively with alternative concepts for flexible power generation in conventional power plants that can be employed according to needs.

Working Panel Pipe Systems, Valves and Pressure Vessels

Technical Group Pipes and Valves

Christian Stolzenberger

With a manufacturer of valves and packings the group discussed the following issues:

- Experience with the construction and operation of valves for 700 °C power plants,
- Materials and design of platings (seats, etc.), measures preventing spalling,
- Measures to reduce noise emissions at valves,
- Designs of injections with and without motive steam,
- Design of spindles and valve guides in safety valves,
- Parameters of flange connections,
- Comparison of old and new calculation methods of flanges,
- Solutions for mechanical seals in power plant pumps,

As regards the exchange of experience, the group dealt with problems with disassembly of self-sealing cover plates due to scaling, failures of piston pressure switches made of plastics in hydraulic plants, optimisation of the start-up time of a combined cycle power plant, failure of a ferritic compensator due to the long-term impacts of chlorides and damage at plating seats. Problems in connection with possible buffering at seat platings will be an issue on the agenda of next meeting.

The research project «Spindle Coatings» was terminated. It was demonstrated that carbide coatings are a proven material for coating spindles and that air moisture during storage is influencing the leakage rates of packings. The final report can be downloaded under the VGB project number 369.

Technical Group Civil Concepts/Specific Civil Solutions

Technical Group Civil Structural Maintenance/Condition Monitoring

Thomas Eck

After reorganisation of the VGB committees, the issue of civil engineering within VGB, i.e. its two Technical Groups «Civil Concepts/Specific Civil Solutions» and «Civil Structural Maintenance/Condition Monitoring» are now associated with the new Technical Committee «Mechanical and Civil Engineering».

The former Technical Committee «Civil Engineering» was dissolved after its meeting at the beginning of 2015. The new TC and its associated TGs are now assuming the former tasks according to the new rules of procedure.

The Technical Group «Civil Concepts/Specific Civil Solutions» is still focusing on new-built projects and the modernisation as well as retrofit measures at power plants and power plant-specific buildings. These cover thermal power plants as well as civil engineering constructions for renewable energies.

The second Technical Group «Civil Structural Maintenance/Condition Monitoring» is dealing with issues of lifetime management of buildings in power and industrial plants, also under the aspect of modified residual lifetime.

The exchange of experience is also an issue permanently on the agenda of the meetings that usually take place twice a year. New procedures like e.g. the multi-copter technology (aerial photography and aerial video) supporting condition monitoring of buildings are also being discussed. The possibilities and limits of this new technology, which is using infrared technology to fly over power plant buildings with drones/multi-copters (particularly over stacks and cooling towers, Figure 6 and Figure 7), were outlined by a guest lecture.

Apart from the two technical groups, another seven project groups were set up, revising and elaborating existing or new VGB-Standards and VGB Instruction Sheets. After revision, the following VGB literature will soon be published as VGB-Standards:

- VGB-R 604 «Application and assembly of anchors in concrete foundations»,
During the reporting period, the Technical Committee «Materials and Quality Assurance» was mainly dealing with:

- Flexibilisation, lifetime concepts,
- Material development,
- Measures assuring quality within the scope of the procurement, manufacturing and assembly of steam boilers, pressure vessels and pipe systems,
- Evaluation of damage at pressurised components,
- Standards on quality, condition and operation of pressurised equipment,
- Requirements to be met by welded bearing structures of offshore wind power plants and the related transformer stations.

The following research projects were focused:

- Development of a new generation of 12 % Cr steels,
- 725 °C high-temperature material test 1 and II at GKM,
- Exemplary investigation on the effects of flexible power plant operation on components of the cycle system,
- Residual lifetime of components,
- Evaluation of extrapolation processes on the creep strength of high-temperature steels.

As regards «power plant flexibilisation», the following issues were focused:

- Lifetime concepts, creep fatigue, storage technologies,
- R&D projects «Partner steam power plant» and
- R&D project «Determination of residual lifetime for critical components of existing power plants».

The following damages were also evaluated:

- Damage at material T24 and HR3C,
- Damage at injection coolers and
- Stress corrosion cracking in compensators.

The issue of renewables comprised the following:

- Load bearing structures of wind power plants and related standardisation projects for weld connections at wind power plants and
- Research project «Fatigue life load sequences effects and failure-probability driven inspection».

The VGB Workshop «Materials and Quality Assurance» took place in Linkebeek and Brussels on April 29/30, 2015 (Figure 8). 62 representatives from 10 European countries and Turkey attended the workshop which comprised 20 papers, divided into four subjects (Lifetime Assessment/Flexibility, Materials and Components, Pumps, Renewable Energy). The evening event was held at the Atomium in Brussels.

Working Panel Supervision of Construction and Assembly/Quality Assurance

Technical Committee Materials and Quality Assurance

Olaf Baumann

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Working Panel Supervision of Construction and Assembly/Quality Assurance

Technical Group Supervision of Construction and Assembly/Quality Assurance

Christian Stolzenberger

During the reporting period, the group focused on «Quality Management of Offshore Wind Power Plants» against the background of the revision of the BSH Standards and merger of rules of Germanischer Lloyd (GL) and Det Norske Veritas (DNV) into DNVGL. A constructive talk was held with DNVGL of the department of «Renewable Energies». Following this talk, VGB was invited as guest to attend the constituent meeting of the Committee of Experts (CoE) of the department «Renewable Energies». A membership in the CoE is to be discussed in the autumn of 2015. VGB asked to being involved into the hearings of new DNVGL rules.

The group started elaborating a standard together with wind farm operators and the Federal Waterways Engineering and Research Institute (BAW) on corrosion protection of offshore wind power plants. A first draft is likely to be presented by the end of 2015.
As regards the exchange of experience, the group discussed the following issues:
- Austenitic cooling water pipe system,
- Boiler recirculation pump,
- T24 membrane,
- Material HR3C and
- Leaking steam pipe system made of 12Ch1MF/P91.

The VGB-Standard VGB-S-013 «Construction and installation supervision in the manufacture and assembly of water-tube boilers and associated systems in thermal power plants» was published in the German and English language. Unfortunately the standard could not be published in cooperation with FDBR as originally desired. Talks with FDBR will be continued when first experience will have been made with the VGB-Standard. Austenitic materials might be dealt with in a new VGB-Standard.

Technical Committee Electrical Engineering, I&C and IT
Jörg Kaiser

The Technical Committee «Electrical Engineering, I&C and IT» deals with strategic issues (e.g. concepts for E and I&C projects, requirements to be met by the interface power plant-grid) as well as research projects and elaborates VGB-Standards for the field of electrical engineering and I&C. Jointly with its four associated technical groups, the committee also focuses on current daily issues (e.g. I&C failure, generator damage, transformer monitoring, quality supervision and issues from the interface power plant-grid).

Preparation activities for KELI 2016, to be held in Cologne on May (10) 11/12, 2016, have already started (Figure 9), i.e. a «Call for Papers» was published. A programme committee was set up together with the Technical Group «Plant Management Systems» and manufacturer representatives. Integration of renewables and distributed generation as well as continuation of the special programme for students will be the corner points of the conference.

The research project «Wear investigation models» for primary and secondary control in thermal power plants in the ENTSO-E grid was carried out by Rostock University. The project aimed at the determination of the effects of control energy, i.e. the lifetime of related components of the water-steam cycle and turbo set. Gas- and steam turbine plants as well as hard coal- and lignite-fired power plants were investigated with dynamic simulation.

The research project «Generator wear reactive power supply» was carried out jointly between Ruhr Hochschule West and the company Sensoplan. The project was to provide results on the fact that generators and their auxiliary equipment suffer from wear because of the supply of additional reactive power.

The results of the two research projects will be included in the holistic assessment of expenditures for the operation and maintenance of generation plants which were additionally elaborated by VGB committees and groups.

VGB is participating in a new research project, i.e. the dena (German Energy Agency) platform «System services 2030» which is to identify new options and technical feasibility that renewables and new technologies can assume more responsibility for system services. VGB will participate and offer its technical expertise also gathered from conventional generation.

Technical Group Electrical Equipment
Jörg Kaiser

Different VGB-Standards are under way in the field of electrical engineering. The issue of quality is still of central importance. Product warnings were assessed and conclusions were drawn jointly with manufacturers concerned.

Fig. 9: Preparation activities for KELI 2016, to be held in Cologne on May (10) 11/12, 2016.

Fig. 10: VGB-Standard VGB-S-036 «Preservation of Steam Turbo-Generator Sets ».

Project Group Generators

The VGB Project Group «Generators» manages the damage data base and holds technical discussions with manufacturers to evaluate current events and to identify jointly optimum solutions to improve operations and long-term stability of generators in the future. A technical discussion with Siemens took place; weak points of current generator designs were listed from the viewpoint of VGB. Siemens presented their new approaches and compared them with old designs. According to the current market estimations, design principles for the new generator modular system were presented.

The group also performed work for a new VGB-Standard VGB-S-036 on the conservation of generator turbo sets (Figure 10). VGB-S-166 was revised to improve the H2 safety in a harmonised European environment and to create uniform recommendations for manufacturers and operators for the design and operation of new plants. This also involved basic recommendations for measures at existing generators which, however, have to be assessed and implemented individually for each case. The contents was coordinated by the experts of the VGB core Working Group «Ordinance Operational Safety ».

The Project Group «Generators» also set up a Sub-group «Mechanical Engineering for Generator Protection» with experts of operators and manufacturers of generators at steam turbines, gas turbines, hydro turbines and wind turbines. The group revises the former VDEW recommendation and turns it into a new VGB-Standard.
Project Group Transformers

During the reporting period the group worked on the VGB-Standard VGB-S-169 «Quality Requirements of Mineral Oils in High-capacity Transformers». A separate project group elaborated criteria for assessing the quality of generator oil, oil preparation and handling along the supply chain including factory testing.

Ageing management, monitoring options, and methods of large-scale transformers are in the focus. A data collection is available on the issues of «online monitoring» and «transformer instrumentation». A table comparing maintenance and monitoring measures in individual companies was elaborated.

Technical Group Panel Control and Instrumentation and IT

Jörg Kaiser

The group continued elaborating the new VGB-Standard VGB-S-171-43 «Measurement Technology» and finalised content-related activities. Based on the former VGB Guideline VGB-R 170 C1.9, proven and recommendable measurement systems were described reflecting experience and recommendations of operational practice. All relevant measured values in conventional and renewable plants for power and heat generation were considered.

Three expert groups checked the scope for revision of the guidelines of the VGB-R 170 B series «Design standards for instrumentation and control equipment» and initiated first steps.

The Working Panel «I&C and IT» held discussions with manufacturers of different I&C components within the scope of its meetings in order to present and discuss special issues and to debate realisation of the VGB Guidelines of the VGB-R 170 series.

The new Rheinhafen-Dampfkraftwerk Karlsruhe (RDK 8) as well as different modernisation projects were taken as example to discuss different issues to optimally realise I&C, thus meeting the requirements of new power plant operation (Figure 11). The issues of know-how, engineering capacities and assessment of advantages and disadvantages of digital interfaces have to be mentioned in this connection. The company Indu-Sol presented requirements to be met by quality-assured planning and engineering of I&C grids as well as solutions on grid monitoring.

It is expected that by mid-2016 the Federal Government will pass the IT security act and its related ordinances to define critical infrastructure as well as a safety catalogue for energy conversion plants. Jointly with the BDEW, VGB set up a project group to observe the process.

Technical Group Interface Power Plant – Grid

Jörg Kaiser

The Technical Group «Interface Power Plant Grids» is available to all VGB members for any issue related to the interface power plant – grid.

European network codes are elaborated and approved, thus contributing to the harmonisation of the internal market and creating the necessary pre-condition for the increasing need for volatile (renewable) energy without jeopardising supply security. It is urgently needed that operators form their opinion about the draft network codes of Entso-E jointly and in close operation with EURELECTRIC. The most important network code for generators, i.e. «Requirements for Generators», was critically observed during elaboration. It turned out that intensive European exchange of experience is needed within the technical group during and after the legislative procedure and the transposition into national law.

Contracts and/or regulations for the operation of the interface power plant – grid, e.g. redispatch and supply of reactive power, are another important aspects of the group’s activities. The processes on national and German level have to be influenced and synopses about the European status are to be drafted. The elaboration of joint statements and position papers on European level is desired.

The Project Group «German Regulation» is entrusted with coordinated reactions on German requirements and regulations, e.g. the amendment of the energy act (EnWG), determination and consultation procedures of BNetzA (Federal Network Agency), «Green Paper» (electricity market design for Germany’s energy transition) of the German Federal Ministry for Economic Affairs and Energy (BMWi). The statements and comments are agreed upon with BDEW.

Technical Group Acceptance and Control Tests

Wolfgang Czolkoss

The assessment in terms of economic efficiency and environmental compatibility of power plant processes of new as well as existing plants after modernisation and retrofit is one of the major aspects of power plant operation. Requirements and specifications are laid down in agreements for the acceptance in the sense of verifying guarantees after finalisation of measures; these are generally proven by expert measurement teams. The Working Group «Acceptance and Control Tests» is creating a common base of understanding between operators and contractors and makes recommendations for selecting specialised measurement tools as well as assessment and verification methods.

After reorganisation of the VGB committee structure, the technical group is no longer allocated to the Technical Committee «Operation and Maintenance» (former Technical Committee «Power Plant Operation»), but to the Technical Committee «Electrical Engineering, I&C and IT». However, numerous tasks of the group belong to

Fig. 11: The Rheinhafen-Dampfkraftwerk Karlsruhe with the new unit RDK 8. One example to discuss different issues to optimally realise I&C.
operational issues; therefore multi-committee exchange will be vital in future.

One major aspect of the panel’s activities is still the exchange of experience and the assessment of new measuring techniques and equipment particularly as concerns application for acceptance and control measurements.

Field bus systems are increasingly replaced by wireless systems with wireless HART technology. Further development and application experience are being observed.

Pulverised coal measurements were a priority issue. A new project group was set up to deal with this important issue because of its meaning for operation optimisation. The group is to develop specifications and a manufacturer-neutral measurement procedures based on practical experience and changing conditions. The specifications and measurement procedures are to be published in a new VGB-Standard.

Different project groups are still completing several VGB-Standards. Some members of the technical group and their project groups are participating in standardisation activities for acceptance measurements (VDI 2048, ISO 1888, IEC 60953, VDI 3921) thus guaranteeing a good exchange of information.

Technical Committee
Power Plant Operation

Technical Committee
Operation and Maintenance
Jörg Kaiser

The Technical Committee «Operation and Maintenance» manages the activities of its associated technical groups and deals with operational and strategic issues which are of particular interest for the management of generation plants. Topics of maintenance will get a more prominent position in the committee, after maintenance management had been integrated into the Technical Committee «Operation & Maintenance».

The consideration of strategic issues will become increasingly important for the committee’s activities. The current market situation requires measures to maintain and improve the economic efficiency of operation and maintenance of generation plants. The Technical Committee «Operation & Maintenance» is dealing with consequences resulting from the utilisation of generation plants, IT support and personnel. Early harmonisation of impacts of planned and new legal requirements (Europe and Germany) on power plant operation is part of the strategic consideration. In this connection legal and authority requirements, e.g. related to environmental protection, also have to be taken into account.

Training and advanced training of power plant personnel, knowledge management and trainee concepts are important subjects to improve the long-term competitiveness of utilities.

Issues like quality of supply, maintenance of power plant components and assessment of current events are of particular significance for operational management. These topics are modules that guarantee the necessary effectiveness and competitiveness and form thus the basis for collaborative business activities.

Working Panel Training of Plant Personnel
Technical Group
Operational Management
Hans-Werner Otte

The former VGB Working Panel «Training of Plant Personnel» was completely set up anew as Technical Group «Operational Management» during the reporting period. It completely revised its fields of activity. The focal issues of training were no longer sufficient for market and future oriented committee work. In 2014 the panel formulated its future key issues and laid the foundation for the new direction of the Technical Group «Operational Management», which will remain the competent body of VGB as regards the training contents of KRAFTWERKSSCHULE E.V. (Power Plant Training Centre).

Extension of the range of activities mainly concentrates on the operation of power plants. The term «operation» involves the entire activities related to power generation and maintenance. Since power plant operation is based on the capabilities, qualifications and competencies of staff, it had only been logical to extend the former range of the field of «training and advanced training».

The technical group took into account the dynamics of the current change process in the energy business and developed new working methods. The group is striving for a kind of «speed dating» with the VGB community and changing experts in order to deal with continuously changing but current issues which are discussed at the group’s meetings and dealt with rapidly.

For the time being, the following fields were defined for the new technical group:

Organisation
- Information man-machine,
- Physical and psychological stress of staff,
- Handling of the flood of information of modern plant management processes,
- Shift organisation,
- Standards for product management,
- Legal requirements for operational management,
- Changed roles in shift operation,
- Increasing requirements by future shift leaders,
- Development of a target profile for shift (leader)manager,
- Economic performance in shift operation,
- Shift as value driver of production.

Staff/personnel
- Multi-qualification in operational application,
- Concepts for the cooperation of plant management and maintenance,
- Plant responsibility,
Fig. 13: Results from the power plant information system KISSY: Energy availability and energy utilisation of dual boiler units from 2004 to 2013.

- Flexibility of personnel,
- Shortage of skilled workers,
- The following issues were elaborated by the Working Group «Operation Practice» during the reporting period:
  - Work isolation procedures by taking into account the isolation procedure according to the rule BGR/GUV-R 240 (German statutory accident insurance),
  - Organisation of shift plans,
  - Maintaining the know-how of shift personnel and
  - Economic efficiency of training and advanced training.

Technical Group
Plant Management Systems
Jörg Kaiser

The Technical Group «Plant Management Systems» is pursuing activities to support the value adding processing of data as supporting information for all areas of products up to management. The panel wants to support integration of staff, data and information systems in order to use IT as management tool. The profile of this technical group needs to be better communicated among VGB committee groups.

The issue of IT safety refers to all power plant areas and administration; particularly when data networks are being used. A staged concept is being used corresponding to the degree of protection which is being described in the VGB-Standard VGB-S-175 «IT Security for Generating Plants» (Figure 12). The issue is permanently on the agenda and checked for up-dates.

A VGB workshop was held on November 26, 2014 in order to exchange experience on the issue of IT security. More than 60 participants from 9 countries gathered experience and information provided by interesting lectures and comprehensive discussions.

Headed by the Project Group «Exchange of Experience of IT Security Commissioners» and in cooperation with representatives of the former PG, which was to revise VGB-S-175, German VGB members are currently taking the necessary steps to accompany current legislative procedures. A joint PG with BDEW was also set up which can be contacted for talks with representatives of authorities and ministries and which will provide concrete input. This applies in particular to the ordinance on the definition of critical infrastructure and the IT security catalogue for energy facilities. Within VGB, the necessary activities also have to be coordinated with wind power plants and distributed generation as far as these are concerned.

Technical Group
Performance Indicators
Stefan Prost

During the reporting period the working panel dealt with the revision and translation of guidelines for the definition of parameters, the elaboration of an inter-plant statistics for regenerative power plants and the advancement of the power plant information system (KISSY).

A total of 27 national and 13 international VGB members are supplying data and are taking part in the cross-plant availability statistics. A total of 807 power plant units with an installed gross capacity of some 277 GW are cooperating in KISSY. Last year more interested VGB members from east Europe participated and cooperated in panel activities (Figure 13 and 14).

KISSY is being extended by new diagrams, i.e. quartiles (best, median, and worst) will be calculated in future. Besides, it will become possible to select a larger time frame which will indicate a possible trend for different parameters. The diagrams will be published in the technical-scientific reports and the on-line assessment of KISSY.

The VGB-Standard «Basic Terms of Electricity Generation» (VGB-S-002-T-01) was revised, because international influence was to be incorporated. The VGB-Standard «Hydro Power» (VGB S 002 02) was translated into the English and French language. The VGB-Standard «Wind Power – Definitions and Parameters» (VGB S 002 05) is being developed with experts.

The Project Group «KISSY/Wind Energy» comprises international members of the VGB Technical Groups «Wind Energy» and «Performance Indicators». The group is to define parameters for availability and to assess them. The establishment of an event data base is also planned in order to localise component weak points and to deliberately improve such components.

Technical Group
Reference Designation and Plant Documentation
Andreas Böser

Following the initiative of the technical group, the cooperation agreement between VGB and eCl@ss e.V. could be signed in 2015. This cooperation is a sensible extension of the VGB and eCl@ss portfolio in the field of multi-industry standards. VGB expertise is integrated into the existing eCl@ss working group «power plant engineering and- operation/main- tenance». These extended VGB activities will be incorporated in an industrial standard according to ISO/IEC standards.

The technical group cooperated in drafting DIN SPEC 91303 (Components and structure of a plant documentation system for renewable energy plants) which was published at the beginning 2015. The DIN SPEC describes the structure of a plant documentation system (CV), however, only few requirements for a digital plant
A follow-up project within the scope of the research project CVCtec, also with active participation of the technical group, is to define the requirements to be met by a digital system. The project 51.104 is funded by the Federal Ministry of Education and Research (BMBF) and runs from 9/2014 to 9/2016. EBCsoft GmbH is developing jointly with Leipzig University and bse Engineering Leipzig GmbH a «digital CV» (curriculum vitae) for technical plants. Such a CV is to improve coordination among all parties involved along the entire lifetime of a component. A simple information model is being developed within the scope of the project. The model is based on existing standards and rules and takes into account the different information requirements by the parties involved. The CV prototype is being evaluated in different practical applications. The digital CV unifies the technical, technological, material, legal and ecological view on the lifecycle of a plant. Yet VGB has only looked on the technical aspect of a plant with its VGB-R 171. However, changing legal requirements increasingly focus on the holistic view on the lifecycle. The technical group is of the opinion that this development needs to be actively shaped for the benefit of VGB members.

The Maintenance Team (MT) is making technical extensions and is maintaining the «RPS-PP Application Guideline». The team comprises experts from the wind business and identification systematics. The results are published timely and as free download on the VGB website. The application explanations for hydro power (VGB-S-823-31) and the general part for power plants (VGB-S-823-01) are going to be published soon (two columns and bilingual).

Maintenance of the KKS key parts (guideline VGB-B 105) was basically confirmed. The technical group annulled the «KKS Application Explanations» (guideline VGB-B 106). Revision of the guideline text with elimination of faults, adoption to key parts and elimination of the invalid references to standards are to be published within the scope of the index F in the entire code VGB-B 105.

**Technical Group Maintenance Management**

*Heinrich Grimmelt*

Within the scope of the new VGB structure, the Technical Group «Maintenance Management» was set up. The new group mainly comprises the members of the former, identically named, VGB technical committee.

A VGB position paper provisionally entitled «Recommendations on the organisational structure, personnel qualification and staff number of a single unit power plant» is to be drafted. The paper will describe how a cool-fired unit of the 800 MW range can be organised. A leaner structure is favoured without dispensing with functions like e.g. plant manager. Core functions like operation, plant maintenance and fuel supply and disposal are described. Details like administration of licensing documentation or work preparation for current maintenance activities are allocated to corresponding functions. Support functions like procurement, controlling, accounting, laboratory, technical documentation (IH), and human resources (HR) will be outsourced or provided centrally by the group.

The issue of quality assurance runs like a red thread through the group’s activities. In the past, the VGB Instruction Sheet VGB-M 132 «Recommendations for the outsourcing of maintenance services» was revised and supplemented by the issue of «monitoring of quality requirements». Now, the focus is less on the manufacturing sector but rather on service companies. It is obvious that a lot of companies employ less-qualified personnel and consequently deteriorate the quality of work as a consequence of cost cutting. Therefore, criteria and procedures are to be described how to check whether a service company is basically suited to meet legislative and operator requirements and thus fits the job. A new test will be carried out within the course to verify whether the company will perform the working package in line with quality requirements.

![Fig. 14: Results from the power plant information system KISSY: Energy unavailability of fossil-fired power plants 1991 to 2013.](image-url)
Renewables and Distributed Generation

Targets of the European Union

**Ulrich Langnickel**

In 2013 the share of renewables in the final gross energy consumption in the EU amounted to 15.0 % compared to 8.3 % in 2004, the first year where corresponding data was available. The EU is aiming at increasing the share of renewables in the final energy consumption to 20 % by 2020. An individual target value was set up for each member state. The national targets of member states take into account the different initial situations, the potential in the field of renewables and the economic capacity. According to the governments’ national action plans, a share of 34 % is expected for the electricity sector (Figure 1), 21.3 % for heating and cooling and 11.3 % for the transport sector. In 2020, renewables will cover about one third of the entire electricity generation in the EU.

The share of renewables in gross final energy consumption has been increasing in all EU member states since 2004, with at least 100 % increase in 13 member states in the past ten years. The largest increase occurred in Sweden with 52.1 % in 2013, followed by Latvia with 37.1 %, Finland with 36.8 % and Austria with 32.6 %. The lowest share in renewables was registered for Luxembourg with 3.6 %, Malta with 3.8 %, The Netherlands with 4.5 % and the United Kingdom with 5.1 %.

Bulgaria, Estonia and Sweden have already met their 2020 targets. Lithuania, Romania and Italy need less than 0.5 % to reach their individual 2020 targets. The United Kingdom, The Netherlands, France and Ireland show the biggest gap before reaching their target values (Figure 2).

As regards the traffic sector, Sweden (17.6 % of renewables) was the only EU-28 member state that reached the target value of 10 % in 2013. With 9.9 % Finland nearly met the target. Most EU countries have reached 50 % of their 2020 targets. With shares of less than 1 % of renewables in the traffic sector, Estonia (0.2 %), Spain (0.4 %) and Portugal (0.7 %) are far away from reaching the 10 % EU target.

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**Fig. 1: Shares of renewables in EU-28.**

**Source:** Eurostat (2013), EuroObserv’ER (2013)

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### Targets of the European Union

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<td>Electricity</td>
<td>34.0 %</td>
<td>21.3 %</td>
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<td>Heating and cooling</td>
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<td>11.3 %</td>
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<tr>
<td>Transportation</td>
<td></td>
<td></td>
<td>20 %</td>
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</tbody>
</table>

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### 2013 - Total: 853 TWh

- Large hydro power: 320 TWh
- Small hydro power: 235 TWh
- Wind energy power: 157 TWh
- Biomass: 50 TWh
- Geothermal energy: 495 TWh
- Solar radiation: 232 TWh
- Concentrated Solar: 11 TWh

### 2020 - Total: 1,196 TWh

- Large hydro power: 304 TWh
- Small hydro power: 83 TWh
- Wind energy power: 11 TWh
- Biomass: 6 TWh
- Geothermal energy: 232 TWh
- Solar radiation: 11 TWh
- Concentrated Solar: 51 TWh

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**Source:** Eurostat (2013), EuroObserv’ER (2013)
Strategic Forum Hydro

Technical Committee Hydro Power

Wolfgang Czolkoss

The former Steering Committee «Hydro Power» continues its activities in the Strategic Forum (SF) «Hydro». The forum comprises management members of European hydro power operators and offers them a platform for discussing strategic issues of the European market and coordination with EURELECTRIC in Brussels and other international and domestic organisations.

Besides, the SF coordinates and harmonises the topics of the Technical Committee «Hydro Power» (Figure 3).

In the Technical Committee «Hydro Power» technical experience is exchanged and projects are being coordinated with other organisations in the field of hydro power (German Association of Energy and Water Industries (BDEW), German Association for Water, Wastewater and Waste (DWA), Working Group Alpine Hydro Power (AGAW), …).

During the reporting period, the committee members discussed new projects like the renewal of the Töging and Obervermuntwerk II power plants or revisions in the hydro power plant group Pfreimd, Vianden. Professor Mudersbach, Bochum University, presented and discussed the probable impacts of climate change on the utilisation of hydro power.

During the period under report, two expert groups completed and published two new VGB-Standards «Evaluation of Components in HPP Exposed to Fatigue» (German and English) and «Interaction of Conformity Assessment and Industrial Safety in Hydro Power Plants» (German). Another expert group was dealing with issues of fish protection. The group compared guidelines and standards for fish migration devices and fish passages and presented their results on the VGB homepage.

As regards the reorganisation of VGB committees and panels, the Strategic Forum «Hydro» entrusted the Technical Committee «Hydro Power» with the activities by setting up technical groups (TG) and project groups (PG).

A Technical Group «Ecological Aspects of Hydro Power» was jointly set up with AGAW. The new group developed from the Expert Group «Fish Protection» will elaborate an independent quoted synthesis paper on the forum fish protection of the German Environmental Protection Agency (UBA) which had been existing from 2011 to 2014. The paper is to outline the position of the large hydro power operators and is to be passed on to UBA. The group considered and pursues current operators’ and universities’ research projects on fish protection. The impacts and consequences of the 2nd National Water Management Plan (NGP) on individual member companies were discussed. German operators ordered a legal opinion on the situation of hydro power in Germany and problems with licensing. The technical group will participate by defining the state of the art and with the help of VGB-Standards and other publications. It is desired that members of the technical group will cooperate in different DWA committees in order to ensure due consideration of operators’ interests in DWA rules which are often taken as basis for licensing procedures.

The new Technical Groups «Operation & Maintenance» and «Hydro Components» were mainly set up with members of the technical committee. Maintenance strategies are to be considered and selected issues of the maintenance of hydro power plants are to be coordinated by project groups established for that purpose.

The Project Group «Lifetime Assessment» will continue the activities of the Expert Group «Component Fatigue». The group is to complete the VGB-Standards on the assessment of components exposed to fatigue by adding examples, comparing assessment methods and the resulting requirements for testing intervals. The group will also carry out a workshop on that topic.

Fig. 2: Share in renewables according to member state (in % of the gross final energy consumption).

Fig. 3: Hydro power. VERBUND's run-of-river plant Ybbs-Persenbeug. The project «Ybbs2020» will increase the output. (Photo: VERBUND).
A Project Group «Maintenance Strategy» is to deal with the operational requirements and experience made with the maintenance of hydro power plants.

The technical committee set up additional project groups to deal with further issues. The Project Group «Conformity Assessment for Hydro Power Plants» will prepare a workshop on that issue after publication of the new VGB «Interaction of Conformity Assessment and Industrial Safety in Hydro Power Plants». Besides, the Standard is to be extended and changed ordinances are to be updated. The second edition of the standard is also to be published in the English language.

Based on the VGB-Standard VGB-S-175 «IT Security for Generating Plants», the new Project Group «IT Security» will elaborate the safety risks and consequences for the equipment and operation of hydro power plants. The major issues and work priorities were laid down at a kick-off meeting.

### Strategic Forum Wind

#### Technical Committee

**Wind Energy**

Ulrich Langnickel

Wind power has to be extended in order to meet the requirements of the European Union within the scope of the EU «Energy and Climate Change Package». However, extensions have to be selected deliberately at favourable «wind sites» and by taking into account power-plant specific criteria. By the end of 2014, about 24,807 wind power plants were in operation with an output of 39,165 MW in Germany. At that time the installed capacity in Europe amounted to 133,968 MW (compare Table 1) and worldwide to 371,191 MW. VGB member companies are operating wind power plants with a total capacity of more than 33,000 MW. Approximately 80% of the installed offshore wind capacity is owned by VGB member companies.

Leading wind power plant operators – E.ON, EnBW, RWE Innogy, Statkraft and Vattenfall – agreed on bundling their interests under the roof of VGB PowerTech. Apart from the exchange of information and experience, the companies are mainly interested in cooperation to push forward standardisation (best practice) and to incorporate operator interest in the different user groups. Reduction of installation and operational costs and increase of operational safety require coordinated and joint analysis of operational experience. The findings and knowledge thereby derived will be the basis for determining construction and operational standards (VGB-Standards). The Strategic Forum (SF) «Wind» was constituted on April 30, 2015. Strategic requirements on utilisation of wind power from the viewpoint of operators are discussed on management level and corresponding measures are launched. Besides, the activities of the Technical Committee «Wind Energy» and of the different user groups are coordinated.

All companies active in the wind energy business are striving or have to strive for decreasing the costs of maintenance and repair of wind power plants. This target was mainly pursued by the following activities:

#### Conferences/workshops

On February 24/25, 2015, the annual Technical Conference «Maintenance of Wind Power Plants» was held with support by the Technical Committee «Wind Energy» and RheinEnergie AG in Cologne. More than 80 participants from 10 countries dealt with issues on operational optimisation of wind power plants particularly in the fields of oil, gear box and condition monitoring systems (Figure 4). The papers and discussions underlined that the wind power industry is still facing great challenges. These apply in particular for the optimisation of maintenance and repair strategies and the related cost reduction potentials. The next technical conference will take place in Hamburg on March 2/3, 2016 in parallel with the VGB Conference «Maintenance in Power Plants» including technical exhibition. The double event offers a platform for extensive exchange of experience among operators of wind power plants and conventional power plants. Further VGB workshops are being carried out on issues like oil management, drive train damages as well as lightning and fire protection in order to intensify the exchange of information and experience.

#### VGB-Standards/ VGB databases

Further «professionalisation» of wind power needs standardisation of the entire chain of added value. Therefore, requirements on installation and operation of on-and offshore wind power plants are specified in different VGB-Standards, similar to the conventional sector.

Owners of wind power plants are responsible for all issues related to industrial safety, therefore, the manufacturers have to provide all assembly, operation and maintenance documents.

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<table>
<thead>
<tr>
<th></th>
<th>Installed capacity end 2012 [MW]</th>
<th>Installed capacity end 2013 [MW]</th>
<th>Installed capacity end 2014 [MW]</th>
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<tr>
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<td>109,581</td>
<td>121,572</td>
<td>133,968</td>
</tr>
</tbody>
</table>

The related requirements on documentation for wind power plants were integrat-
ed into the VGB-Standard VGB-S-831-00-
DE-EN (former VGB-R 171) «Provision of Technical Documentation (Technical Plant Data, Documents) for Power Plants».

In the spring of 2014, VGB PowerTech published the international designation system «Reference Designation System for Power Plants – RDS-PP®», for wind power plants which is being updated continuously. It supports operators, manufactur-
ers and service companies efficiently upon planning, construction, operation and maintenance of wind power plants. The designation systematics of RDS-PP® is applied as uniform feature over the entire life cycle of wind power plants. Thanks to RDS-PP®, which is based on international designation standards, it is possible for the first time to share digital data between all parties of the branch, i.e. plan-
ers, manufacturers, insurance companies, operators and plant owners. This brings about major advantages up to cost reduc-
tion, because all stakeholders «speak one language».

Another VGB-Standard «Guide for Lifetime Management of Foundations and Towers of Onshore Wind Power Plants» will main-
ly deal with maintenance and retrofitting of these components which are made of steel, reinforced concrete and other mate-
rials as well as compounds of these. This document also deals with basic materials and maintenance materials like mortar or coatings. However, electrified or power generating components are not consid-
ered in the VGB-Standard which is to be published at the beginning of 2016.

A project group of the TC «Wind Energy» is cooperating with the TG «Performance Indicators» in order to develop a uniform systematic for recording availabilities and unavailabilities to carry out statistic assess-
ments and technical, scientific analyses. In this case the technical availability of wind power plants of dif-
ferent manufacturers can be compared with each other.

VGB PowerTech deals with corrosion protection of offshore wind power plants jointly with the BAW (Federal Waterways Engineering and Research Institute). By the end of 2015, a draft standard, comprising the following chapters covering all op-
tions of corrosion protection, will be completed:

- General,
- Requirements on coating systems,
- Application of coating systems,
- Repair of coating systems and
- Cathodic corrosion protection.

On June 26, 2015, the constituent meet-
ing of the group drafting the VGB-Stand-
ard «Fire Protection in Wind Power Plants» took place. Members of the Technical Committee «Wind Energy» and fire fight-
ing experts (Technical Group «Fire Protec-
tions») will determine the minimum require-
ments of fire protection. At the first meet-
ing a detailed plan was outlined which takes into account fire-protection require-
ments as well as economic and engineer-
ing demands.

According to a decision of the SF «Wind», a future VGB-Standard has to deal with acceptance regulations and the takeover procedure after the warranty periods.

User groups
The user groups deal with specific techni-
cal issues – from foundation to rotor blade – of wind power plants of certain manu-
facturers.

VGB member companies are striving for optimised maintenance and repair meas-
ures. The improvement proposals jointly worked out are subsequently discussed with manufacturers. Following a decision taken by the SF «Wind», VGB user groups are to concentrate on the multi-MW plants by Siemens and Vestas. Further groups, e.g. treating the Senvion plants, can be set up if needed. VGB member companies that already operate wind power plants of these manufacturers or which have made corresponding contracts can become members of the user groups.

Research projects
Condition monitoring of technical plants is to detect deviations of normal operating behaviour indicating to the development of damage. Condition monitoring sys-
tems, which are also designated as struc-
tural health monitoring systems in case of structural components, enable condition-
based, preventive maintenance which is characterised by the optimum utilisation of component lifetime as well as the preven-
tion of unforeseen failures and subsequent plant damage. The VGB Research Project «Condition Monitoring of Wind Turbines: State of the Art, User Experience and Recommendations» is based on compre-
hensive evaluations of available technical literature, pertinent standards and product information as well as on interviews with wind power plant operators (VGB mem-
ber companies). The final report was pub-
lished in February 2015.

Icing is significantly influencing the de-
velopment and operation of wind power plants. It causes production losses and is a safety risk for passers-by and service personnel (Figure 5). Optimised opera-
tion needs firstly detection of icing on rotor blades as early as possible, i.e. the plant can be stopped and the deicing equip-
ment can be activated and secondly an instrument is needed giving a signal that the rotor is ice-free again and normal oper-
ation can be assumed. Reliability of these systems is analysed in a VGB research pro-
ject and compared with corresponding op-
erator experience of VGB member compa-
nies. The results of the VGB research pro-
ject will be available in November 2015.

Technical Group HSE for Offshore Windparks
Karl-Heinz Puch
More than 40 committees are dealing with H&S issues in offshore wind plants. Provision of an information platform and a «market place» for H&S issues (Figure 6) is among the core tasks.

VGB had established a network in order to accompany the development and im-
plementation of a legal frame for «Heath and Safety Offshore». This also involves, among others, the fields of emergency control centre, rescue chain, regulations of the employers’ liability insurance associa-
tion, different medical issues, protection and rescue equipment, safety training, diving and harmonisation of international requirements.

The major results were communicated at different VGB workshops.
Technical Committee
Use of Renewables and Distributed Generation

Ulrich Langnickel

The Technical Committee (TC) «Use of Renewables and Distributed Generation» assesses the technical development and application options of renewables and decentralised generation technologies with a special focus on operator requirements. Since utilisation of renewables is highly depending on EU energy policy and legislation, EURELECTRIC representatives are reporting on the general conditions set in Brussels. The international committee manages the activities of three technical groups: «Biomass», «Biogas» and «Distributed Generation» and accompanies different national and international research projects, the results of which are presented and discussed in the different committees and groups. Besides, the committee publishes corresponding position papers and statements on the efficient use of renewables and organises technical conferences in its field of business.

The extension of renewables also has impact on the position and tasks of the related committees and groups. The integration of renewables into the existing network and the development/demonstration of storage technologies will play a major part in the future. Besides, the VGB groups will also deal with new forms of utilisation of renewables like wave and tidal energy – all from the viewpoint of operators.

There are different national support programmes in the EU backing the utilisation of renewable energies. The same applies to the variety of general conditions regulating the application of renewables including combined heat and power plants. The most important modifications to these support programmes are summarised regularly every six months for VGB members.

Technical Group Biomass

Sebastian Zimmerling

Evaluation of the national action plans for renewables utilisation shows that in addition to wind energy, biomass has to play an important part in order to meet the European 2020 targets. Currently VGB member companies are operating biomass plants with a total electrical capacity of approximately 4,000 MW.

The Technical Group «Biomass» – jointly with other relevant VGB committees and groups – deals with technical issues related to the operation of biomass-fired plants. The topics cover the whole range of the power plant process from fuel production, provision, and storage up to flue gas cleaning. The topics cover mere biomass-fired plants and fossil-fired plants (Figure 7) with biomass co-firing.

The group also deals with measures that are needed to switch a plant from fossil combustion to 100 % biomass combustion. The topic of ash utilisation from biomass mono-combustion is treated separately by the TG «Biomass Ash».

The VGB Technical Group «Biomass» organised a workshop on the issue «Fire and Explosion Protection in Biomass Power Plants» in Essen. The workshop took place on October 24, 2014 and was well attended by 47 participants from 10 countries. The seven lectures were held in English. After a short presentation of the VGB-Standard VGB-S-018 «Fire and Explosion Protection in Biomass Power Plants» and the VGB Research Project «Biomass Storage Monitoring», detailed information was provided on the theoretical and engineering principles of the issue. Reference was also made to proper firefighting in silos as well as the requirements of insurance companies to be met by operators of biomass-fired power plants. At the end of the workshop, the fire and explosion protection concepts of the Rodenhuize and Ironbridge power plants and the Liverpool Bulk Terminal were presented and discussed.

Another important topic related is the surveillance of biomass heaps and the detection and localisation of hot spots. Due to the isolating characteristics of biomass, smouldering fires are only detected very late. Besides, large amounts of carbon monoxide develop inside the heap caused by natural degradation processes, therefore, the detection of that gas cannot be used for the early detection of fires. The Technical Group «Biomass» suggested a research project for solving these problems. A comprehensive market study is to be carried out as first step. This analysis is to be supplemented by a survey among operators. The next step could be the selection of the most promising technology with final field tests in different forms of storage. This could be used to assess which technologies are suited for monitoring of heaps and localisation of hot spots and whether such technology would have to be adjusted or a new approach is needed.

According to the regulations of the 17th Ordinance of the Federal Immission Control Act, (17. BlmschV), German biomass-fired power plants, which are fired with waste wood of category AIII and AIV, have to meet an ammonia limit value in...
flue gas of 10 mg/m³ as of January 1, 2016. This value turned out to be difficult to meet in the plant of one group member. In this plant chlorine-induced high-temperature corrosion and nitrogen oxide emissions have yet been controlled by the injection of a pre-set, over-stoichiometric amount of ammonia sulphate according to the ChlorOut procedure via the existing SNCR system. The live steam temperature of currently 520 °C could not be reduced to 450 °C, i.e. below a temperature range that is not critical for corrosion, because of the downstream production plants. The ChlorOut injection increased the superheater lifetime and reduced nitrogen oxides, but the limit values of ammonia slip could not be met. The problem was intensively discussed by the group and first approaches were developed. Some group members cooperated and could develop a solution, i.e. ammonia sulphate is premixed with iron-sulphate depending on the flue gas measurement. Thanks to the application of this procedure, corrosion is prevented and nitrogen oxide emissions as well as ammonia slip can be kept to the required limit values. At the next planned plant standstill the procedure will be verified by checking the superheaters.

**Technical Group Biomass Ash**

Hans-Joachim Feuerborn

The EWG «Biomass Ash» is dealing with all topics related to higher shares of co-combustion as well as mono-biomass combustion in power plants. The recording of ash characteristics and the identification of utilisation options is one major aspect of the group’s activities. In some EU members states there is an obvious trend for increased biomass-based generation which naturally also increases the amount of biomass ashes, which however, depends on the quality of biomass energetically utilised. Besides, the combustion process is decisive for the share of fine and coarse ash. First findings from a European survey are summarised in a status report. It was ascertained that the timely development in some countries required corrections as regards the legal situation. Special issues were identified, e.g. utilisation options.

On April 29, 2015, a VGB Workshop took place on the issue of «Biomass Ash» in Berlin. Reports were given on generation, characteristics and the utilisation of biomass ash and practical experience with fluidised bed combustion plants. Special treatment is tested for the application of waste woods on plants with corresponding license in order to recover metals and to minimise heavy metal contents. A report was also given on geographical exploratory works to determine the fertiliser demand of forest sites as well as fertilisation/or limiting of forest areas with biomass ash and/or dolomite blends. Biomass ashes permitted for such applications were produced in certified power plants which combust fresh wood only. Certification involves internal and external surveillance which mainly focuses on environmentally relevant parameters. Particularly the north European countries have been fertilising forest and agricultural areas for years with biomass ashes, either as liquid fertiliser or as dry product, if needed as granulate in order to facilitate application. Biomass ash is also used in road construction, for landfilling and as soil improvement. However, application is sometimes prevented due to the situation of waste legislation and environmental licenses. The workshop results will be incorporated in the group’s activities.

**Technical Group Biogas**

Sebastian Zimmerling

Biogas methane blends can be used in small combined cycle power plants for electricity and heat generation. These plants currently achieve efficiencies of up to 45 % based on methane as primary source of energy. However, economically-efficient biogas plants (Figure 8) need to feed heat into the local and district heating grid or any other alternative in addition to electricity generation. In Germany, at least 60 % of waste heat has to be utilised according to the 2012 amendments of the German Act on Renewables (EEG).

Biogas can also be treated and fed into the natural gas grid. It can be stored intermediately and then used deliberately at locations having a heat sink. Treatment and feeding of biogas into the existing natural gas grid is the decisive advantage of this technology with a view to integrating renewables into existing supply structures and utilisation of storage potentials. Currently some 22 biogas feed-in plants are operated by VGB member companies (state December 31, 2014).

In future the Technical Group «Biogas» will increasingly deal with issues of optimisation and plant management of existing plants. A specific plant component or element of the biogas process will be put on the agenda each meeting and will be discussed. Reliable measurement of the gas amount and composition was the first focal topic on the agenda. Measurement of the raw biomass is particularly challenging. The gas leaving the fermenter is usually hotter than the ambient temperature and loaded with water and gas-accompanying substances. When cooling down, the gas condenses resulting in highly corrosive conditions. Besides, the biogas process hardly permits introduction of additional pressure losses at this location. Common measurement technology, like turbine meter, quickly reaches its limits and has to be adjusted by corresponding research and development work. Such work has already been carried out for ultrasonic flow measurement within the scope of cooperation between one group member and a manufacturer, i.e. a common measurement system was adjusted to the specific conditions of biogas reaching market maturity.

The utilisation of process additives was identified as next focal issue. Such materials are mainly enzymes, enzyme blends or mineral additives added to the fermenter to improve the efficiency or stability of the microbiological degradation process.

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Fig. 7: Moabit power plant (Vattenfall).
These two types of additives have basically different effects. When fermenting only one substrate over a longer period of time, it can be often observed that the biogas yield is decreasing. In a lot of cases this observation is said to be due to lacking essential micronutrients needed for the activity of bacteria. In these cases, mineral additives are to solve the problem. Enzyme-based additives are to make biological material degradable that normally is not accessible to microbiology. In both cases it is difficult to reliably verify the effectiveness. Independent operation of two fermenters is hardly possible in most biogas plants in order to directly compare operation with and without additives. In case of enzyme-based additives, the blend is highly depending on the substrate applied. A research project has already been presented on this issue: an enzyme reactor was developed and integrated into the biogas plant. The reactor is fed with the same substrate as the biogas plant. Thus substrate-specific enzymes can be provided. First laboratory tests show that the biogas yield is increasing.

Apart from assessing the relevant technologies, the Technical Group «Distributed Generation» also deals with system integration of renewables, because fluctuating feed-in of renewables is posing special challenges.

In this context it is necessary to extend storage capacity. The requirements on storages are differing according to application from fast reaction time via high load cycling, small space requirements up to the selection of the proper site. The fields of storage technology are also very various: central storages power plants, distributed battery storages, small local storages, short-term storages or thermal storages.

The technical and economic development of storage systems power-to-gas (PtG) and power to heat (PtH) were also on the group’s agenda.

Power-to-gas offers a possible solution to decrease the necessary grid extension and to transport and store renewable energies. The existing gas grid can also be used as storage.

PH means the utilisation of power to provide heating and cooling. With these systems the increasing share of renewables can be better used. PH plants can directly be integrated in the local district heating system and are supplementing flexibilisation and efficiency of combined heat and power plants. In Germany the total installed capacity of PH plants currently amounts to 350 MW. The group members are aiming at the technical and economical optimisation of this storage technology. This also applies to accompanying research projects like the development and integration of high-temperature storage systems in PH plants.

A large number of national and international demonstration projects are being carried out to integrate fuel cells in residential buildings. Currently the Solid Oxide Fuel Cells (SOFC) and Polymer Electrolyte Membrane (PEM) Fuel Cell are being used for these applications. The testing results obtained yet are very promising. However, from the viewpoint of operators it is required to increase the lifetime of the fuel cell stacks, particularly at changing loads and to decrease cost. More than 50,000 fuel cells of the Japanese manufacturer Panasonic have been installed (Figure 9).

100 state-of-the-art micro combined cycle power plants of the 1.0 to 4.7 kWel and 0.5 to 12.5 kWth range were installed in residential buildings in Bottrop within the scope of the research project «100 micro-CHP plants in Bottrop». These plants are tested and their operation is being optimised in order to save fossil fuels and avoid CO₂ emissions. The project is being coordinated by the Essen-based Gas and Heat Institute (GWI). Corresponding storage systems are to be applied in a follow-up project to guarantee self-sufficient energy supply.

In November 2014, the two-day VGB Technical Conference «Distributed Generation – Status and Perspectives» with associated technical exhibition was held in cooperation with Kufstein University of Applied Science in Tyrol, Kufstein/Austria. The conference was a forum for developers and users of distributed generation facilities. It addressed application options of gas-driven small combined heat and power plants, fuel cells, Stirling engines and the system integration of these technologies.

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Fig. 8: Karstädt biogas plant (STEAG New Energies).

Technical Group Distributed Generation

Doreen Kückelmann and Ulrich Langnickel

The Technical Group «Distributed Generation» assesses the technical as well as economical development of small combined heat and power plants that are mostly based on conventional piston engines. In this output range micro gas turbines, fuel cells or Stirling engines are also applied. These innovative technologies enable combined heat and power generation within a small range of output. This applies in particular to district heating and the industrial sector.

Fig. 9: Fuel Cell CHP Vitoval 300Philip Viessmann.
Environmental Technology, Chemistry, Safety and Health

Technical Committee Environment

Hans-Joachim Meier and Volker Hamacher

The main activities of the international technical committee focus on reports on developments important for power plants in the individual member states and companies as well as the exchange of experience. Pursuing of technical and licensing developments in other member states is among others a possibility to tune in on requirements to be met by own national companies. Solutions identified by European colleagues might be of benefit for the own utility. The committee members dealt with the following issues:

- Report on the initial (original) state for soil and ground water according to the Industrial Emissions Directive (IED),
- Experience in the cooling water cycle with zebra mussels,
- Cost of water consumption in power plants,
- Emissions trading (Figure 1),
- The Seville process for data collection – Manual method of determination of the concentration of total mercury (moist-chemical technique). Besides, a standard is to be elaborated on mercury (Hg) determination with downstream solid sorbent ([sorbent trap]).

As regards VGB activities, the committee dealt with the current state of the future VGB policy. The new committee structure, new rules of procedure and the plans for moving VGB to Essen-Kupferdreh were also presented.

The committee members also discussed the impacts and experience made with the new German energy policy («Energiewende/energy transition»). It was outlined that the increase of renewables in Germany results in large load fluctuations in the grid. In this connection, VGB was cooperating in the new research initiative «Partner-steam power plant» in order to identify whether grids can be stabilised with the aid of existing steam power plants. The committee members were also highly interested in the impacts on the electricity wholesale market and the power plant shutdown due to the extreme extension of renewable sources of energy in Germany and Europe.

Technical Group Emission Monitoring

Volker Hamacher

The Technical Group (TG) «Emission Monitoring» is still intensively dealing with CEN standardisation activities, mostly through the cooperation of group members in CEN working groups (WGs). Thanks to the liaison of VGB offices with CEN, representatives of member companies can be nominated for cooperation in the WGs. This is an important option to orient standards at operational practice and adjust them to the needs of the electricity industry. The white print of the EN 14181 Standard «Stationary source emissions – Quality assurance of automated monitoring» was published in February 2015. Modifications compared to the former version are outlined in the following (Heading «Emissions and Immissions»). The paper was elaborated by WG 9 in CEN TC 264; the WG is still developing a standard on quality assurance with data measured by automated measuring devices («Quality assurance of AMS data»). WG 8 will update the Standard EN 13211 «Air quality – Stationary source emissions – Manual method of determination of the concentration of total mercury» (moist-chemical technique). Besides, a standard is to be elaborated on mercury (Hg) determination with downstream solid sorbent ([sorbent trap]). WG 37 is dealing with the standardisation of PEMS (»predictive emissions monitoring system«) software-based data recording systems for continuous determination of emissions with the aid of process data. Reports were given on testing automatic NH₃ measuring devices, a comparison between US and EU emission regulations and maintenance of automatic emission measurement and assessment devices. The emission limit values of the Industrial Emissions Directive (IED) for gas turbines...
Inspections are partly made without prior announcement, – Operators receive a possible list of deficiencies normally before publication of the inspection results in the internet, – Results are normally tightened up in the internet, – Not all inspection results were published, – Environmental inspections mainly orient at key issues, – In the case of one gas-fired plant that was inspected, the authority required the complete licensing history of the plant since commissioning in 1970 including all side approvals and their implementation. Missing documents were assessed as «deficiency», – A (former) «26th measurement agency» has drafted a wrong report according to Federal Immission Control Act (BlmschG). This was considered as deficiency, because the operator had not noticed the mistake and/or had not checked the report. In this context, the importance of the testing note has to be pointed out, – The duration of the inspection can be considerably shortened by complex preparation, – Synergism with the ordinance on failures (simultaneous inspection) occurred rarely.

The initial (original) state report (AZB) for soil and ground water was another topic on the agenda. The discussion revealed that the AZB is often part of the licensing application. As regards the implementation of the AZB, the authorities often only refer to the LABO/LAWA (joint committee of federal and state authorities) «aid for the initial state report for soil and ground water». It was also added that in the case of contaminated sites, certain soil protection regulations will be applicable that require ground rehabilitation. A report was given about a site where rehabilitation had amounted to 2 million Euro. One company was asked to compile findings about former accidents/events for a site that had been previously used. It was also remarked that comparison of current with older measurement data became more difficult in case of larger periods between measurements because of the different state of measurement technology. The revised standard DIN EN 14181 «Stationary source emissions – Quality assurance of automated measuring systems» was published in February 2015. Some significant technical modifications are outlined in the following (Figure 2):

- Qualification test (QAL 1) for new automated measuring devices (AMS): certification according to DIN EN 15267,
- For old equipment (already existing at the site): description of the procedure in accordance with authority, if requirements of DIN EN 15267-3 cannot be met,
- Consideration of the requirements of DIN EN 15259 (measurement sections and sites and for the measurement objective), when assembling automated measuring systems (AMS),
- Recommendations for testing the functions within the scope of calibration (QAL 2) to be carried out within a month prior to comparative measurements by involving peripheral waste gas parameters,
- In case of comparative measurements, AST is possible instead of QAL2, if the measurement value of the standard reference procedure (SRM) in AST and at least 95 % of the AMS measurement values are within the permissible tolerance range (trust range according to EU Directive),
- Criterion scatter diagram changed: SRM measurement values now have to be within the permissible range of scatter (previously 15 % of emission limit value),
- Calibrated AMS measurement value for water vapour content may be used for converting SRD data to dry or moist conditions; in case of wet separators with nearly constant content of water vapour in waste gas, conversion to dry or moist waste gas is also permitted by applying calculated contents of water vapour.

**Technical Group Emissions/Immissions**

Volker Hamacher and Sven Göhring

The environmental inspections according to the IED were one major issue of the technical group. Some results of the exchange of experience are listed in the following:

- The state of the introduction of environmental inspections is still considerably differing between individual German federal states,
- Inspections are partly made without prior announcement,
- New procedure to set up the calibration function, if all measured values in the scatter range are around zero (scatter diagram at zero): consideration of reference material at zero and limit value, assessment of variability on the basis of real gas measurement.
- Supplement of the criterion for the valid calibration range: at least 20% of the emission limit value.
- Assessment for verification of the valid calibration range in case of discontinuous plant operation on the basis of the last 168 operating hours (corresponds to one week).
- Checking of variability: calibration of AMS for oxygen and water vapour is recommended in order to decrease the influence on variability.

The VGB Workshop «Emission Monitoring», held on February 3, 2015, was positively responded. Some results of the lectures and discussions are listed in the following:

- It seems that manufacturers of measurement equipment refuse to design/produce new equipment for measuring soot numbers, because the cost for QAL1 certification according to DIN EN 15267 is too high when compared with the expected sales figure of such new equipment.
- Since measurement of the soot number is no European requirement, it should be aimed at the application of the original values for the soot number for announcing suitability and that there will not no connection to DIN EN 15267 that is too loose when revising the VDI 3950.
- It seems that the authorities are not of uniform opinion as regards possible suitability checks upon the retrofit of additional measurement components in multi-component measuring devices.
- Clear savings can be achieved through the option described in DIN EN 14181 to carry out AST (annual functional test) instead of QAL 2 (calibration) under certain conditions.

When studying the paper by Dr. Barbara Zeschmar-Lahl «Mercury emission from coal-fired power plants in Germany – State of emission control» it was striking that the tables listed in the paper, i.e. the values derived from the pollutant release and transfer register (PRTR), include some emissions that are not plausible, e.g. for Hg, N₂O and NH₃. Since relevant stakeholders use PRTR data in order to e.g. inform the public about allegedly disproportionate power plant emissions, it is important that the values published in the register are correct and not too high due to conservative estimations or failures in data transfer. More detailed investigations by VGB offices revealed that in some cases the authorities might have made post-corrections or might have filled gaps without using appropriate or outdated emission factors. In the on-line BUBE system (Betriebliche Umweltdaten Bericht Erstattung, reporting of operational environmental data), e.g. for reporting emission freights, data from the emission manual for emission declarations 2004 of the Federal State of Baden-Württemberg appeared. Utilities were asked to check the corresponding BUBE data and to correct them if needed.

Technical Group Noise Control
Volker Hamacher

During the reporting period, the group dealt with a large number of topics listed in the following:

The draft for the revision of the DIN standard 45680 «Measurement and assessment of low-frequency noise immissions» is much more stringent than the current version as regards the assessment for low-frequency noise. A lot of objections were raised; this could not be fixed yet for the opposition hearings. Power plant business is affected among others by the extension of the major third frequency range to 125 Hz in a lot of noise sources like transformers, combined heating and power plants, fans etc. Critical issues relevant for operators are reflected by several objections.

It is important to pursue the planning activities of neighbouring communities in order to deal in due time with problems of new residential buildings in the vicinity of power plants as regards requirements of the allocation of utilising existing plants. It was recommended to resist against allocation requirements which fall below the current approved values. If new residential areas are approaching power plant sites, there are scopes for noise emissions; however, these are limited or not existing at all in case of possible health impairment.

When planning distributed generation sites, cogeneration plants need particular careful attention in terms of noise control, because these plants are normally located in densely populated areas where problems of low-frequency noise and vibrations must be avoided (Figure 3).

An interesting aspect was revealed in connection with corona noise of DC overhead electrical power lines for the planned grid extension: AC DC lines cause less noise at rain than DC lines. DIN SPEC 8987 «Acoustics – Determination of Corona Noise» is to be elaborated in 2015. Two members of the Technical Group «Noise Control» are cooperating in the DIN committee.

An electrical fire-fighting device in a waste-to-energy plant was replaced by a diesel-driven system, because in case of fire power supply might have failed. The increased noise level caused by the diesel engine in case of emergency is permitted according to the exemption regulation No 7.1 of the Technical Instruction «Noise Control». The exemption was also granted for the emergency generator of a computing centre.
When measuring individual noise immissions, the immission values are often higher than forecasted. According to the group members this is not unusual, because changing weather conditions can result in varying immissions up to 15 dB without having changed operating conditions.

The Seville IPPC (Integrated Pollution Prevention and Control) office published a background paper for the BREF-LCP and the revised conclusions, chapter 10. The group had elaborated a number of comments on the first draft of the BREF-LCP. Particular objections were raised against the conclusion – serving as binding reference documents for licensing – that surveillance of noise (3 times/a) is state of the art. This requirement was deleted following numerous objections by the European industry. Other passages of chapter 10.1.8 on noise emissions were also deleted. Other comments and objections made by operators were only less considered which is likely not to have any negative effects.

Technical Group
Water Management

Dittmar Rutschow

Micro biology in cooling systems

The final report «Investigation on the meaning of emissions of micro organisms, particularly of legionella in plumes of natural drought cooling towers» by Professor Michael Pietsch will be available in the autumn of 2015. It is planned that the report is to be published firstly in a scientific technical paper before publication in VGB PowerTech.

The Project Group «Micro Biology in Cooling Systems» was jointly set up with the Technical Group «Cooling Systems in Power Plants». The project group is actively participating in the discussions with the authorities about data of legionella concentration in cooling water of local power plants. The measurement data were published on the VGB homepage as required by the NRW state ministry. Besides, a research project was initiated on the emission, transmission and immission of legionella in order to determine to what extend cooling towers are affected. The project group is managing the project that is being carried out by the institute of medical micro biology of the Johannes Gutenberg-Universität, Mainz.

State of the plant ordinance on handling water-endangering substances (AwSV)

According to the current status, it is still not clear whether the AwSV will be passed, because the Federal Ministries of Agriculture and Environment have still not settled discrepancies.

On May 23, 2015, the Federal Council (Bundesrat) voted about the draft ordinance and accepted 26 modifications. In the course of the procedure, BDEW could reject a number of difficulties that would have been occurred for the energy industry from the draft AwSV. Prior to the council meeting, BDEW had approached the federal states stressing the position of the energy and water industries. The Federal Council agreed on all issues.

The Council’s provisions require a new notification at the European Commission and confirmation by the Federal Government. A cabinet draft will not be completed before four months. Due to the four months deadline prior to enforcement, the ordinance is likely not to be enforced before the early summer of 2015.

VGB Instruction Sheets

The VGB Instruction Sheets M 305 «Handling of Water-endangering Substances in Power Plants», M 306 «Reference on Waste Water Levy Act» as well as M 115 «Fire Fighting Water Retaining Directive» are to be revised as soon as the new AwSV will have been enforced.

Technical Group
Power Plant By-products

Hans-Joachim Feuerborn and Thomas Eck

The Technical Group «Power Plant By-products» deals with issues related to the production and utilisation of power plant by-products from coal combustion in pulv erised fuel and fluidised bed combustion furnaces. This applies in particular to fly ash, bottom ash and boiler slag as well as products from flue gas desulphurisation (FGD) like FGD gypsum and SDA product. In this context, European and national rules, particularly those governing the quantities and quality of by-products, are being mentored (Figure 4).

During the reporting period, the group focused on:

- Revision of the testing standards on determining the free calcium oxide content in fly ash and its fineness (DIN EN 451-1 and -2) and the related support of data collection on European level,

- Verification of the revised version of EN 450-2 on conformity evaluation of fly ash in concrete,
Discussion on the exclusion of bottom ash in rural road construction,

Application to integrate lignite fly ash as binder and soil improvement at the Research Association for the Road Sector (FGSV),

Information package of the Project Group «Quality Management» for the utilisation of certified fly ash with increased loss on ignition in concrete or concrete products,

Risk modelling within the scope of the toxicological assessment of gypsum and gypsum product on the basis of a new exposition scenario.

Final reports were presented on the following research projects:

- «Gypsum-Cement-Puzzolanic-Granulated Blast Furnace Slag with Fly Ash and FGD Gypsum for Concrete»,
- «Literature Study: Sulphate Resistance of Fly Ash Concrete – Extension of the Fly Ash Rule for XA2 (3,000 mg/l)» and
- «Fly ash with higher loss on ignition use in concrete».

Technical Group

By-products from thermal waste incineration are directly affected by the «Ordinance on the Determination for the Discharge of Substances into Ground Water, the Utilisation of Substitute Building Materials and the Utilisation of Soil and Material Similar to Soil» that has been announced for some years. The third draft is being expected. This is to serve as basis for a BMU business game to describe administration scenarios.

The criteria for «hazard characteristics» H 14 (eco toxicity) in connection with the classification of wastes according to waste catalogue have not been defined yet, neither on national nor on European level. A decision is to be made in the near future. Activities of single authorities were observed critically and constructively.

The recycling potential of by-products of thermal waste incineration was broadly observed. Different projects are aiming at recycling and separating of metallic fractions. However, this has considerable influence on the utilisation of the remaining mineral fraction as building material. Metal recycling is highly depending on metal prices.

Fig. 5: Metals – Valuable products of thermal waste utilisation.

Utilisation aspects are focused on at regular workshops and are extended by additional current issue like e.g. recycling of metal (Figure 5).

Technical Group

Emissions Monitoring

Project Group

Greenhouse Gas Monitoring

Volker Hamacher

UBA (German Environmental Agency) entrusted the German Research Institute for Public Administration (FOV) to evaluate the administration of the EU Emissions Trading System (EU ETS). At a special meeting, some members of the project group held an interview with UBA about the aforementioned project:

- Basic assessment of emissions trading in the third trading period as regards efficiency, effectiveness and transparancy,
- Concrete implementation problems in connection with allocation, registers and monitoring,
- Implementation behaviour of the German Emissions Trading Authority (DEHSt) as well as
- EU Commission and advantages and disadvantages of a possible European emissions trading authority.

The compilation of improvements of the form management systems (FMS) of DEHSt was one important topic on the agenda during the reporting period. As early as two years ago, the group had passed on such a proposal to DEHSt, however, only a few improvements were put into practice. Based on additional experience and after being asked by DEHSt, improvement options were identified and passed on to DEHSt as joint association paper with the Association of the Chemical Industry (VCI). It is being expected that DEHSt is more willing to accept the improvement proposals due to the collaboration of several associations.

The group members also discussed bulk density of coal storage yards (for determining the amount of coal combusted) and modification of the carbon leakage status. As regards the first issue, DEHSt had asked operators for the method applied. Most operators use literature references of about 1 % is usually achieved by the frequency of «restacking».

Some members determine the amount of coal fired by the weight difference resulting from stacked and extracted coal. DEHSt asked operators to check any possible carbon leakage status against the background of the new carbon leakage list published by the EU and by taking into account the reference papers issued by DEHSt, i.e. the data basis for free allocation. A survey among group members turned out that some member companies can now expect additional allocation of emission certificates.

The issue of plant decommissioning according to § 15 (3) BImSchG and the related abolition of the duty to trade the emissions according to «Greenhouse Gas Emissions Trading Act» was also on the agenda (TEHG). The German emissions trading authority had asked some operators to continue submitting emission reports although the plants in question had already been decommissioned. According to DEHSt, only the complete abandoning of a plant license means an actual plant decommissioning in the sense of the TEHG, because information on decommissioning according to § 15 (3) BImSchG can be annulled. A plant that has been in operation at least for three years or which is completely disassembled is considered at decommissioned plant.

The group members also dealt with applications to dispense with on-site inspections, determination of the point in time of commissioning of a heat generator and problems with the access to the virtual mail box.
Fig. 6: VGB Managing Director, Erland Christensen, awards VGB silver badge of honour to Professor Herwig Maier.

Technical Committee Chemistry
Andreas Wecker and Dittmar Rutschow

The Technical Committee «Chemistry» coordinates the Technical Groups «Analyt- ics», «Chemical Process Engineering», «LWR Chemistry» and «Emission Control» and determines the general conditions and the focus of the annual VGB Conference «Chemistry in Power Plants». It also deals with chemical issues of the water-steam cycle and chemical influence on corrosion in power plants.

The technical groups’ reports showed that the issue of investigating legionella in cooling towers was a central issue. The topic was intensively discussed. The issue of mercury emissions is accompanied by the international VGB Project Group «Mer- cury» which focused on elaborating and discussing comments on the «background paper» of the current European process for recording the BAT for large combustion plants (BREF-LCP process).

The committee is also involved in drafting of the VGB-Standard on conservation of power plants.

Adipic acid in flue gas desulphurisation (FGD)
When testing the addition of adipic acid into the FGD of a waste-to-energy plant no adipic acid concentrations could be de- tected in the clean gas upon measurement. The daily addition of 15 to 25 kg did not show any negative impact by adipic acid. The desludged suspension from the spray driers could be easily disposed of.

The VGB-Standard «Buffer Acids in FGD», which is being elaborated, outlines in de- tail the advantageous application of adi- pic-, formic- and maleic acid.

Technical Group Analytics
Andreas Wecker

The technical group is completing a VGB-Standard on procedures in power plants. The mayor relevant European and Ger- man standards are to be listed with de- tailed comments on the power-plant-specif- ic aspects.

The current round robin test on the deter- mination of mercury in coals is to check the comparability of different solid ana- lysers used in laboratories and to identify possible errors.

Hg oxidation catalysts will gain in im- portance in existing plants against the background of decreasing limit values for mercury emissions in new coal-fired power plants and the discussion about the «best available techniques» (BAT) according to the BREF-LCP documents, which are being elaborated within the scope of the Seville Process in Europe. Oxidised mercury is the prerequisite for its efficient removal in wet scrubbers. Hg-Ox catalysts are to maximally oxidise mercury that is released upon the combustion of coal in the flue gas downstream of the boiler. Meanwhile Hg-Ox-catalysts – specially developed for this purpose – are commercially available, however, a uniform testing procedure to reliably verify the activity of such catalysts is still being missing.

While the activity of DENOX catalysts is influenced by a manageable number of parameters and basic knowledge has al- ready been described in the VGB-Stand- ard 302, the number of free parameters describing determination of mercury oxida- tion is much higher. Currently Hg oxida- tion activity of catalysts is mainly being measured in micro- or semi-bench reac- tors, which more or less properly simulate the conditions of industrial-scale plants.

However, often it is not possible to directly compare laboratory measurements due to
the highly deviating measurement conditions with sample geometries. Besides, transferability of results to the real application (large than in a test capsule) is restricted because of strong downsizing of the process and flue gas composition. Therefore, it is very important to unify testing procedures on international level in order to compare results with each other thus creating a reliable basis of assessment for manufacturers and operators alike. In this context the VGB Project Group «Hg-Oxtest» was set up to deal with this issue.

Technical Group Chemistry of Light Water Reactors

Dittmar Rutschow

The chairman Heinz-Rudolf Sauer from Brokdorf nuclear power plant will retired by mid-2015, Dr. Timo Stoll from Emsland nuclear power plant was unanimously elected new group chairman and Udo Krumpolz from Gundremmingen power plant was confirmed as vice-chairman.

Heinz-Rudolf Sauer was awarded the VGB silver badge of honour at his farewell for his meritorious committee work.

Dosing of zinc to improve plant radiology at KGG unit B

A brass condenser was replaced by a stainless steel condenser. Since zinc is missing (contained in brass), CRUD (chalk river unidentified deposit), forming at fuel assembly cladding, is mobile. The desired dosing of depleted zinc into feedwater results in CRUD remaining on the cladding tubes of the fuel assemblies and can be removed later together with the Castor storage casks. Dosing of zinc largely prevents the insertion of Co-60 into the spinel structure of raw surfaces. This reduces the radiation dose of personnel during inspections.

Condensate polishing was also redesigned, i.e. the iron intake via feedwater could be reduced by some 75%.

Current state upon the application of boron acid/hydrazine

VGB successfully rejected the classification of boron acid and sodium tetraborate as substances of high concern as intended by the European Chemicals Agency (ECHA). In 2014, the following substances were put on the list of very alarming substances:

- Disodium tetraborate (anhydrous),
- Tetraboron disodium (heptaoxide hydrate),
- Diboron trioxide and boronic acid.

VGB raised objections at ECHA against the classification of these substances.

QP database

The QP database which qualifies new products for being employed in nuclear power plants. It is based on DIN 25493 «Nuclear facilities – Protection of metallic surfaces of structural parts from damage from assembly aids, gaskets, packings, packaging material and thermal insulating materials». Yet the database was maintained by AREVA. The Technical Group «Light Water Reactors» set up a new Working Group «QP Database» to identify a more cost-effective maintenance.

Storage capability of fuel

The Federal Office for Information Security published the study «New findings on the storage capability of fuel for grid replacement plants (NEAs)». According to the study, diesel for grid replacement plants contains up to 7% of biofuel (addition of up to 7% of fatty acid methyl ester (FAME)). According to DIN EN 590, a maximum storage time of 90 days is assumed for passenger cars and stationary diesel engines. Biodiesel is added to about 9,000 NEAs, e.g. in hospitals, police stations, fire brigades etc. 74 NEAs were tested, 25 NEAs used diesel according to DIN EN 590. There were only two plants where the fuel could be used without restrictions. Better results were achieved when using fuel oil according to DIN 51603-1 instead of diesel. Only 2 out of a total of 31 NEAs could not be used any longer and 22 could be used without restrictions. Therefore, the Federal Office for Information Security recommends to exclusively using low-sulphur fuel oil enhanced with additives in NEAs.

Technical Group Emission Control

Andreas Wecker

Apart from the exchange of experience, the group prepared the Workshop «Flue Gas Cleaning 2014», Marseille/France and discussed the results of the former workshop in Rotterdam which met with great interest due to the broad range of topics. However, the share of German participants has clearly declined, while the interest of European operators has increased.

Increased sulphite formation was currently observed in scrubbers which is probably due to the feed coal and can be avoided by controlling the redox potential. Injection of lime hydrate upstream of the air preheater also seems to be a promising option to reduce SO₂. Further experience has to be awaited.

Technical Committee Health and Safety (H&S)

Karl-Heinz Puch

The definition and interpretation of key performance indicators (KPIs) is among the committee’s core issues.

Contractor safety management was analysed in detail. It was revealed that the accident rates of the partner companies are higher by the factor 2 to 3. This trend is to be stopped by e.g. «safety walks», awards, safety talks and safety instructions.

Mental health, stress management and work-life balance are gaining in importance as regards the interplay between the internal structure, role of seniors and the relationship between industrial and health protection. The exchange of experience is an important source of information. Accidents and investigations methods are also a prominent issue of committee work.

Technical Group Fire Protection

Sebastian Zimmerling

The Technical Group «Fire Protection» has a new chairman and secretary. Within the scope of this change, the group will also restructure its activities, i.e. meetings will take place at the same location in order to minimise organisational expenditure and every meeting will be devoted to a predetermined priority topic. Project groups will concentrate on the revision of VGB-Standards. Documents drafted will then be harmonised and finalised by the group.
The spring meeting of the group already took place according to the new scheme. The fire protection conceptioning of hybrid cooling towers was the first priority issue discussed with the aid of two practical examples. Based on the discussion results and in accordance with other VGB committees, it was decided to draft a recommendation on this topic.

The second priority topic was examination of the recommendation for silo storage of pulverised lignite. It can be ascertained that there is probably a contradiction between the values calculated in standards as regards pressure development after explosion pressure relief and the values provided by current simulation tools. It is desired to investigate this contradiction in detail in a research project. Besides it was resolved to participate in the Project Group «Fire Protection in Wind Power Plants» that was set up by the Technical Committee «Wind Energy».

The existing VGB Standard VGB-R 108 «Fire Protection in Power Plants» has been debated since publication in 2009. Revision and new publication as VGB-Standard VGB-S-108 is to be terminated by the end of 2015.

The technical rules of the Industrial Safety Regulation (BetrSichV) has been accompanied by the Technical Group «Fire Protection» because of the issues of «fire protection» and «explosion protection». Due to the amendment of the Industrial Safety Regulation, explosion protection will become an issue of the legal regulation on hazardous substances. Fire protection had already been excluded from the BetrSichV, because this issue is duly considered by Construction Law. The effects of the amendment of BetrSichV will be discussed as «key issue» at the next autumn meeting of the Technical Group «Fire Protection».

The Technical Group Industrial and Environmental Medicine/Health Management

Lena Jentjens

Traditionally the technical committee is intensively exchanging experience in the fields of industrial and environmental medicine and health management at its bi-annual meetings. The group was particularly focusing on:

Ordinance on Occupational Medical Precaution (ArbMedVV)

Occupational medical precaution was regulated anew when passing the Ordinance on Occupational Medical Precaution (ArbMedVV). Measures of occupational medicine divided according to compulsory, offered and desired precaution are exclusively for staff advice by a physician with technical qualification. Since this precaution is for staff only, the result is not passed on to the employer but to the employee only. Therefore, the employer can no longer draw conclusions from occupational precaution whether the employee is suited for certain tasks. Besides, precaution does not provide whether there are risks for colleagues or third parties.

If the employer determines hazards for personnel or other persons or expensive assets from the activities according to his own judgment, employers can require a clinical assessment of «fitness for work» for a certain job or aspects of a certain job.

Employers are facing enormous challenges with these new regulations and a lot of effort was needed last year to elaborate suitable company agreements.

Health parameters

Medical leave involves immense personnel cost. However, medical leave due to illness or accidents is only the tip of the iceberg. A much larger influence, more difficult to quantify, is caused by events while staff are at work, like burn-out, stress, mental resignation and frustration. Often it was ascertained that staff are not sufficiently motivated by managers. It is planned to deal with these issues more intensively in the future.
Technical Services

Technical Services/ Engineering consultancy
Christian Ullrich and Oliver Then

Cooperation of the different departments at VGB offices and integration of experts rendered expertise for the benefit of the member companies belonging to the VGB community for solving also very complex problems. VGB Technical Services cover all areas of energy and power plant engineering, VGB’s most prominent fields are listed in the following:

- Engineering consultancy upon planning, construction and operation of power plants,
- Interdisciplinary damage (root cause) analysis,
- Material investigations,
- Water-chemistry investigations and
- Supervision of construction and assembly including quality management and expediting.

Engineering consultancy

Engineering consultancy and damage analysis are among VGB’s prime competencies. Its vendor independence and its role as expert with view on owner and operator within the energy business are the main reasons for making use of VGB’s consultancy services. Consultancy also means acquiring of new members which is a tool not to be underestimated. The following examples from the reporting period are to demonstrate the variety of tasks VGB’s Technical Services are dealing with:

- Regular peer reviews within the scope of the erection and commissioning of different new plants of an international VGB member company,
- Risk and hazard analysis (Safety Integrity Level, SIL) for the boiler of a chemical site,
- Support in formulating the tender for an operation contract for the energy supply facilities of a German university,
- Elaboration of an expertise for a wood-fired power plant on behalf of the financing creditor,
- Damage assessment of the internal insulation of a waste gas duct for an international chemical company active in Germany,
- Final editing of the order specification of a new steam turbine for a waste-to-energy plant,
- Determination of damages and their assessment at steam and gas turbines of different sizes and operation cases, among others distorted casing, damaged blades and axial bearings,
- Optimisation of turbine operation to prevent casing distortion and resulting impermissible vibrations,
- Auditing of a non-OEM workshop on behalf of an operator,
- Joint assessment and discussions with VGB’s department «Supervision of Construction and Assembly» and the water-chemistry laboratory concerning the entering of salt freights into a turbine.

Maintenance

When carrying out large inspections at steam turbines it was often observed that defaults had been made when planning and tendering these inspections. Either necessary single works were not listed which had to be carried out later resulting in additional cost, or no quotations had been asked for optional works. These defaults open the floodgates for service partners who can claim high additional charges.

These deficits were realised by one of our member companies. Jointly with the consultancy department of VGB a bespoke supply and service catalogue was formulated for the existing turbine which is to serve as basis for future tenders. If only a small or medium inspection is planned the catalogue can be abridged analogously.

Turbine condenser

Deposits and corrosion in cooling tubes of turbine condensers and other heat exchangers can be detected and investigated by endoscopic examinations. In several cases, special cleaning measures or changes in the operation modes of tube cleaning systems were introduced and
Damage investigations were carried out for five biomass-fired combined cycle power plants. This also involved fuel sampling and laboratory investigations of the tube materials. This bears potentials for the future, because insurance companies hardly have own damage engineers. Together with the VGB materials and water laboratory we are well positioned to also assess complicated damage cases and to carry out laboratory investigations (unique feature of VGB PowerTech e.V.).

During the reporting period about 230 damage cases were investigated with state-of-the-art laboratory equipment by the VGB materials laboratory. Special mention is to be made about the scanning electron microscope (field emitter) and the X-ray diffraction.

Apart from damage determination, in most cases the laboratory staff managed to jointly develop solutions with VGB member companies in order to reduce damage occurrence in future. This target is also met through the close exchange with the VGB departments of water chemistry, supervision of construction and assembly and the experts of the VGB Competence Centre of Power Plant Technology.

Apart from damage investigations, numerous investigations were also carried out at the sites of VGB members. In addition to ambient metallography for the assessment of lifetime consumption, a large number of special tests were made. Here it is the objective to jointly develop with the member company objective assessment strategies for the component in order to enable economic and foremost safe operation of the plant.

During the reporting period special emphasis was put again on investigations in connection with the susceptibility of stress corrosion cracking of the austenitic material HR3C. Damage at these materials was detected in several new constructions at reheater 2. VGB materials laboratory investigated the cracked weld seams of the damaged reheaters that had occurred in the first two power plants. These investigations clearly identified stress corrosion cracking as root cause. Stress corrosion cracking occurs in low-chromium regions along the grain boundary when impacted by a corrosive medium. Depletion of chromium is caused by the input of welding heat. Several laboratory tests were carried out to confirm the «root cause», i.e. special corrosion tests like the Strauss test proved that welded connections are generally susceptible to stress corrosion cracking. Numerous tests were then made at the power plants sites for verification. It was detected that a sulphate-containing aqueous solution can result in the cracks observed. This solution can develop in the superheater tubes when sulphate containing air is sucked in during commissioning. In this connection boiler heating is to be mentioned which was carried out for T24 heating surfaces.

Water chemistry

The department of water chemistry is supporting operators of fossil-, substitute fuel and bio-mass-fired power plants of all output ranges. The department extended its experience already made with the interplay between water as working medium and the materials it is in contact with. These experiences and findings are directly involved in the latest generation of new fossil-fired steam generation plants. Thank to the close cooperation between the material laboratory and water chemistry it was possible to implement the scientific findings about the behaviour of new materials into practical operation.

Regular seminars in the field of water chemistry, i.e. «Chemistry of the Watersteam Cycle», and «Water Treatment», are major instruments and appropriate measures to counteract the threatening loss of expertise. In these seminars the impacts of deviating quality parameters on permanent plant operation are explained.
R&D Activities and VGB RESEARCH FOUNDATION

Sabine Polenz, Guido Schwabe and Ludger Mohrbach

VGB offers to its member companies a neutral platform for joint research. The research activities are controlled by the experts from VGB member companies which are organised in the VGB technical committees with the support of the relevant VGB technical advisors (Figure 1).

Research projects associated to VGB CC1 «Nuclear Power Plants» are completely funded by operators, thus research results are only available to the project participants (see report at hand, chapter «Nuclear Power Plants»). All other research projects are financed by VGB «mixed budgets» (third parties and operators); therefore, the results of non-nuclear projects are normally published.

The VGB technical committees formulate research requirements in their respective fields of activity or examine external research proposals with respect to their practical relevance and short- or medium-term practicability for plant operations. The technical committees and VGB technical advisors supervise project execution and transfer of results.

Three key research programmes emerged in this generally bottom-up research coordination:

- Waste management from coal-fired power plants and waste combustion plants (ERKOM),
- New materials for power plants (NWK),
- Advanced Coal Power Plant with Optimised Efficiency, Economy and Environmental Sustainability (Emax) and
- Efficient Use and System Integration of Renewables (EUSI-RES).

The contributions received from member companies are the key to financing VGB research projects. In addition a general research contribution is levied from ordinary member companies as part of the ordinary membership fee. The VGB Board of Directors decides on spending of these funds.

Public funds make a significant contribution to research projects of broad interest.

Project funding 2014

The German-language Table 1 shows the status of project funding as of June 2015. It contains information on the financial interests and publications of research results. Furthermore, the projects worked on within a key research programme are identified.

Short descriptions of individual projects are provided on www.vgb.org/forschung and are continuously updated. The website also contains information about the relevant expert contact at VGB offices as well as notes on results.

In 2014, VGB took part in a total of 35 (non-nuclear, see above) projects with a total volume of 65.1 million € (previous year: 38 projects with a volume of 62.6 million €). Of these, 12 projects with a volume of 6 million € were started in 2014 (previous year: 8 projects and 2.3 million €).

The share of operator funds spent on these new projects amounted to 25 % which was raised through 16 % project contributions of independent companies (ordinary VGB members) and 9 % from the joint research contribution of ordinary VGB members (VGB research levy). «Other funds», among them manufacturer contributions, amounted to 42 %. One third of the total project volume was raised through public funding (33 %).
### Tab. 1: Projects funded by VGB since 2008, completed projects are highlighted in grey (as of 06/2015).

<table>
<thead>
<tr>
<th>No.</th>
<th>Abbreviated title</th>
<th>Duration</th>
<th>VGB Research key</th>
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<td>Investment requirements in European electricity-generating infrastructure towards 2050</td>
<td>2014-2015</td>
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<td>379</td>
<td>Microbiological emissions from cooling towers</td>
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<td>141</td>
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<td>DENA Ancillary services platform****</td>
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<td>381</td>
<td>Ice Detection Systems for Wind Turbines, Part I - Best Practice Study****</td>
<td>2015-2016</td>
<td>42</td>
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<td>42</td>
<td>84</td>
<td>Final report</td>
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<td>382</td>
<td>Impact of flexible power plant operation on boiler circulation pumps</td>
<td>2015-2015</td>
<td>58</td>
<td>12</td>
<td>70</td>
<td>70</td>
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<td>Final report</td>
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</table>
Nuclear power engineering

The committees and panels associated to the VGB General Committee «Nuclear Power Plants» fund operation-related research and development projects for nuclear power plants. These projects are financed by nuclear power plant operators according to the principle of sharing costs across all plants involved. In 2014, a total of 33 projects with a total funding volume of 2,666,272 € were supported (previous year: 48 project with 2,229,070 €).

Collaboration with universities and promotion of vocational training

VGB’s close collaboration with universities is mainly realised through the work of the VGB Scientific Advisory Board which supports VGB on all issues related to research, development and education in the field of power plant engineering. The VGB Scientific Advisory Board comprises about 30 experts from twelve European countries (Austria, Belgium, Czech Republic, Denmark, Finland, Germany, Great Britain, Greece, Italy, Poland, Slovenia and Sweden), who represent all faculties of energy conversion and electricity supply.

Supported by the Scientific Advisory Board and financed by the VGB RESEARCH FOUNDATION, a summer school course in power plant engineering was again held for advanced students from August 18 to 29, 2014. The summer school POWER PLANTS provides a concise insight into the industrial practice of electricity and heat generation. The programme includes presentations from all areas of power and heat generation as well as excursions to representative plants (Figure 2).

In 2014, 20 students from 11 German, Austrian, Polish and Slovenian universities took part (Figure 3). For the first time students from energy engineering university courses took part.

VGB RESEARCH FOUNDATION also funds subscriptions of the VGB organ «VGB PowerTech» for university institutions in order to support practical education. The subscription has been extended by the digital edition of VGB PowerTech providing direct access for students and university staff.

VGB RESEARCH FOUNDATION was also a neutral sponsor for 70 students taking part in the VGB KELI Conference, an international forum of experts in electrical engineering, I&C and information processing in power plants that took place in Landshut from May 6 to 8, 2014. A special forum for students was offered to attract juniors to start in the energy business after having finished their university course (Figure 4). Interested students could get directly in touch with VGB member companies at the conference.

VGB Innovation Award

Since 1981, VGB RESEARCH FOUNDATION has awarded the Heinrich-Mandel award to young university graduates who are active in the field of power and heat generation. In 2014, the board of trustees of VGB RESEARCH FOUNDATION awarded the 10,000 € donation (former Heinrich-Mandel award) to Benjamin Witzel for his optimised gas turbine combustion system. Dr Michael Fübi, the chairman of the VGB Board of Directors, handed over the award on the occasion of the VGB Congress POWER PLANTS 2014 in Hamburg (Figure 5).

Further information, also on the 2015 award, can be obtained from the VGB homepage (www.vgb.org).
The changes in the energy business also make an impact on training and advanced training and thus on KRAFTWERKS-SCHULE E.V. (KWS, Power Plant Training Centre). These changes partly shifted the foci of some KWS departments.

Training at the KWS

Theoretical training for conventional and nuclear power plants

In both departments (conventional and nuclear), new foci developed due to the turnaround in energy policy («Energiewende»). KWS offers training and advanced training in all fields of renewables. This applies to biomass and/or on/offshore wind power plants as well as hydro power plants. Besides, standard courses covering new issues related to renewables were added.

A second course «Service Technician for Wind Power Plants», which is comparable to the training for control room operators (Kraftwerker) in conventional power plants, was successfully conducted and finalised with IHK (industrial chamber of commerce) exam.

In the department of nuclear engineering training, KWS offers its members a new plant supervisor course in the field of radiation protection as well as special courses taking into account relevant issues in connection with disassembly and idle operation.

120 participants attended the successful Conference «Decommissioning 2014», which took place at the shut down Zwentendorf (Austria) nuclear power plant. The issues and challenges related to the decommissioning of nuclear power plants were discussed intensively. KWS is planning to repeat the event with new subjects in 2016.

Simulator training

KRAFTWERKSCHULE E.V. has been offering state-of-the-art power plant simulators for training operational and failure situations.

The simulators cover all recent power plant designs, i.e. the 800 MW hard coal-fired plants, the 1,100 MW lignite-fired units including main control and instrumentation supplied by Siemens (SPPA T3000) and the 1,100 MW hard coal plants with main control and instrumentation supplied by ABB (ABB 800 XA).

A new combined-cycle variant with main control and instrumentation – HLT SPPA T3000 – supplied by Siemens is available for any training situation.

In recent years, KWS also concentrated on simulators for realising virtual commissioning measures prior to the real commissioning of power plants.

International activities

KWS can support foreign members’ activities and can carry out simulator and theoretical training courses worldwide. KWS is familiar with a lot of structures of foreign training and advanced training. Additionally, KWS elaborates operational solutions jointly with the companies. Lecturers’ expertise is extended by linguistic competencies; courses can be run in English and Dutch. The complete training documents are available in the English and Dutch language.

Innovation projects

The development of training models at simulators to meet the new challenges of grid operation is among the innovative tasks of KWS.

We responded to the continuously growing requirements to be met by power plant personnel. These requirements reach far beyond mere technical requirements thus creating new advanced training schemes. The issues related to «focus on humans» offer solutions for conflict management and standards for shift handover.

Apartment blocks/ conference venue

With the new apartment house, that was opened in mid-July 2013, KWS now bundles all activities at the «Deilbachtal Energy Campus».

KWS can offer conferences venues – also for several days – of any kind in our state-of-the-art conference rooms which also meet demand of modern communication.
VGB: Events and Publications

VGB Events

Angela Langen

During the period under review from July 2014 to June 2015, VGB organised 29 events which were attended by a total of 2,500 participants. Seven events were accompanied by technical exhibitions where 242 companies presented their products and services.

VGB Congress «POWER PLANTS 2014» in Hamburg

The VGB Congress «POWER PLANTS 2014» took place in Hamburg on September 17 and 18, 2014. The newly concepted Congress was attended by more than 500 participants from 28 countries to discuss current issues under the Congress heading «TECHNICAL LEADERSHIP TO OVERCOME ECONOMIC CHALLENGES».

115 operators, manufacturers and service companies presented their portfolios in hall H of Kongress Center Hamburg.

VGB Conference «Chemistry in Power Plants 2014» in Linz

The traditional VGB Conference «Chemistry in Power Plants 2014» and the associated technical exhibition took place for the 50th time and the first time abroad in Linz, Austria from October 28 to 30, 2014. 42 exhibitors and 234 conference participants exchanged their experiences. 50 interesting years of VGB’s Conference «Chemistry in Power Plants» and the development proved that – despite all fears in the early years – power plants did not turn into small chemical factories. However, it can be noted that power plant chemistry is one important element of power plant operation to minimise large risks related to engineering as well as legal and financial aspects of power and heat generation.

The exchange about all these aspects on a platform like the VGB Conference «Chemistry in Power Plants» is still highly estimated.

VGB Conference «Generation in Competition 2015» in Berlin

On April 21 and 22, 2015, the well-known VGB Conference «Power Plants in Competition» took place in Berlin and for the first time under its new name «Generation in Competition 2015». The conference was renamed in order to underline the extended scope, i.e. renewables and distributed generation were added to this technical key conference of the association. 180 participants discussed the options for a more flexible and secure future energy supply. The topics comprised all aspects of power and heat generation: from the application of accumulators, operating experience with offshore wind parks up to technical challenges for increasingly demanded flexibility of conventional power plants.

VGB Technical Conference «Gas Turbines and Gas Turbine Operation 2015» in Lübeck

Every two years, operators, manufacturers, insurance companies, authorities, and R&D experts discuss current issues of gas turbines and their operation. The conference had already taken place in 2010 at this venue (MuK, Musik- und Kongresshalle) in Lübeck on May 6/7, 2015. Contacts at the exhibition stand and the side programme provided numerous opportunities for 250 participants and 39 exhibitors to exchange their views and intensify their business contacts.

VGB would like to thank all participants, sponsors, cooperation partners and exhibitors for the good cooperation. We highly appreciate your participation and we are looking to joint future events.
<table>
<thead>
<tr>
<th>Date</th>
<th>Place</th>
<th>Kind of event</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 and 12 September 2014</td>
<td>Berlin</td>
<td>Workshop</td>
<td>Water in Power Plants</td>
</tr>
<tr>
<td>12 and 13 September 2014</td>
<td>Emden</td>
<td>Workshop</td>
<td>Offshore Wind Power Plants – Occupational Health</td>
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<tr>
<td>17 and 18 September 2014</td>
<td>Hamburg</td>
<td>Congress with exhibition</td>
<td>Power Plants</td>
</tr>
<tr>
<td>23 and 24 September 2014</td>
<td>Velen</td>
<td>Workshop</td>
<td>Flexible Power Plants</td>
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<tr>
<td>30 September 2014</td>
<td>Essen</td>
<td>Workshop</td>
<td>Change of the Pressure Equipment Directive</td>
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<tr>
<td>14 and 15 October 2014</td>
<td>Munich</td>
<td>Conference</td>
<td>EUROCOALASH</td>
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<tr>
<td>15 and 16 October 2014</td>
<td>Egestorf</td>
<td>Training</td>
<td>QS Requirements of Nuclear Processing of Orders/Purchase</td>
</tr>
<tr>
<td>24 October 2014</td>
<td>Essen</td>
<td>Workshop</td>
<td>Fire and Explosion Protection in Biomass Power Plants</td>
</tr>
<tr>
<td>28 to 29 October 2014</td>
<td>Kassel</td>
<td>Conference with exhibition</td>
<td>Waste Incineration</td>
</tr>
<tr>
<td>28 to 30 October 2014</td>
<td>Linz, Austria</td>
<td>Conference with exhibition</td>
<td>Chemistry in Power Plants</td>
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<tr>
<td>4 to 6 November 2014</td>
<td>Essen</td>
<td>Seminar</td>
<td>Chemistry in the Water Steam Cycle</td>
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<tr>
<td>10 to 11 November 2014</td>
<td>Dresden</td>
<td>Workshop with exhibition</td>
<td>Municipal Utilities and Industrial customer generation</td>
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<tr>
<td>18 November 2014</td>
<td>Berlin</td>
<td>Workshop</td>
<td>Products of Waste Incineration</td>
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<tr>
<td>19 and 20 November 2014</td>
<td>Kufstein, Austria</td>
<td>Conference with exhibition</td>
<td>Local Generation – Status and Perspectives in Co-operation with the University of Kufstein</td>
</tr>
<tr>
<td>25 November 2014</td>
<td>Essen</td>
<td>Seminar</td>
<td>Basic Information on the Ordinance on Industrial Safety and Health and VGB-S-104-00 (BetrSichV, German National Law)</td>
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<tr>
<td>26 November 2014</td>
<td>Essen</td>
<td>Workshop</td>
<td>IT-Security in Power Generation</td>
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<tr>
<td>25 to 27 November 2014</td>
<td>Lahnstein</td>
<td>Training</td>
<td>Training for Immission Control and Incident Commissioners (German national law only)</td>
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<tr>
<td>3 February 2015</td>
<td>Essen</td>
<td>Workshop</td>
<td>Emission Control</td>
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<tr>
<td>24 and 25 February 2015</td>
<td>Cologne</td>
<td>Conference</td>
<td>Maintenance of Wind Power Plants</td>
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<tr>
<td>25 and 26 March 2015</td>
<td>Niederstetten</td>
<td>Seminar</td>
<td>VGB Training for advanced learners – module 2 building inspection and module 3 documentation</td>
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<tr>
<td>14 to 16 April 2015</td>
<td>Höhr-Grenzhausen</td>
<td>Training</td>
<td>Training for Water Protection and Waste Management Commissioners (German National Law, only)</td>
</tr>
<tr>
<td>14 to 16 April 2015</td>
<td>Egestorf</td>
<td>Training</td>
<td>VGB Training for advanced learners – module 1 VPU</td>
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<td>21 and 22 April 2015</td>
<td>Berlin</td>
<td>Conference with exhibition</td>
<td>Generation in Competition</td>
</tr>
<tr>
<td>29 April 2015</td>
<td>Berlin</td>
<td>Workshop</td>
<td>Biomass Ash</td>
</tr>
<tr>
<td>29 and 30 April 2015</td>
<td>Linkebeek, Belgium</td>
<td>Workshop</td>
<td>Material &amp; Quality Assurance</td>
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<tr>
<td>6 and 7 May 2015</td>
<td>Istanbul, Turkey</td>
<td>Workshop</td>
<td>Flue Gas Cleaning</td>
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<tr>
<td>6 and 7 May 2015</td>
<td>Lübeck</td>
<td>Conference with exhibition</td>
<td>Gas Turbines and Operation of Gas Turbines</td>
</tr>
<tr>
<td>20 and 21 May 2015</td>
<td>Niederstetten</td>
<td>Training</td>
<td>QS Requirements of Nuclear Processing of Orders/Purchase</td>
</tr>
<tr>
<td>23 and 24 June</td>
<td>Rostock</td>
<td>Workshop</td>
<td>Oil-Workshop for wind power plants</td>
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</table>

Tab. 1: VGB events July 2014 to June 2015.
Energy fairs 2015

VGB PowerTech e.V. and VGB PowerTech Service GmbH had an exhibition stand at the POWER-GEN Europe in Amsterdam, The Netherlands and will also take part in the “Husum Wind” in September 2015.

VGB Publications

Christopher Weßelmann

VGB PowerTech Journal

From July 1, 2014 to June 30, 2015 a total of 163 technical articles were published in 11 editions of the International VGB PowerTech trade journal. Since January 2001, the joint international German-English bilingual edition of the former VGB KraftwerksTechnik has been published under the name of «VGB PowerTech». The redesign of VGB PowerTech has been produced a high level of acceptance amongst member companies, subscribers and readers.

Since 2006, VGB PowerTech offers a digital version of the trade journal. The annual edition is always published at the end of May of the following year. In the meantime, the issues since 1990 were digitalised and are available on DVD covering some 20,000 pages.

VGB-Standards

In the course of the Europeanisation of VGB PowerTech e.V., it was decided that all VGB Guidelines and Instruction Sheets (hereafter marked and abbreviated VGB-R/M for ease of reference) should basically be published in German and English. They should be converted into documents with the new designation VGB-Standards (VGB-S) by August 1, 2011. VGB-Standards can be translated into other languages if demanded by VGB member companies.

The following VGB-Standards, VGB Guidelines, VGB Instruction Sheets, Books and Reports have been completed during the year under review:

- VGB-S-002-02-2014-11-DE Wasserkraft
- VGB-S-013-00-2014-12-EN Construction and installation supervision in the manufacture and assembly of water-tube boilers and associated systems in thermal power plants
- VGB-S-013-00-2014-12-DE Bau- und Montageüberwachung bei der Herstellung und Errichtung von Wasserdampfkesseln und zugehörigen Anlagen in Wärmekraftwerken
- VGB-S-016-00-2014-08-EN Turbine internal drains
- VGB-S-016-00-2014-08-DE Turbineninterne Entwässerungen
- VGB-S-031-00-2014-09-EN Operation of steam boiler installations Demand on the operator for the operation of steam boiler installations of categories III (from 1,000 bar/liter) and IV
- VGB-S-033-00-2014-12-DE Zusammenwirken von Konformitätsbewertung und Arbeitsschutz in Wasserkraftanlagen
- VGB-S-034-00-2014-10-EN Assessment of fatigue loaded components in hydro power plants
- VGB-S-034-00-2014-12-DE Bewertung ermüdungsbeanspruchter Bauteile in Wasserkraftanlagen
- VGB-S-035-00-2014-12-DE Konformitätsbewertung im Kraftwerksbau
- VGB-S-036-00-2014-10-DE Konservierung von Dampfturbosätzen
- VGB-S-036-00-2014-10-EN Preservation of Steam Turbine-Generator Sets
- VGB-S-165-00-2014-07-DE Empfehlungen zur Verbesserung der H2-Sicherheit wasserkühler Generatoren
- VGB-S-165-00-2014-07-EN Recommendations for the improvement of H2 safety in hydrogen-cooled generators
- VGB-S-170-42-2014-08-EN Sampling Points for Process Measurement in Water and Steam Carrying Systems - Type, Selection and Design
- VGB-S-170-42-2014-08-DE Entnahmestellen für verfahrenstechnische Messungen an wasser- und dampfführenden Systemen – Ausführung, Auswahl und Auslegung
- VGB-S-219-00-2015-03-DE Feuerfeste Auskleidung von Wirbelschichtfeuerungen
- VGB-S-219-00-2015-03-EN Refractory Linings in Fluidized Bed Combustion Systems
- VGB-S-221-00-2014-06-DE Heizflächenreinigungsanlagen für Dampferzeuger Betrieb, Instandhaltung und Expertensysteme.
- VGB-S-416-00-2014-10-DE Teil A: Überwachung von gebrauchten Turbinenölen in Dampf- und Gasturbinen; Teil B: Überwachung von gebrauchten schwer entflammbaren Flüssigkeiten in Dampf- und Gasturbinen
- VGB-S-416-00-2014-10-EN Part A: In-service monitoring of turbine oils in steam and gas turbines Part B: In-service monitoring of fire-resistant fluids for steam and gas turbines
- VGB-S-513-00-2014-07-EN Internal Cleaning of Water-Tube Steam Generating Plants and Associated Pipework
- VGB-S-513-00-2014-07-DE Innere Reinigung von Wasserdampferzeugeranlagen und Rohrleitungen
- VGB-S-517-00-2014-11-DE-EN Direktanschluss von Wärmeübertragungsanlagen an Wasserdampferzeuger-Steuersysteme
- VGB-S-517-00-2014-11-DE Direktanschluss von Wärmeübertragungsanlagen an Wasserdampferzeuger-Steuersysteme
VGB PowerTech is co-operating with the following organisations and associations worldwide (in alphabetical order):

AGFW | Der Energieeffizienzverbund für Wärme, Kälte und KWK e. V.
Arbeitsgemeinschaft Kernmaterial-Überwachung (AKÜ)
Arbeitsgemeinschaft Druckbehälter (AD)
Arbeitsgemeinschaft warmfeste Stähle
ASME American Society of Mechanical Engineers
Association of European Gypsum Industries
Bundesverbund und der Energie- und Wasserwirtschaft (BDEW)
BDI Bundesverbund der Deutschen Industrie
Berufsgenossenschaft der chemischen Industrie
Berufsgenossenschaft Feinmechanik und Elektrotechnik
Bundesverbund und der Gipsindustrie e. V.
BVK Bundesverbund und Kraftwerknebenprodukte e. V.
CEN – Europäisches Komitee für Normung
CENELEC European Committee for Electrotechnical Standardization
Deutsche Akkreditierungsstelle «Stahlbau und Energietechnik e. V. (DASET)»
Deutsche Elektrotechnische Kommission (DKE)
dena – Deutsche Energie-Agentur
Deutsche Gesellschaft für chemisches Apparatengewerbe e. V. (DEHEMA)
Deutsche Vereinigung für Verbrennungsforschung e.V. (DVV)
Deutscher Ausschuss für Stahlbeton (DAfStb)
Deutscher Verbund für Schweißtechnik e. V. (DVS)
Deutsches Atomforum e. V. (DAfF)
Deutsches Institut für Bautechnik
Deutsches Institut für Normung e. V. (DIN)
Deutsches Komitee Inst and haltung (DKin)
ECOBA European Coal Combustion Products Association
EIPPCB European Integrated Pollution Prevention and Control Bureau
EnergieAgentur NRW
Entsorgungskommission (ESK)
EPPSA, European Power Plant Suppliers Association
EPRI Electric Power Research Institute
ENTSO European Network of Transmission System Operators for Electricity
EUnited Turbines - European Association of Gas and Steam Turbine Manufactures
EURATOM Supply Agency
EURELECTRIC Union of the Electricity Industry
European Association for Coal and Lignite (Euracoal)
European Wind Energy Association (EWEA)
Fachverbund und für Strahlenschutz e. V. (FS)
FDBR Fachverbund und Dampfkessel-, Behälter- und Rohrleitungsbau e. V.
FGSV Forschungsgesellschaft für Straßen- und Verkehrswesen
FORATOM, European Atomic Forum
Gemeinschaftsausschuss Kennzeichnungssysteme (GA KS)
GIS Gesellschaft für Simulatorschulung mbH
GVC/DEHEMA-Fachausschuss «Abfallbehe and lung»
Hauptverbund und der gewerblichen Berufsgenossenschaften
HEA - Fachgemeinschaft für effiziente Energieanwendung e. V.
IAEA International Atomic Energy Agency
IEA International Energy Agency
IEA Clean Coal Centre
IERE Central Office
ITAD – Interessengemeinschaft Thermischer Abfallbeh and lungsanlagen Deutschl and e. V.
Kerntechnische Gesellschaft (KTG) e. V.
Kerntechnischer Ausschuss (KTA)
KSG Kraftwerks-Simulator-Gesellschaft mbH
Nationales Komitee des Welternegierates der Bundesrepublik Deutschl and and DNK
OECD/NEA Nuclear Energy Agency
Performance Indicator Working Group (PIWG)
PGL-Committee (Performance of Generating Plant)
Reaktor-Sicherheitskommission (RSK)
Stahlinstitut VDEh
Strahlenschutzkommission (SSK)
TEC FLAM (Universitäts-Arbeitgemeinschaft Technische Flammen)
TENPS – Thermal and Nuclear Power Engineering Society, Tokyo, Japan
VDMA Arbeitsausschuss «Gasturbinen»
Verb und Kommunaler Städtereinigungsbetriebe (VKS)
Verb und der Industriellen Energie- und Kraftwirtschaft e. V. (VIK)
Verein Deutscher Ingenieure (VDI)
Verein Deutscher Zementwerke (VDZ)
Wirtschaftsverb und Kernbrennstoff-Kreislauf und Kerntechnik e. V. (WKK)
World Association of Nuclear Operators (WANO)
World Energy Council (WEC)
A few definitions and results from the VGB Statistics «Availability of Thermal Power Plants» are presented in the accompanying summary. The data pool was created with the help of the VGB power plant information system «KISSY». Using KISSY, the operating data from 653 power plants and 168 machine sets of storage and pump storage hydro power plants were recorded online.

VGB analysed the data in detailed in its annual reports «Availability of Thermal Power Plants» (VGB-TW 103 V) and «Analysis of Unavailability of Thermal Power Plants» (VGB-TW 103 A). The current annual reports contain the operating results for the operating period between 2005 and 2014.

Basic terminology for assessing the capacity of a power plant are shown in Figure 1 and Figure 2. All definitions are explained in detail in the VGB-Standard VGB-S-002-T-01 «Basic Terms of the Electric Utility Industry». A free download of this VGB-Standard is available at www.vgb.org

In the explanatory statements and in the statistical analyses, care was taken to highlight in green the operating times in which the power plant was continuously «available».

Times of unavailability are highlighted in dark red (unplanned) or in light red (planned) throughout. Times in which a power plant was available, but could not be used, are highlighted in yellow.
Fig. 3: VGB member units evaluated in 2014.

Fig. 4: Energy availability and energy utilisation. Data for 2014 and mean values for 2005 to 2014.
Fig. 5: Energy unavailability. Data for 2014 and mean values for 2005 to 2014

*) French nuclear power plants without "unplanned disposable labor NV"
### Nuclear power plants: availability data year 2014 and mean values 2005 to 2014.

<table>
<thead>
<tr>
<th>Power Plant Type</th>
<th>Unavailability in %</th>
<th>Availability in %</th>
<th>Available but not in operation in %</th>
<th>Utilisation in %</th>
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</thead>
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<td>Pressurised water reactor</td>
<td>≤ 399 MW</td>
<td>18.8</td>
<td>81.2</td>
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<td>≥ 400 MW</td>
<td>18.4</td>
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<th>Mean value 2005 to 2014</th>
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<td>Energy availability in %</td>
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<td>Time availability</td>
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<tr>
<td>Time utilisation</td>
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### Hard coal-fired power plants: data for availability year 2014 and mean values 2005 to 2014.

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<tr>
<th>Power Plant Type</th>
<th>Unavailability in %</th>
<th>Availability in %</th>
<th>Available but not in operation in %</th>
<th>Utilisation in %</th>
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</thead>
<tbody>
<tr>
<td>Boiling water reactor</td>
<td>≤ 399 MW</td>
<td>20.8</td>
<td>79.2</td>
<td>49.8</td>
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<td></td>
<td>≥ 400 MW</td>
<td>18.6</td>
<td>81.4</td>
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<th>Mean value 2005 to 2014</th>
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<td>Energy availability in %</td>
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<tr>
<td>Energy availability</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Lignite-fired power plants: data for availability year 2014 and mean values 2005 to 2014.

<table>
<thead>
<tr>
<th>Power Plant Type</th>
<th>Unavailability in %</th>
<th>Availability in %</th>
<th>Available but not in operation in %</th>
<th>Utilisation in %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤ 399 MW</td>
<td>20.8</td>
<td>79.2</td>
<td>49.8</td>
</tr>
<tr>
<td></td>
<td>≥ 400 MW</td>
<td>18.6</td>
<td>81.4</td>
<td>53.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Year 2014</th>
<th>Mean value 2005 to 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy availability in %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy availability</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Fossil-fired power plants: data for availability 2005 to 2014.

<table>
<thead>
<tr>
<th>Power Plant Type</th>
<th>Unavailability in %</th>
<th>Availability in %</th>
<th>Available but not in operation in %</th>
<th>Utilisation in %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤ 399 MW</td>
<td>20.8</td>
<td>79.2</td>
<td>49.8</td>
</tr>
<tr>
<td></td>
<td>≥ 400 MW</td>
<td>18.6</td>
<td>81.4</td>
<td>53.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Year 2014</th>
<th>Mean value 2005 to 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy availability in %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy availability</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig. 6: Nuclear power plants: availability data year 2014 and mean values 2005 to 2014.

Fig. 7: Hard coal-fired power plants: data for availability year 2014 and mean values 2005 to 2014.

Fig. 8: Lignite-fired power plants: data for availability year 2014 and mean values 2005 to 2014.

Fig. 9: Fossil-fired power plants: data for availability 2005 to 2014.
VGB Membership
Benefits and conditions of VGB membership

VGB PowerTech e.V. (VGB) aims, in accordance with statutory regulations, to unite all companies for which the power industry is an important basis, with the objective of joint support and raising operating safety, availability, compatibility with the environment and cost-effectiveness for the members of existing and future plants for heat and power generation.

VGB is working on the standardisation and the drawing up of Technical Guidelines and Regulations in the area of the above-mentioned plants.

Membership of VGB is voluntary. Membership with VGB is open to all companies operating the above-mentioned plants. There are three types of membership:

a) Ordinary members

are companies operating or owning plants for the generation of power and heat. Companies with power plants in different locations can become a member as one body or each power plant can be a separate member.

b) Affiliated members

are authorities, associations and federations interested in planning, construction and operation of plants for the generation of power and heat. The individual members of such associations and federations do not become members of the VGB.

c) Sponsoring members

are companies and individuals making a substantial contribution to the planning, construction and operating of plants for the generation of power and heat.

Structure of members

The entire installed capacity of 461,000 MW of the VGB PowerTech members is represented in the following power plants (as of 30 June 2015):

- 246,000 MW fossil-fired power plants
- 120,000 MW nuclear power plants
- 95,000 MW hydro power plants and other renewables

The member contributions are taken in accordance with the contribution regulation for thermal power plants on the installed steam generating capacity and, for non-thermal power plants, for the electrical gross capacity.

In the reporting period 2014/2015, 12 companies joined the VGB with a total capacity of 21,000 t/h. 17 companies with a total capacity of 1,000 t/h withdrew from VGB.

The installed steam generating capacity of the members at that point increased by 18,947 t/h or 1.5% to a total of 1,325,000 t/h as a result of the steam generating capacity of the new members and after the drop in the steam generating capacity of the withdrawn companies.

The headquarters of 356 members are located in Germany, the country in which VGB PowerTech was set up in 1920. The headquarters of 132 members (27%) are located in further 33 countries in Europe and other parts of the world.

<table>
<thead>
<tr>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
</tr>
<tr>
<td>1 Brazil</td>
</tr>
<tr>
<td>1 China</td>
</tr>
<tr>
<td>2 Croatia</td>
</tr>
<tr>
<td>1 Czech Republic</td>
</tr>
<tr>
<td>6 Denmark</td>
</tr>
<tr>
<td>11 Finland</td>
</tr>
<tr>
<td>3 France</td>
</tr>
<tr>
<td>356 Germany</td>
</tr>
<tr>
<td>1 Greece</td>
</tr>
<tr>
<td>1 Ireland</td>
</tr>
<tr>
<td>2 Israel</td>
</tr>
<tr>
<td>3 Italy</td>
</tr>
<tr>
<td>2 Japan</td>
</tr>
<tr>
<td>1 Latvia</td>
</tr>
<tr>
<td>2 Luxembourg</td>
</tr>
<tr>
<td>1 Mongolia</td>
</tr>
<tr>
<td>15 Netherlands</td>
</tr>
<tr>
<td>2 Norway</td>
</tr>
<tr>
<td>5 Poland</td>
</tr>
<tr>
<td>1 Portugal</td>
</tr>
<tr>
<td>2 Romania</td>
</tr>
<tr>
<td>2 Russia</td>
</tr>
<tr>
<td>3 Slovenia</td>
</tr>
<tr>
<td>1 South Africa</td>
</tr>
<tr>
<td>2 Spain</td>
</tr>
<tr>
<td>7 Sweden</td>
</tr>
<tr>
<td>9 Switzerland</td>
</tr>
<tr>
<td>2 Turkey</td>
</tr>
<tr>
<td>1 United Kingdom</td>
</tr>
<tr>
<td>1 USA</td>
</tr>
</tbody>
</table>

Fig. 1: VGB memberships according to European countries. Outside of Europe, another 11 companies in 9 countries are VGB members.
Size of members with thermal power plants according to installed steam capacity:

<table>
<thead>
<tr>
<th>Size</th>
<th>Share 2013/2014 in %</th>
<th>Share 2014/2015 in %</th>
<th>Share of total steam capacity 2013/2014 in %</th>
<th>Share of total steam capacity 2014/2015 in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 200 t/h</td>
<td>37.9</td>
<td>34.0</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>201 to 500 t/h</td>
<td>22.1</td>
<td>22.0</td>
<td>1.6</td>
<td>1.3</td>
</tr>
<tr>
<td>501 to 1,000 t/h</td>
<td>8.9</td>
<td>9.0</td>
<td>1.2</td>
<td>1.2</td>
</tr>
<tr>
<td>more than 1,000 t/h</td>
<td>31.1</td>
<td>35.0</td>
<td>95.9</td>
<td>96.2</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

On June 30, 2015 VGB had the following membership:

<table>
<thead>
<tr>
<th>Companies Number</th>
<th>Steam capacity in t/h</th>
<th>Steam capacity in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public supply companies (utilities)</td>
<td>165</td>
<td>1,284,600</td>
</tr>
<tr>
<td>Industrial supply companies</td>
<td>94</td>
<td>41,400</td>
</tr>
<tr>
<td>Total (supply companies)</td>
<td>259</td>
<td>1,325,000</td>
</tr>
<tr>
<td>Affiliated members</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Sponsoring members</td>
<td>194</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>488 members</td>
<td></td>
</tr>
</tbody>
</table>

The installed capacity of the 94 industrial member companies is divided over the following branches of industry:

<table>
<thead>
<tr>
<th>Industry</th>
<th>2013/2014 in %</th>
<th>2014/2015 in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mining</td>
<td>10.8</td>
<td>10.7</td>
</tr>
<tr>
<td>Chemical industry</td>
<td>26.5</td>
<td>26.8</td>
</tr>
<tr>
<td>Iron and steel industry</td>
<td>18.1</td>
<td>17.9</td>
</tr>
<tr>
<td>Textile industry</td>
<td>2.3</td>
<td>2.2</td>
</tr>
<tr>
<td>Paper and cellulose industry</td>
<td>16.7</td>
<td>17.2</td>
</tr>
<tr>
<td>Potassium, aluminium, glass and cement industry</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Oil refineries, petrol industry</td>
<td>10.8</td>
<td>10.3</td>
</tr>
<tr>
<td>Apparatus industry, electrical and automotive industry, shipyard</td>
<td>10.6</td>
<td>10.5</td>
</tr>
<tr>
<td>Rubber, linoleum and leather industry</td>
<td>0.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Breweries, food and washing-agent industry</td>
<td>0.8</td>
<td>1.0</td>
</tr>
<tr>
<td>Waste management and recycling</td>
<td>2.8</td>
<td>2.7</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

List of ordinary, affiliated and sponsoring VGB Members
(Status: June 30, 2015)

Ordinary members

Abfallwirtschaftsbetrieb des Landkreises Neu-Ulm, Weißenhorn, Germany
Abfallwirtschaftsbetrieb Stadt Nürnberg, Nuremberg, Germany
Air Liquide Industrie B.V., Rotterdam, Netherlands
AK ENERGIE GmbH, Osnabrück, Germany
Akzo Nobel Industrial Chemicals B.V., Hengelo, Netherlands
Allesa Chemie GmbH, Frankfurt am Main, Germany
AMK – Abfallentsorgungsgesellschaft des Märkischen Kreises mbh, Iserlohn, Germany
Arbeitsgemeinschaft Versuchs-Reaktor (AVR) GmbH, Jülich, Germany
AS Latvenergo, Riga, Latvia
AVA Abfallverwertung Augsburg GmbH, Augsburg, Germany
AVA Velsen mbh, Saarbrücken, Germany
AVBKG Abfallverbrennungs- und Biokompost-Gesellschaft mbh, Tornesch-Ahrenlohe, Germany
AVEA Entsorgungsbetriebe GmbH & Co. KG, Engelskirchen, Germany
AVG Abfallentsorgungs- und Verwertungsgesellschaft Köln mbh, Cologne, Germany
AVR-Afvalverwerking B. V., Duiven, Netherlands
AWG Abfallwirtschaftsgesellschaft mbH Wuppertal, Wuppertal, Germany
Axpo Power AG, Baden, Switzerland
Basell Polyolefine GmbH, Wesseling, Germany
BASF SE, Ludwigshafen (Rhein), Germany

Ordinary members

Bayer MaterialScience AG, Brunsbüttel, Germany
Bayer Pharma AG, Bergkamen, Germany
Bayer Pharma AG, Berlin, Germany
Bayer Technology Services GmbH, Leverkusen, Germany
BEKW Bioenergiekraftwerk Emsland GmbH & Co. KG, Emlichheim, Germany
Berliner Stadtreinigungsbetriebe, Berlin, Germany
BioMa Energie AG, Salzburg, Austria
BIPOWER SKW GmbH, Eberhardzell, Germany
biotherm Hagenow GmbH, Hagenow, Germany
BKW ENERGIE AG, Berne, Switzerland
Boehringer Ingelheim Pharma KG, Ingelheim am Rhein, Germany
BP Europa SE, Lingen/Ems, Germany
Brauerei Beck GmbH & Co. KG, Bremen, Germany
Braunschweiger Versorgungs-AG & Co. KG, Braunschweig, Germany
Bremerhaven Entsorgungsgesellschaft mbh, Bremerhaven, Germany
Cargill Germany GmbH, Krefeld, Germany
Carmel Olefins Ltd. Haifa, Israel
Centrales Nucléares Almaraz Trillo, Madrid, Spain
CEZ a.s., Praha, Czech Republic
Colakoglu Metalurji, Kocaeli, Turkey
CURRENTA GmbH & Co. OHG, Leverkusen, Germany
Mälarenergi AB, Västeras, Sweden
Mark-E Aktiengesellschaft, Hagen, Germany
Martinwerk GmbH, Bergheim, Germany
MAYR-MELNHOF KARTON GmbH, Frohnleiten, Austria
Membrana GmbH, Wuppertal, Germany
Meridian Energy Australia Pty Ltd., Chatswood NSW, Australia
MHB Hamm Betriebsführungsgesellschaft mbH, Hamm, Germany
MIBRAG mbH, Zeitz, Germany
MIRO Mineralöleraffinerie Oberrhein GmbH & Co. KG, Karlsruhe, Germany
Mondi Neusiedler GmbH, Ulmerfeld, Austria
Moritz J. Weig GmbH & Co. KG, Mayen, Germany
Müllheizkraftwerk Kassel GmbH, Kassel, Germany
Müllverbrennungsanlage Bielefeld-Herford GmbH, Bielefeld, Germany
Müllverbrennungsanlage der Stadt Solingen, Solingen, Germany
MVV Energie AG, Mannheim, Germany
N.V. Delta Nutsbedrijven, Middelburg, Netherlands
Nehlsen Heizkraftwerke GmbH & Co. KG, Sleenagen, Germany
N-ERGY AG, Nuremberg, Germany
Nettingsdorfer Papierfabrik AG & Co KG, Haid bei Ansfelden, Austria
Nucleoelectrica Argentina SA, Buenos Aires, Argentina
Nuon Energie & Service GmbH, Heinsberg/Oberbruch, Germany
NUON Energy Power, Heat & Services, Amsterdam, Netherlands
Nuon Power Buggenum, Buggenum, Netherlands
Oil Refineries Ltd., Haifa, Israel
OMV Germany GmbH, Burghausen, Germany
OMV Power International GmbH, Vienna, Austria
OMV Refining & Marketing GmbH, Vienna, Austria
OXEA GmbH, Oberhausen, Germany
Papierfabrik August Koehler SE, Oberkirch, Germany
Papierfabrik Meldorf GmbH & Co. KG, Tornesch, Germany
Pfeifer & Langen GmbH & Co. KG, Cologne, Germany
PGE GiEK SA, Belchatow, Poland
Public Power Corporation S. A., Athens, Greece
PVO-Lämpövoima Oy, Vaasa, Finland
RAG Anthrazit Ilbenbüren GmbH, Ilbenbüren, Germany
REMONDIS Production GmbH, Lünen, Germany
Reno De Medici Arnsberg GmbH, Arnsberg, Germany
RheinEnergie AG, Cologne, Germany
Romande Energie SA, Morges, Switzerland
ROMONTA GmbH, Seengebiet Mansfelder Land, Germany
RWE Innogy GmbH, Essen, Germany
RWE Power AG, Essen, Germany
RWTI Aachen, Aachen, Germany
Sachtleben Chemie GmbH, Duisburg, Germany
Salzburger Landesverwaltung, Salzburg, Austria
Salzgitter Flachstahl GmbH, Salzgitter, Germany
Sappi Austria Produktions-GmbH Co. KG, Gratkorn, Austria
SCA Hygiene Products GmbH, Mannheim, Germany
Schluchseewerk AG, Laufenburg, Germany
SEO Société de l’Our Centrale de Vianden, Vianden, Luxembourg
Smurfit Kappa Herzberger Papierfabrik GmbH, Herzberg am Harz, Germany
Smurfit Kappa Zülpich Papier GmbH, Zülpich, Germany
Solvay Acetow GmbH, Freiburg, Germany
SOLVAY Infra GmbH, Rheinberg, Germany
SRS EcoTherm GmbH, Salzbergen, Germany
SSAB Special Steels, Ovelösund, Sweden
Städte Werke Energien + Wärme GmbH, Kassel, Germany
Stadtreinigung Hamburg, Hamburg, Germany
Stadtwärme Augsburg Energie GmbH, Augsburg, Germany
Stadtwärme Bielefeld GmbH, Bielefeld, Germany
Stadtwärme Bochum Holding GmbH, Bochum, Germany
Stadtwärme Duisburg AG, Duisburg, Germany
Stadtwärme Düsseldorf AG, Düsseldorf, Germany
Stadtwärme Flensburg GmbH, Flensburg, Germany
Stadtwärme Hannover AG, Hanover, Germany
Stadtwärme Karlsruhe GmbH, Karlsruhe, Germany
Stadtwärme Leipzig GmbH, Leipzig, Germany
Stadtwärme Münster GmbH, Münster, Germany
Stadtwärme Rosenheim GmbH & Co. KG, Rosenheim, Germany
Stadtwärme Rostock AG, Rostock, Germany
Statkraft, Oslo, Norway
Statkraft Energi AS, Oslo, Norway
STEAG GmbH, Essen, Germany
STEAG Power Saar GmbH, Saarbrücken, Germany
Stora Enso Maxau GmbH, Karlsruhe-Maxau, Germany
SWB Energie- und Wasserversorgung Bonn/Rhein-Sieg GmbH, Bonn, Germany
swb Entsorgung GmbH & Co. KG, Bremen, Germany
swb Erzeugung GmbH & Co. KG, Bremen, Germany
SWB Verwaltung MWA Bonn GmbH, Bonn, Germany
SWM Versorgungs GmbH, Munich, Germany
SVW Stadtwerke Neumünster GmbH, Neumünster, Germany
SVU Energie GmbH, Ulm, Germany
Tampere Energy Production Ltd, Tampere, Finland
TAURON Wytwarzanie S.A., Katowice, Poland
Technische Hochschule München, Forschungsneutronenquelle Heinz Maier-Leibnitz (FRM II), Garching, Germany
Technische Werke Ludwigshafen AG, Ludwigshafen am Rhein, Germany
Teollisuuden Voima Oyj, Euroajoki, Finland
TERMÖLEKRARN SOSTANJ d.o.o., Sostanj, Slovenia
Thyssen Krupp Steel AG, Duisburg, Germany
TIWAG-Tiroler Wasserwerkverband AG, Innsbruck, Austria
Trianel Gaskraftwerk Hamm GmbH & Co. KG, Aachen, Germany
Trianel Kohlekraftwerk Lünen GmbH & Co. KG, Lünen, Germany
Universität Göttingen, Göttingen, Germany
UPM GmbH, Augsburg, Germany
UPM-Kymmene Austria GmbH, Steyrermühl, Austria
Vantaan Energia Oy, Vantaa, Finland
Vaskiluodon Voima Oy, Vaasa, Finland
Vattenfall A/S Generation Nordic, Copenhagen, Denmark
Vattenfall Europe Generation AG, Cottbus, Germany
Vattenfall Europe New Energy GmbH, Hamburg, Germany
Vattenfall Europe Nuclear Energy GmbH, Hamburg, Germany
Vattenfall Europe Wärme AG, Berlin, Germany
Vattenfall Värmekraft, Stenungsund, Sweden
Vattenfall Wärme Hamburg GmbH, Hamburg, Germany
VERBUND Hydra Power GmbH, Vienna, Austria
VERBUND Thermal Power GmbH & Co. KG, Graz, Austria
Versorgungs- und Verkehrsgesellschaft Saarbrücken mbH, Saarbrücken, Germany
voestalpine Stahl GmbH, Linz, Austria
Vorarlberger Illwerke AG, Schruns, Austria
VSE AG, Ensdorf, Germany
VW Kraftwerk GmbH, Wolfsburg, Germany
Wels Strom GmbH, Wels, Austria
wep Wärme-, Energie- und Prozesstechnik GmbH, Hückelhoven, Germany
WIEN ENERGIE GmbH, Vienna, Austria
WIEN ENERGIE GMBH, Betriebsstätte Spittelau, Vienna, Austria
WindMW GmbH, Bremerhaven, Germany
Windtest Grevenbroich GmbH, Grevenbroich, Germany
WSW Energie und Wasser AG, Wuppertal, Germany
Zellstoff Pöls AG, Pöls, Austria
Zellstoff Stendal GmbH, Arneburg, Germany
Zweckverband Abfallverwertung Südostbayern, Burgkirchen, Germany
Zweckverband für Abfallwirtschaft Südwestthüringen, Zella-Mehlis, Germany
Zweckverband Müllverwertung Schwandorf, Schwandorf, Germany
Zweckverband Müllverwertungsanlage Ingolstadt, Ingolstadt, Germany
Zweckverband Restmüllheizkraftwerk Böblingen (RBB), Böblingen, Germany

Affiliated members

AGR Abfallentsorgungsgesellschaft Ruhrgebiet mbH, Heren, Germany
ALLRUSSIA THERMAL ENGINEERING INSTITUTE, Moskva, Russia
AUCOTEC, Hanover, Germany
Bundesverband der Deutschen Kalkindustrie e. V., Cologne, Germany
DBFZ Deutsches BiomasseForschungszentrum gemeinnützige GmbH, Leipzig, Germany
DBI Gas- und Umwelttechnik GmbH, Leipzig, Germany
DTU Mechanical Engineering, Lyngby, Denmark
EKONERG, Zagreb, Croatia
Elektroinstitut Milan Vidmar, Ljubljana, Slovenia
ELFORSK, Stockholm, Sweden
epro GmbH, Gronau, Germany
Fachverband Dampfkessel-, Behälter- und Rohrleitungsanbau e.V., Düsseldorf, Germany
FORCE Technology, Broendby, Denmark
Fraunhofer-Institut für Werkstofftechnik IWM, Freiburg, Germany
DNV GL (Germanischer Lloyd Industrial Services GmbH), Hamburg, Germany
Helmholtz-Zentrum Geesthacht Zentrum für Material- und Küstenforschung GmbH, Geesthacht, Germany
ICEMENERG – Institut für Forschung und Modernisierung der Energiewirtschaft, Bucharest, Romania
Instandhaltungsausschuss in der Energiewirtschaft e.V., Zittau, Germany
JSC ATOMENERGOPROEKT, Moskva, Russia
K + K Management GmbH, Hamburg, Germany
KW Bankenguppe, Frankfurt am Main, Germany
KRAFTWERKSSCHULE E.V., Essen, Germany
MPA Stuttgart, Materialprüfungsanstalt Universität Stuttgart – Abteilung Werkstoffverhalten, Stuttgart, Germany
Müller und Medenbach GmbH, Gladbeck, Germany
SOLIDO Bautenschutz GmbH, Steinfurt, Germany
SP Technical Research Institute of Sweden – Energy Technology Boras, Sweden
Technische Universität Darmstadt – Fachgebiet und Institut für Werkstoffkunde, Darmstadt, Germany
The Government Implementing Agency ENERGY Authority Ulaanbaatar, Mongolia
TÜV AUSTRIA SERVICES GmbH, Vienna, Austria
TÜV Nord Systems GmbH & Co. KG, Hamburg, Germany
TÜV Rheinland Industrie Service GmbH, Cologne, Germany
TÜV Süd Industrie Service GmbH, Munich, Germany
TÜV Technische Überwachung Hessen GmbH, Darmstadt, Germany
TÜV Thüringen e.V., Erfurt, Germany
Verband der TÜV e.V. (VdTÜV), Berlin, Germany
Sponsoring members

3P-Solutions S. A., Echternach, Luxembourg
ABB AG – Division Energietechnik, Mannheim, Germany
Abeinsa Business Development SA, Seville, Spain
ACE European Group Ltd., Cologne, Germany
Allianz Risk Consulting GmbH, Munich, Germany
ALSTOM AUSTRIA GmbH, Vienna, Austria
ALSTOM Power GmbH, Mannheim, Germany
ANDRITZ Energy & Environment GmbH, Raaba, Graz, Austria
Andritz Hydro GmbH, Ravensburg, Germany
ARCA Regler GmbH, Tönisvorst, Germany
Arena GmbH, Erlangen, Germany
Avalon GmbH, Rheine, Germany
AXA Corporate Solutions, Cologne, Germany
B&B-Agema GmbH, Aachen, Germany
Balcke-Dürr GmbH, Ratingen, Germany
Barlage GmbH, Flechum, Germany
Bechmann, Dr., Cologne, Germany
Billfinger SE, Oberhausen, Germany
BHK Aindling GmbH, Herten, Germany
BK Giulini GmbH, Ludwigshafen, Germany
Bockhold, Dr., Marl, Germany
Böhler Schweisstechnik Germany GmbH, Hamm, Germany
Bopp & Reuther Sicherheits- und Regelarmaturen GmbH, Mannheim, Germany
Braun Industrieservice, Dortmund, Germany
Brenner GmbH, Bürstadt, Germany
BRUSH HMA b. v. Aftermarket, Ridderdijk, Netherlands
Burmeister & Wain Energy A/S, Kgs. Lyngby, Denmark
Caliqua AG, Basel, Switzerland
Camfil Power Systems GmbH, Bremen, Germany
CAMREUSE, Louvain-la-Neuve, Belgium
Clyde Bergemann GmbH, Wesel, Germany
Conco Systems SPR, Lillois, Belgium
Container Company GmbH & Co. KG, Krefeld, Germany
D & D Marine Engineering GmbH – Turbinenservice, Bremen, Germany
Daume Regelarmaturen GmbH, Isenhagen, Germany
Diamond Power Germany GmbH, Zörbig, Germany
DISA energy GmbH, Rangsdorf, Germany
DOKING d.o.o., Zagreb, Croatia
Doosan Babcock Energy Germany GmbH, Hohenthurn, Germany
Doosan Lenjies GmbH, Ratingen, Germany
DURAG GmbH, Hamburg, Germany
E.ON Energy Sales GmbH, Essen, Germany
EBINGER KatalysatorenService GmbH & Co. KG, Wildeshausen, Germany
Ed. Züblin AG, Duisburg, Germany
Eisenkrein, Ms., Bochum, Germany
EMIS Electrics GmbH, Lübbenau, Germany
enQ Energie- und Verfahrens-Consult GmbH, Braunschweig, Germany
Energoinstal SA, Katowice, Poland
Envirotherm GmbH, Essen, Germany
ESI Eurosilvo BV, Purmerend, Netherlands
ETABO Energietechnik und Anlagenservice GmbH, Bochum, Germany
Eugen Arnold GmbH, Filderstadt, Germany
Eutech Scientific Engineering GmbH, Aachen, Germany
Ewex-Engineering GmbH & Co. KG, Ratingen, Germany
F & S Prozessautomatisation GmbH, Dohna, Germany
Fichtner GmbH & Co. KG, Stuttgart, Germany
Flowserve Service Center Ost, Lauma, Gähren, Germany
FLSmidth Hamburg GmbH, Pinneberg, Germany
FMT Industrieholding GmbH, Wels, Austria
Foster Wheeler Energia Oy, Espoo, Finland
FUEL TECH S.R.L., Gallarate, Italy
GABO IDM mbH, Erlangen, Germany
GE Jenbacher GmbH, Frankenthal, Germany
GEA Energietechnik GmbH, Bochum, Germany
GESTRA AG, Bremen, Germany
GFI – Kennflex mbH, Buchholz, Germany
GIS Gesellschaft für integrierte Systemplanung mbH, Erlangen, Germany
GNS Gesellschaft für Nuklear-Service mbH, Essen, Germany
Grontmij GmbH, Bremen, Germany
GW T Gesellschaft für Wasser- und Wärmetechnik GmbH, Leobersdorf, Germany
Halberg Maschinenbau GmbH, Ludwigshafen, Germany
Hamon Thermal Germany GmbH, Bochum, Germany
Harter Turbine Consult, Vinnna, Austria
HDI-Gerling Industrie Versicherung AG, Hanover, Germany
HDI-Gerling Sicherheitstechnik GmbH, Hanover, Germany
Heitkamp Ingenieur- und Kraftwerksbau GmbH, Herne, Germany
Hochtiefe Solutions AG, Essen, Germany
Holter Regelarmaturen GmbH & Co. KG, Schloss Holte-Stukenbrock, Germany
Howden Ventilatoren GmbH, Heidenheim, Germany
HYDAC TECHNOLOGY GMBH, Sulzbach (Saar), Germany
Hydro-Engineering GmbH, Mülheim an der Ruhr, Germany
IBH Engineering GmbH, Ludwigshafen, Germany
IHI Corporation, Tokyo, Japan
Imerys Ceramic Centre, Limoges, France
IMTECH Germany GmbH & Co. KG, Planegg, Germany
Ingenieurbüro Björn Reese GmbH, Gummersbach, Germany
Ingenieurbüro GABO GmbH, Höchstadt, Germany
Ingenieure Prof. Sturm + Partner GmbH, Dresden, Germany
INP Germany GmbH, Rümerberg, Germany
Institut für Studien und Entwürfe der Energiewirtschaft (ISPE), Bucharest, Romania
Inwatec GmbH & Co. KG, Bergheim, Germany
IRIS GmbH, Mannheim, Germany
Japan Nus Co. Ltd., Tokio, Japan
Josef Bertsch Ges. mbH & Co. KG, Bludenz, Austria
Kaefer Industrie GmbH, Bremen, Germany
Knick Elektronische Messgeräte GmbH & Co. KG, Berlin, Germany

64 4 | Association Structure
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(Status: June 30, 2015)

Executive Board
Fischer, Bernhard, Dr. E.h. (Chairman)
Chairmen E.ON Kernkraft/E.ON Kraftwerke
and Special Advisor to the CEO
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Vattenfall Europe Generation AG,
Vattenfall Europe Mining AG, Cottbus, Germany

Giger, François, Dr.
(2nd Vice-Chairman)
Manager Strategy,
EDF Fossil-fired Generation and Engineering,
Saint-Denis, France

Gruber, Karl-Heinz, Dipl.-Ing. Dr.
Member of the Board of Directors,
VERBUND Hydro Power GmbH, Vienna, Austria

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Secretary General,
EURELECTRIC, Brussels, Belgium

Brockmeier, Udo, Dr.
Chairman of the Board of Directors,
Stadwerke Düsseldorf AG, Düsseldorf, Germany

Broos, Wim
Director Fleet Management
ENGIE, Brussels, Belgium

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Grosskraftwerk Mannheim AG, Mannheim, Germany

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Regional Senior Vice President,
Stalitmarkt GmbH, Hürth, Germany

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E.ON Technologies, Ratcliffe on Soar, United Kingdom

Hartmann, Ulrich, Dr.
Executive Vice President
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Essen, Germany

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Koellmann, Roger,
Member of the Executive Committee,
BDEW Bundesverband der Energie-und Wasserwirtschaft e.V.,
Berlin, Germany

Koko, Matshela,
Division Executive Technology Group,
Johannesburg, South Africa

Křížek, Karel
Chairman of the Board of Directors,
ÚJV Řež a.s., Husinec, Czech Republic

Mathis, Rolf W.
Director Hydraulische Energie,
Axpo Power AG | Hydroenergie, Baden, Switzerland

Stamatelopoulos, Georgios, Dr.,
Senior Vice President Generation,
ENBW Energie Baden-Württemberg AG, Stuttgart, Germany

Szulc, Waldemar
Vice President of the Management Board for Operations
PGE Górnictwo i Energietchnologii, Belchatów, Poland

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Chairman of the Management Board,
Chief Executive Officer,
TAURON Wytwarzanie SA, Katowice, Poland

van Ophemegen, Alexander
Head Operations Netherlands, NV Nuon Energy
Amsterdam, The Netherlands

Zimmer, Hans-Josef, Dr.
General Manager Bereich Technik,
EnBW Energie Baden-Württemberg AG,
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VGB PowerTech e.V., Essen, Germany

Technical Advisory Board
(Status: June 30, 2015)

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Director Energy Technology,
STEAG Energy Services GmbH, Essen, Germany

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Geschäftsführer Kraftwerke,
EVN AG,
Maria Enzersdorf, Austria

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Prof. Electricity Generation Univ. of Gent and
ENGIE Technology Intelligence Officer, ENGIE, Brussels, Belgium

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EnBW Energie Baden-Württemberg AG,
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Felwor, Peter, Dipl.-Ing.,
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EURELECTRIC AISBL, Brussels, Belgium
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(Status: June 30, 2015)

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Director, TAURON Wytwarzanie SA,, Jaworzno, Poland

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Institut für Energietechnik und Thermodynamik,
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Hald, John, Prof.
Technical University of Denmark,
Department of Mechanical Engineering, Lyngby, Denmark

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Faculty of Mechanical Engineering, Praha, Czech Republic

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Process Chemistry Centre,
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Janicka, Johannes, Prof. Dr.
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Johnsson, Filip, Prof.
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Division of Energy Technology, Göteborg, Sweden

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Quality Management,
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RWE Power AG, Safety at Work,
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RheinEnergie AG, Cologne, Germany

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Hanover, Germany

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Pasini, Sauro, Dr.
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Rall, Hansjörg, Dr.
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MVV Umwelt & O&M GmbH, Mannheim, Germany

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Head of International Q&M,
Fortum Power and Heat Oy, Espoo, Finland

Szynol, Kazimierz, Dipl.-Ing.
Director, TAURON Wytwarzanie SA,, Jaworzno, Poland

VGB Secretariat

Then, Oliver, Dr.
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Johnsson, Filip, Prof.
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(Representative of research)
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Meyer, Bernd, Prof. Dr.
Lehrstuhl für Energieforschungstechnik und
thermische Rückschlagbehandlung,
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Technische Universität Darmstadt, Fachgebiet und Institut für
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National Technical University of Athens, Greece

Tigges, Klaus-Dieter, Dr.
Bereichsleiter Technik
Babcock Borsig Steinhüller GmbH, Oberhausen, Germany
(Representative of the power plant manufacturing industry)