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Dear ladies and gentlemen,

With the present Annual Report, VGB PowerTech presents the results of its activities for the reporting period 2013|2014. VGB PowerTech, 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, i.e. operators, manufacturers, service companies as well as research and development institutes. VGB PowerTech also coordinates relevant activities of member companies with government institutions and additional partners in international cooperation worldwide.

Challenges for electricity supply

The structures of electricity supply in Europe are subject to drastic changes with impacts on all areas from generation to distribution up to local supply. The challenges we are facing do not only relate to the well known and far reaching economic issues – particularly in the field of conventional generation and the considerable cost pressure due to the difficult market conditions in numerous European countries – but also to technical aspects affecting all kinds of generation and totally changing the structure of power supply. In the foreseeable future conventional power plants will have to guarantee supply security with sufficient capacities and grid stability at increasing volatility and will have to cover about 75 % of power demand. At the same time these plants have to remain at the state of the art. Issues like maintenance, industrial safety and the classical load management are gaining in importance in the field of renewables.

All stakeholders are facing these challenges and have to accept them in order to jointly and cooperatively shape the change and identify solutions in order to take on the technical responsibility for a stable and efficient electricity supply grid and for guaranteeing the integration of renewables into the future power supply infrastructure. Cooperation of the industry is particularly important at times of tight budgets in order to increase cost efficiency through the exchange of experience, development of joint standards or identification of technical solutions. Here VGB offers the ideal platform as strong partner who initiates, channels and efficiently advances the exchange.

VGB PowerTech: Shape the change

VGB PowerTech will accompany the change with corresponding adjustments. It goes without saying that VGB PowerTech, VGB offices and its members will not only follow the change but will actively shape and influence it. With its proven and reliable portfolio, VGB will be active for the benefit of its members in order to make a contribution to optimising the value added chain in power generation with technology that is optimised, state-of-the-art and meeting market requirements. This covers conventional generation as well as hydro power, biomass and wind power.

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 2013|2014!

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 present annual report and the activities of the connected five Competence Centres* document how VGB PowerTech supports its members in their business by finding technical solutions for tasks and problems or to avoid such at a very early stage.

Dr.-Ing. Michael Fübi
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 493 members from 34 countries represent a power plant capacity of 455,000 MW thus in 2013/2014 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).

At the beginning of 2012, CC2 was renamed «Power Plant Technologies» in order to underline the traditional links and cross-sectional tasks of CC2 with the other VGB Competence Centres.

VGB PowerTech also set up a new Competence Centre 5 «Technical Services» for the well-known and established sections of quality control, water chemistry, and materials laboratory. CC5 will make optimum advantage of the existing synergies and will serve as central contact for all important technical issues and tasks.

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 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 Committee is responsible for allocating the committee members and determination of tasks. Currently committees are active in four fields with a large number of technical and special committees and working groups. The «European Technical Committees (ETCs)» are of particular significance for European tasks. Additionally, workshops and R&D projects are organised with European partners. The development of VGB at European level is coordinated by the VGB Technical Advisory Board.

VGB represents a worldwide power plant capacity of 455,000 MW

<table>
<thead>
<tr>
<th>Fossil-fired power plants</th>
<th>246,000 MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear power plants</td>
<td>120,000 MW</td>
</tr>
<tr>
<td>Hydro-power plants and other renewables</td>
<td>89,000 MW</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>455,000 MW</strong></td>
</tr>
</tbody>
</table>

EU-28: 466 Members in 21 Countries

- Austria, Belgium, Croatia, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Luxembourg, The Netherlands, Poland, Portugal, Romania, Slovenia, Spain, Sweden, United Kingdom

Other Europe: 16 in 4 Countries

- Norway, Russia, Switzerland, Turkey

Outside Europe: 11 in 9 Countries

- Argentina, Australia, Brazil, China, Israel, Japan, Mongolia, South Africa, USA

| **Total:** | **493 in 34 Countries** |

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 and working panels of VGB convened at over 180 meetings. All VGB members are informed about the results of these meetings through the monthly «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-Forschungstitung (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 Kraftwerkssimulator-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 nature 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 Klinkenstraße 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 on pages 50 to 53 of this report.
Nuclear Power Plants

Ludger Mohrbach

During the reporting period, the VGB Competence Centre 1 (CC1) «Nuclear Power Plants» tightened its committee structure and reorganised itself in response to the German «Energiewende» (turnaround in German energy policy) that puts more cost pressure on central energy generation and has particular impact on nuclear power (Figure 1). The newly set up general committee jointly with the VGB Technical Advisory Board decreased the number of working panels from 27 to 14 and terminated assistance of working groups apart from defined, service orientated exceptions.

Among others, individual measures comprise:
- New nominations for all CC1 bodies,
- Reduction of the «nuclear levy» by 50% until 2018,
- Introduction of project management for research projects,
- Introduction of a new reporting for cost control,
- For the first time mid-term budget planning for the members (five years),
- Further development of the database software for projects (FESY),
- Development of a formalised ordering process for projects from external VGB bodies (using the existing infrastructure for project management),
- Determination of terms of reference (including commenting by legal experts) for the general committee and its three technical committees and
- Identification and determination of the necessary VGB resources.

All these measures have been taken yet and their results will be updated according to demand. The new working panels and technical committees took note of and accepted the proposals of VGB management; however, the work burden was commented as being ambitious.

Since the beginning of 2013, project costs were reduced in the amount of € 778,678 due to the adjustment and termination of running contracts. Additional revenues amounting to € 101,762 were yielded by selling results to external partners. Additional offers for participation amounting to € 1,725,640 are still pending.

According to mid-term budgeting, the project budgets will decrease from 12,048 k€ in 2014 to 3,962 k€ in 2018.

Currently the Competence Centre «Nuclear Power Plants» is developing workflows and mid-term budgeting in order to enable plant-specific cash flow planning.

![Fig. 1: New structure of Competence Centre 1 (CC1).](image-url)
Furthermore, CC1 concentrated on the following main issues:

- Reduction of participation fees and funds for external organisations for the members,
- Further reduction of project costs and integration of the «INES evaluation of experience» into the «AREVA evaluation contract» as well as minimisation of the scope of the evaluation contract (together some 0.5 million €/a),
- New projects particularly in the field of equipment qualification and spare parts management.

In the Technical Committee «Nuclear Power» the exchange of information was focused on political frame conditions (e.g. «Repository Site Selection Act», «Complaint of Unconstitutionality», «Storage Cask Licensing») but also on new EU regulations, including the guidelines on nuclear safety and liability as well as the amendment of the German Act on Renewable Energies (Erneuerbare Energien Gesetz – EEG).

Technical Committee
Engineered Safety
Ludger Mohrbach and Thomas Linnemann

On initiative of the General Committee «Nuclear Power Plants», a workshop on «project management» was held on August 20, 2013 at VGB offices. The workshop dealt with the future scope, procedure and control of joint projects.

For that workshop VGB evaluated the current projects’ status. According to that evaluation, nuclear power plant operators have been carrying out a total of 1,436 joint projects for the last 25 years spending 188 million € on them (Figure 2 and Figure 3).

The evaluation according to cost groups shows that the majority of projects consumed small to medium budgets (category 1 and 2) only and that in recent years some projects were realised with large budgets.

The total annual project sums are highly fluctuating in a range of 3 to 15 million €/a.

At the beginning of 2014 the general committee agreed on a medium-term budget planning 2014 to 2018 that had been developed among all CC1 committees and panels. According to this planning, in 2014 all operators will have to expect total costs amounting to 12 million €, 66 % of which are going to be spent on running projects and 34 % are estimated to be needed for new joint projects (Figure 4).

Further evaluation of the five-year period reveals a clear decrease of the costs for joint projects: it is expected that in 2018 the total costs will be reduced by two thirds down to 4 million €. The next medium term planning (2015 to 2019) is to be made in the autumn of 2014.

Working Panel
Safety Assessments
Thomas Linnemann

The panels’ activities were still characterised by the discussions between operators and regulators about plant-specific «Post-Fukushima Measures» and the «National Action Plan», as well as by discussions about the recommendations of the Reactor Safety Commission (Reaktor-Sicherheitskommission RSK, among others on the robustness of nuclear power plants and «New Nuclear Regulation Frameworks»).
The panel drafted among others the following VGB statements on:

- «References and Recommendation of the National Action Plan» and
- «Further increase in safety for plants in idle operation exemplified by the Emsland nuclear power plant».

These documents as well as all additional concepts can be obtained from the VGB homepage, «Different Documents», filed in the closed user group of the panel on www.vgb.org.

The panel members also discussed

- Integrity of mechanical seals of main coolant pumps after external events,
- Required minimum load of emergency power generators,
- Simplified procedures for the safety case earthquake resistance of the filtered containment pressure relief system («venting»),
- Potential release of hydrogen from the venting system into adjacent plant areas and
- Cooperation with the Federal Nuclear Regulatory Committee (KTA) and the German Institute for Standardisation (DIN).

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

The panel was also involved in drafting the German national report for the sixth monitoring conference of the Convention on Nuclear Safety (CNS) that was held from March 24, 2014 to April 3, 2014, at the headquarters of the International Atomic Agency (IAEA) in Vienna. Within the scope of the several stage drafting process for national reports, the panel provided harmonised comments and tests on operator activities and answered questions Germany was asked by other contract partners.

For the time being the panel decided to maintain 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) plants by taking into account mechanical, thermal, corrosive and radio-chemical boundary conditions.

The panel also dealt with

- Event-based exchange of experience about damages and their transferability to other plants,
- Securing of component integrity through the application of appropriate integrity concepts and fracture mechanical calculation methods,
- Assistance to investigations on root-cause analyses and determination of damage mechanisms,
- Damage prevention and provision of component integrity,
- Implementation of findings in plants and
- Public relations as well as cooperation with external bodies (publications, lectures, regulations).

Three main issues are briefly outlined it the following:

Assessment of damage cases

Two examples are to be mentioned here to demonstrate the handling of material-related damage reports (cause, mechanism, remedy and assessment of transferability):
Deformation of fuel assembly guide pins

Upon visual inspection of an open reactor core it was detected that the edge of a fuel assembly head was pressed down by some 4 cm. Within the scope of further control it was also detected that the throttle inside the fuel assembly showed obvious deformations and that the entire structure was deformed. Besides it was revealed when visually inspecting the plate of the upper core grid that one fuel assembly guide pin was missing at that position. According to documentation the pin had been made of austenitic material which was inserted into the core as replacement in 1990. Obviously, when putting on the core grid plate, the pin hole missed the corresponding bore and thus deformed the fuel assembly head in such a way that it could no longer be used as a load attachment point for handling. The pin was found and was recovered like the fuel assembly. (Figure 5 and Figure 6)

Assessing the transferability of material defect in the reactor pressure vessels of Doel-3 and Tihange-2

In 2012 a large number of manufacturing flaws (hydrogen flakes up to several cm) were detected with ultra-sound technology in the reactor pressure core shells of these Belgium plants (commissioned in 1982). The panel discussed the findings in detail and with experts of the plant manufacturer and additional Belgium experts. After analysing and comparing with the existing documentation, it could be excluded that such damage would occur in German nuclear power plants.

Research projects

The panel mentored five research projects which are all related to corrosion, crack growth and NDT of structure materials:
- «Determination of Crack Growth Rates for Alloy B2 at Low K Values under PWR Primary Water Environment»
- «Chloride Effects on Fluid-induced Cracking of Low-alloy Steels in Oxygenated High-temperature Water»
- «Compatibility Consideration Related to the Load of Fuel Assembly Guide Pins»
- «Investigation on the Limits of Ultrasonic Analysis Methods on Dissimilar Metal Welds»

Non-destructive testing

The panel is mainly dealing with the exchange of experience about testing techniques, test results, RSK recommendations and the support and mentoring of above-mentioned projects as well as with the cooperation on nuclear standards and codes.

Working Panel Reactor Core

Guido Vallana

Current projects are dealing with issues of neutronic and thermo-hydraulic core design as well as layout and operating behaviour of fuel assemblies and fuel rods. Due to the phasing out of nuclear power in Germany, the panel has to deal increasingly with intermediate storage.

During the reporting period, the panel held a total of five meetings on the following topics:
- Consequences of the new nuclear safety requirements («new regulations») among others with a view on reactivity transients and uncertainty analysis as well as shutdown margin safety,
- Bending of fuel assemblies and resulting reactivity behaviour; four presentations were made yet in front of RSK1,
- Fuel assembly corrosion upstream of the active zone,
- Assessment of uncertainties upon fuel element burn up, and determination of safety margins of cask designs for stored fuel assemblies,
- Discussion of the calculation methods for decay heat loads to DIN (important for cycle safety cases),
- Possible effects of zirconium hydride in fuel pin cladding tubes in case of long-term intermediate storage caused by temperature impacts from dry and wet storage,
- Continuation and participation in international research projects like the HALDEN reactor project of OECD,
- Assessment of inspection results and safeguarding of undercriticality during fuel exchange processes.

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

1 It can be summarised that remedial measures (steel guide tubes, less spring forces) have proven to be effective.

Fig. 5: Fracture surface of the broken fuel element centring pin with intercrystalline cracks.

Working Panel Impacts on Civil Structures

Jens Ganswind

The panel, which was reorganised in 2013, is mainly dealing external hazards like e.g. earthquake, high tides, extreme weathers, explosions, fires and also ageing management and on civil structures. Apart from the traditional exchange of experience on rules, requests by authorities, and definition of the «state of the art», special emphasis was put on keeping and exchanging of know-how.

In the spring of 2014 the panel conducted an international workshop on «Nature-induced Impacts». Due to the positive response, another workshop is planned for the autumn of 2014 dealing with «Revised KTA rules in civil engineering».

The panel initiated a total of eight projects, among others for the qualification of fixing elements (anchors), drafting/updating of an earthquake catalogue or the assessment of conservative earthquake design.

New VGB-Standard on the ageing management in civil engineering

The panel also produced a new VGB-Standard «Implementation of ageing management in civil engineering according to KTA 1403» which justifies the existing heterogenic approaches and which can also be applied internationally for lifetime extension as a standard tool.

Fig. 6: Broken fuel element centring pin.
**Fire Protection**

The panel also represents operators’ positions concerning forthcoming amendments of rules of the KTA code 2101 «Fire protection» within the scope of the KTA subcommittee «Plant and Civil Engineering».

**Technical Committee Nuclear Power Plant Operation**

*Ludger Mohrbach*

The following topics are examples of the exchange of experience about engineering in nuclear power plants:

- Minor reactor pressure vessel leakages or flux detector penetrations in the Gundremmingen nuclear power plant,
- WANO experience (World Association of Nuclear Operators, London) from peer reviews,
- Experience made with load following and frequency support operation,
- Transformer failures, e.g. in the Isar-2 and Cattenom-1 nuclear power plants,
- Experience made with decontamination of primary cycles, e.g. in the Biblis, Neckarwestheim-1 and Philippsburg-1 nuclear power plants,
- Missing dummies on installation places not occupied in C&I cabinets (important for earthquake safety cases),
- Filling up of low velocity water zones in cooling water inlets with concrete as «good practice» against mussel growth,
- Optimal utilisation of the remaining reactivity of the Grafenrheinfeld nuclear power plant under the aspect of the German nuclear fuel tax and
- Optional transport of the remaining spent fuel assemblies of the Obrigheim nuclear power plant to the Neckarwestheim power plant via the river Neckar (e.g. by 2017).

Another interesting report was given by a nuclear power plant with a pressurised water reactor: the core outlet temperature fluctuated over a period of 40 to 60 minutes with amplitudes in the range of 0.8 K with a frequency of two to three minutes. Protection or limit values were not reached. The committee assumes rope formation and wide bending of the fuel assemblies in preference modes and corresponding response on neutron flux and performance.

During the reporting period the committee held three meetings and discussed and passed 15 new projects mainly in the field of spare parts management and qualification of instrumentation and control (I&C) equipment.

For the first time VGB PowerTech will host the WANO «Site Vice Presidents’ & Plant Managers’ Conference» in Düsseldorf from September 22 to 24, 2014. The conference was organised by the technical committee.

**Working Panel Mechanical and Process Engineering**

*Heinrich Grimmelt*

The working panel, with experts from Germany, (plants in operation or in post-operation phase), Switzerland, the Netherlands and Brazil, which was set up on March 14, 2013, meets four times a year.

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

Following the request of the RSK, operators’ experts are revising the VGB-Standard «Avoidance of Foreign Matter in Opened Systems/Components of Nuclear Power Plants».

A number of hypothetical events on the reactor floor («unplanned situations») were of top priority on the panel’s agenda, i.e. the panel drafted proactively instructions, made feasibility studies or procured special tools. The panel is still to discuss about other situations.

**Working Panel Electrical and I&C Engineering**

*Jörg Kaiser*

The panel coordinates the technical issues of different VGB internal and external committees and panels, develops VGB policies and analyses and evaluates events of cross-plant importance. This also includes findings and knowledge from parallel committees and panels dealing with conventional power plants, mainly large electrical components like generators and transformers. Issues like maintaining functionality of I&C as well as LOCA (Loss-of-coolant-accident) resistance of electrical equipment are part of the activities of the panel after restructuring of the CC1 bodies.

**Ageing management of I&C components according to KTA 1403**

The working panel entrusted finished its work with determining the component ageing reports to the data base «VGB-Info-system». The group was to allocate all relevant measures yet realised and to be realised in future to the individual component groups. The effects concerning ageing control were assessed quantitatively for each typical case. The task was solved by the structural establishment of so-called component ageing reports and the connection with the VGB-QN/QE databases of the existing type classes in the equipment catalogue. Thus, the damage mechanism can be directly allocated to the specific equipment variant. The effectiveness is tested and thereby it is guaranteed that the effects of ageing can be governed for all I&C components.

Besides, the «VGB-Info-system» contains maintenance reports of all plants, application numbers and numerical evaluation methods (e.g. failure statistics), i.e. it is possible to verify the effectiveness of remedial measures with statistics.

**Impacts of single-phase grid connection failures**

GRS (German expert organisation plant and reactor safety) has drafted a report on single-phase grid failure, i.e. asymmetrical voltage in nuclear power plants. The VGB Working Panel «Electrical and I&C Engineering» entrusted a Working Group «Grid Issues» to analyse the effects and possible measures for the detection of single phase failures and the related asymmetries in the internal station grid of nuclear power plants. Comprehensive simulations were made and a VGB-Standard «Recommendation for the Detection of Phase Failure on Maximum and High Voltage of the Supply System of Nuclear Power Plants» was drafted.

Corresponding test measurements are needed to verify the theoretical models, particularly with a view to disturbances on operations. The working group presented the state of investigations by the end of 2013 in the RSK Committee «Electrical Installations».
Working Panel Practical Radiation Protection
Lena Jentjens
Operational events and developments in operating plants and are being focused on at the panel meetings that take place twice a year. Besides, the panel and its associated working groups mostly dealt with:

EU Basic Safety Standard on Radiation Protection
After finalisation of the EU «Basic Safety Standard for Protection against Ionising Radiations (BSS)» by the EU Council of Ministers in January 2014, the EU member states now have a time frame of four years for transposing it into national law. In Germany this will involve comprehensive revision of the radiation protection and X-ray ordinances. Besides, the Federal Government is considering a radiation protection act (including the X-ray ordinance) instead of a radiation protection ordinance.

The panel members fear that the extension of dose values will first-hand extend administrative efforts without any equivalent gain for personal dose rates. The responsible Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) appreciates the operators’ initiative signalling their willingness for early discussions. Since it is most likely that the BMUB will entrust the Radiation Protection Commission (SSK) with the transposition of the EU-BSS into national law, the panel has already supported operator representatives in SSK with corresponding arguments.

ENISS (European Nuclear Installations Safety Standards) and IAEA standards on radiation protection
In 2013 a working group provided two operator comments within four weeks on the two standards «DS 427 Radiological Environmental Impact Assessment» and «DS 453 Occupational Radiation Protection». Additional comprehensive works are being carried out in 2014.

International Committee on Radiological Protection ICRP
The ICRP discusses – scientifically-grounded – issues of radiation protection. It develops rules and recommendations sometimes hard to implement in practice difficult to be understood by the public due to their complexity.

The VGB working panel developed in collaboration with WKK (Trade Association Nuclear Fuel Cycle and Nuclear Technology, Wirtschaftsverband Kernbrennstoffkreislauf und Kernbrenntechnik e.V.) a comment and passed it on to ICRP about a new draft guideline on environmental protection. However, the ICRP ignored this contribution after having received several other (about 20) comments from different sides.

Radiation protection upon NDT
Radiation-relevant accidents are happening worldwide but also in Germany within the scope of non-destructive (NDT) material testing. Therefore the panel is elaborating a VGB-Standard on how to improve application of this technique in (fossil-fired and nuclear) power plants.

Qualifications in radiation protection
The working panel revised the standards
- «Minimum requirements on the training of radiation protection technician (VGB)» and
- «Minimum requirements on the training of radiation protection technician (VGB)/radiation protection engineer (VGB)».

The new editions will be published soon.

Information System on Occupational Exposure ISOE of OECD-NEA
One authority representative (GRS) and two operator representatives (from the working panel) represent Germany at the bi-annual meeting about the «Information System on Occupational Exposure» ISOE run by OECD and IAEA (International Atomic Energy Agency).

The ISOE working group SAM (severe accident management), that was set up in 2012, is planning to draft a report by the end of 2014. The VGB working panel is actively involved. It is also planned to participate in the related workshop.

The working panel is also cooperating with additional committees and panels, among others in the Technical Association for Radiation Protection (Fachverband für Strahlenschutz), the Working Panels «Physicians in Nuclear Power Plants», the committee «Emergency Protection» of the Radiation Protection Commission (RSK) and of BGETE (Accident Prevention and Insurance Association). A joint study is being developed with the latter investigating the risk of cancer of staff exposed to radiation.

Working Panel Nuclear Power Plant Management Systems
Georg Schafer
The panel is dealing with cross-plant tasks of system- and product-related quality assurance and safety culture, this involves the:
- Exchange of information on management systems and their advancement, both nationally and internationally,
- Adaptation of management systems to post-operation mode,
- Assessment of contractors according to KTA Rule 1401 (198 in 2013, currently the VGB contractor list comprises 700 contractors),
- Training of particular nuclear knowledge for contractors and operator personnel in the field of mechanical engineering for the execution of nuclear orders as basic training and advanced training in the fields of pre-testing (module 1, Figure 7), controlling of civil engineering and supervision of construction (module 2) as well as documentation (module 3). During the reporting period some 120 participants were trained in six courses.

In the field of mechanical engineering, the panel initiated the generic qualification of HELICOIL screws (Figure 8) for application in nuclear power plants, i.e. for the arrangement and/or permanent repair of inside screw threads.

Fig. 7: Flyer for the advanced training course on nuclear procurement.
Safety culture is the second main task of the working panel. During the reporting period, a total of five assessments of safety culture were conducted. The experience made was used to further improve the catalogue for assessing safety culture and to make it more efficient. Version 3.1 has been available in the meantime. The training of safety culture assessors was fostered in parallel.

Working Panel Event Analyses
Guido Vallana
The panel focuses on «Holistic event analyses», «Specific tasks for nuclear safety commissioners (kSb)», «Assessment of safety culture and carrying out of assessments» (for details see above Management Systems) as well as «Human factors». Apart from German nuclear power plants, there are also Swiss, Dutch and Brazilian plants cooperating in the panel.

Holistic event analysis

Holistic event analyses according to the man-technology-organisation (MTO) approach were carried out in different nuclear power plants and discussed by the panel during the reporting period. The pertinent 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 adapt it to the state of the art. Apart from system-ic models for event analyses, aspects of safety culture and safety management are also to become part of the analyses. Besides, the long-term experiences of event analyses experts are to be incorporated into the advancement of SOL.

Specific tasks of nuclear safety commissioners
Also during this reporting period, 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 reports and interpreted messages to be passed on to IRS [Incident Reporting System], IAEA and WANO. All participating nuclear power plants fully met their duty to report regularly generic findings to WANO.

Technical Committee
Decommissioning and Disposal

Katrin van Bevern

Cooperation in national projects
After publication of the EURATOM-Waste-Management Guideline in summer 2011, the committee members actively accompanied the implementation in Germany.

The BMUB, responsible in Germany for nuclear power, is also drafting a report on the 5th Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management of IAEA in 2015. VGB and WKK submitted a joint report to BMUB in May 2014.

The committee entrusted in summer 2013 a Working Group «Requirements to Intermediate Storage» to make a short-term analysis because of the amended regulations (e.g. requirements of the disposal commission) related to the planned new erection of interim storage sites for wastes with deniable heat production at sites of plants. The group’s report was presented by October 31, 2013. Among others, the report comprises state of planning, substances to be stored, function of the storage sites as well as information on erection and design.

The technical committee also controls the working panels listed in the following and the Working Groups «Utilisation of Plutonium» as well as «Uranium Standards» and deals with:

- Provision of information on the issues of supply and disposal for the General Committee «Nuclear Power Plants» and the Committee «Nuclear Power» of the German Association of Energy and Water Industries (BDEW) which is administered by VGB,
- Drafting of «Guides» for the realisation of periodic safety checks for intermediate storage (pilot projects Gorleben and Emsland),
- Drafting of a checklist for the «autarchy of interim storage sites»,
- Preparatory measures for the introduction of data transfer in the site intermediate storages to meet the safeguards requirements of IAEA and EURATOM inspectors,
- Marginal conditions for passing on the issue of sealing of fuel casks from inspectorates to operators,
- Cooperation in the advisory board of EURATOM.

Working Panel Decommissioning

Katrin van Bevern

After the 13th amendment of the German Atomic Energy Act which involves 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.

At the beginning of 2010, the panel had set up a Working Group «Contamination of Buildings and Radiological Clearance» to exchange cross-operator experience and findings. The focus was on clearance routine, measurements for making decisions, evidence of exposition scenarios and nuclide vectors. Thanks to the intensive exchange of experience it was possible to directly involve the findings into DIN 25457 «Activity measurement methods for the clearance of radioactive substances and nuclear facility components».

![Fig. 8: Screws (thread repair technology)](image-url)
The panel also exchanged views with the «Facility Group» set up by the Federal State of Baden-Württemberg which focused on nuclear buildings to be demolished and with alternatives for clearance measurement at existing buildings. The results were summarised at the beginning of 2014 in a final report which now provides an overview for the planning of such processes and the options in the area of contamination clearance.

The working panel also dealt with:

- Exchange of experience about current decommissioning projects,
- Exchange of experience with Switzerland on the ENSI-G-17 Guideline «Decommissioning of Nuclear Plants» and the shutdown of the Mühleberg nuclear power plant in 2019,
- Observation and cooperation on «IAEA Safety Guides and Requirements» on decommissioning,
- Data management for the IAEA-PRIS database (Power Reactor Information System),
- Exchange of experience, cooperation and observation of the decommissioning projects and costs of the OECD/Nuclear Energy Agency,
- Cooperation with World Nuclear Association WNA and European Nuclear Installations Safety Standards ENISS,
- Observation of current findings on the development of decommissioning costs, and
- Minor interpellations related to the Federal Government and inquiries to authorities.

Working Panel Interim Storage

Andre Seidel

The working panel deals with relevant issues concerning the loading of fuel assembly transport and storage casks as well as their interim storage. The panel also ensures the exchange of experience as requested in the guideline of the Disposal Commission (ESK) and nuclear licenses.

Mentoring 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 (online authority information library) for mutual information of federal state supervisory authorities and their experts. Status discussions are held regularly in order to reflect practical experience and operators’ benefit by taking into account operators’ financial expenditure. 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.

The exchange of experience on the operation of site interim storages as well as issues of cask loading is also being organised by a working group associated to the panel. Representatives of utilities’ head offices and from 12 site interim storages, the interim storages Ahaus and Gorleben, the interim storage site in Greifswald as well as ZWILAG (Switzerland) met with representatives of manufacturers for transport and storage of spent fuel assemblies (GNS Gesellschaft für Nuklear-Service mbH and AREVA TN). Reports on particularities of storage operation, 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.

The exchange of information with operators of interim storage sites and experts of probabilistic safety checks of nuclear power plants was continued within the scope of the pilot project «periodic safety checks (PSU) for the Gorleben fuel assembly interim storage site», which among others, served for checking the applicability of the «ESK guidelines on the realisation of periodic safety checks and on technical ageing management for interim storage sites for irradiated fuel elements and heat-producing radioactive wastes».

In the light of decommissioning, concepts are increasingly needed which guarantee the stand-alone operation of intermediate storage sites close to the power plants and the long-term provision of necessary infrastructure. The panel drafted a checklist for this transition.

Working Panel Safeguards

Katrin van Bevern

Concerning the exchange of experience on current monitoring of safeguards by the European Atomic Energy Community (EURATOM) and IAEA, the working panel is particularly observing the events of monitoring underway. After the new monitoring regime «Integrated Safeguards» (IS), which is based on the principle of random inspections, had been introduced in 2010, the panel was focusing on its implementation. In 2011 monitoring expenditure was reduced at power plant sites as well as at interim storage sites. The decrease at power plant sites amounts to 40 to 45 % and at storage sites to about 50 %. The same applies to 2012 and 2013, where expenditures were also decreased in comparison to the pre-2010 regime.

Introduction of remote transmission for safeguard data

Cooperation and positioning concerning the issue of introducing remote data transmission in site interim storages and nuclear power plants is a central issue of the working panel. After successful termination of the field test in the Ahaus interim storage, EURATOM, the panel and the German Federal Ministry for Economic Affairs and Energy (BMWi) agreed on carrying on the field test on long-term stability and reliability until 2014. A report on the field test (apart from results on long-term stability) was drafted within the scope of the German support programme for IAEA/BMWi. In April 2014, BMWi asked the Federal Office for Information Security (BSI) and the BMUB for a statement on the introduction of remote data transmission in Germany. The consultation phase is expected for the summer of 2014. The next step anticipated is the information of the responsible authorities and plant operators about the introduction of remote data transmission at interim storage sites.

The panel also dealt with

- Cooperation in the working group «Supervision of Nuclear Material» in the programme committee of BMWi/IAEA support programme,
- Observation and Discussion with BMWi, IAEA- and EURATOM inspectors on the creation of a valid legal basis by adjusting «Facility attachments» and «Particular control requirements»,
- Assumption of sealing of fuel assembly vessels by operators, mentoring of pilot projects at the Unterweser site,
- Exchange of experience on current inspection practice by EURATOM and IAEA; handling of safeguard systems that remained at the sites and their transport and
- Exchange of experience on «Integrated Safeguards» in Germany, particularly on the 24 (48)-hour lead time prior to random inspections.
Power Plant Technologies

General Committee Power Plant Technologies

Oliver Then

The relatively young committee with European members is still acting as general committee to control its associated committees and panels. Besides, the committee deals with current issues from the national viewpoints of all VGB members. In this respect the committee focused on the development of the European marginal conditions and the national power markets as well as the consequences of increasingly flexible operation of conventional power plants. In addition to their committee work, the GC members are also involved in selecting the programme for the VGB Conference «Power Plants in Competition» and the awardees of the VGB Quality Award. The procedure for the 2014 Quality Award was revised completely in order to increase transparency of the decision and the attractiveness of the award.

During the reporting period, the legworks and cooperation with the German Association of Energy and Water Industries (BDEW) and the European Union of the Electricity Industry (EURELECTRIC) was 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/or launched. The joint work on different network codes, like «the requirements for generators» (RIG) or high voltage direct current transmission (HVDC), continued successfully. The work performed cannot be estimated very high enough because of the long-term and complex process. The network code on the requirements for grid connection (is now in the legislative process and after having incorporated some improvements and after it had been externally examined by DNV KEMA. It is not likely to be passed before the first quarter of 2015. The committee continued dealing with further processes – also in view of national transposition – like the BREF-LCP (European best available technique reference document on large combustion plants) or BREF for industrial cooling plants. The committee successfully performed some legwork for EURELECTRIC for the study «Highway 2050», i.e. VGB elaborated the technical and economic perspectives of different power generation technologies.

Projects under the umbrella of COMTES+ developed differently. The ENCIO project was terminated by March 31, 2014 (i.e. before commissioning of the test plant) due to cost increase and risks, mainly in view of the changed market. Currently the project is being finalised for good. The project HWTII met its targets before the test plant had to be shut down permanently in April 2014 after a component failure.

Following an R&D workshop, a coordination office was set up in the autumn of 2013 to deal with ideas/projects related to the issue of «flexibility». Project ideas from the field of hydro power and IT security have been collected.

The PEPP (PEPP = Platform for Experience for Power Plants) database has been activated since October 2013. All important events and damages at fossil-fired power plant components are to be collected in this database. The data is to be provided in order to derive «lessons learnt» for new designs and component operation. Comprehensive information and trainings are to increase the degree of popularity and acceptance of PEPP among member companies and sufficient input is to be secured. Yet the respond was only very cautiously.

The activities already launched during the former reporting period, i.e. the structural strengthening of the area of renewables, also involved CC2 experts who are now more cross-department active. In the second phase of the project «Future VGB», a partial project aiming at increasing efficiency was elaborated mainly by CC2 in addition to other measures aiming at cost cutting. The core elements of that project were the identification of future and value-increasing issues, the new organisation of committees and panels to obtain a leaner and more flexible structure as well as the more efficient operation of committees and panels and VGB offices. The plans are to be implemented in the first half of 2015 after the responsible VGB bodies will have agreed on them.
As regards CC2 events, the general committee looks back on a successful year, however, with numbers of participants that – according to expectations – did not achieve the high levels of former years. Apart from the difficult economic situation of our industry, VGB has to cope with events organised by competitors with partly identical topics and lecturers which also attract VGB’s participants. Our large well-known conferences like «Maintenance in Power Plants» in Dresden, jointly held with the Technical Conference «Maintenance of Wind Power Plants», the «KEL 2014 I&C Conference» in Landshut, and the Conference «Steam Generators, Fluidised Bed Firing Systems and Cogeneration Plants» in Weimar, which for the first time was conducted jointly by three VGB working panels offered interesting and highly focal topics in association with high-level technical exhibitions.

Internally Dr Oliver Then became successor to Dr Herbert Urban on October 1, 2013. Oliver Then is now head of the VGB Competence Centre «Power Plant Technologies» and has firstly made his contribution in the annual report at hand.

Technical Committee 
Power Plant Concepts

Hans-Joachim Meier

During the reporting period the Technical Committee «Power Plant Concepts» was mainly dealing with the impacts of the new orientation of the European power business, i.e. the new concepts and operation of conventionally-fired coal and gas power plants. The committee members were unanimously of the opinion that secure power supply requires a mix of generation capacities comprising renewables as well as coal- and gas-fired conventional thermal power plants.

Since large storage capacities in the GWh range for balancing fluctuating wind and solar power generation will not be available in the near future, thermal power plants will have to secure power supply. The increasing extension of power generation plants with highly fluctuating feed again resulted last year in less utilisation of thermal power plants. Urgently needed retrofit measures for increasing plant flexibility could not be realised because of the poor economic situation of these plants. Plans for new power plants were often postponed or even abandoned due to the difficult economic situation.

The current European situation is reflected by the survey, initiated in 2007 by the Technical Committee «Power Plant Concepts», that has been updated regularly since then, i.e. it shows power plants (thermal and hydro power plant as well as power plants run with renewables, however, without photovoltaic plants) that are planned, under way or under construction. There are still some 93 GW of capacity in the planning stage, 86 GW are in the licensing stage and some 62 GW are under construction or in trial operation. Besides it is also shown that power plant capacity amounting to some 32 GW has been abandoned during the period under report (Figure 1).

The committee also dealt with:
- Discussion of concepts for new thermal power plant fired with lignite or hard coal,
- Discussion of measures to improve minimum load and load follow velocity of thermal power plants,
- Consideration of measures to shorten the start-up times from the operation modes «cold, warm and hot start-up»,
- Consideration of the engineering impacts on thermal power plants by an increasing share of renewables-based power plant capacity,
- Discussion about the economic operation of thermal power plants by taking into account the increasing power feed from renewables,
- Development and integration of thermal storage systems in conventional power plants,
- Assessment of impacts of the European emission trading system,
- Drafting of inspection proposals for the European Directive on the limitation of emissions of large combustion plants (BREF-LCP).

Technical Committee 
Steam Generation Plants

Werner Hartwig

At its autumn meeting the Technical Committee «Steam Generation Plants» dealt mainly with the grid situation taking an grid operator as an example. The exchange of experience with a grid operator results in improved mutual understanding in view of boiler operation.

At its spring meeting the committee dealt with «design-induced leakage at (standardised) flange connections». The reasons for leakages were identified and different design solutions were present to avoid and eliminate such leakage at existing connections as well as new power plants. Legally required prioritisation of renewables-based power feed in into the grid results in high start-up gradients of fossil-fired plants and extremely stressed plant components as well as accelerated exhaustion that have to be assessed over component lifetime. Pipe and tube connections are, however, no components displaying accelerated exhaustion; they rather show unfavourable deformation behaviour with negative impacts on tightness of conventional flange connections upon changing and/or additional loads. The problems with flange leakages as a result of deformation can be controlled reliably with the new and proven design solutions presented.
The discussions were also focused on quality problems in current power plant projects. This applies in particular to new hard coal-fired projects with very high steam parameters. In a lot of cases the problems cannot be generalised, because it is all about engineering details with considerable impact on power plant operation. The committee members highlighted different techniques of heat treatment and repair of new materials (e.g., T24, Super 304 H and HR3C).

The joint VGB Conference of the three VGB Working Panels «Steam Generators, Fluidised Bed Firing Systems and Industrial and Cogeneration Plants» was very successful. The joint event was very beneficial for all parties. It was the first time that the plenary lecture was given by a member of the German Bundestag (lower house of German parliament). The related discussion was lively and is to be repeated at similar events.

**Working Panel Steam Generators**

Werner Hartwig

Last year the Working Panel «Steam Generators» focused on part load of existing power plants. Particular mention is to be made of those measures at mills or boilers (additional burner in hot mill air, modification at mills or boiler, flue gas by-passes etc.) which finally prevented disconnection of plants from the grid.

Several damage cases at bearing constructions occurred at heat recovery steam generators. Root cause analyses revealed that such damage was mainly due to quick start-ups and large output transients within short periods. The panel will deal with measures in order to guarantee an improved mode of operation.

In future fossil-fired power plants will be needed which allow to be operate power plants in the minimum part load range and with very fast load cycling in order to meet high energy efficiencies. The panel dealt with a new boiler. Drum boilers which use a lot of material limit the flexibility of combined plants. One-through boilers can be the optimum solution for this type of plants. The future boiler is equipped with just one in- and outlet header with steam generation taking place in one cycle (preheating, evaporation, and superheating). The application of finned tube heating surfaces with smallest core tube diameter and the installation of throttles at the water inlet side achieve a high stability of water distribution.

The omission of thick-walled components like drums and connecting lines is very well suited for the above-mentioned new operation profile. The boiler is also characterised by low weight, requires less space and can be assembled quickly due to its modular design. The boiler can also be used as flue gas-side by-pass because of its austenitic materials (dry mode of operation).

The panel also started to renew the VGB Guideline VGB-R 116 «Preservation of Power Plant Systems». The ad-hoc working party decided at the beginning of its work that it is not sensible to just revise the guideline, because preservation comprises additional power plant systems, i.e., systems like turbines and flue gas cleaning equipment has to be added.

A new VGB-Standard dealing with power plant insulation is being elaborated. The ad-hoc working party entrusted will mainly cooperate with the Association of the German Construction Industry (Hauptverband der Deutschen Bauindustrie e. V.) in order to update the existing AGI Q 101.

**Working Panel Fuel Technology/Firing Systems**

Ludwig Müller

The VGB Working Party «Cleaning of Heating Surfaces» finished revising the corresponding instruction sheet which was translated for the first time and is currently being printed together with the German version. Major operating experience of recent years was considered, this applies particularly to the calculation of real fouling, measurement of thermal elements and the application of video cameras in order to achieve condition-based soot blowing.

The proven Technical Conference «Fuel Technology and Firing» took place in Kassel on June 25/26, 2014. The conference programme comprised 12 papers focusing on co-combustion and plant flexibility (load cycling, low load, start-up and shutdown).

A different image was revealed when discussing for the first time operating experience made with imported coals and co-combustion:

- Cutting of government subsidies for biomass utilisation led to decreased biomass co-combustion in the Netherlands, at least for the time being,
- High-sulphur US coal can mostly be combusted only when blended with low-sulphur coal. Some operators have these mixtures blended at Rotterdam harbour,
- Several operators detected increased dust development at transfer points of coal feeding. Dust deposits are intensively cleaned off for safety reasons.

The following issues from the general exchange of experience are to be emphasised:

- A failure occurred at the pressure relief flaps of the boiler funnel of a 1,000 t/h steam generator,
- Primary measures at lignite fired boilers are continued to be taken in order to meet the more stringent emission limit values for NOx and CO and to improve fuel burn-up,
- The dry lignite burners for the Jänschwalde power plant were successfully tested in the Oxyfuel test facility,
- Another 8 biomass burners were installed in the Dutch Amer power plant, unit 9, in order to generate 50 % of heat energy from biomass. Since termination of government subsidies in September 2013, the biomass plant of unit 8 has been idle,
- In Finland the Inkoo power plant will be decommissioned in 2014 (3 x 250 MW,). By 2025 no more hard coal is to be used for electricity generation in Finland.

**Working Panel Fluidised Bed Firing Systems**

Ludwig Müller

From the general exchange of experience it can be reported:

- In one circulating fluidised bed combustion plant (Lurgi type) the installation of an excentric cyclone immersion tube with inside guide sheet resulted in several improvements like increased degree of separation, less consumption of quartz sand and increase of steam generation from 135 to 145 t/h.
- One fluidised bed combustion chamber lined with SiC plates suffered from damage (one third) when being started up too quickly (the flue gas temperature dropped within five minutes by 400 K).
- Sewage sludge co-combustion (150,000 t/a) was retrofitted to a circulating fluidised bed combustion systems with steam output of 400 t/h.
Revision of the VGB Instruction Sheet VGB-M 219 «Refractory Linings in Fluidised Bed Combustion Systems» is likely to be completed by the beginning of 2015. Co-operation with refractory lining manufacturers turned out to be of advantage.

This year the 7th Workshop on «Fluidised Bed Combustion Systems» was jointly held with the conference of the VGB Working Panels «Steam Generation Plants» and «Industrial and Co-generation Stations». It took place in Weimar on March 26/27, 2014 with 10 papers focusing on corrosion/erosion and co-combustion, presented by the Panel «Fluidised Bed Firing Systems».

Working Panel Thermal Waste Utilisation
Ulrich Schirmer

The national expert committee – headed by the Federal Environment Agency (UBA) – prepared revising the BREF-WI (Waste Incineration) according to the requirements of the BAT Conclusions. Ambiguous, not clearly defined statements are to be eliminated. The first meeting for revision is to take place in Seville at the end of November/December 2014. Four working groups of the expert committees will draft proposals for amendments by September. Topics are currently being identified, i.e. the role of urea in SNCR, combustion conditions, continuous Hg measurement, continuous PCDD measurement (required by France), harmonisation of the individual conditions, continuous PCDD measurement, continuous PCDD measurement (required by France), harmonisation of the individual policy of the EU states and form of the sur-tax. The first meeting for revision is to be held biannually in order to better prepare the event, i.e. a comprehensive programme at two conference days with about 15 to 20 papers is to be offered. The next conference will take place in Kassel from October 28/29, 2014.

Contact groups for the entire panel focus on one topic each thus triggering PR, conference papers and VGB-Standards. The work was structured as follows:

- Work focusing on safety: Implementation of general safety rules, Work organisation
- Operation organisation: Comparison of individual solutions, Operating manuals, Staff organisation, Check lists
- Isolation: Concretisation of general rules, Discusions with authorities
- SNCR: Evaluation of experience with own tests/modification, Elaboration of further testing programmes for optimisation, Elaboration of investigation programmes for recording ammonia that is not reacting usefully, Preparation of a research project
- Mercury: Determination of sources, Measures to be taken when Hg occurred, Legal measures (problematic peaks are due to illegal dumping)
- Retrofit for waste gas cleaning systems: Competence matrix for operators
- Measurement and supervision: Possibilities to adjust measuring procedures and equipment to DIN 14 181, (Calibration of equipment beyond the scope of experience of DIN)
- Turbiners: Dissatisfaction with manufacturer support, Working quality and service providers, Typical mistakes, Data collection

The results are reported at the panel meetings and the VGB Conference «Thermal Waste Utilisation».

Working Panel Industrial and Co-generation Stations
Werner Hartwig

The panel deals with a broad variety of subjects.

One research project was mentored 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.
The project is dealing with seawater FGD that is often jointly operated with desalination plants and the disposal of brine via oxidation basin which increases environmental compatibility. The addition of brine increases the capacity of the oxidation basin. Pre-measurements of kinetic parameters in laboratory and in a large-scale plant were carried out in order to enable simulation of hydro dynamics. The influences of flow and gasification intensity can be presented.

Three requirements have to be met to allow water to flow back from the oxidation basin into the sea:

- The oxygen content of water must be > 80 % of the saturation value,
- The sulphite content of water must be < 0.01 mmol/l and
- The water pH must be > 6.0.

Yet the following conclusions can be drawn:

- Brine has nearly always positive effects on the oxidation basin,
- At low sulphur loads is it also more advantageous to use brine as substitute instead as additive, because further savings can be expected,
- In case of high-sulphur loads, functioning of the plant can only be guaranteed through additive application of brine,
- Brine should be preferentially added at the beginning of the basins due to its high alkalinity,
- At low temperatures, the sulphite content is the relevant design parameter.

The project is to be terminated in the course of the current year.

The panel is dealing with possible retrofit measures needed for meeting the emission limit values of the new 13th BImSchV (Ordinance on the German Federal Emission Control Act) due to the impacts of burning high-sulphur US coals on FGD and low load operation. Impacts to be expected and to be observed for flue gas cleaning were determined.

Fig. 2: Erosion of an L-0 blade.

Technical Committee Machines

Peter Richter

The Technical Committee «Machines» coordinates the Working Panels «Steam Turbines», «Gas Turbines» and «Cooling Systems in Power Plants». The committee also cooperates with other technical committees due to the variety of tasks, i.e. mainly the Technical Committees «Materials and Quality Supervision», «Control and Instrumentation and IT», «Steam Generators» and «Emissions/Immissions» as well as «Noise Control».

The following can be reported from the general exchange of experience (Figure 3):

A report was given about one power plant in the lignite area: so-called laser cladding was successfully carried out at the guide vane supports of the LP turbine for the L-1 and L-0 blade rows. Erosion corrosion was clearly reduced. (Figure 2).

It was reported about the leakage of a partial joint of an 800 MW steam turbine. The leakage was detected at the HP/MP casing. It escaped so much steam at the partial joint that the unit had to be shut down. Investigations by the turbine manufacturer (among others FEM calculations) revealed that the housing screws still had reserves and that the leakage could be eliminated by fastening the screws. The proposal of the turbine manufacturer was discussed together with VGB experts and realised. The unit could be reconnected to the grid after an interruption of about one week since the joint was sealed metallically without using sealing material. A report was given about a fire in one of the new hard coal-fired power plants. The fire was caused by a leakage (screw connection) at a hydraulic system of the by-pass stations. Repair of the damage delayed decommissioning of the unit by several weeks.

It was reported that a feedwater drive turbine was retrofitted from friction to magnetic bearing. The retrofit is supported by the regional partners (Zittau university and original equipment manufacturer of the turbine).

Magnetic bearings have the following advantages:

- No mechanical contacts, i.e.
- No friction and no wear,
- Reduction of losses at the bearings,
- No lubricant/cooling agent needed,
- The bearing force can be controlled automatically,
- It is possible to automatically compensate imbalances.

The plant will be equipped with an online-diagnoses-system for early detection.

Working Panel Steam Turbines

Peter Richter

The influence of the position of the dewatering valve on condenser pressure was checked online because the vacuum decreased. When opening the HP dewatering line, the condenser pressure changed immediately. Thus the dewatering lance was isolated and it was ascertained that the line had no cracks but an irradiated area at the dewatering lance below the inflow of the HP dewatering.
A crack of a length of some 25 cm was detected at the bottom part of the by-pass valve on the control valve side in one plant within the scope of vacuum search at an isolated by-pass valve. The damaged piece was cut out, weld-repaired and heat-treated at the side. The damage was caused by thermal shock cracks in GS17CrMo55 caused by an improperly isolated dewatering line.

The rotor of a feedwater drive turbine was detuned by tip-timing – a kind of blade de-tuning to modify the own resonance of blades – in order to achieve good part load behaviour. Very good results were achieved with this measure, i.e. minimum unit load of the turbine was reached without having to activate the electrical feed pump.

A report was given about the damaged protection of a compensator in the MP-LP overflow line. Parts of the compensator highly damaged the blades of LP1. The damage was mainly due to water that had been accumulated between protection cover and compensator (invisible corrosion attack). Dewatering was improved by a new arrangement of a de-watering boring.

A report was give on a solar plant in Abu Dhabi. The plant was purged, but the necessary steam parameters were not met. Therefore, traces of impaction at turbine blades were detected which has been caused by impurities that had not been removed. It was pointed out that such impurities can even destroy the steam strainer.

When discussing the ordinance on operational safety (Betriebssicherheitsverordnung BetrSichV) it was determined that one plant was operated with too high live steam compared to design parameters. Since 1992 the plant had been operated with 107 % load. Subsequent calculation revealed that above 200,000 operating hours problems would occur with blade notches La 1-6 as well as cracks in valve housings. The components were replaced.

A report was given on a 600 MW peak load plant. A crack of 3 mm was detected at the HP rotor in the area of the balancing piston below circumferential 45°. This area was rebored. The damage is probably due to gland steam. When shutting down the turbine, the own supply of gland steam is switched to external supply with a temperature drop of 210 °C. Besides, the external supply system was insufficiently dewatered.

A report was given on four turbines of identical design, and with identical vibrational behaviour. All four turbines displayed a vibration peak at irregular intervals. Vibrations start at the external bearing of the turbines. It is most likely that the vibrations are due to carbonisation of the oil scraper ring.

Working Panel Gas Turbines

Peter Richter and Dr. Manfred Freimark

The panel focuses on the exchange of experience and knowledge related to the operation, maintenance, modernisation, lifetime extension and damage at gas turbine series and individual gas turbine models of different capacity. The Working Panel «Gas Turbines» and BDEW discussed the excessive NOx emission limit values for gas turbines due to the transposition of the EU EED into national legislation in May 2013. The EU Directive was transposed through the amendment of the 13th BImSchV. According to § 8 (11) exemption from emission limit values is only permitted for those gas turbines which are used in clearly defined cases of emergency up to 300 operating hours (e.g. hospitals, fire brigade, rescue teams like the German THW etc.). VGB and its member companies are of the opinion that in the light of the challenges of the German «Energiewende» (turnaround in German energy policy) older available back-up-plants (limited to 300 operating hours) are to be considered vital and as relevant parts of the power plant park in order to keep up system stability. The VGB Working Panel «Gas Turbines» and BDEW had extensive discussions with BMU due to the often economically unjustified retrofit of back-up-plants («wet primary measures») with less operating hours for an NOx emission limit value of 150 mg/Nm³ in case of natural gas firing and 200 mg/Nm³ in case of FOEL firing according to § 8 (10) and § 8 (2) with the new stipulation of NOx- and CO emission limit values for part load operation of gas turbines in the range of some 40 to 70 % ISO nominal capacity. During these discussions the parties also debated about the application of the aggregation rule according to § 3 and definition of start-up and shutdown procedures of gas turbines according to § 22.
As regards the discussion about the realisation of «wet» primary measures for the reduction of NOx emissions through the injection of water, steam or «water-in-fuel-emulsion» mode of operation in the case of liquid fuels, VGB doubted in its case study (R03.1), laid out as position paper, the «integrated environmental protection approach» as pursued by BMU. According to this study, for a 100 MW plant it is demonstrated that due to the larger specific heat consumption, i.e. additional CO2 emissions, and increased CO emissions as a consequence of deteriorated combustion, an integrated environmental benefit, as intended by the ministry, will not emerge. VGB and BDEW also complained about the short deadline in connection with the «Energiewende», i.e. by January 1, 2014 a decision had to be taken about shutting down back-up-plants up to 2,500 MW until December 31, 2023 with a residual utilisation of 17,500 operating hours as of January 2016. BDEW and VGB suggested to delay the deadline for another twelve months. First experience of VGB member companies showed that individual gas turbine operators had talks with their responsible state authorities about § 8 «emergency operation» in the context of system relevance and that individual moderate emission limit values with a sense of proportion can be achieved.

Transposition of the EU-IED (Industrial Emission Directive) into national legislation was among the most prominent projects of the energy business in 2013. Transposition of the EU-IED was realised by amending the 13th BImSchV with partly significant tightening of the NOx emission limit values for gas turbines as of 50 MW rated thermal output through application of the aggregation rule. The scope of the tightening of NOx emission limit values for existing, old and planned gas turbines, as had been announced by BMU and UBA, caused the VGB Committee «Machines» and its associated Working Panel «Gas Turbines» to actively accompany this important project at a very early stage. VGB bodies jointly with other associations like BDEW and VDMA brought in their expertise that is asked for and appreciated by politics. VGB passed on several position papers outlining VGB’s rational arguments in several workshops with BMU and BMWI and underlined VGB’s willingness for active cooperation in the moderate implementation of the EU-IED. VGB managed to ease initial extreme positions concerning the emission limit values. VGB outlined the meaning of existing and new gas turbines for realising the German «Energiewende» and the operational consequences from extended flexibility as well as additional increase in efficiency. Although VGB did not manage to enforce gas turbine operator interests for all new emission limit values due to the NEC environmental policy as regards national maximum emission limits, the working panel considers the amendment of the 13th BImSchV a good result thanks to the committed cooperation of VGB bodies (ELV table on the 13th BImSchV, Rev 03.1).

The Working Panel «Gas Turbines» commented jointly with BDEW on the first draft of an EU Directive on the limitation of air emissions in «medium furnaces with thermal capacity 1 to 50 MWt».

More low cycle fatigue (LCF) damage at components of the hot gas path of heavy duty gas turbines can be observed because existing gas turbines are increasingly marketed for grid services like primary control, secondary control and minute reserve which involves more non-steady stress (Figure 4).

Operators complained again about quality deficits in service and spare parts. Increased blade damage caused by foreign objects (FOD) were detected upon inspection of some gas turbines. These damage cases could not be explained and caused gas turbine operators to cooperate with original and non-original equipment manufacturers (OEM, non-OEM) in order to improve quality management upon reassembl and the preparatory work prior to recommissioning (Figure 5).

Within the scope of lifetime extension measures, three-stage process air filter systems and modern blade profiles were retrofitted to gas turbines which resulted in considerable efficiency improvements. The extensive exchange of experience on this issue was a valuable basis for decision making for operators.

Gas turbine operators started jointly with OEM to develop concepts for turbine utilisation in the lower load range, i.e. 40 to 70 % base load, because according to authorities new emission limit values have to be defined for this range according to the 13th BImSchV, § 8 (2), i.e the load range was not regulated in terms of emission limit values before.

Within the scope of European standardisation on quality parameters for fuel gas, the working panel together with representatives of the EUCEN project committee 408 and gas turbine manufacturers dealt with the requirements of bio methane as regards the total silicium content to be determined for gas turbines. VGB PowerTech e.V. formulated a recommendation for CEN 408 which had been harmonised with some OEM concerning the total amount of Mg, Ca and Se due to the importance of future regulations for the operation of older and state-of-the-art gas turbines. Knowing that the variety of fuel gases fed into the European gas transport system will increase and that important combustion parameters (Wobbe index and methane number) will vary over a large range, the working panel dealt in more detail with this issue at its meetings and the VGB Conference «Gas Turbines and Gas Turbine Operation 2013». In the context of the «Gas-Quality-Harmonisation» (GQH) of CEN 408, gas turbine operators and OEM were advised in due time to discuss with gas turbine manufacturers consequences to be expected and measures to be taken at combustion systems for gas turbines.

![Fig. 5: Impact damage at turbine row 1 detected after some 3,000 operating hours with blade fracture and removal of thermal barrier coating.](image-url)
During the reporting period 2013/2014 some members of the working panel and OEM representatives continued revising the VGB Guideline VGB-R 121 (now VGB-S-121) «Supervision-, Limiting- and Protection Devices on Gas Turbine Systems».

Within the scope of the VGB Project «Future VGB Phase II» to increase efficiency of the committee and panel work, a short-term comprehensive survey was conducted among panel members regarding the requirements of panel members and/or member companies on committee and panel work. In this context the requirements to be met by the Technical Committee «Machines», that manages the Working Panel «Gas Turbines», were formulated as well as the time of panel members for panel activities.

Working Panel Cooling Systems in Power Plants

Wolfgang Czolkoss

The Panel «Cooling Tower Systems in Power Plants» 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.

Modifications at the air intake of cooling towers and model calculations were carried out in order to decrease the cold water temperature. All these measures are assessed differently. The further development is being observed.

Future back cooling systems will be mainly hybrid cooling systems or cell cooling towers for reasons of licensing procedures. The new requirements on acceptance measurements of hybrid cooling towers were discussed. This applied in particular to the definition and assessment of «plume freeness». The existing regulations DIN EN 14705 and CTI ATC-150 do not contain clear requirements. Therefore, additional reference is to be made in a new VGB-Standard on the planning and operation of cooling towers. This new Standard will replace the former VGB guidelines VGB-R 129 and VGB-R 135.

The Working Party «Micro Biology in Cooling Systems», jointly set up with the Working Panel «Chemistry of Water Treatment», participates together with BDEW in drafting an ordinance on the operation of evaporation cooling systems. This ordinance was required following the legionella epidemic in Warstein/Germany in the spring of 2014. Microbiological investigations proved that high power plant cooling towers are not causing infections. Further microbiological investigations on different issues are planned together with an independent institute for microbiology and hygiene. Objections were raised concerning the draft of the new VDI-Standard «Open recoller systems – Securing hygienically sound operation of evaporative cooling systems (VDI Cooling Tower Code of Practice)».

The revised VGB-Standard 455 «Cooling Water Guideline – Water Treatment and Use of Materials in Cooling Systems» will address in addition to corrosion problems and cooling water treatment also different problems occurring upon the operation of cooling systems. Reference is also made to guidelines, standards and regulations. Work on that extended edition will probably be finished at the beginning of 2015.

The exchange of experience is another important aspect of the half-yearly panel meetings where panel members reported about vibration problems at fans and cooling towers, blockages of cooling water inlet by jelly fish, fracture of a flow guide in the clean gas duct, advantage and disadvantage of film- or grid type fills.

Technical Committee Electrical Engineering, I&C and IT

Jörg Kaiser

The Technical Committee «Electrical Engineering, I&C and IT» and its associated working panels deal with current daily issues (e.g. generator damage, transformer monitoring, modernisation of I&C, quality supervision) and coordinate research projects. Besides, the technical committee deals with strategic issues (e.g. concepts for E and I&C projects, requirements to be met by the interface power plant-grid, consideration of E and I&C in connection with renewables-based generation) and elaborates VGB-Standards for the field of electrical engineering and I&C. The internal structure is shown in Figure 6.

KELI (VGB Conference «Electrical Engineering, Instrumentation and Control, Information Technology»)

This year’s KELI took place in Landshut from May 6 to 8, 2014. More than some 400 visitors and exhibitors took part which showed that the concept that has been pursued since 2004, i.e. the close connection between papers held by operator representatives and technical papers delivered by manufacturers and an accompanying technical exhibition, is meeting the demand of the industry. The technical committee and its panels elaborated a programme comprising issues of

- Electrical engineering
- Control engineering
- Information processing that dealt with the complexity of process control and the requirements of business.

KELI 2014 was also a platform for discussing technical challenges of the current energy policy in Germany and Europe. Issues like

- Integration of renewable energies into the power grid, (system stability, challenges on electrical and control technology and power plant information systems) as well as
- Requirements on electrical and control technology and power plant information systems for all generation options were addressed in papers and discussed by conference participants.

Fig. 6: TC «Electrical Engineering, I&C and IT». Structure and main working topics.
It has become a good tradition to host students at the KELI with a special students’ programme. Students’ travel and accommodation costs are being funded by VGB.

Research projects

The research project «Wear investigation model» for primary and secondary controlled thermal power plants in the ENTSOE grid is being carried out by Rostock university, i.e. the influence on controllable power plants caused by the feed-in of fluctuating wind and solar power is being investigated. The project is aiming at the determination of the effects on control energy, i.e. the lifetime of related components as well as the timely estimated efficiency of thermal power plants. Gas- and steam turbine plants as well as hard coal- and lignite-fired power plants are being investigated with dynamic simulation.

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

Working Panel Electrical Equipment

Jörg Kaiser

Different VGB-Standards are under way. The issue of quality is still of central importance. The current internal structure is shown in Figure 7.

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.

Quality supervision of generators describes as new VGB-Standard VGB-S-166 testing during manufacturing and lists testing methods and guide values recommended by VGB. Work was terminated and the VGB-Standard is available.

The group did also legwork for a new VGB-Standard on the conservation of generator turbo sets.

The VGB-Standard on the improvement of H₂ safety at generators (VGB-S-165) is currently being updated.

Transformers

Ageing management, monitoring options, and methods of large-scale transformers are in the focus. A data collection is available on the issues of on-line monitoring and «transformer instrumentation». A table comparing maintenance and monitoring measures in individual companies was elaborated. A project group elaborates criteria for assessing the quality of generator oil, oil preparation and handling along the supply chain including factory testing. The information is to be involved in a VGB-Standard.

Motors and drives for frequency converters

A new VGB-Standard VGB-S-168 «Implementation guideline for motors and variable-speed power drive systems» was drafted. Apart from experts, representatives of renowned manufacturers cooperated in the group. This new edition will replace the former ZUM and ZIU of VDEW-Verlag.

Working Panel Control and Instrumentation and IT

Jörg Kaiser

Standards

The former VGB Guideline VGB-R 123C1 «Volume I Measurement Technology» was checked for up-to-dateness and its demand for revision was determined. Different parts, especially with a view to new materials for impulse lines, immersion sleeve etc. will be modernised. A Project Group «Measurement Engineering» was responsible for revision of the VGB-Standards VGB-S-170-43 by the end of 2014.

Discussions with manufacturers and service companies

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 R170 series. The development of simulators was also on the agenda because simulators are of particular importance in the commissioning of plants. It was proven in different projects jointly carried out by Kraftwerks schule, I&C supplier, process technology and operators that the quality of commissioning is improved by simulators and that at the same time schedules are being met (virtual commissioning of main I&C by application of emulator systems).

Project Group SIL – Safety Integrity Level for Safety-oriented Applications

The Safety Integrity Level (SIL) is of particular importance to I&C implementation of safety-oriented applications for new plants and in modernisation projects. A project group comprising experts from process technology and I&C was set up. The group is to elaborate concrete solutions for analysing hazards. Based on the machine guideline and the guideline on pressure vessels as well as relevant standards, the trip criteria for safety cycles were recorded and a table was drafted suggesting SIL classes (VGB-S-008). Comprehensive explanations detailing the SIL classes will enable alignments and comparison with project-specific site conditions.

Fig. 7: Working Panel «Electrical Equipment».
European Working Group Power Plant – Grid

Jörg Kaiser

The European Working Panel «Power Plant Grid» is available to all VGB members for any issue related to the interface power plant – grid. Figure 8 shows the internal structure and major topics.

The following issues need to be dealt with priorly:

– European network codes: development of joint opinions on the network codes by Entso-E in close cooperation with EURELECTRIC. Major relief was achieved for the network code «Requirements for Generators» that is most important to operators.

– Contracts at the interface power plant – grid, e.g. redispatch, supply of reactive power, shaping of the process on national level and synopses about the European status.

– Reaction on German requirements from laws and ordinances, e.g. EnWG amendment, determination and consultation procedure of Federal Grid Agency (BNetzA) in the PG «German Regulation».

Research Project System Stability

The above-mentioned research project was investigated by the Stuttgart and Rostock universities. The question arises concerning the effects on future secure reliable electricity supply due to the increasing feed-in of renewable energies. The question has to be answered whether there are physical or system-technical limits restricting stable operation of the entire system power plant – grid. The research project was completed in the spring of 2014. Currently VGB is deriving the further procedures following the project results.

Technical Committee
Civil Engineering

Jürgen Lenz

Following the new committee structure, the Technical Committee «Civil Engineering» and its associated Panels «Constructional Concepts/Specific Civil Solutions» and «Structural Maintenance/Condition Monitoring» restarted as early as at the end of 2013. The constituent meetings were held by December 2013.

The first mentioned panel will focus on issues related to new constructions (as well as retrofit and modernisation) of all power plant specific facilities (e.g. thermal power plants and plants for renewables). The second panel is to deal with lifetime management of individual power plant buildings.

The current revisions of VGB-Standards and instruction sheets (later also to be converted into VGB-Standards), i.e. R 604 «Application and Installation of Anchors in Concrete Foundations», VGB-R 609 «Application, Design and Quality-assurance Criteria for the Use of Fibre-reinforced Plastics in Power Plant Construction», VGB-B 602 «Condition Monitoring of Stacks», and VGB-M 642/643 «Industrial Stacks» will be terminated by mid-2014 as scheduled. These Standards provide important information for practical application in power plants in order to meet authority and safety requirements.

A VGB-Standard «Structural Maintenance/Requirements on Condition Monitoring» was considered as urgently needed. A draft is to be made by mid-2014. A corresponding project group is to be set up by the Panel «Structural Maintenance/Condition Monitoring».

The Hamburg-Moorburg coal-fired power plant, which was commissioned in 2014, generates an electrical net output of 2 x 820 MW (with 2 x 120 MW additional district heating capacity). The plant is among the most efficient, state-of-the-art plants of its kind, which does not only refer to plant- but also to civil engineering, because of the trend-setting solutions that were selected. Mention is to be made of the hybrid cooling tower, the stack made of reinforced plastics and the coal storage with a wooden roof construction (Figure 9).

Technical Committee Materials and Quality Supervision

Olaf Baumann

During the reporting period, the following issues were on the agenda of the Technical Committee «Materials and Quality Supervision»:

Flexibilisation, lifetime concepts

– Material developments, research projects for highly efficient power plants and future power plant generations,
The committee dealt with the following research projects:
- Development of a new generation of 12% Cr steels
- 725 °C high-temperature material test I and II at GKM
- COORETEC investigation at alloy 263 and alloy 617 about creeping behaviour and ageing
- Deformation and strength behaviour of alloy 740
- Evaluation and extrapolation procedure on creep strength of high-temperature steels

The committee discussed the following issues related to power plant flexibilisation:
- Lifetime concepts, creep fatigue, storage technology
- R&D project «Partner steam power plants»
- VGB Workshop «Power Plant Flexibilisation» in Velen on September 23/24, 2014

The Working Party «Calculation Methods» focused on the issue of flexibilisation.

The following damage cases were evaluated:
- Damage at an austenitic tube material in the reheater area
- Blade damage by failure of air preheater

As regard renewables, the committee dealt with:
- Support structures of wind power plants
- The FeloSeFI (Fatigue Life Load Sequences Effects and Failure-probability driven Inspection) research project
- Standardisation procedure for weld connections at wind power plants

The next VGB Workshop «Material & Quality Assurance» is to take place on April 22/23, 2015.

Working Panel Pipe Systems, Valves and Pressure Vessels

Christian Stolzenberger

The working panel focused on the exchange of experience, revision of VGB-Standards and coordination of R&D.

The butterfly valve of a cooling water line with single side locking was wrongly assembled. Thus it was no longer safe to patrol the cooling water line. The valve is replace by a device that can be locked on both sides. The panel recommends valves that can be locked on both sides as standard.

The wedge of a live steam valve (535 °C/105 bar) showed a broken wedge sealing surface. The damage was due to a non-buffered weld connection and/or too high weld energy between the base material P91 and hard facing made of Stellit 6, which resulted in a deviation of hardness which was too high. It is recommended to use alternatively hard facing made of Stellit 21 or other materials without buffering. More details can be obtained from the VGB Guideline R 540 «Steam Cooling».

Fig. 9: Moorburg power plant, Vattenfall Europe Generation AG.

Strain-induced crack corrosion occurred at the phase transition of a finned wall made of the material 15Mo3. It is most likely that the damage was due to insufficient welding and a damaged oxide layer. Wedge-type separations occurred on the tube inside which resulted in ovality of the tube and finally to rupture. A pattern was made in order to detect the ovality of tubes.

When pressure testing an auxiliary condenser line, an area of roughly palm-size opened after about half of the testing pressure. The damage area was right behind the control valve and had a very small wall thickness. Reduction of wall thickness is probably due to erosion corrosion caused by two-phase flow after pressure reduction. It is recommended to use higher quality steel or even a protection cover in areas with two phase flow to avoid erosion corrosion.

The panel revised about two thirds of the VGB-Standard VGB-S-107 «Ordering and Designing of Fittings in Thermal Power Plants». The panel will recommend not to apply DIN EN ISO 4126-5:2013-12 «Safety devices for protection against excessive pressure - Part 5: Controlled safety pressure relief systems», because this standard is deficient concerning the construction of safety valves. However, this does not apply to DIN EN 12516-2:2004 «Industrial valves - Shell design strength - Part 2: Calculation method for steel valve shells» which will be incorporated compulsory to secure the function and quality of safety valves.

Within the scope of the VGB Research Project 369 «Optimisation of stuffing box stem seals in fittings as far as function and emission behaviour through surface coating is concerned» a possible connection was detected between storage moisture of stuffing box and leakage rate as regards sealing of stuffing boxes.
The philosophy of quality assurance of new constructions was presented and successfully demonstrated at a concrete project. One major aspect is the adoption of quality and safety standards from the petrochemical industry. Implementation confirms results of studies on quality management, i.e. every Euro invested in quality avoids additional costs that can amount to up to 40% of total costs. Irrevocability of licenses was of particular interest. The power plant operator himself had to file a law suit against the license in order to achieve the status of irrevocability.

The VGB-Standard VGB-S-013 «Manufacturing, Construction and Monitoring of Assembly of Steam Boilers» was revised and is now in consultation with FDBR.

Technical Committee Maintenance Management

Heinrich Grimmelt

The technical committee concentrated on the exchange of experience. The committee members reported about experience with certain technologies, with strategies but also about damage cases, their root cause and repair.

It is also common practice to invite companies to the committee meetings which can offer innovative support and solutions in the field of service and maintenance. Often new approaches are identified for old problems.

The committee will concentrate on qualification of own personnel as well as the requirements of the new BSVO.

VGB Conference «Maintenance in Power Plants 2014»

This year’s VGB Conference «Maintenance in Power Plants» took place in the Maritim Congress Center in Dresden on February 19/20, 2014. (Figure 10)

More than 80 exhibitors and 320 participants met the expectations of the technical committee.

«Calls for papers» sent out prior to previous conferences were omitted this year, because an editorial committee had been set up to draft lecture titles and asked experts to deliver corresponding papers.

The future of maintenance was among the topics. An overview was given on the changed marginal conditions for the operation of power plants and maintenance.

The issue was intensified in two expert discussions. Although simultaneous translation was offered, the number of English speaking audience was limited.

Workshop «Cold End»

Failures in turbine condenser result in capacity and availability losses. Fouling and deposits in cooling tubes disturb heat transfer and deteriorate efficiency. Corrosion can be triggered resulting in tube leakages and early new tubing. Thus, operation- and condition monitoring as well as maintenance of the turbine condenser are important contributions towards efficient power plant- and turbine operation.

In the workshop, suppliers, service companies and operators of steam turbines of the energy economy and other industries were brought together in order to discuss the requirements and options for optimum operation of turbine condensers and to present and discuss the partly strongly changing marginal conditions (idle operation, part load etc.). Monitoring options and tools for the early detection and elimination of failures and for maintenance of problems were discussed. The workshop focused on the exchange of experience in order to identify and exploit individual measures to improve cost cutting.

The workshop took place in Papenburg on November 26/27, 2013 with 55 participants and 13 papers.

Technical Committee Power Plant Operation

Jörg Kaiser

The technical committee focuses on operational and strategic topics within the scope of the operation of electricity generation plants and co-ordinates the activities of its associated working panels.

Issues like quality of supply, maintenance of power plant components, and assessment of current events are of particular significance for plant operation. These are the modules that guarantee efficiency and competitiveness and form the basis of cross-company activities. VGB offers effective tools, e.g. VGB-Standards and data bases, for event and damage management to support successful and efficient activities.
From the strategic point of view, European issues, that are more and more directly affecting power plant operation, are of special importance. Examples are European emissions and immissions threshold values and requirements to be met by the interface power plant – grid.

Early harmonisation of impacts of planned and new legal requirements (Europe and Germany) on power plant operation is one of the focal issues of the committee.

Industrial safety, meeting of authority requirements (e.g. environmental protection), training and advanced training of power plant personnel, knowledge management, and trainee concepts are important subjects to improve the long-term economic efficiency of generation plants.

Working Panel Training of Plant Personnel

Hans-Werner Otte

In the reporting period the working panel has been dealing with current developments in the field of qualification of plant personnel. Moreover, a regular exchange of information and experience on the training and education programme with KRAFTWERKSSCHULE e.V. (KWS, Power Plant Training Center) has been maintained.

In detail, the working group discussed the following topics:

Revision of Power Plant Operator Training

The Working Group «Revision of Power Plant Operator Training» has completed revising the corresponding course recommendation during the reporting period. The course recommendation complies with the requirements of modern training with today’s tasks in power plant operation. The review has been conducted as part of an intensive dialogue between businesses, training institutions and the Chamber of Commerce (Handelskammer) in Germany. Thereby it has been guaranteed that all relevant groups have been involved in this project. The working group considered this an important result. The presentation of the new framework training plan has taken place on April 8, 2014 at KRAFTWERKSSCHULE e.V. The new VGB standard provides, in the opinion of the Working Group «Training of Power Plant Personnel» a milestone in the training for certified power plant operators.

Fig. 11: Different views of the power industry.

Shift schedules

The design of shift schedules is a huge challenge for managers of power plants. Those schedules have to comply with various operational requirements, economical challenges and the acceptance of employees. The staffing during the times of vacation or illness can result in problems, i.e. may lead to understaffing during shift terms. Modern shift schedules must be designed in accordance with the requirements of the current operational tasks, with seasonal operation of plants in today’s energy market so that under- and overstaffing will be specifically avoided. The interests of the employees must not be disregarded. The working group will develop a «toolbox for structuring a flexible staff deployment in shifts of fossil-fired power plants» and provide this as soon as possible.

Knowledge management, knowledge transfer and maintenance of technical knowledge

Knowledge management deals with the acquisition, development, transfer, storage and use of knowledge. The working group examined the applicability of methods of knowledge management for the daily requirements of power plant operation.
The transfer of knowledge between junior and senior staff is vital for any business. This is especially true today with the current structural changes and optimisation programmes. The topic dealing with the maintenance of technical competence of the employees as part of knowledge management is a vital task for power plant management. Management has to ensure regular training and instructions for the operation of the power plant of the plant operators. The working group will provide methods and tools for the issues.

**New VGB-Standard issued**

The new VGB-Standard relating to competence management «Training 4 Future» is available now. This new VGB-Standard can be ordered on the VGB Homepage «Publications/VGB-Standards».

**Working Panel Plant Management Systems**

**Jörg Kaiser**

The panel 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 man, data and information systems in order to use IT as management tool.

The current issues of the Panel «Plant Management Systems» are:

- Transfer of experience of conventional generation for the IT support of business processes related to renewables-based generation
- IT security: pursuing of the current status, co-organisation of workshops
- Presentation and assessment of costs and benefits of plant management systems.

**IT safety**

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. The concept is described in the VGB-Standard S-175 IT «Security for Generating Plants». The issue is permanently on the agenda and checked for updates.

A project group comprising operators and experts was set up due to the assessment of the panel and the problems of «STUXNET» in order to update and advance the former VGB-R 175. Work on the guideline showed that the activities for treating risks and processes need higher priority, particularly in the fields

- Determination of protection
- Analysis of threat
- Risk analysis

Revision of VGB-S-175 was completed and the new Standard can be obtained. The new structure comprises general documents, catalogue of requirements and recommendations for action.

**Working Panel 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. Last year more interested VGB members from east Europe participated and cooperated in panel activities. A total of 838 power plant units are cooperating in KISSY with an installed gross capacity of some 278 GW. The new VGB member LATENERGO (Latvia) is interested in KISSY and participation in the exchange of experience.

**VGB-Standards**

VGB-Standards like «Basic Terms of Electricity Generation» (VGB-S-002-T-01) are regularly updated, because international influence and the constant change within energy supply are taken into account. The analysis levels of grid operators were added to the two well-known opinions of power plant operators and load dispatchers (Figure 11). New commercial parameters, resulting from the opinion, are included in the VGB-Standards (VGB-S-002-T01, VGB RV 808).

**Hydro power plants**

The Project Group «Availability of Hydro Power Plants» comprises international members of the VGB Technical Committee «Hydro Power Plants» and the European Working Group «Performance Indicators». The group establishes the principles for cross-plant availability statistics for hydro power plants. The successful adoption of availability statistics in KISSY was terminated. Currently six countries (AT, CZ, DE, LU, PT, ZA) with 187 turbo sets are cooperating, covering the years 2005 to 2013. The VGB Guideline «Hydro Power» from 1992 was transformed into the VGB-S-002-T02 and revised. The project group will be dissolved after publication of the VGB-Standards.

**Wind power plants**

The Project Group «KISSY/Wind Energy» comprises of international members of the VGB European Working Groups «Wind Energy» and «Performance Indicators». The group is to set up an event data base for recording unavailabilities of wind power plants. Weak points are to be identified in order to make improvements. Availability parameters will be defined and evaluated in a second step. First assessments show the frequency of events of wind power plants. The large number of short-term failures is striking. Figure 12 and Figure 13 present the unavailability of wind power plants.
R&D projects

Jointly with the Dutch company DNV GL the panel conducts the research project «Reliability Indicators with KISSY». The final report is available (http://www.vgb.org/shop/tw104.html) and confirms that KISSY offers a sound data base for calculating reliability. The final report takes into account power plant components applied in different plant types like lignite- and hard coal-fired stations, nuclear and combined cycle power plants as well as gas turbines of different age (state of the art and older plants). Currently it is being considered to integrate an assessment method into a new module of KISSY and to extend technical-scientific reports by several parameters and figures. These parameters are to support optimisation of power plant components upon planning as well as maintenance strategies during operation.

Perspective

The power plant information system is being extended by further functions. The following improvements will be made in a first step:

- Extension of an online report assistant by additional filter criteria,
- Addition of more figures,
- Inclusion of RDS-PP (Reference Designation System for Power Plants) to the existing plant designation system KKS,
- Introduction of commercial parameters,
- Modification of the Technical-scientific Reports «Availability» and «Analysis of Unavailability of Thermal Power Plants».

These novelties and further developments are presented in an international workshop.

Working Panel Acceptance and Control Tests

Wolfgang Czolkoss

The Working Panel «Acceptance and Control Tests» is creating a common base of understanding between operator and contractor and makes recommendations for selecting specialised measurement tools as well as assessment and verification methods. The panel members are cooperating in various committees of e.g. VDI or international standardisation committees in order to perform these tasks.

Application of the VDI Guideline 2048 when assessing complex measurements of energy and process technology plants was among the focal issues. It became clear that VDI 2048 is a good tool for process optimisation, however, due to its complex mathematical calculations, which are difficult to understand, it has not been wide-spread in practice. The integration of a quality-controlled, easy-to-handle software tool is inevitable.

The Z-algorithm developed by the Braunschweig technical university for validating measurement data when applying VDI 2048 could be further developed for the dynamical validation of non-steady processes (load cycling), which do not have a mature solution yet. With the integration of developers and users, some concrete steps towards the advancement of VDI 2048 could be initiated.

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.

Fieldbus systems are increasingly replaced by wireless systems with wirelessHART-technology. First operating experience could be discussed. These results show that the wirelessHART technology is obviously more suited for stationary monitoring than for branched acceptance measurements.

Several project groups are dealing with the establishment of new VGB-Standards and revision of existing guidelines:

- The Project Group «Process Quality» is elaborating a VGB-Standard on detailed determination of methods of monitoring process quality. The PG was also involved in the completion of the relevant chapters of the VDI Guideline VDI 4603 «Operation management and process monitoring in power generation and utilities».
- Two project groups are revising the VGB Guidelines VGB-R 130 «Acceptance Measurements and Operational Monitoring of Water-cooled Surface Condensers» and VGB-R 131 «Acceptance Test Measurements and Operational Monitoring of Air-cooled Condensers under Vacuum».

The Project Group «Uncertainties of Measurements» elaborated a new Standard supporting determination of uncertainties of measurements.

Working Panel Reference Designation and Plant Documentation

Andreas Böser

The panel cooperated in drafting the DIN Specification (DIN SPEC) 91303 «Components and structure of a plant documentation system for renewable energy plants». Operators of renewables-based generation plants have to meet different operators’ duties and documentation tasks along the life cycle of a renewable plant. Owing to the intersections with VGB-Standards, it is appreciated that reference is made in DIN SPEC 91303 to VGB-S-823-32 and VGB-B 103.

For the year 2014 it was achieved to adopt ISO/TS 16952-10 into the series of standards ISO/TS 81346-10. This is an important step towards international standardisation for RDS-PP® (Reference Designation System for Power Plants). The VGB Panel «Acceptance and Control Tests» is significantly involved in the development of RDS-PP.
After intensive cooperation with manufacturers, operators, research institutes and maintenance companies of the wind business, the work on the application guideline for wind power plants was successfully terminated. After release it was published in March 2014 as VGB-S-823-32-2014-03-EN-DE. The new application guideline was well accepted on the market; it can be nearly dispensed with company-specific data.

The bilingual German-English edition supports user on international markets and takes into account the global orientation of German companies in the wind business.

Due account was also taken of the dynamic development of the wind business, i.e. a maintenance team (MT) was set up guaranteeing that latest findings and developments will immediately be integrated into the guideline. The maintenance team comprises experts of the wind business and designation systematics. The aim is to provide the technical expertise for extending and maintaining the application guideline.

Revision of the application guide of hydro power (VGB-S-823-31) and the general part for power plants (VGB-S-823-01) have been completed. Findings of VGB-S-823-32 have been involved in both Standards. Similar to the application guide for water and hydro power, a two-column, bilingual edition is to be established.

Revision of KKS Guidelines

Updating of the KKS Guidelines was basically confirmed. However, new edition of the key parts (VGB-B 105) and application guides (VGB-B 106) is abandoned. Necessary changes are to be communicated via «change sheets» which will be generally available and which is to be considered as instruction manual.

Documentation and technical plant data

The documentation guideline VGB-R 171 (supply of technical documentation, i.e. technical plant data, documents) is currently being totally revised. The focus is on the adoption of demand lists which are to be facilitated in order to guarantee easier handling.

The extension of the guideline by the requirements of civil engineering has nearly been completed. Several meetings with representatives of the construction industry took place. The draft was harmonised with the General Association of the Construction Industry, the civil engineering departments of large utilities and the VGB Technical Committee «Civil Engineering». The extensions agreed upon are to be published as annex to VGB-R 171.

European Working Group «Flue Gas Cleaning»

This European working group is mainly focusing on the developments in the BREF-LCP process (Best available techniques REference for Large Combustion Plants) and exchanging operating experience.

Another important item on the agenda is the organisation and selection of topics for the annual Workshop «Flue Gas Cleaning» (WS FGC) which took place in Marseille/France this year. Due to the large spectrum of topics addressed on this year’s WS FGC covering the whole range of flue gas cleaning, numerous international participants attended the workshop. However, the number of German participants is still decreasing. This year it was the first time a paper was delivered on the legal aspects of international contracting when retrofitting or erecting waste gas cleaning plants. The attention was drawn to the fact that particularly the term «scope of work» has to be defined unambiguously.

Possible research projects on the holistic consideration of mercury removal were discussed at the group meetings and the members exchanged experience and views on the retrofit activities in the individual countries.
Targets of the European Union

Ulrich Langnickel and Sebastian Zimmerling

The EU countries set themselves ambitious targets for the extension of renewable energy sources (renewables). With the EU Directive 2009/28/EC, a support scheme for renewables was laid down with binding national targets in order to increase the share of renewables in gross final energy consumption to 20% and in traffic to 10% by 2020. In 2012 the share of renewables to the final gross energy consumption in EU-28 amounted to 14.1% compared to 8.3% in 2004, the first year where corresponding data was available. For wind power e.g. the forecast increase will amount to some 495 billion kWh in 2020 compared to 200 billion kWh in 2012. This is the result of the national action plans of the EU member states for the extension of renewables (Figure 1). The national action plans expect for the electricity sector a share of 34%, for the heating/cooling sector a share of 21.3% and for the transport area a share of 11.3%.

Accordingly, about one third of the total electricity generated in the EU will probably be based on renewables. Sustainable utilisation of biomass in electricity generation is to amount to 232 billion kWh by 2020. Another 1,051 billion kWh is added as heating energy. Biomass means substitute fuels for combustion, biogas generated through fermentation as well as landfill and sewage sludge gas.

The share of renewables in gross final energy consumption has been increasing in all EU members states since 2004. The largest increase occurred in Sweden (from 38.7% in 2004 to 51.0% in 2012), Denmark (from 14.5% to 26.0%), Austria (from 22.7 to 32.1%), Greece (from 7.2 to 15.1%) and Italy (from 5.7 to 13.5%). The maximum share of renewable energies in final energy consumption was recorded in 2012 in Sweden with 51.0%, Latvia with 35.8%, Finland with 34.3% and Austria with 32.1%. The minimum values were recorded in Malta (1.4%), Luxembourg (3.1%), the United Kingdom (4.2%) and the Netherlands (4.5%). In 2011 Estonia was the first member state that reached its target value.

Fig. 1: Share of renewables for the electricity sector in EU-28.
for 2020 (25 %). This was also achieved in 2012 in Bulgaria and Sweden (16 % and 49 %, respectively), Figure 2.

Steering Committee Hydro Power/Technical Committee Hydro Power Plants

Jürgen Lenz and Wolfgang Czolkoss

The Steering Committee «Hydro Power» and the Technical Committee «Hydro Power Plants» have coordinated their requirements and intentions concerning the ongoing activities and those to be prepared or started in the near future.

The preliminary initiative to compare the methods of planning and design of upstream fish migration devices has been finished; the results are to be published on the VGB Homepage as soon as the completed document will be available. The new VGB project group is to be set up to continue mainly considering downstream fish migration and fish protection in general.

The topic «downstream fish migration/fish protection» has been forced by the VGB hydro power bodies especially with regard to the launched European research programme HORIZON 2020. In preparation of an official application (2014/2015) detailed considerations regarding contents and participations are necessary, after this a promising, convincing project description should be developed for submission to the EU.

Two subjects, treated by two appointed VGB project groups, have meanwhile reached an advanced state of elaboration:

The planned VGB-Standard «Evaluation of Components in HPP Exposed to Fatigue» is almost completed, some editorial remaining works still needs to be done. The final technical approval by the TC was intended subsequently, i.e. in the second half of the year. The legal examination by Schluchseewerk has proved the unrestricted acceptance for practical application including insurance law. A release of the Standard (German version and English translation later) is recommended, if possible prior to the VGB Congress 2014.

The VGB-Standard «Functional Safety in HPP» is well advanced. Special attention has been paid to the requirement to guarantee implicit compliance with relevant (here: expressively German) ordinances, i.e. a suitable transposition of official demands into practice should be supported. After finalisation of the draft version, the benefit of an English translation is to be considered.

New projects, i.e. supplementary pumped storage schemes in Germany Schluesselwerk PSP Atdorf – and in Austria – VW PSW Obervermunt II – are being considered or prepared. The approval process for PSP Atdorf is still ongoing. The receipt of permit for the execution of the 1,400 MW plant is expected for mid 2015. For PSW Obervermunt II, planned power output in turbine and pumping mode 360 MW each, the start of construction was scheduled for May 2014. Start of operation is expected for the 4th quarter 2018. Both projects should contribute to the urgent demand for additional storage capacities with regard to the continued development of other RES generation facilities (Figure 3).
European Technical Committee
Use of Renewables and Distributed Generation

Ulrich Langnickel

The European Technical Committee «Use of Renewables and Distributed Generation» is assessing the technical development and possible applications of renewable energy sources and distributed generation technologies. The requirements from operators’ viewpoint are underlined in particular. Since utilisation of renewable energy sources is highly depending on EU energy legislation, a representative of EURELECTRIC is reporting promptly about the general conditions set in Brussels.

The international committee is co-ordinating the activities of the four European Working Groups «Wind Energy», «Biomass», «Biogas» and «Distributed Generation» and mentors different national and international research projects, the results of which are presented and discussed in the groups. Besides, the committee is publishing position papers on the efficient use of renewables and organises technical conferences dealing with the above issues.

The significance and tasks of the committee are increasing due of the large extension of renewables. In the future, system integration of renewables and development/demonstration of storage technologies will play a major role.

The first workshop «Research and Development in the Field of Renewables and Distributed Generation» took place in January 2014. The workshop was aiming at recording the research activities of individual VGB member companies and exchanging information and experience. 11 companies presented their activities. In future, the coordination of the research activities will be intensified by the above-mentioned committees.

European Working Group
Wind Energy

Ulrich Langnickel

Wind power has to be extended urgently by 2020 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 2013, about 23,645 wind power plants were in operation with an output of 33,730 MW in Germany. At that time the installed capacity in Europe amounted to 121,474 MW (compare Table 1) and worldwide to 318,137 MW. VGB member companies are operating wind power plants with a total capacity of more than 32,000 MW. Approximately 85 % of the installed capacity of offshore wind farms belongs to VGB member companies.

All members of the EWG «Wind Energy» and all companies active in the wind energy business are striving or have to strive jointly to reduce the maintenance costs of wind power plants. In order to meet this objective, the following activities have been carried out:

- Conferences/workshops

The annual technical conference «Maintenance of Wind Power Plants» was held with support by the EWG «Wind

<table>
<thead>
<tr>
<th>Installed capacity end 2011 [MW]</th>
<th>Installed capacity end 2012 [MW]</th>
<th>Installed capacity end 2013 [MW]</th>
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</thead>
<tbody>
<tr>
<td>Germany</td>
<td>29,060</td>
<td>31,308</td>
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<tr>
<td>Spain</td>
<td>21,674</td>
<td>22,796</td>
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<tr>
<td>Denmark</td>
<td>3,871</td>
<td>4,162</td>
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<td>Italy</td>
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<tr>
<td>United Kingdom</td>
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<tr>
<td>Greece</td>
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<td>1,749</td>
</tr>
<tr>
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<td>Remaining Europe</td>
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<tr>
<td>Europa</td>
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</tr>
</tbody>
</table>


Fig. 4: Maintenance in wind power plants.
Energy». It took place in Dresden on February 19/20, 2014 in parallel with the VGB Technical Conference «Maintenance of Power Plants» and a joint technical exhibition. This event involved the extensive exchange of experience between operators of wind power plants and conventional power plants. More than 90 participants from 8 countries dealt with issues on operation, repair and maintenance of onshore wind power plants (Figure 4). The conference programme focused on plant safety, optimisation of operation strategies and different maintenance concepts.

This also involved the presentation of the VGB-Standard «Reference Designation System for Power Plants – RDS-PP®». The state of the integration of wind power plants into the VGB Database of «KISSY» was also outlined. The papers and intensive discussions demonstrated that the business is still facing huge challenges. This applies in particular to the optimisation of operation strategies and the related cost reduction potentials. The next technical conference will probably take place in Cologne in the spring of 2015.

The members of the EWG «Wind Energy» decided to carry out further VGB internal workshops on issues like «de-icing of rotor blades/wind forecasts», «oil management/drain train damages» and «lightning/fire protection» in order to further optimise the exchange of information and experience.

- VGB-Standards/VGB Databases

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

In a first step the VGB position paper «Improvement of Relationship between Manufacturers and Owners of Wind Power Plants» was published in October 2013. This is supported by all VGB member companies of the EWG «Wind Energy». As owners of wind power plants they are responsible for all issues related to industrial safety which leads to operators’ point of view to the following two main requirements:

- Respecting intellectual property rights, manufacturers have to provide detailed and comprehensive documentation to enable the owner/operator to perform safe operation and maintenance independent from the manufacturer.
- Manufacturers/service providers have to deliver detailed and comprehensive maintenance reports after each intervention and on request of the owner.

According to the VGB position paper it is foreseen to integrate all specific requirements on documentation for wind power plants in the VGB-Standard VGB-R 171 «Proposal of Technical Documentation (Technical Plant Data, Documents) for Power Plants». This will help to make operators’ requirement more clearly.

In the spring of 2014 VGB PowerTech published the international designation system «Reference Designation System for Power Plants – RDS-PP®», for wind power plants. It supports operators, manufacturers 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. It is helpful and necessary to designate, structure and label wind power plant components for reasons of economic planning, erection, operation and maintenance up to disassembly. This designation systematics is the basis for structured plant documentation and standardised product documentation. Thanks to RDS-PP® that 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. planners, manufacturers’ insurance companies, operators and plant owners. This brings about major advantages up to cost reduction, because all parties involved «speak one language».

Another VGB-Standard «Guideline for Lifetime Management of Foundations and Tower of Onshore Wind Power Plants» will mainly deal with maintenance and retrofitting of these components which are made of steel, reinforced concrete and other materials as well as compounds of these. The standard also deals with basic materials and maintenance materials like mortar or coatings. However, electrified or power generating components are not considered in the standard which is to be published at the beginning of 2015.

A project group of the EWG «Wind Energy» is cooperating with the EWG «Performance Indicators» in order to identify weak points of wind power plants and to improve operation. A uniform systematics for recording availabilities and unavailabilities is established in order to carry out statistic assessments and technical, scientific analyses. In this case the technical availability of wind power plants of different manufacturers can be compared with each other. Such an accepted method has been established for a long time for thermal power plants which is now being adapted to the characteristics of wind power plants. The necessary master data of plants were already determined. Currently the categorisation of events is being discussed. These data are to be integrated in the existing, multi-language power plant information system «KISSY» in order to enable cross-utility analyses.

- User Groups

The user groups deal with specific technical issues – from foundations to rotor blades – of wind power plants of certain manufacturers. The companies are striving for optimised maintenance strategies. The improvement proposals jointly worked out will subsequently be discussed with manufacturers. Currently there are VGB User Groups dealing with the multi-MW-plants of Siemens, Enercon 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

Status reports about the conditions of wind power plants are continuously recorded and stored with the aid of SCADA systems (system control and data acquisition) to coordinate maintenance work. It is e.g. possible to remotely control wind power plants via a standard internet browser and to retrieve different plant conditions and reports. However, manufacturers of wind power plants use their own systems which are often not compatible. Besides, different, manufacturer-independent systems are offered on the market. The signals must be harmonised because plant management operators often have to process data of different plant types. A compact remote terminal unit (RTU) was developed within a VGB research project in order to eliminate the weak points of data connection of wind power parks. The focus was on operators’ requirements The AsCo box (Figure 5) supplies practical solution for data connection of different systems.

The foundations of offshore wind farms are regularly checked by professional scuba divers. According to the requirements by the Federal Agency for Marine Shipping and Hydrography (BSH), foundations of wind power plants have to be checked every four years and platforms of transformers every year. Therefore, it is necessary to extend the period of repeated testing in order to reduce maintenance costs. VGB PowerTech participates in a corresponding research project. If the periods for such activities could be prolonged this would result in a high cost-saving potential.

European Working Group Safety and Health at Work at Offshore Wind Power Plants

Karl-Heinz Puch

One core issue was the coordination of the interests of all stakeholders. VGB had established a network comprising European companies, associations, authorities and other partners. A common understanding for the task «occupational and health protection offshore» is to be developed and implemented (Figure 6). Examples are the VGB statement «emergency management» and the cooperation for the recommendation «medical fitness» of offshore workers.

The group also dealt with working time regulation, protective equipment, rescue devices and safety training. Besides, VGB cooperated in drafting different codes (e.g. emergency control room, diving work regulations of Liability Insurance Associations). The results were successfully communicated at different workshops.

European Working Group Biomass

Sebastian Zimmerling

Evaluation of the national action plans for renewables utilisation shows that 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 more than 3,800 MW.

The EWG «Biomass» – jointly with other relevant VGB committees and panels – deals with technical issues on 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 range from mere biomass-fired plants (Figure 7) to fossil-fired plants 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 EWG «Biomass Ash».

VGB organised, supported by the EWG «Biomass» and Vattenfall Europe Wärme AG, the biomass Technical Conference «Challenges of Biomass Combustion» at the Klingenberg plant site. The conference took place on November 13/14, 2013 and was well attended by 80 participants from 14 countries. The conference was held in the English language. A total of 18 presentations were given. After a brief overview on VGB’s activities in the field of biomass, the first day’s focus was on practical experience made with the new construction and switching of fossil-plants to 100 % biomass-fired plants. Fuel switching of the Ironbridge E.ON power plant from coal to wood pellets, the new construction of the Polaniec Green Unit of GDF Suez Energia Polska with mono-combustion of mainly agricultural residues and first operating experience made in the straw-fired Fynsværket unit 8 of Vattenfall were presented. The first day was closed with an overview on the activities of the EWG «Biomass Ash» and the RHC (renewable heating and cooling) platform.
On the second conference day special issues of chlorine-induced high-temperature corrosion and related damage symptoms were addressed. Besides, reports were given on operating experience with counter-measures like dosing of additives or hard coal fly ash. The conference also dealt with fire and explosion protection for the storage and handling of different biomass and introduced the VGB-Standard «Fire and Explosion Protection in Biomass Power Plants». Finally examples were selected to demonstrate the special characteristics of fire fighting in silos and practical examples of fire and explosion protection were given.

The VGB-Standard VGB-S-018 «Fire and Explosion Protection in Biomass Power Plants» was published at the beginning of 2014 in the German and English language. It is providing compact information – in addition to the VGB Guideline VGB-R 108 «Fire Protection in Power Plants» – on the special features of fire- and explosion protection for storage and handling of biomass in power plant operation. The brief introduction is followed by a detailed analysis of all process steps from biomass delivery to storage and transport ways. The standard is supplemented by a chapter with practical examples.

The issue «fire- and explosion protection in biomass power plants» is to be addressed in depth at an English-language one-day workshop to take place in October 2014 at VGB offices. Detailed information on explosion protection, practical experience of fire fighting in silos and corresponding requirements of insurance companies will be provided.

The discussions and exchange of experience of the EWG «Biomass» on the VGB Workshop «Research and Development in the Area of Renewables and Distributed Generation» revealed that the surveillance of biomass heaps and the localisation of hot spots needs to be improved. Due to the isolating characteristics of biomass, smouldering fires are only detected in a very late state. 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 EWG «Biomass» suggested a research project for solving these issues. 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.

**European Working Group Biomass Ash**

Dr. Hans-Joachim Feuerborn

The increasing share of biomass combustion naturally also increases the amount of combustion ashes. Apart from small plants, more and more biomass is fired in larger power plant units either due to fuel switching, i.e. mostly from coal to wood pellets or the new construction of fluidised bed combustion plants.

The trend of co-combustion of higher shares of biomass in coal-fired power plants clearly decreased because of a modified subsidy scheme and supply problems. Co-combustion of up to 40 m.-% biomass (50 % in the case of fresh wood) is covered by the new European Standard «Fly Ash in Concrete» EN 450-1. It has been proven in numerous research projects and regular monitoring that the small share of ash from biomass co-combustion does not have any impact on fly ash quality.

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. Apart from legal conditions, the ash composition is of particular importance particularly when using similar biomass. There are a number of publications on the composition and utilisation of biomass ashes, particularly wood ashes. Their utilisation options range from forest liming up to their use as fertilisers. The latter utilisation option is permitted through the European ordinance on fertilisers, however, additional national rules, particularly limit values for trace elements, have to be taken into account. In some member states the ashes are processed for utilisation as fertilizers. Biomass ashes are also covered by the European Product Standards for aggregates. Apart from technical parameters like grain size distribution and density, environmental requirements like elutable components and constituents are of importance. In some European member states biomass ashes are regularly used in earth works and road construction.

The experience on the production, characteristics and utilisation of biomass ashes will be incorporated in a status report on biomass ashes in Europe. The legal situation and the properties of specific biomass will be assessed in order to extend existing utilisation options or to open up new ones. Besides, the possibilities of preparation related to the utilisation as fertiliser or construction material will be checked. Special account is taken of the definition of biomass, because ash characteristics are defined by the fuel.

**European Working Group Biogas**

Sebastian Zimmerling

Biogen 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 waste heat utilisation in addition to electricity generation. In Germany, at least 60 % of waste heat was to be utilised according to the 2012 amendments of the German Act on Renewables (EEG).

Biogas can also be upgraded and fed into the natural gas grid. It can be stored intermittently and then used deliberately at locations having a heat sink. Upgrading 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 about 20 % of biomethane is produced by VGB member companies (state December 31, 2012).

In addition to the other biogas upgrading techniques, the group intensively discussed a new membrane system – developed jointly by EVONIK Fibres GmbH with EnviTec Biogas AG.

The membrane material was particularly developed for a high throughput with simultaneous high selectivity and resistance against organic acids and hydrogen sulphide which have caused serious problems in common membrane processes. The entire efficiency of the membrane system is comparable to common processes of high pressure water scrubbing or pressure swing adsorption, however, the methane slip amounts to 0.5 % only. The efficiency mainly depends on the selection of the compressor which amounts to about 40 % of the total investment. The discussions were supplemented by visiting the demonstration plants of EnviTech Biogas AG in Köckte (Saxony-Anhalt) as well as the biogas plant of E.ON Bioerdgas GmbH in Merzig (Saarland) where the raw biogas is upgraded by organic physical scrubbing to natural gas quality.

When storing biogas substrates silage liquids occur with a high amount of organic acids which attack concrete walls and seals of the silo resulting in leakages. The EWG «Biogas» treated in detail the issue of research and development. Every group member presented current research activities in the field of biogas generation. One focal issue is the production of alternative energy crops. Yet mostly maize was used in biogas plants because according to experience maize yields best harvest at most sites and can be easily fermented. However, for improving sustainability and increase of biodiversity, it is necessary to cultivate different substrates. Currently Sipplie and Szarvasi energy grass are considered due to their comparatively high yields. So-called wild plant mixtures are a promising alternative to increase biodiversity of soils. The main challenge of cultivating alternative energy crops is the selection of suitable sites and the integration into harvest campaigns.

European Working Group Distributed Generation
Doreen Kückelmann

The European Working Group «Distributed Generation» assesses the technical as well as economical development of small combined heat and power plants. Possible fields of application are also considered for these plants. They are an important technical innovation because they enable combined generation within a small range of output. This applies in particular to local heating and the industrial sector. Smaller plants, mostly designed as combined cycle power plants, are either based on classical piston engines or later technologies like the micro gas turbine, fuel cell or Stirling engine. Investigations are being carried out to run these plants with renewables-based fuels like e.g. biogas.

Apart from assessing the relevant technologies, the EWG «Distributed Generation» also deals with system integration of renewables, because the extension of 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 storage power plants, distributed battery storage and short-term or long-term storage systems (Figure 9). The application of required storage plants that are technically needed is currently being delayed because of the high costs involved. Power-to-Gas offers a possible solution to decrease the necessary grid extension and to transport and store renewable energies. Applications of these storage technologies are also treated by the EWG «Distributed Generation».

Managed by Enel S.p.A., some members of the EWG «Distributed Generation» as well as VGB took part in the tender of the European General Research Programme HORIZON 2020, Call LCE 8 – 2014 for the integration of distributed storage technologies into local energy supply structure. In November 2014, the two-day VGB Technical Conference «Distributed Generation – Status and Perspectives» with associated technical exhibition will be held in cooperation with Kufstein University of Applied Science in Tyrol, Kufstein/Austria. The conference will be a forum for developers and users of distributed generation facilities. It will focus on the application options of gas-driven small combined heat and power plants, fuel cells, Stirling engines and the system integration of these technologies.

Fig. 9: Pellworm hybrid power plant, source: E.ON.
Environmental Technology, Chemistry, Safety and Health

**Hans-Joachim Meier**

During the reporting period more than 900 experts from Germany, Europe and other international VGB member companies gathered in 25 technical committees (TC), working panels (WP) and 24 project groups (PG) for meetings organised by the VGB Competence Centre 4 (CC4). The committees, panels and groups dealt with important cross-sectional issues of conventional and renewable energy technologies. National issues were treated in joint bodies (integrated technical committees and project groups) with the German Association of Energy and Water Industries (BDEW). The European topics were harmonised with the European umbrella organisation EURELECTRIC.

All results of technical discussions that are important for the technical exchange of experience were filed in the online VGB archive, which has been the well-established communication platform for years, and can be accessed by all VGB member companies (closed user groups of each body). A new search function was added to the archive in the spring of 2014 which allows efficient keyword search in the committee documents.

European and other international panel and committee members who were unable to attend the meetings due to long travelling ways were increasingly integrated as on-line participants of the meetings.

The state of the art of waste gas cleaning, water management and noise control, environmentally compatible utilisation of power plant by-products and securing of industrial safety and health protection was jointly advanced with VGB members, and where sensible, integrated into VGB-Standards.

The increasing feed-in of renewables-based power and its technical impact was among the core issues of committee and panel work.

As in the previous years, the European power industry managed again a substantial decrease in emissions. In January 2014 EUROSTAT published a statistics (Figure 1) which shows that the greenhouse gas emissions of the energy business were decreased from 1,668 million tonnes to 1,406 million tonnes of CO₂ equivalent. When taking into account the current reduction rates, it can be assumed that the targets of the European energy business, i.e. reduction of greenhouse gas emissions of 20% by 2020, can be exceeded.

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**Fig. 1: Development of greenhouse gas emissions in the energy business in million tonnes (EU 27)**

The tasks and results of the Working Panels «Health & Safety at Offshore Wind Parks» and «Biomass Ash» are described in this chapter «Renewables and Distributed Generation».
During the reporting period the following CC4 research projects were initiated or continued dealing with special technical issues of power plant operation (project period in brackets):

- Fly ash with higher LOI – Use in concrete (2013 – 2014)
- Bromide addition (2012 – 2013)
- Predictive emissions monitoring systems – An alternative to continuous emissions measurement (2011 – 2013)
- ASR – Variation of pre-storage time (2011 – 2013)
- Avoidance of alkali reaction through fly ash (2010 – 2013)

The results and findings gained from research projects are/will be presented and discussed with VGB member companies and interested parties in the following CC4 technical conferences, trainings and workshops:

- Water in Power Plants, September 2013, Berlin
- Chemistry in Power Plants, October 2013, Leipzig
- Industrial Medicine – Offshore Wind Power Plants, November 2013, Emden
- Advanced Training Emission Protection and Events, November 2013, Lahnstein
- European Occupational Health & Safety Conference, April 2014, Freising
- Workshop Waste Gas Cleaning, 2014, May 2014, Marseille
- Water in Power Plants, September 2014, Berlin
- Occupational Medicine – Offshore Wind Power Plants, September 2014, Emden
- Conference EUROCOALASH, October 2014, München
- Chemistry in Power Plants, October 2014, Linz

Fig. 2: Parallel measurements in the framework of automated emission monitoring.

Major results of CC4’s work were incorporated into the following VGB-Standards being revised or drafted:

- Testing of DENOX Catalysts
- Analyses Procedures in Power Plants
- Construction, Operation and Maintenance of Flue Gas Denitrification (DENOX)
- Safe Cooperation/Customer and Contractor in the Power Business
- Water Desalination with Ion Exchangers
- Refractory Lining in Plants for Thermal Waste Utilisation
- Particularities of Fire Protection in Waste Incineration Plants
- Cooling Water Standard – Water Treatment in Cooling Systems

Besides, more than another 200 VGB publications (VGB-Standards, instruction sheet, guidelines and technical scientific reports) are available from all VGB CCs which document and reflect VGB’s panel and committee activities.

Technical Committee Emissions/Immissions
Volker Hamacher

The Technical Committee «Emissions/Immissions» discussed the requirements in terms of measurement technology according to the 1st draft of the amendment of the BREF ICP (Best Available Technique Reference Document on Large Combustion Plants). Such documents which bindingly determine for all EU member states the state of the art for the avoidance and management of emissions from industrial activities have to be drafted according to the Industrial Emission Directive (IED). Application of this draft would have considerable effects on emission monitoring (components, measurement frequency, measurement range), e.g. (Figure 2):

- Heavy metal measurement 3x/a for coal, biomass and HS,
- Hg measurement in case of coal + co-combustion of coal: 4x/a (< 300 MW), continuously (> 300 MW); no exception with reference to < 50 (20) % ELV,
- HCl measurement 4x/a in case of coal, biomass, gas turbines, light oil/HFO
- HF measurement 4x/a in case of coal,
- NH3 measurement continuously in case of coal, biomass, gas turbines, light oil/HFO
- N2O measurement 2x/a in case of coal and biomass-fired fluidised bed combustion,
has developed an environmental monitor -

preparatory work has already been made

the IED. In Germany considerable pre-

Industrial Emissions all member states

According to art. 23 of the Directive on

reed nearly all amendment proposals.

above-mentioned bureau which consid-

committee were submitted via UBA to the

statements developed by the technical

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committee that is headed by the Federal

port authorities which define requirements

when elaborating BREFs and is to sup-

to support the technical working groups

(ROM)» is another document of the EIPPC

office. The paper is not binding and is

to support the technical working groups

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port authorities which define requirements

for emission monitoring. VGB offices are

member of the German national mirror

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Environment Agency (UBA). The VGB

statements developed by the technical

committee were submitted via UBA to the

above-mentioned bureau which consid-

ered nearly all amendment proposals.

According to art. 23 of the Directive on

Industrial Emissions all member states

have to introduce a system of environ-

mental inspections for plants subject to

the IED. In Germany considerable pre-

paratory work has already been made

at the District Council of Cologne, which

has developed an environmental monitor-

ing concept. Criteria are defined, among

others for risk assessment, determined on

the basis of potential and real impacts on

the environment as well as operator-relat-
ed criteria. With these criteria the inspec-
tion frequency – in the case of IED plants
every 1 to 3 years – is determined for
each individual plant. A survey among
representatives of the technical committee
showed that nearly all operators had al-
ready been approached by their respon-
sible authorities. Duration and scope of
the inspections carried out yet have been
very different. Some authorities concen-
trated on focal aspects. The publication
in the internet of deficiencies detected is
different as regards details. It was ascer-
tained that in some federal states there
are no plants (e.g. determination of in-
spection frequency) whereas some states
have already very detailed plans. The
technical committee criticised that organi-
sations’ work load will increase at times
where cost cutting and reduction of per-
sonnel are essential. The committee rec-
ommended to have inspections according
to IED and Seveso Directive carried out in
parallel to make advantage of synergies
and to save costs.

The Seveso-III Directive has to be trans-
posed into national legislation by May
31, 2015. The Federal Ministry for the
Environment, Nature Conservation, Build-

ing and Nuclear Safety (BMUB) has
drafted a working paper with mainly
legal contents, e.g. monitoring of loca-
tion, public consultations and partici-
pation of the public in decision making
as well as access to courts. The ministry
had asked associations in order to esti-
mate the number of plants not subject
to immission protection licensing which
handle dangerous substances according
to the Seveso-III Directive and how often
modifications are being made. The tech-
nical committee members pointed to the
fact that modifications to the classifica-
tion of substances according to the CLP
Ordinance (Regulation on Classification,
Labelling and Packaging of Substances

and Mixtures) can also influence the
«Seveso assessment» and thus have to be
observed in order to determine need for
action.

Within the scope of the national imple-
mentation of the IED, the committee mem-
ers also discussed the modified time
reference for meeting the soot limit value
from one day to three minutes. The com-
mittee members were also asked to check
old measurements in view of problems that
might have occurred in connection with
this modification and to communicate such
problems to VGB offices. The Federal Envi-
ronmental Agency signalled its willingness
for discussions. It was also recommended
to classify the soot number only as of a
certain minimum temperature above the
dew point because otherwise it has to be
expected that the measurement point will
increase through aerosol development.

Reports were given about problems with
«cheap» experts. In one case e.g. the cali-
bration curve deviated considerably from
former curves although the boundary con-
ditions had not changed. The committee
recommended reporting of such events to
the responsible authority unless the expert
can explain such deviation. It was pointed
out that such problems could be expected
when changing the expert.

The committee discussed in detail the cali-
bration of SO2 raw gas measurements for
determining the degree of sulphur removal
from clean gas/raw gas measurements. Among others the question was raised
whether the raw gas concentration can be
considered as reference value so as not to
determine a calibration range. Besides it
is also doubtful whether the raw gas con-
centration can be validated because there
does not exist a limit value for it. The au-
thorities have different opinions whether
the SO2 raw gas concentrations are an
auxiliary value or not. Partly the raw gas
content is being calibrated and consid-
ered as «limit value» of the SO2 concen-
tration which results if fuel with maximum
S content is being used. The SAG is then
calculated with validated values in the
clean gas and raw gas. It is recommend-
ed using high-sulphur fuel for calibration.

- Measurement of CO + NOx continu-
ously also in case of gas turbines < 100 MW,
- SO2 measurement continuously also in

case of light oil,
- TOC measurement continuously in case
of co-combustion,
- Zn measurement 3x/a in case of co-
combustion of sewage sludge.

Since such requirements would consid-

erably increase the burden for member

companies, the technical committee is

collecting critical comments which were

passed on the EIPPC (European Integrated

Pollution Prevention and Control) bureau

in Seville which is responsible for drafting

the BREFs.

The «Reference Report on Monitoring

(ROM)» is another document of the EIPPC

office. The paper is not binding and is

to support the technical working groups

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tration which results if fuel with maximum
S content is being used. The SAG is then
calculated with validated values in the
clean gas and raw gas. It is recommend-
ed using high-sulphur fuel for calibration.

Fig. 3: Noise and vibration investigations.
Technical Noise Control

Volker Hamacher

The technical committee focused on the elaboration of comments on the draft of the BREF LCP. The committee objected fiercely against the conclusion, which serves as binding reference documents of the draft, that noise control of plants 3x/a is state of the art. The EIPPC bureau had not asked for the frequency of noise measurements in the vicinity of power plants.

The committee discussed impacts of the draft standard DIN 45680:2013-09 «Measurement and assessment of low-frequency noise immission». Among others it is planned to extend the deep frequency range to be investigated to the third octave band with the medium frequency range 8 Hz to 125 Hz. The level difference CA for preliminary investigations is to be reduced from 20 to 15 dB. Reference to assessments is now the threshold of detection instead of the threshold of hearing. It was reported that one expert has already classified transformer noise as annoying deep frequency noise. It can be expected that in future increasingly deep frequency noise is classified as annoying. The committee members were offered to formulate objections. As of July 2015, the reduction of 5 dB(A) will be omitted when assessing noise caused by rail traffic according to the 11th law on the amendment of the Federal Immission Control Act (BlmSchG) of July 2, 2013. The members of the technical committee discussed possible impacts of this law on their companies. It was reported that the committee has already classified transformer noise as annoying deep frequency noise. It can be expected that in future increasingly deep frequency noise is classified as annoying.

The committee discussed a judgment of the Federal Administrative Court which says that immission values are no significant, reliable measurement for correct plant operation. It was pointed out that immission measurements in power plants can last for years until all conditions are met at all check points. It was also added that most complaints about noise at wind power plants are registered after gear box replacement.

During the exchange of experience it was reported that the noise emitted by a coal conveyor belt was abated by 20 dB/m through the replacement of pulleys.

European Technical Committee Chemistry

Dr. Andreas Wecker and Dr. Dittmar Rutschow

The European Technical Committee «Chemistry» coordinates the Working Panels «Analytics», «Chemistry of Water Treatment», «Chemistry of Flue Gas Cleaning Plants» and «LWR Chemistry», it 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. (Figure 4)

Originally the two Technical Committees «Chemistry» and the European Technical Committee «Chemistry» were separate but decided in 2013 to merge and to set up a European committee. This procedure has proven well.

The European Technical Committee «Chemistry» is developing an online manual about power plant chemistry in order to make available the wealth of knowledge about power plant chemistry to VGB members at any time. A table of contents was developed. Technical realization is to be checked in a second step.

The last Conference «Chemistry in Power Plants 2013» took place in Leipzig; 300 participants attended the conference. The issues ranged from water-steam cycle, flue gas cleaning, water preparation and analytics. The field of nuclear chemistry was not as represented as usual in the previous years.

Working Panel Analytics

The results of the third round robin test (USA, Japan, China) on checking DENOX catalysts in bench reactor was incorporated into the updated VGB-Standard VGB-S-302-00-2013-04-DE so far published as VGB Guideline VGB-R 302 «Guideline for Checking DENOX Catalysts».

The round robin test jointly conducted with the company r-concept on the analysis of FGD gypsum according to the VGB Instruction Sheet VGB-M 701 showed that the values of the parameters Hg, Se, purity, calcium carbonate, pH, whiteness and Mg were in line with a comparison coefficient of < 25 %. All other values were above 32 % and have to be considered as critical. Therefore, the round robin test was degraded as a laboratory comparison test. The Hg results are also in good agreement without using a hybrid system. Most laboratories have only investigated those parameters that are checked on a routinely basis; these results are satisfactory, too. The conclusion can be drawn that the samples were homogenous and that the main constituents were determined well. A further investigation may be more international. The panel is also drafting a VGB-Standard on analytical procedures in power plants and is making various round robin tests on combustion and residues analyses and verification of analytical procedures.
Working Panel Chemistry of Flue Gas Cleaning Plants

The panel dealt with consequences of the addition of bromide to coal to improve mercury capture at coal-fired power plants. This is another option to further reduce mercury emissions. The related KEMA study was completed and the open questions will be discussed in the working panel. Therefore, this technique cannot be classified as state of the art. The panel is currently also adding a chapter on adipic acid to the VGB Instruction Sheet 419 «Design, Operation and Maintenance of Flue Gas Desulphurisation Plants (FGD)».

The VGB Working Group «Mercury» commented on the first draft of the amendment of the BREF LCP (Best Available Technique Reference Document on Large Combustion Plants) and added important comments on the state of the art.

Working Panel Chemistry of Water Treatment

The panel revised the VGB Instruction Sheet VGB-M 405 «Water Demineralisation with Ion Exchangers». Modifications were integrated into the current draft. The final version will be soon distributed among panel members for proof-reading.

At the last meeting of the Technical Advisory Board, the chairman of the Project Group «Microbiology» presented the measurements and results of the VGB Research Project «Microbiology in Cooling Towers». It was suggested carrying out further measurements supported by research funds. These investigations are firstly made at German plants only. Then the results are to be exchanged also on European level. Members of the Project Group «Microbiology» will report their results to the VGB European Technical Commit-
Laboratories are carrying out round robin tests as instrument of quality control. The basic target of round robin tests is the provision of references to the laboratories taking part, i.e. on possible systematic mistakes upon measuring, calibration and chemical sampling and to document the state of measurement technique and determination methods applied. The round robin test initiated by the panel on chemical parameters has been carried out successfully for some time by the company r-concept. Therefore, the panel suggested realisation of a further round robin test on the determination of the B-10 contents in boric acid. The results of the round robin test carried out for the first time were discussed and it was recommended to continue the test for determining the B-10 contents in boric acid.


Technical Committee Fire Protection

Dr. Ulrich Schirmer

The existing VGB Guideline R 108 «Fire Protection in Power Plants» has been further discussed since its publication in 2009. A planned adoption of the structure to the needs of new constructions has been abandoned due to the current situation on the electricity market. The new edition of the VGB-S-217 «Particularities of Fire Protection of Waste to Energy Plants» was finished by the VGB Working Panel «Thermal Waste Utilisation». The standard is available in the German and English language.

The VGB-Standard for biomass-fired power plants VGB-S-018-00-2013-DE/EN «Fire and Explosion Protection in Biomass Power Plants» which was jointly elaborated with the European Working Group «Biomass» of the European Technical Committee «Use of Renewables and Distributed Generation» and some external experts was published in the German and English language.

The technical rule on the operational safety ordinance has been mentored by the Technical Committee «Fire Protection» due to the subjects of «fire protection» and «explosion protection». In future the operational safety ordinance will be renamed into operating media safety ordinance within the scope of an amendment. In this connection a new structure will be implemented. Accordingly, explosion protection will become part of the law on hazardous substances. Fire protection has already no longer been part of the operational safety ordinance because this has been sufficiently regulated by construction law.

Modifications within VGB offices with impacts on the activities of the Technical Committee «Fire Protection» were discussed by the panel aiming at concentrating on the work performed. Mentoring of the VGB-Standard S-108, and the exchange of experience were identified as major parts of the committee activities. The development of fire protection are also discussed and examined in view of their relevance for power plant engineering.

Additional focal points were:
- Coal storage in silos and possibilities of fire fighting in silos
- Handling of hard coals in housed storages bearing in mind risk assessment
- Early detection of fires in circular storage yards
- Emergency emptying of pulverised coal silos
- Operation of coal storage yards from the viewpoint of fire fighting protection of hard coal mills

Additional topics result from standardisation like setting up of transformers (see new DIN VDE 0101). Besides, the committee discussed new technical options on fire and explosion protection. Acoustic monitoring of transformers has been increasingly offered on the market: after detection of an acoustic signal, e.g. triggered by an arc in the transformer boiler, countermeasures will be taken within a few milliseconds. Fires are to be prevented with this technology.

Technical Committee Power Plant By-products

Dr. Hans-Joachim Feuerborn and Thomas Eck

The Technical Committee «Power Plant By-products» is to ensure utilisation of power plant by-products from coal combustion in pulverised fuel and fluidised bed combustion furnaces. Mineral power plant by-products cover combustion products like fly ash, bottom ash, and boiler ash as well as products from flue gas desulphurisation (FGD) like FGD gypsum, and SDA product (Figure 7). In this context, European and national rules, particularly those governing the quantities and quality of by-products, are being mentored.

The following is to be emphasized:
- «Guidance on updating information of the declaration of performance (DOP) for fly ash for concrete according to EN 450-1 according to the «Construction Products Regulation» (CPR) prepared by the Project Group «Quality Management» to introduce DIN EN 450-1 in Germany"
Application to increase the sulphate concentration from 1500 to 3000 mg/l (exposition class XA2) of the sulphate rule within the scope of revising DIN 1045-2
- Conditions for the further application of certified fly ash with increased loss on ignition in concrete or concrete products
- Assessment of eluate values of concrete for a uniform without-further-testing classification of concrete
- Application to integrate lignite fly ash as binder when revising the Instruction Sheet «Soil solidification and soil improvement with binders»
- Investigations on the radioactivity of fly ash from certain coals
- Toxicological assessment of gypsum and gypsum products
- Long-term investigation on the assessment of sulphate resistance of fly ash concrete
- Support of the European data compilation for an ER3 dossier for fly-, bottom and fluidised bed ash as well as boiler slag (oxide composition, constituents and elutable constituents)
- REACH registration classes for ashes and FGD gypsum

**Technical Committee By-products of Thermal Waste Incineration**

*Karl-Heinz Puch*

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 Soils» that has been announced for some years. Therefore, the development has been observed with attention. Particular emphasis has been put on the established use of ashes, however, future options are also to be assessed. The committee was in permanent dialogue with authorities and industries affected.

The criteria for «hazard characteristics» H 14 (eco toxicity) in connection with the classification of wastes according to waste catalogue have not yet been defined, neither on national nor on European level. Procedures suggested in an EU consulta-tion paper orienting on the law on chemicals are currently being discussed. 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 (Figure 8) was broadly observed. Different projects are aiming at recycling and separating of metallic fractions. In these processes it is mostly needed to work with fine fractions. However, this has considerable influence on the utilisation of the remaining mineral fraction as building material. Metal recycling is highly depending on the metal prices.

Procedures for determining constancy of volume of ashes of domestic wastes in road construction are being carefully checked.

The above issue was intensively discussed at regular workshops and it was supplemented by additional current topics like underground deposition or handling of flue gas cleaning products. The above issue was intensively discussed at regular workshops and it was supplemented by additional current topics like underground deposition or handling of flue gas cleaning products.

Integrated Committee Waste and By-products

*Thomas Eck*

During the reporting period the Integrated Technical Committee «Waste and By-products» dealt with the current legal development of national and European environmental legislation. Special mention is to be made about issues like «Adoption of the European Waste Catalogue», «Ordinance on Registration and Waste Permits» as well as the «General Framework Ordinance Ground Water/Substitute Construction Materials/Soil Protection». Besides the committee dealt with practical issues and other issues: BREF LCP, REACH, plant ordinance on handling water-endangering substances (AwSV), construction product regulation, German resource efficiency programme (ProgRes) and recovery of phosphor.

The European Commission is currently checking the adoption of hazardous characteristics of wastes according to annex III of the Waste Framework Directive (so-called H-criteria, future HP criteria) to the ordinance classification, labelling, and packing of substances and mixtures (CLP Regulation) as well as the resulting adoption of the European Waste Catalogue. Adoption and unification of regulations are basically appreciated, however, it is feared that more stringent requirements for power plan by-products, yet classified as harmless, would apply. BDEW and VGB commented on the planned modifications and discussed the issue with national authority representatives and on European level via EURELECTRIC.

Since the spring of 2014 suggestions have been submitted to the Commission concerning the revision of the European Waste Catalogue. These amendments do not foresee changes to the hazard classes of power plant by-products. The documents available also comprise references about the reliability of other internationally accepted testing procedures. According to these alternative testing procedures, the classification of power plant by-products as «irritant» or «corrosive», as shown within the scope of REACH registration, can be excluded. Clarifying statements from pre-drafts on the pH or CaO/Ca(OH)₂ contents were omitted. The proposals are to be taken to the vote in the summer of 2014.

The «Ordinance on the Determination for the Discharge of Substances into Ground Water, the Utilisation of Substitute Construction Materials and the Utilisation of Soil and Material Similar to Soil» (General Framework Ordinance) covers new reg-

**Fig. 8:** Art made of products from thermal waste utilisation.
ulations of the ground water ordinance, ordinance on federal soil protection and abandoned polluted areas as well as ordi-
nance on deposits and for the first time an ordinance regulating substitute construc-
tion materials. After BMU had presented a first working draft at the beginning of
2011, a second draft was presented by the end of 2012. After fierce criticism
from the federal states, BMU had set up a government-state group which tried to
eliminate criticism at five meetings in mid-
2013. The results of these meetings were
summarised as modification- and supple-
ment recommendation and submitted to
BMU. These recommendations were to be
considered in the later draft. The recom-
mendation of the government-state group
was more stringent than the last draft
which was criticised by associations (e.g.
DBI). The federal state working group
waste (LAGA) did not agree on the recom-
mendation.

After the elections of the federal govern-
ment and the new organisation of the
BMUB, no progress has been made. Due
to the new organisation of the ministry
and the missing agreement by LAGA, the
future of the general ordinance is still un-
settled; therefore it has to be assumed that
the ordinance will not be passed in the
near future.

The ordinance on the continuation of mon-
itoring of waste has been announced on
December 10, 2013 in the Federal Law
Gazette. It contains article 1 of the new
registration and permission ordinance
(AsbAEV), which was enforced on June 1,
2014. The BMUB has published an imple-
mentation guide (Anzeige- und Erlaubnis-
verfahren nach §§ 53 und 54 KfWG und
AsbAEV, state January 29, 2014) to deal
with all practical basic issues. In contrast
to the original planning of IFA, i.e. to set
up an individual guide, the business-relat-
ed issues on AsbAEV will be dealt with in
the next supplement for the disposal manu-
al. The references are also to be published
on the homepage of VGB and BDEW to
support member companies.

European Technical Committee
Safety and Health at Work

Karl-Heinz Puch

The European Technical Committee «Safe-
ty and Health at Work» is dealing with
contractor management in maintenance
and power plant new constructions. This
topic is on top of the agenda. All stake-
holders established rules for dealing with
external companies, however, their ap-
proaches differ. The VGB Service Certifi-
cate of «SeSaM» is being applied for the
assessment of external companies. The
companies assessed were included into a
reference list, which can be used free of
charge by VGB member companies.

Accident numbers were recorded on the
basis of accidents per one million working
hours (LTIF = Lost Time Injury Frequency
Index). External companies, accidents that
nearly happened, and outages are also
taken into account. The committee also
collected and evaluated «safety alerts».
Effective root cause analysis is the pre-
condition for preventive measures. This,
however, requires the introduction of cor-
responding tools, methods, and suitable
communication.

The correlation between process safety
and occupational health are being dis-
cussed and analysed. Regular technical
conferences held jointly with Liability Insur-
ance Associations (Berufsgenossenschaften)
are valuable modules for safety and
health at power plants.

Technical Committee Industrial-
and Environmental Medicine/
Health Management

Dr. 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. Occupational medi-
cal precaution was regulated anew when
passing the ordinance on occupational
medical precaution (ArbMedViV). Meas-
ures 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. There-
fore, the employer can no longer draw
conclusions from occupational precaution
whether the employee is suited for certain
tasks. Besides, precaution does not pro-
vide 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 ac-
cording to his own judgment, employers
can require a clinical assessment of fitness
for work for a certain job or aspects of a
certain job. This hold particularly true for
energy supply (utilities) which are needed
for directly serving the public. If there is a
direct connection between an activity
in the utility and the secure supply of cus-
tomers with energy, the requirement can
be derived that medical fitness has to be
proven before starting or upon continua-
tion of the activity. The right of informative
self-determination would be met through
the physician who would communicate
the examination result to the employer
only. However, the employee can inform
the employer or not. In the latter case this
would mean that the employer is no longer
suited for a certain activity.

The requirement for suitability checks is
derived from hazard assessment. Examples
from the utility sector can be works rel-
ated to falling which e. g. can pose a risk
for the worker and third people as well
as rescue personnel. Driving, controlling
and monitoring can also be considered
as activities with potential danger to third
parties. The same applies to control room
personnel which have to secure public
power supply. Additional third party haz-
ard can result from potential rescue ser-
dices for staff wearing respiratory protec-
tion or staff with high-temperature working
places. Particularly for staff wearing staff
wearing respiratory protection rules of fire
brigades may apply.

The concrete hazard assessment by the
employer always forms the basis for as-
sessing the requirements of medical suita-
bility check. The scope of suitability checks
in companies can be determined by em-
ployer/works council agreement. Concre-
tisation by hazard assessment is needed
in any case.

It is well known after the fifth year of sup-
ply that iodine tablets have to be checked
randomly every year for their stability.
The test results yet available to BMUB and
KHG have – according to expectations –
not given rise to any complaint. Stability
checks are to be continued for the federal
states. The storages are to be continued to
be kept with KHG.

In the spring of 2013 an increased quota
of inability to work was recorded at one
company. The reason was mainly due to
respiratory disease and probably due to
a high share of influenza B-infections. Ir-
respectively of that occurrence, it is still not
considered necessary to procure familiu.
European Technical Committee (ETC) Environment

Volker Hamacher

The main work of the ETC focuses on reports about the development in the individual member states and companies relevant to power plants. Observation of the development in other European states provides among others the possibility to prepare to corresponding requirements that may also be imposed nationally. Solutions already identified in foreign members companies might also be applied in national utilities. The committee dealt with the following issues:

- Initial state report for soil and ground water according to IED
- Prohibition of deterioration for surface and ground water according to the Water Framework Directive
- Definition of start-up and shutdown procedures

Within the scope of reporting on VGB activities, the work on the future of VGB was presented. It was stressed during discussions that the cooperation between EURELECTRIC (lobby work) and VGB (technical support of lobby work) has proven well yet. The new structure of the VGB website and its new options for online search (within the documents of panels and bodies) were also presented.

A report was given from the European Working Groups (EWG) «Mercury», «Biomass Ash» and «Emissions Monitoring». The European Working Group «Mercury» does not belong to the European Technical Committee «Environment». The group coordinates the VGB activities on the issues «mercury» and elaborates technical comments on relevant publications related to mercury emissions of power plants.

The European Working Group «Biomass Ash» associated to the European Technical Committee «Use of Renewables and Distributed Generation» is collecting the different legal, technical and economic general conditions for biomass co-combustion in Europe. The group also deals with characteristic features like possible application ranges of biomass ash and drafts a status report on the situation of biomass ash in Europe.

The results of two research reports, realised with members of the European Working Group «Emissions Monitoring», were presented. One research project on the measurement of low Hg concentration with the Dowex/activated carbon technique showed that this method is equivalent to the wet chemical method described in EN 13211. However, the first method is enabling lower detection limits and is less comprehensive.

The research project «Validated methods for flue gas flow rate calculation with reference to EN 12952-15» demonstrated that the formulas of EN 12952-15 «Water-tube boilers and auxiliary installations – Acceptance tests» are well suited to calculate the flue gas volume flow of fuels, including biomass and waste. Expensive measurements might be dispensed with.

The European Working Group «Emissions Monitoring» is still dealing intensively with CEN standardisation, mainly by cooperation of EWG members in CEN working groups (WGs). Thanks to the liaison of VGB-offices with CEN it is possible to recruit staff of members companies for the WGs. This is an important opportunity to make European standardisation more practical and to adjust it to the requirements of the industry. WG 9 of CEN TC 264 has finalised revising EN 14181 «Stationary source emissions – Quality assurance of automated measuring systems». Among others the paper is dealing with the treatment of outliers upon calibration and the annual functional test as well as the possibility to decrease the number of measurement days in certain cases. The white print is to be expected in 2014. Standardisation work on electronic evaluation systems is progressing. The standards on manual and continuous measurements of the flue gas volume flow (EN ISO 16911-1 and -2) were published. Due to the results of the aforementioned VGB project and intensive cooperation in corresponding CEN-WG, calculation is also possible as alternative «manual» reference procedure. However, when applying the calculation method for the continuous determination according to part 2 the calculation method has to be verified by a standardised measurement procedure. Realisation of a corresponding research procedure has been agreed on.

The gamma ray back-scatter method for determining the density of coal stockyards within the scope of emissions trading was presented to the European working group. Holes are drilled at different locations up to the bottom of coal yards. Every hole is equipped with a gamma source and a detector insulated from the source (Figure 9). The density of the coal yard is derived from the intensity of the back-scattering of gamma rays.

EURELECTRIC gave an overview about the current European development in environmental protection legislation as well as on the state of BREF LCP. Presentations were delivered on issues like «The (new) principles and use of the unreasonable cost calculation in the EU Monitoring and Reporting Regulation for the EU-ETS», «Finnish R&D projects on biomass» and «The carbon price support mechanism in the UK».

Fig. 9: Stock drilling point set out.
The members of the Project Group «Monitoring of Greenhouse Gas» made partly comprehensive and different experience with monitoring and reporting of CO₂ emissions within the scope of emissions trading. It has been demonstrated in practice that the intensive exchange of experience among utilities is vital and needed in order to harmonise uniform procedures and responses on legal and technical requirements and technical inputs related to comments and statements as well as any other lobby work. Numerous contacts to DEHSt (German Emissions Trading Authority) and the EU Commission took place within the framework of the group’s activities.

The exchange of experience was focused on the operational implementation of reporting obligation according to § 22 ZuV (ordinance on allocation allowances) «Modification of plant operation». Accordingly operators have to provide any relevant information to the authority concerning planned or real modifications to capacity, activity rates and plant operation by January 31 of the following year. According to the project group the reporting obligation has not to be verified absolutely according to § 22 ZuV. It was remarked that within the scope of the reporting duty experts only have to check the method applied for determining allocation-relevant activities instead of real figures. Concerning modification of the activity rate it is being feared that «data graveyards» are generated at DEHSt if information will be provided that does not refer to the allocation allowances. Therefore, the general opinion prevails that only minimum information is to be provided. It was complained that the essential threshold of 5 % for deviations from the activity rate is clearly too small. Scattering is common in this range e.g. for peak load and district heat supply (weather-related fluctuations).

During the exchange of experience it was also reported that burnt lime applied in flue gas cleaning is of different quality (different carbonate content). Purchase of lime was also reported that burnt lime applied in flue gas cleaning is of different quality (different carbonate content). Purchase of lime from the carbon content from the application of burnt lime. Now the situation has changed, i.e. operators have to give account of these emissions. Parity utilities’ monitoring plans have to be changed and licensed anew. According to the monitoring ordinance, two methods are available to determine process emissions from waste gas scrubbing (on the basis of carbonate used/gypsum produced). Correspondingly the data to be recorded for each plant have to be determined according to the method applied in the plant. It was recommended to analyse SAP (spray absorption product) and also gypsum on the basis of carbonate; particularly in the case of SAP, a lot of carbonate is absorbed from the flue gas and might be substracted when determining CO₂ emissions.

Concerning the emission report, the group was unanimously of the opinion that only the mandatory fields are to be filled in. The emission report was mainly drafted – apart from figures – by importing the monitoring plan. It was reported that when drafting the pdf file, problems occurred with the form management system.

The group also discussed the monitoring plans, the state of allocation, drafting of a heat balance, possible consequences of very late allocation and virtual mail room. Concerning reporting obligations, reference was made to the challenges for utilities in connection with data collection on the state of carbon leakage from heating customers. Particularly in district heating grids, changes often occur on the customer side.

European Technical Committee Safety & Health at Work
Karl-Heinz Puch
The definition and interpretation of Key Performance Indicators (KPIs) was one of the core issues. This also involved partner companies, outsourced activities, visitors and other general parameters. The committee also dealt with the meaning of «incentives». Impacts on well-being and health were also highlighted (Figure 10).

Contractor safety management was analysed in detail and evaluated. The same applies to queries related to coordination and cooperation. The meaning of this issue is underlined by the «VGB Safety and Health Awards».

Issues like mental health, stress management and work/life-balance became increasingly important. These fields also have a key-function in connection with the inner structures, role of management and the relationship between occupational and health protection as well as human resources (HR). The exchange of experience is an important source of information.

Safety management systems were permanently on the agenda. The committee focused on the high standard of utilities including the possibilities to keep that standard on all levels.

Accidents and investigation methods absorbed a large part of committee work. Aspects like quality, role allocation, schedules and mental conditions play an important part.

Superior issues on occupational and health protection were dealt with in the framework of a European technical conference.
Engineering consultancy/
Technical services

Dr. Oliver Then, Christian Ullrich and Andreas Heß

During the period under report, VGB again provided successfully support to its member companies in solving technical and extraordinary problems. Apart from the expertise of VGB offices, advantage could also be taken from members’ know-how within the scope of business cooperations. Besides, consultancy activities deliver valuable input for VGB’s standardisation and committee activities presenting a further aspect of VGB’s know-how management.

The services offered covered all areas of energy and power plant engineering:

- Engineering consultancy upon planning, construction and operation of power plants,
- Damage analysis,
- Supervision of construction and assembly including quality management and expediting,
- Material investigations and
- Water-chemistry investigations.

Engineering consultancy and damage analysis

VGB’s competency, its vendor independence and its role as expert 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 CC5 is 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 for the boiler of a chemical site,
- Support in formulating the tendering 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, among others at distorted casing, damaged blades and axial bearings of different sizes and operation cases,
- 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 the 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 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 investigations. In several cases, special cleaning measures or changes in the operation modes of tube cleaning systems were introduced and controlled after inspections. Thus, losses of turbine output and cooling tube corrosion were stopped and eliminated avoiding tube leakages. In one case it could also be settled that apart from lime deposits, that had not been removed completely,
also air was entering into a leaking pre-heater flange at the condenser which was also responsible for output losses. VGB localised the air entrance with a special CO₂ leakage detection method.

**Steam generators**

**Optimisation of a power plant site with three thermal power units**

The main task was the independent neutral engineering consultancy and subordinate benchmarking of three plants for the areas of generation and logistics and engineering and maintenance. The technical processes of the single units were assessed and the entire plant was investigated to identify potentials for improvement and optimisation. The existing steam grids (5 steam systems with pressures of 100 to 1.5 bar) were checked in parallel for possible improvements.

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 members 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.).

**Materials laboratory**

During the reporting period about 250 damage cases were investigated with state-of-the-art lab 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 develop jointly 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 metallurgy for the assessment of lifetime consumption, a large number of special tests were made. Here it is the objective to develop jointly 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 material T24. VGB experts were able to describe factors decisive for crack formation and remedies could be defined. The influence of the O₂ contents of the boiler feedwater could be proved under laboratory conditions resulting in the requirements of strictly controlled O₂ dosing and to limit it by special measures particularly during initial operation. Thanks to the close cooperation between material laboratory and water chemistry it was possible to implement the scientific findings about the behaviour of new materials into practical operation.

**Water chemistry**

The department of water chemistry is supporting operators of fossil, substitute fuel and biomass-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. Thanks to the close cooperation between 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 Water–steam–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).

The VGB technical committees formulate research requirements in their respective fields of activity and examine external research proposals with respect to their practical relevance and short- or medium-term practicability in 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 key to financing VGB research projects is the contributions received from member companies. In addition to project-specific contributions from individual member companies, a general research contribution is levied from ordinary member companies. 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 2013

The German-language Table 1 shows the status of project funding in May 2014. 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 2013, VGB took part in a total of 38 projects with a total volume of 62.6 million Euros (previous year: 38 projects with a volume of 68.8 million Euros). Of these, 8 projects with a volume of 2.3 million Euros were started in 2013 (previous year: 13 projects and 1.4 million Euros).

The share of operator funds spent on these new projects was 23%, 15% of which was raised through project contributions of individual companies (VGB ordinary members) and 8% from the joint research contribution of ordinary VGB member companies (VGB research levy). «Other fund» among them manufacturer contributions, amounted to 20%. A considerable share of the funds was raised through public funding (57%).
Tab. 1: Projects funded by VGB since 2008, completed projects are highlighted in grey (as of 05/2014).

<table>
<thead>
<tr>
<th>No.</th>
<th>Abbreviated title</th>
<th>Duration</th>
<th>VGB Research levy</th>
<th>VGB ordinary members</th>
<th>Public funds</th>
<th>Other funds (Supplier)</th>
<th>Total volume</th>
<th>Project results</th>
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<td>Reziproduktionen von Flugaschebeton*</td>
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<td>Microstructure of Alloy 623 under long term creep loading*</td>
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<td>Crack growth rates under thermomechanical loading conditions***</td>
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<td>System stability of electricity supply***</td>
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* VGB Annual report 1986/87, p. 51/52
Tab. 1 (cont.) : Projects funded by VGB since 2008, completed projects are highlighted in grey (as of 05/2014).

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<th>No.</th>
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<th>Duration</th>
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<td>Standardised remote terminal unit for wind power plants***</td>
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<td>Further investigations of the sulphate resistance of fly ash concrete (Continuation 336)*</td>
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<td>Fly ash with higher LOI - Use in concrete*</td>
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<td>Combustion of mechanically agitated lumpy solid fuels (Continuation 358)**</td>
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<td>Burner-induced vibration values of boilers</td>
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<td>Pipe flow rate determination according to EN ISO 16911</td>
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<td>119 93</td>
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<td>119 93 212</td>
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</table>

* Focal point research programme “Residue Management of Coal-fired Power Plants and Waste Incinerator Plants” (ERKOM)
** Focal point research programme “New Materials for Power Plants” (NWK)
*** Focal point research programme “Advanced Coal Power Plant with Optimized Efficiency, Economy and Environmental Sustainability” (Emax)
**** Focal point research programme “Efficient Use and System Integration of Renewables” (EUSI-RES)
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 2013, a total of 48 projects with a total funding volume of about 2,229,070 Euros were supported (previous year: 71 projects and 7,638,243 Euros).

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 covering basic research and application of techniques.

Supported by the Scientific Advisory Board and financed by the VGB-FORSCHUNGSSTIFTUNG (Research Foundation), a summer school course in power plant engineering was again held for advanced students from September 2 to 13, 2013. The summer school POWER PLANT 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 2013, 19 students from 12 German and Slovenian universities took part (Figure 3).

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

Heinrich-Mandel Prize

The Board of Trustees of VGB Research Foundation awarded the 2013-Heinrich Mandel Prize for Power Plant Engineering to Sandra Schmidt for her analysis and optimization of CO₂ separation with monoethanolamine in Niederaußem lignite-fired power plant and Dr Björn Brosch for his numeric simulation of grate firing systems upon biomass co-combustion. The 10,000 Euros prize was awarded on the occasion of the VGB Congress «Power Plants 2013» on September 25, 2013 in Maastricht by the VGB Chairman Professor Dr Gerd Jäger (Figure 5).

Since 1981 VGB Research Foundation has rewarded the outstanding performance of young engineers in the area of power plant engineering with the Heinrich-Mandel-Prize. Further information and the winner of the 2014 prize can be found on the VGB website at www.vgb.org/mandelpreis.
The changes in the energy business also make an impact on training and advanced training and thus on KRAFTWERKSSCHULE E.V. (KWS). 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 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.

For the first time the course «Service technician for wind power plants» was successfully conducted with final IHK (industrial chamber of commerce) examination.

The same applies to the department of nuclear engineering training. KWS offers to it 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.

As regards disassembly and idle operation, different measures were taken during the reporting period with increasing course numbers.

Simulator training

Since last year, KRAFTWERKSSCHULE E.V. has been offering state-of-the-art power plant simulators for training operational and failure situations. This applies to all power plant types that went into operation in recent months or are going to be connected to the grid in the near future. This covers the simulator variants of 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 knows a lot of structures of foreign training and advanced training. Additionally, KWS elaborates operational solutions jointly with the companies. Lecturers’ expertise is supplemented 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.

Another future project is the development and extension of our E-learning products. We have elaborated virtual structures in order to be able to offer the basic qualification of the power plant supervisor course as E-learning module (on-line). The on-line basic qualification offers a saving potential of three months for plant supervisor courses. KRAFTWERKSSCHULE would be grateful to present the new scheme to any interested parties.

The range of KWS products is rounded off by the new apartment house opened in mid-July 2013. National as well as international guests can use the state-of-the-art KWS facilities also for conferences and use the apartment house at the KWS site for overnight stays.

KWS is still offering at-the-site courses in Germany and abroad. These courses are bespoke according to customers’ needs and can be carried out in various languages.

Apartment house

The new apartment house was opened in mid-July 2013. Now, all activities are concentrated on the campus of «Deilbachtal» in Essen-Kupferdreh. A large car park directly connected to the training centre and apartment house makes everything within easy reach.

KWS students highly appreciate the new apartments.
During the period under review from July 2013 to June 2014, VGB organised 27 events with a total of 3,271 participants. Of these, 741 people took part in seminars and workshops and 2,530 in conferences and symposia.

Eight events were conducted with associated technical exhibitions with 382 companies displaying their products and services.

**VGB Congress «Power Plants 2013» in Maastricht**

The VGB Congress «Power Plants 2013» took place in Maastricht from September 25 to 27, 2013. It was attended by more than 700 participants from 26 countries who discussed in the plenary lectures the challenges and solutions with a view on the market model from the viewpoint of consumers, manufacturers and utilities. More than 30 lecturers presented their issues and discussed them with the audience in the sections «Security of Supply: A Common European Challenge», «Technical Solutions for our Future Electricity Generation», «Operational Experience as a Key Competence» and «Thinking ahead: Projects and Visions 2020+».

Besides, some 148 exhibitors presented their production on the exhibition area of the MECÇ Maastricht with a net space of 1,967 m².

**VGB Conference «Chemistry in Power Plants 2013» in Leipzig**

The traditional VGB Conference «Chemistry in Power Plants» and the associated technical exhibition took place in Hamburg from October 29 to 31, 2013. The conference concentrated on the water/steam cycle and water treatment. 53 exhibitors and 341 conference participants exchanged their experiences.

**VGB: Events and Publications**

**VGB Congress «Power Plants 2013», Maastricht/The Netherlands.**

**VGB Conference «Chemistry in Power Plants 2013», Leipzig.**

**VGB Conference «Maintenance in Power Plants», Dresden.**

**VGB Conference «Steam Generators, Fluidised Bed Firing Systems and Cogeneration Plants 2014» in Weimar.**

This year’s VGB Conference «Maintenance in Power Plants» was held again jointly with the VGB Conference «Maintenance of Wind Power Plants». More than 300 participants visited mutually the technical exhibition with 71 exhibitors and the lecture programme of both events.

**VGB Conference «Steam Generators, Fluidised Bed Firing Systems and Cogeneration Plants 2014» in Weimar.**

This conference, which takes place every two years in the autumn, was now held in the spring of 2014. For the first time it was run in parallel with the VGB Workshop «Fluidised Bed Combustion Systems». The combined event took place in Weimar from March 25 to 27, 2014.

224 participants visited both events and 23 companies exhibited their products in the associated technical exhibition.

**VGB KELI Conference 2014 in Landshut.**

The Conference «Electrical Engineering, C&I and Information Processing in Power Plants», briefly called KELI took place in Landshut from May 6 to 8, 2014. The technical utility papers were supplemented by deliberate technical papers of manufacturers and exhibitors. The issue of training and junior engineers was also on the conference agenda in a students’ forum that was added by a contact market. The conference was very successful with more than 400 participants and 32 exhibitors.
<table>
<thead>
<tr>
<th>Date</th>
<th>Place</th>
<th>Kind of Event</th>
<th>Title</th>
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<td>Edertal</td>
<td>Workshop</td>
<td>Oil-workshop</td>
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<td>10 September 2013</td>
<td>Essen</td>
<td>Workshop</td>
<td>Control of Conditions and Examination of Steam Boilers, Pressure Vessels and Tubes</td>
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<td>Challenges of Biomass Combustion</td>
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<td>25 and 26 June 2014</td>
<td>Kassel</td>
<td>Conference</td>
<td>Fuel Technology and Combustion</td>
</tr>
</tbody>
</table>

Tab. 1: VGB events July 2013 to June 2014.
VGB Publications

Christopher Weßelmann

VGB PowerTech Journal

From July 1, 2013 to June 30, 2014 a total of 161 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 19,000 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-018-00-2013-12-EN Fire and Explosion Protection in Biomass Power Plants
- VGB-S-024-00-2014-01-DE Umsetzung des Altersungsmanagements in der Bautechnik nach KTA 1403
- VGB-S-026-00-2013-04-EN Civil Engineering in Nuclear Power Plants
- VGB-S-030-00-2013-06-EN Oil system cleaning for gas and steam turbine plants
- VGB-S-030-00-2013-06-DE Reinigung der Ölsysteme von Gas- und Dampfturbinenanlagen
- VGB-S-031-00-2012-08-DE Betrieb von Dampfkesselanlagen
- VGB-S-166-00-2014-02-EN Quality Assurance in the Manufacture of Generators
- VGB-S-166-00-2014-02-DE Qualitätssicherung bei der Fertigung von Generatoren
- VGB-S-168-00-2013-12-EN Implementation guideline for motors and variable-speed power drive systems
- VGB-S-168-00-2013-12-DE Ausführungsrichtlinie für Motoren und drehzahlgeregelte Antriebssysteme
- VGB-S-175-00-2014-04-EN IT Security for Generating Plants
- VGB-S-175-00-2014-04-DE IT-Sicherheit für Erzeugungsanlagen
- VGB-S-504-00-2013-12-EN Inspection and Testing of Large Forgings and Castings for Steam and Gas Turbine Generator Sets
- VGB-S-823-32-2014-03-EN-DE RDS-PP – Application Guideline; Part 32: Wind Power Plants
- VGB-TW104 Reliability Indicators with KISSY - VGB Research Project 361
VGB PowerTech is co-operating with the following organisations and associations worldwide (in alphabetical order):

AGFW | Der Energieeffizienzverband 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
Bundesverband der Energie- und Wasserwirtschaft (BDEW)
BDI Bundesverband der Deutschen Industrie
Berufsgenossenschaft der chemischen Industrie
Berufsgenossenschaft Feinmechanik und Elektrotechnik
Bundesverband der Gipsindustrie e. V.
BVK Bundesverband Kraftwerksnebenprodukte 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 Apparatewesen e. V. (DEHEMA)
Deutsche Vereinigung für Verbrennungsforschung e.V. (DVV)
Deutscher Ausschuss für Stahlbeton (DAFStb)
Deutscher Verband für Schweißtechnik e. V. (DVS)
Deutsches Atomforum e. V. (DAIf)
Deutsches Institut für Bautechnik
Deutsches Institut für Normung e. V. (DIN)
Deutsches Komitee Instandhaltung (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
ELUnited 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)
Fachverband für Strahlenschutz e. V. (FS)
FBDR Fachverband Dampfkessel-, Behälter- und Rohrleitungsbau e. V.
FGSV Forschungsgesellschaft für Straßen- und Verkehrswesen
FORATOM, European Atomic Forum
Gemeinschaftsausschuss Kennzeichnungssysteme (GAG)
GFS Gesellschaft für Simulatorkonstruktion mbH
GVC/DEHEMA-Fachausschuss «Abfallbehandlung»
Hauptverband 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
Kernenergie für Deutschland e. V.
Kerntechnische Gesellschaft (KTG) e. V.
Kerntechnischer Ausschuss (KTA)
KSG Kraftwerks-Simulator-Gesellschaft mbH
Nationales Komitee des Weltenergierates der Bundesrepublik Deutschland DNK
OECD/NEA Nuclear Energy Agency
Performance Indicator Working Group (PIWG)
PGP-Committee (Performance of Generating Plant)
Reaktor-Sicherheitskommission (RSK)
Stahl Institut VDEh
Strahlenschutzkommission (SSK)
TEC FLAM (Universitäts-Arbeitsgemeinschaft Technische Flammen)
TENPES – Thermal and Nuclear Power Engineering Society, Tokyo, Japan
VDMA Arbeitsausschuss »Gasturbinen«
Verband Kommunaler Städtetechnik (VKS)
Verband der Industriellen Energie- und Kraftwirtschaft e. V. (VIK)
Verein Deutscher Ingenieure (VDI)
Verein Deutscher Zementwerke (VIZ)
Wirtschaftsverband Kernbrennstoffkreislauf 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 838 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 2004 and 2013. Statistical data for hydro power and pumped hydro power plants are now more than three and a half times more than at the beginning. Today data are feed in from operators from Germany, Luxembourg, Austria, Portugal, South Africa and Czech Republic. Operators from France and Italy have expressed their interest in an participation.

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».

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. 1: Analysis of unavailability, availability, dispatchability (reference plane net). Different views of the power industry.

Fig. 2: Operating diagram and performance indicators.
Fig. 3: VGB member units evaluated in 2013.

Fig. 4: Energy availability and energy utilisation. Data for 2013 and mean values for 2004 to 2013.
**Energy unavailability**

**Fig. 5: Energy unavailability. Data for 2013 and mean values for 2004 to 2013**

*) French nuclear power plants without “unplanned disposabel energy availability.”

<table>
<thead>
<tr>
<th>Source</th>
<th>Planned, Average</th>
<th>Planned, Year</th>
<th>Unplanned, Average</th>
<th>Unplanned, Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear power</td>
<td>11.3</td>
<td>0.1</td>
<td>8.2</td>
<td>0.1</td>
</tr>
<tr>
<td>Hard coal</td>
<td>10.9</td>
<td>1.1</td>
<td>9.4</td>
<td>1.1</td>
</tr>
<tr>
<td>Lignite</td>
<td>9.3</td>
<td>0.9</td>
<td>6.8</td>
<td>0.9</td>
</tr>
<tr>
<td>Oil/Gas</td>
<td>8.5</td>
<td>1.4</td>
<td>6.4</td>
<td>1.5</td>
</tr>
<tr>
<td>Combined cycle</td>
<td>8.8</td>
<td>0.3</td>
<td>5.0</td>
<td>0.8</td>
</tr>
<tr>
<td>Gas turbines</td>
<td>8.8</td>
<td>0.8</td>
<td>3.1</td>
<td>0.8</td>
</tr>
</tbody>
</table>

*) French nuclear power plants without “unplanned disposabel energy availability.”
Fig. 6: Nuclear power plants: availability data year 2013 and mean values 2004 to 2013.

Fig. 7: Hard coal-fired power plants: data for availability year 2013 and mean values 2004 to 2013.

Fig. 8: Lignite-fired power plants: data for availability year 2013 and mean values 2004 to 2013.

Fig. 9: Fossil-fired power plants: data for availability 2004 to 2013.
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 455,000 MW of the VGB PowerTech members is represented in the following power plants (as of 30 June 2014):

- 246,000 MW fossil-fired power plants
- 120,000 MW nuclear power plants
- 89,000 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 2013/2014, 31 companies joined the VGB with a total capacity of 49,000 t/h. 49 companies with a total capacity of 263,000 t/h withdrew from VGB (incl. formerly suspended members).

The installed steam generating capacity of the members at that point decreased by 208,531 t/h or 14 % to a total of 1,306,053 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 137 members (28 %) are located in further 33 countries in Europe and other parts of the world.

1 Argentina
1 Australia
36 Austria
6 Belgium
1 Brazil
1 China
2 Croatia
1 Czech Republic
5 Denmark
11 Finland
4 France
356 Germany
1 Greece
1 Ireland
2 Israel
3 Italy
2 Japan
1 Latvia
2 Luxembourg
1 Mongolia
15 Netherlands
1 Norway
5 Poland
1 Portugal
2 Romania
2 Russia
3 Slovenia
1 South Africa
2 Spain
7 Sweden
11 Switzerland
2 Turkey
2 United Kingdom
1 USA

493 Companies from 34 countries

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>2012/2013 Share</th>
<th>2013/2014 Share</th>
<th>Share of total steam capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2012/2013 in %</td>
<td>2013/2014 in %</td>
<td>2012/2013 in %</td>
</tr>
<tr>
<td>up to 200 t/h</td>
<td>34.3</td>
<td>37.9</td>
<td>1.2</td>
</tr>
<tr>
<td>201 to 500 t/h</td>
<td>19.5</td>
<td>22.1</td>
<td>1.4</td>
</tr>
<tr>
<td>501 to 1,000 t/h</td>
<td>9.4</td>
<td>8.9</td>
<td>1.1</td>
</tr>
<tr>
<td>more than 1,000 t/h</td>
<td>36.8</td>
<td>31.1</td>
<td>96.3</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

On June 30, 2014 VGB had the following membership:

<table>
<thead>
<tr>
<th>Companies Number</th>
<th>Steam capacity Total (supply companies) in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public supply companies (utilities)</td>
<td>164</td>
</tr>
<tr>
<td>Industrial supply companies</td>
<td>93</td>
</tr>
<tr>
<td>Total (supply companies)</td>
<td>257</td>
</tr>
<tr>
<td>Affiliated members</td>
<td>33</td>
</tr>
<tr>
<td>Sponsoring members</td>
<td>203</td>
</tr>
<tr>
<td>Total</td>
<td>493 members</td>
</tr>
</tbody>
</table>

The installed capacity of the 93 industrial member companies is divided over the following branches of industry:

<table>
<thead>
<tr>
<th>Industry</th>
<th>2012/2013 in %</th>
<th>2013/2014 in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mining</td>
<td>10.8</td>
<td>10.8</td>
</tr>
<tr>
<td>Chemical industry</td>
<td>26.3</td>
<td>26.5</td>
</tr>
<tr>
<td>Iron and steel industry</td>
<td>18.2</td>
<td>18.1</td>
</tr>
<tr>
<td>Textile industry</td>
<td>2.2</td>
<td>2.3</td>
</tr>
<tr>
<td>Paper and cellulose industry</td>
<td>16.8</td>
<td>16.7</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>10.9</td>
<td>10.8</td>
</tr>
<tr>
<td>Apparatus industry, electrical and automotive industry, shipyard</td>
<td>10.5</td>
<td>10.6</td>
</tr>
<tr>
<td>Rubber, linoleum and leather industry</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Breweries, food and washing-agent industry</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td>Waste management and recycling</td>
<td>2.9</td>
<td>2.8</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, 2014)

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
- Allessa 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
- AWA Abfallverwertung Augsburg GmbH, Augsburg/Germany
- AWA Velsen mbH, Saarbrücken/Germany
- AVBKG Abfallverbrennungs- und Biokompost-Gesellschaft mbH, Tornesch-Ahrenlohe/Germany
- AVEA Entsorgungsbetriebe GmbH & Co. KG, Engelskirchen/Germany
- AVG Abfallentsorgung- und Verwertungsgesellschaft Köln mbH, Cologne/Germany
- AVR-Afvalverwerking B. V., Duiven/The Netherlands
- AWG Abfallwirtschaftsgesellschaft mbH Wuppertal, Wuppertal/Germany
- Axpo Power AG, Baden/Switzerland
- Basell Polyolefine GmbH, Wesseling/Germany
- BASF SE, Ludwigshafen (Rhein)/Germany
- 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
- BIOPOWER 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
- Bremerhaveners Entsorgungsgesellschaft mbH, Bremerhaven/Germany
- Cargill Germany GmbH, Krefeld/Germany
- Carmel Olefins Ltd. Haifa/Israel
- Centrales Nucleares Almaraz Trillo, Madrid/Spain
- CEZ a.s., Prague/Czech Republic
- Colakoglu Metalurji, Kocaeli/Turkey
- CURRENTA GmbH & Co. OHG, Leverkusen/Germany
Mainova AG, Frankfurt am Main/Germany
Mälarenergi AB, Västeras/Sweden
Mark E Aktiengesellschaft, Hagen/Germany
Martinswerk GmbH, Bergheim/Germany
MAYR-MELNHOF KARTON GmbH, Frohleiten/Austria
Membrana GmbH, Wuppertal/Germany
Meridian Energy Australia Pty Ltd., Chatswood NSW/Australia
MHB Hamm Betriebsführungsgesellschaft mbH, Hamm/Germany
MIBRAG mbH, Zeitz/Germany
MIRO Mineralölfaffinerie Oberrhein GmbH & Co. KG, Karlsruhe/Germany
Mond Neusiedler GmbH, Ulm/Germany/Austria
Moritz J. Weig GmbH & Co. KG, Mayen/Germany
Mühlheizkraftwerk Kassel GmbH, Kassel/Germany
Mühlverbrennungsanlage Bielefeld-Herford GmbH, Bielefeld/Germany
Mühlverbrennungsanlage der Stadt Solingen, Solingen/Germany
MVV Energie AG, Mannheim/Germany
N.V. Delta Nutsbedrijven, Middelburg/Netherlands
Nehlsen Heizkraftwerke GmbH & Co. KG, Stavenhagen/Germany
N-ERGIE AG, Nuremberg/Germany
Nettingsdorfer Papierfabrik AG & Co KG, Haid bei Ansfelden/Austria
Nucloelectrica Argentina SA, Buenos Aires/Argentina
Nuon Energie & Service GmbH, Heinsberg/Oberbruch/Germany
NUION Energy Power, Heat & Services, Utrecht/Netherlands
Nuon Power Buggenum, Buggenum/Netherlands
Oil Refineries Ltd., Haifa/Israel
OMV Germany GmbH, Burghausen/Germany
OMV Power International GmbH, Vienna/Austria
OMV Réfining & 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 Ilbenbürren GmbH, Ilbenbürren/Germany
REMONDIS Production GmbH, Lünen/Germany
Reno De Medici Amsberg GmbH, Amsberg/Germany
RheinEnergie AG, Cologne/Germany
Romande Energie SA, Morges/Switzerland
ROMONTA GmbH, Seegebiet Mansfelder Land/Germany
RWE Power AG, Essen/Germany
RWTH Aachen, Aachen/Germany
Sachtleben Chemie GmbH, Duisburg/Germany
Salzburger Landesbetriebe GmbH, Salzburg/Austria
Salzgitter Flachstahl GmbH, Salzgitter/Germany
Sappi Austria Produktions-GmbH Co. KG, Gratkorn/Austria
SCA Hygiene Products GmbH, Mannheim/Germany
Schlüchseewerk AG, Laufenburg/Germany
SEO Société de l’Our Centrale de Vianden, Vianden/Luxembourg
Smurfit Kappa Herberger Papierfabrik GmbH, Herzberg am Harz/Germany
Smurfit Kappa Zürlich Papier GmbH, Zürlich/Germany
Salvay Acetow GmbH, Freiburg/Germany
SOLVAY Infra GmbH, Rheinberg/Germany
SRS EcoTherm GmbH, Salzbergen/Germany
Städtische Werke Energie + Wärme GmbH, Kassel/Germany
Stadtrenovierung Hamburg, Hamburg/Germany
Stadtwerke Augsburg Energie GmbH, Augsburg/Germany
Stadtwerke Bielefeld GmbH, Bielefeld/Germany
Stadtwerke Bochum Holding GmbH, Bochum/Germany
Stadtwerke Duisburg AG, Duisburg/Germany
Stadtwerke Düsseldorf AG, Düsseldorf/Germany
Stadtwerke Flensburg GmbH, Flensburg/Germany
Stadtwerke Hannover AG, Hannover/Germany
Stadtwerke Karlsruhe GmbH, Karlsruhe/Germany
Stadtwerke Leipzig GmbH, Leipzig/Germany
Stadtwerke Münster GmbH, Münster/Germany
Stadtwerke Rosenheim GmbH & Co. KG, Rosenheim/Germany
Stadtwerke Rostock AG, Rostock/Germany
Statkraft, 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 Verwertung MWA Bonn GmbH, Bonn/Germany
SWM Versorgungs GmbH, Munich/Germany
SWN Stadtwerke Neumünster GmbH, Neumünster/Germany
SWU Energie GmbH, Ulm/Germany
Tampere Energy Production Ltd, Tampere/Finland
TAURON Wytwarzanie S.A., Katowice/Poland
Technische Hochschule Ludwigshafen, Ludwigshafen am Rhein/Germany
Technische Universität München, Forschungszentrum Heinz Maier-Leibnitz (FRM II), Garching/Germany
Technische Universität München, Forschungszentrum Heinz Maier-Leibnitz (FRM II), Garching/Germany
Teollisuuden Voima Oyj, Eurajoki/Finland
TERMOLEKTRARNA SOSTANJ d.o.o., Sostanj/Slovenia
Thyssen Krupp Stahl AG, Duisburg/Germany
TiWAG-Tiroler Wasserkraftwerke AG, Innsbruck/Austria
Transitgas AG, Zürich/Switzerland
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 Hydro 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
weg Wärme- Energie- und Prozesstechnik GmbH, Hückelhoven/Germany
WIEN ENERGIE GmbH, Vienna/Austria
WIEN ENERGIE GmbH, Betriebstätte 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 Abfallwirtschaft Südwestthüringen, Zella-Mehlis/Germany
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