Middle East
Tractebel & Lahmeyer
Experience & expertise

India
18 years of Baglihar
Hydropower Station

Germany
Lahmeyer consolidates expertise

2,070 MW FOR ANGOLA
Largest Hydropower Projekt in Africa
Overview

COMPANY

04 | Lahmeyer – A Company of Tractebel
05 | ENR Ranking: Tractebel with Lahmeyer at the forefront of energy transition
05 | Quality secures our Future
06 | New Management: GKW Consult, Tractebel Turkey
06 | German Halcour retires
06 | Change at Lahmeyer Hydroprojekt
07 | New Subsidiary in Oman
07 | News in brief
08 | Lahmeyer Deutschland consolidates Expertise

ENERGY

08 | Middle East: Experience and Know-how in the traditional and young Region
10 | Global: Power Stations Cyber Security with Information Security Management System
12 | Mali: Hybrid Systems (PV/Diesel/Battery) for rural Electrification in Mali
13 | Pakistan: Three Combined Cycle Power Plants utilizing new H-Class Gas Turbines
15 | Kuwait: Masterplan with Building Information Modelling (BIM)
16 | Egypt: Strategic Environmental Assessments for Renewable Energy Projects
17 | Global: Joint Operation of Large Battery Energy Storage and Pumped Storage Scheme

HYDRO & WATER

18 | Tunisia: Brackish Water Desalination using Renewable Energy for South Tunisia
20 | Angola: 2,070 MW Laúca Hydropower Plant Operational
21 | Germany: Neuwürschnitz Flood Retention Reservoir with Full Ecological Culvert
22 | India: 18 years of Baglihar Hydropower Station
23 | Turkey: Doğançay Weir and Hydro Power Plant
24 | Sudan: Multipurpose Project at Upper Atbara for Irrigation, Energy and Drinking Water

BUILDING & TRANSPORTATION

26 | Germany: Refurbishment of Frankfurt International Airport – Flight Operations Continue
27 | Germany: Lahmeyer manages the Construction of 216 Apartments in Berlin

Imprint
Lahmeyer International’s magazine “aktuell” is published once to twice a year in German and English. Reproduction and electronic dissemination, even excerpts, are only possible upon approval of the editors.

Cover page
The hydro power plant Laúca in Angola currently is the largest hydro power project in Africa. End of 2017, the first two power generating units of the 2070 MW facility were commissioned.

Editor
Lahmeyer International GmbH
Friedberger Str. 173, 61118 Bad Vilbel, Germany
Responsible: Sabine Wulf

Artwork and lithography
magenta Kommunikation, Design und Neue Medien GmbH & Co. KG, Mannheim, Germany

Print
Ottweiler Druckerei und Verlag GmbH, Ottweiler, Germany

© Lahmeyer International GmbH, February 2018
Dear readers,

Today, you have in front of you the latest issue of our magazine “aktuell”. It has been a while since the last issue was published. In the meantime, a wind of change has blown some new business ideas into our company. By now, Lahmeyer has been firmly integrated to become an important part within the Tractebel Group, and as such, also a member of the global ENGIE family.

I am very proud that – since November 2016 – I have been entitled to lead our company as CEO and our team of three in the management. In May 2016, Michael Stephan was appointed Lahmeyer CFO and commercial director, incorporating his long-time experience at ENGIE into our work. Since March 2017, Dr. Thomas Brandstätt has been supervising our strategy process as Managing Director for Strategy and M&A to make us – being a part of ENGIE, the biggest independent power company worldwide – fit for the future.

The changes in the energy sector are influencing all of us on an everyday basis. Our company faces the change and actively shapes it for a better future. In doing so, we connect innovative ideas with well-proven experience. Our focus is on the three Ds of the modern energy world: Decarbonisation, Digitalisation and Decentralisation!

As a part of the Tractebel Group, we are a strong partner for our customers, globally and actively driving the energy transition. In this, we are a global player as is demonstrated by our top positions in the ENR Ranking (see page 5). Especially, I would like to draw your attention to our market-leading rank in the field of hydropower & water. With our large hydropower project in Laúca (title and page 20), you can find a good example why we have been able to hold this position for some years now right within this magazine.

We are further strengthening our activities in the field of offshore wind power plants and rolling out new and trendsetting projects regarding topics such as cyber security, battery storage systems or hydrogen technologies.

Given the increasing world population, agriculture is facing the task to produce ever more food with ever less water. Sustainable water management remains to be one of the most vital challenges for food security worldwide. Our company actively contributes to this issue with important international projects in Africa and Asia.

By establishing the Lahmeyer Deutschland GmbH (see page 8f.), we are emphasizing the importance of our domestic market for our company. For example, climate change is also noticeable in Germany. This entails the task of supporting preventive flood protection. In this field, we have excellent competencies, which we will expand continuously.

As you can see, we have started more than a few good things and we will keep on doing so in the future. It is our intention to meet our growth targets by both organic growth and acquisitions.

The articles in this magazine impressively demonstrate our distinguished professional expertise as well as the passion of our employees to realise our vision.

Challenge us – we are looking forward to it!

Your Martin Seeger
As a part of Tractebel, the activities of the Lahmeyer Group play an important role in the service portfolio of the whole company. Within the Tractebel Management Team, Lahmeyer is represented by Martin Seeger.

**INTRODUCING THE TRACTEBEL MANAGEMENT TEAM:**

1. **HEIN DIRIX**  
   CHIEF OFFICER INFRASTRUCTURE AND ENVIRONMENT

2. **RICHARD WILHELM**  
   CHIEF OFFICER POWER & GAS

3. **BERNARD GILLIOT**  
   CHIEF OFFICER GLOBAL BUSINESS DEVELOPMENT

4. **SABIEEN VERMEULEN**  
   CHIEF LEGAL, ETHICS AND COMPLIANCE OFFICER

5. **MARTIN SEEGER**  
   CHIEF EXECUTIVE OFFICER GERMANY AND ASSOCIATED TERRITORIES

6. **CLAUDIO MAIA**  
   CHIEF EXECUTIVE OFFICER LATIN AMERICA

7. **BRIGITTE BOCQUÉ**  
   CHIEF HUMAN RESOURCES AND QHS OFFICER

8. **SAMY BENOUDIZ**  
   CHIEF EXECUTIVE OFFICER FRANCE AND ASSOCIATED TERRITORIES

9. **MARC FRANCHIMONT**  
   CHIEF FINANCE OFFICER

10. **DANIEL DEVELAY**  
    CHIEF EXECUTIVE OFFICER

11. **MICHAEL MARIQUE**  
    MANAGING DIRECTOR LABORELEC

12. **CLAUDIO MAIA**  
    CHIEF EXECUTIVE OFFICER LATIN AMERICA

13. **BRIGITTE BOCQUÉ**  
    CHIEF HUMAN RESOURCES AND QHS OFFICER

14. **SAMY BENOUDIZ**  
    CHIEF EXECUTIVE OFFICER FRANCE AND ASSOCIATED TERRITORIES

15. **MARC FRANCHIMONT**  
    CHIEF FINANCE OFFICER

16. **DANIEL DEVELAY**  
    CHIEF EXECUTIVE OFFICER

17. **MICHAEL MARIQUE**  
    MANAGING DIRECTOR LABORELEC

www.tractebel-engie.com
Tractebel with Lahmeyer at the forefront of energy transition

In 2017, Tractebel climbed to rank 3 (wind) and 4 (solar) in the ENR Ranking of the globally leading international engineering companies for wind and solar projects while affirming its position at rank 2 for hydro power projects. In the field of transmission and distribution, the company holds a strong position at rank 5.

Every year, the magazine Engineering News Record (ENR) publishes the rankings of the biggest global construction and engineering agencies based on gross turnover generated by projects outside of the companies’ respective home countries. The numbers demonstrate the strong position of Tractebel in the field of renewable energy, thus confirming the company’s vision to actively shape the energy transition.

Quality secures our Future

Lahmeyer certified according to the new standard DIN EN ISO 9001:2015

The high quality of our work is a supporting pillar of Lahmeyer’s success. To sustainably ensure this quality, we have introduced a process-oriented quality management system many years ago and had it certified by TÜV Hessen pursuant to DIN EN ISO 9001:2008. This globally renowned standard was completely revised and is superseded by the new DIN EN ISO 9001:2015. Lahmeyer has now successfully completed certification to the new standard.

At Lahmeyer the certification takes place as group certification. Lahmeyer International, Lahmeyer Deutschland, Lahmeyer München and GKW Consult, Mannheim are involved in this matrix certification. All are based on a uniform quality policy and common quality goals, which are described in a common quality management documentation.

“The new standard places new demands. By being certified pursuant to DIN EN ISO 9001:2015, we will assure quality in accordance with valid international standards – a major step for us and the company’s future.”

Volker Rühl, Lahmeyer International Quality Officer
**GKW Consult**

Effective from 1 January 2018, Dr. Christoph Theune and Patrick Kaminsky will take over the positions of Managing Directors of GKW Consult. Dr. Ralf Bufler, the previous Managing Director, is going to pursue a new challenging position outside the group. Dr. Christoph Theune, who will chair the Board of Directors, has been active in GKW in management positions for 24 years and for the last 6 years as Director of Operations. Patrick Kaminsky has been active with GKW for 10 years in various positions, most recently as Financial Director.

**Tractebel Turkey**

As of 1 January 2018, Ugur Aytuna is Managing Director at Tractebel Turkey. In his new position, Ugur Aytuna supports the Turkish subsidiary of Tractebel with winning and realising new projects in power generation. Tractebel Turkey has been active in the Turkish market for more than 18 years. As a connection between Asia, Europe and the Middle East, Turkey is targeting to become an energy hub for future power generation. Tractebel Turkey intends to support the country with this target by providing high quality engineering services.

**German Halcour retires**

Effective from 1 January 2018, German Halcour resigned from his post as spokesman of the management at Lahmeyer Deutschland. For the time being, he will stay with the company as a consultant. German Halcour’s tasks will be taken over by Michael Bergmann, Managing Director at the office in Berlin, and Michael Lebsanft, Managing Director at the office in Bad Vilbel.

In April 2017, the companies Lahmeyer Berlin and Lahmeyer Rhein-Main merged into the Lahmeyer Deutschland GmbH.

After having been Rhein-Main’s Managing Director since 2001, German Halcour was appointed spokesman of the management for the newly established company. He began working at Lahmeyer as early as 1982 and accompanied national and international industry and infrastructure projects until 1992. After a break from 1992 to 1999, he held different leading positions at Lahmeyer.

Lahmeyer CEO Martin Seeger appreciates German Halcour’s work in determining the strategic orientation of the company and developing standards and processes in the handling of large-scale projects.

**Change at Lahmeyer Hydroprojekt**

Effective from 1 January 2018, Dr. Ulrich Kanzow joined the management of Lahmeyer Hydroprojekt. He will lead the company together with Michael Werner as Managing Director. Thus, he succeeds Michael Heiland, who retires after more than 43 years at Lahmeyer. Michael Heiland joined Lahmeyer Hydroprojekt in 2006. Before that, he worked with Lahmeyer International around the world for decades. Additionally, he was involved in associations and committees such as ICOLD, DWA, HTG and VBI. As a recognized expert for dams, he assumed the presidency of the German Committee for Dams (Deutsches TalsperrenKomitee e.V.) from 2010 to 2013.

After having been active in a leading position at two engineering companies involved in hydraulic engineering, water management, infrastructure and plant engineering for 12 years, Dr. Ulrich Kanzow joined Lahmeyer Hydroprojekt in 2015 and has since been responsible for the business unit Weimar. His passion is for the project business including all its challenges.
New subsidiary in Oman

On 12 December 2017, the newly established subsidiary Lahmeyer and Tractebel Engineering Consultancy LLC in the Sultanate of Oman hosted an inauguration event for its opening. The Joint Venture with the Al-Sulaimi Group will strengthen the local positioning of the international engineering company Tractebel.

The inauguration event was attended by the CEOs of many of the companies’ most important customers. “Our inauguration party was a big success as we were able to demonstrate the importance of the region. We could show our commitment to the energy transition and at the same time hold interesting discussions with our local customers,” says Alain Vannerum, Regional Manager Middle East at Tractebel.

The newly formed local company enables the international engineering company to become an even stronger and more local partner to its clients in the Sultanate of Oman as well as in the greater region. A growing number of regional engineering projects made the establishment of a local subsidiary a logical step in the growth plan of the Tractebel company group.

The projects cover a broad range of different activities in the energy, water and infrastructure sectors, including for example master planning for the country’s power generation and transmission through 2030, technical advisory as well as owner’s engineer services for various independent power plants and wind projects, including grid connection studies.

News in brief:

Sale of Shares in LAyE

Lahmeyer has sold its 50 % share in LAHMEYER AGUA Y ENERGIA S.A. in Lima, Peru effective May 3, 2017. The company is now called AGUA Y ENERGIA INGENIEROS CONSULTORES S.A. and is no longer part of the Lahmeyer Group or Tractebel.

Martin Seeger in the Board of NUMOV

In 2017, Martin Seeger, CEO of Lahmeyer, was elected to the board of the German Near and Middle East Association (NUMOV). NUMOV is Germany’s oldest and largest specialised organisation for the Middle East region. For more than 80 years, it has supported member companies in setting up and expanding business contacts with countries in the region.

Cooperation with COIDIC

The China Overseas Infrastructure Development & Investment Corporation (COIDIC) and Lahmeyer International signed a Memorandum of Cooperation (MOC) on 5 July 2017 in Beijing. COIDIC’s Deputy CEO Jiafu Yuan and Lahmeyer’s CEO Martin Seeger as well as the Executive Director Hydropower and Water Resources Bernhard Stabel signed the MOC. The scope of the Memorandum is the cooperation on preliminary project development up to the level of a bankable feasibility study with the projects mainly in the Energy and Power Sector (e.g. Hydropower, Thermal Power Plants, Renewable Energies, Transmission, etc.) and the Water Sector.
Lahmeyer Deutschland consolidates Expertise

Jointly benefit from individual strengths, use synergies and optimise processes - there were lots of reasons to consolidate the expertise of Lahmeyer Berlin GmbH and Lahmeyer Rhein-Main GmbH. The two companies were merged, effective from 24 April 2017. The new company, Lahmeyer Deutschland GmbH, has its registered office in Bad Vilbel. Business is operated from the two sites in Berlin and Bad Vilbel as before, so that Lahmeyer Deutschland is still represented in both metropolitan regions. The consolidated company is managed by the new management board Michael Lebsanft from Bad Vilbel and Michael Bergman from Berlin. On January 1st, 2018, German Halcour resigned as spokesman of the management. However, he will still be available to the company in an advisory role.

Under joint management
The two companies Lahmeyer Rhein-Main and Lahmeyer Berlin had been successful in project management as well as technical and economic consultation in the fields of building construction, industrial construction and complex infrastructural projects throughout Germany for many years. Due to their similar portfolio and comparable tasks handled, both companies had been cooperating closely for years already.

With the establishment of Lahmeyer Deutschland, these activities were placed under a joint management, to facilitate processes, leverage synergy effects and reduce expenses. Expertise was bundled. Projects are handled by a pool of civil engineers, architects and business engineers. Consequently, projects can be implemented more specifically and efficiently.

In addition, Lahmeyer Deutschland can act with more flexibility in relation to tenders and requests for proposals.

Lahmeyer Deutschland combines proven strengths with new benefits. With 50 employees, the new company is continuously active at both locations.

Projects all over Germany
The current projects of Lahmeyer Deutschland include:
- The new construction of the seven-storey building of the Gesellschaft für Internationale Zusammenarbeit [GIZ, German Society for International Cooperation] in Bonn. Lahmeyer supports the client in the control of quality, costs, deadlines and payment releases, as well as in the acceptance procedure.
- The Deutsche Institut für Ernährungsforschung [German Institute for Food Research] is establishing a new research complex including study centre, biobank, laboratories and offices. Lahmeyer oversees project control.

“The bundling of expertise allows us to meet our customers’ demands even more specifically.”
Michael Lebsanft
Managing Director Lahmeyer Deutschland, Bad Vilbel

“Due to our two sites at Bad Vilbel and Berlin, we remain close to our customers.”
Michael Bergmann
Managing Director Lahmeyer Deutschland, Berlin

“Numerous synergies and optimised processes provide added value to both our clients and ourselves.”
German Halcour
former spokesman of the board of Lahmeyer Deutschland
Ready for take-off
• Lahmeyer Deutschland is in charge of project control at Terminal 1 of Frankfurt International Airport, where the fire protection systems are updated during ongoing operation. Lahmeyer ensures the completion of the project within the specified time and cost limits (please also refer to page 26).
• After the shut-down of Berlin Tegel Airport, a research and industrial park, a residential area as well as a “smart city” will be developed on the area of approx. 220 hectares. Lahmeyer Deutschland supports the owner in coordination and project control.

Infrastructure for energy
• With the energy transition, significant network expansion and modernisation will arise in Germany in the coming years. Lahmeyer Deutschland provides project management services for the onshore grid expansion projects of the transmission network operator TenneT.
• On the property of the Wiederaufarbeitungsanlage Karlsruhe (WAK) Rückbau- und Entsorgungs GmbH [nuclear waste reprocessing, dismantling and disposal company], a warehouse and logistics hall are to be constructed for intermediate radioactive waste storage. Lahmeyer Deutschland is the project manager.

We secure the future
By the merger of the two regional companies into Lahmeyer Deutschland, we put our Germany-wide activities on a broad, solid basis - for the successful future of our company and our customers’ success.
www.lahmeyer-deutschland.de

Lahmeyer München
As a stand-alone office in Munich, the Lahmeyer subsidiary offers a wide range of services including project management as well as planning and consulting services in transportation infrastructure.
www.lahmeyer-muenchen.de
Experience and Know-how in the traditional and young Middle East Region

The Middle East is one of the most challenging and most rapidly developing regions in the world. Lahmeyer and Tractebel have been active in the Middle East for more than 40 years. Over 28% of the population is between 15 and 29 years old. Representing over 108 million inhabitants, this is the largest number of people in transition to adulthood in the history of the Gulf countries. The Middle East is hence a very rich region with a comparatively young population. This might be an indication that development in the Gulf countries will continue at the same pace as in the past decades. With this in mind, Lahmeyer International’s business has been developing positively for many years, which is demonstrated by numerous successfully completed projects.

A Growth Region
In the Middle East, one litre of drinking water still costs more than one litre of oil. The economic systems in the Middle East and North Africa (MENA) are still under pressure due to the effects of war and violence in some areas, as well as due to low oil prices.

Nevertheless, the region is a growth market. Landmark infrastructure projects like the Jeddah Tower, large solar plants like Sheikh Mohammed Solar Park in Dubai or the Benban solar project near Assuan in Egypt and Qatar’s Power Transmission System Expansion program are showing the magnitude of investments in this region. Over the past 10 years, Lahmeyer’s multinational team successfully implemented more than 100 projects in the fields of electricity transmission and distribution, power station technology, renewable energy and infrastructure.

Commitment to the Middle East
Tractebel and its subsidiary Lahmeyer formed a dedicated team of highly qualified employees and experienced experts to work on a broad range of different business activities.

The organization includes the new subsidiary in Muscat, Oman, as well as subsidiaries and offices in Dubai, Riyadh, Al-Khobar, Doha and Abu Dhabi.

Projects prove Expertise
Lahmeyer International is known for its capability to handle complex mega projects in the Middle East. One example for this is the combined cycle power station of Qurayyah that supplied a peak capacity of 3,800 MW in summer 2017. Regarding renewable energy production, Lahmeyer has been involved especially in solar technology since the beginning of the latest boom. One of the key solar projects in the world is the Sheikh Mohammed Solar Park in Dubai. Already in 2011, Lahmeyer International prepared the feasibility study including the master plan for the entire solar park development.

Lahmeyer International was also the technical advisor for Dubai’s utility,
DEWA, for the first commercial implementation phase of the solar park, featuring a feed-in price of less than 6 US cents/kwh, which was ground-breaking at that time. This result paved the way for the capacity expansion of another 800 MW PV and 700 MW CSP. The projects will be implemented at the same site in Dubai soon.

**Electricity Transmission and Distribution**

Lahmeyer is particularly strong in the field of electricity transmission and distribution. In 2016 and 2017, vast implementation programs have been implemented with the support of Lahmeyer specialists in Abu Dhabi and Qatar. The most recent project was the successful support of Qatar’s utility KAHARAMAA in phase 13 of their investment program. This project underlines the Client’s confidence in the capabilities of Lahmeyer.

**Master Plan for Energy Transition**

With the merge of the teams of Tractebel and Lahmeyer in the region, our combined capabilities are becoming stronger. This includes the expertise in electricity production, as was shown by our experts in the implementation of the combined cycle power stations of Barka and Tihama. In addition, the Tractebel Power System consultation team on site provides assistance to the energy transition in the region. With the increase of renewable power generation and its impact on the existing supply and transmission systems, this field is gaining importance. The master plans for utilities like Abu Dhabi’s ADWEC and Oman’s TRANSCO show how Lahmeyer and Tractebel support their clients to build the base for the development of the region’s future energy system.

**Infrastructure Projects with Tractebel Dubai**

The Tractebel Dubai office additionally provides design services for infrastructure projects. They focus on complex buildings such as the Al-Wakrah Stadium, as well as on projects in ports and on waterways. Examples are the extension of the promenade in Dubai’s Festival City as well as the boardwalk and piers in Palm Jumeirah.

Cooperation of Lahmeyer, Tractebel Dubai and RED was intensified by the most recent joint activities in a common building project. This resulted in the award of the contracts for two new projects in the field of energy efficiency - a field offering future potential.

**New Subsidiary in Oman**

The new subsidiary Lahmeyer and Tractebel Engineering Consultancy LLC in the Sultanate of Oman - a Joint Venture with the Al-Sulaimi Group – will enhance Lahmeyer’s and Tractebel’s positions on site (see page 6).

The most recent collaborations for two substation projects in Dubai, the Fadhili cogeneration power plant and the award of two master plans in Kuwait demonstrate the joint capacity and capability in the Middle East.

In these projects, Lahmeyer and its parent company Tractebel do not only successfully support their clients, but simultaneously contribute to the energy transition in this challenging market.
Global Power Stations Cyber Security with Information Security Management System (ISMS)

We hear about cyber-attacks, hackers and cybercrime almost on a daily basis. As recent events have shown, industry and energy suppliers are affected, too: Stuxnet, NotPetya or the hacker attack on the Ukrainian energy grid are only a few examples. Lahmeyer International addresses this issue.

Critical infrastructures are targeted more and more by attackers. The degree of cross-linking as well as the quantity of data continue to increase exponentially due to digitalisation and the Internet of Things. With this, the number of security gaps in power stations and energy supply networks also increase. The consequences of an extended breakdown of power or water supply would be disastrous – for people and for the suppliers.

Everyday threats
Apart from wilful acts such as the exploitation of vulnerabilities, phishing and malware, human errors may also result in failures. Missing backups, the thoughtless use of mobile devices or incomplete configurations open the doors for all kinds of cyber-attacks. However, organisational deficiencies such as unrestricted remote maintenance, incomplete patch management and, above all, employees’ insufficient awareness of risks provide security gaps to attackers, too.

Lahmeyer’s contribution to more cyber security
Measures such as firewalls, virus scanners or similar are only small steps towards security. In this regard, an information security management system in compliance with ISO/IEC 27001 is the suitable method to ensure compliance with security objectives such as confidentiality, integrity and availability by means of guidelines, procedures and regulations.

In a first step, existing security risks are identified in a systematic approach. Lahmeyer’s information security team, consisting of information security, IT and OT experts, provides support by guided gap and risk analyses.

Subsequently, suitable measures may be taken to close security gaps. The standards ISO/IEC 27002 and ISO/IEC 27019 provide assistance for the selection of suitable controls. These are not always of a technical nature. Guidelines for the use of mobile devices or awareness campaigns for employees may also be applied.

To ensure efficiency and continuous improvement, regular audits and necessary subsequent corrective measures are required. For instance, Lahmeyer’s Lead Auditors perform test audits to ensure the optimum preparation of customers for certification.

Setting a good example
In order to not only support its customers through consultation, but also contribute to their information security as a provider, Lahmeyer International is currently implementing an ISMS in compliance with ISO/IEC 27001 in their Bad Vilbel office.

Key components of an ISMS

- Management responsibility
- Awareness, training, communication
- ISMS policy
- Inventory of values
- Risk-based approach
- Measures, implementation
- Continuous improvement
- Audits & Management Reviews
Hybrid Systems (PV/Diesel/Battery) for rural Electrification in Mali

Lahmeyer International worked as technical advisor to the national rural electrification agency of Mali (AMADER) for the feasibility study of hybrid systems dedicated to mini-grids in 50 remote villages. Lahmeyer also prepared tender documents for a competitive EPC procurement procedure and the implementation of this World Bank financed program.

With the support of the World Bank, AMADER is planning to develop and implement 50 PV/Diesel/Battery hybrid power plants in remote villages aiming to strengthen the country’s rural electrification system.

The Starting Situation
The 50 villages in this program were to date powered by diesel generators ranging from 30 kVA to 500 kVA operated by private companies and only sporadically providing electricity. Lahmeyer was contracted to assess the opportunity to hybridize existing gensets with photovoltaic (PV) and batteries in order to reduce fuel dependence for electricity generation (and consequently, reducing end-user tariff), while improving continuity of services and power quality.

Business models for rural electrification projects typically include a subsidy (up to 90 %) on the CAPEX, while system operation is entrusted to private operators, or local communities for the whole project lifetime (typically 15-20 years). This setup further increases hybrid system attractiveness compared to diesel-only scenarios.

With the contribution of Lahmeyer’s local partner, all villages were visited to identify potential site constraints and assess suitability of existing diesel power plants to host hybrid power. Site visits also targeted the data collection of socio-economic factors (domestic and productive uses) necessary for the evaluation of current and future electrical demand.

Indeed, estimation of daily load profiles based on reliable data is the first key step in designing proper hybrid systems.

The Realization
With the software tool HOMER Energy, Lahmeyer simulated the functionality of different scenarios and technical configurations of hybrid systems on an hourly basis over a typical year in order to optimize the design from a techno-economical perspective. A financial analysis was conducted in order to determine the required level of subsidy to make the end-user tariff affordable while still ensuring profitability and attractiveness for private operators.

Based on the feasibility study outcomes, tender documents were prepared on an EPC basis to ensure the selection of competent companies and to define the minimum technical specifications of key components. Tender documents also considered strong requirements regarding training of local operators to be performed by the installation company. Indeed, maintaining and operating hybrid systems in remote rural areas remain a key challenge to ensure longevity of these projects.
Three Combined Cycle Gas and Steam Power Plants utilizing new H-Class Gas Turbines

With 100 million inhabitants, Punjab is the most densely populated province in Pakistan and contains 60 % of Pakistan’s industry with an industrial growth rate of 2.9 %. The current electricity demand of 3,000–5,000 MW is not being met. In view of this challenge, Lahmeyer and the consulting firm National Engineering Services Pakistan (Pvt) Limited (NESPAK) have been cooperating in the development of electric power generation capacity in the province of Punjab since February 2015.

Lahmeyer supports NESPAK and two public project companies in the implementation of the three gas and steam combined cycle power plants Balloki, Haveli Bahadur Shah and Bhikki in the province of Punjab. In close cooperation, the specialists from Lahmeyer and NESPAK carried out the project from project specification tendering to the assessment of proposals within only seven months.

Challenging Project
The major challenge of this project, in addition to the high fuel prices (liquid gas), is the short implementation period. The single-cycle phase should be completed within 18 months (first plant) and the combined-cycle phase within 27 months, respectively. This time schedule and the new performance figures of the Chinese EPC contractors stipulating an efficiency of between 61–63 % are quite challenging. For this reason, all three projects will be equipped with GE H-class gas turbines, model 9HA.01 - the first use of these turbines in Pakistan.

Commissioning
All six H-class gas turbines at the three sites were subjected to the first firing tests in July 2017. Following the test, four turbines were transferred into commercial operation. In February 2018 all three power plants went into full commercial operation.

Highest Efficiency Worldwide
Additional measures announced by the manufacturers of H-class gas turbines make it possible to achieve a further increase in efficiency of over 63 % for future combined cycle power plants. In addition, the gas turbine capacity will increase, electricity consumption will drop and the EPC implementation period will be reduced.

Pakistan effectively promotes the development of electricity production on the basis of regasified liquid gases. Advanced gas turbines will be of significance in this regard. The new project Jhang, which is being worked on in the same constellation with NESPAK, was recently also awarded to Lahmeyer. In this project, H-class gas turbines from Siemens are used.
Forecasts show demand

The cooperation with the Ministry started with the joint elaboration of a forecast for demand development regarding electricity and water based on statistical data.

Based on this forecast, the currently installed capacities, the plants proposed and under construction, as well as the plants to be shut down by 2040, a demand gap starting in 2026 was identified. Lahmeyer specialists then elaborated five technical feasibility studies for power stations and desalination plants to cover the forecast demand gap with new capacities until 2040.

Two of the five requested feasibility studies refer to existing power station sites where new plants are to be constructed. For the remaining three sites, appropriate locations were determined in coordination with local authorities.

Efficient, environmentally compatible, profitable

In parallel to the determination of the future demand, the Lahmeyer International specialists composed a selection of suitable technologies for the power stations and desalination plants. Regarding the criteria for these technologies, focus is combining maximum efficiency and optimum environmental compatibility with optimum profitability.

Building Information Modelling – BIM

The Lahmeyer experts use a BIM process for the calculations and designs. BIM is a cutting-edge method for the optimised design, execution and operation of buildings and plants by means of software. All relevant plant data is modelled, combined and recorded digitally. The structure is also visualised geometrically as a virtual model (computer model).

Proposed plant configurations

The comprehensive computation process produced the following plant configurations as standardised blocks:

- For power stations: 1,400 MW with 2 H-class turbines, 2 waste heat boilers and one steam turbine.
- For desalination plants: 70 MIGD as sea water reverse osmosis system

For covering the calculated demand gap, the construction of approx. 20 power station units with a capacity of 1,400 MW each and around 8 desalination plants with a capacity of 70 MIGD each are projected to be required.

Discussions are in progress with Kuwait Petroleum Company (KPC), which is responsible for the power stations’ fuel supply, as the future gas demand for the new power stations must be ensured by 2040.

In January 2017, the Ministry for Energy and Water awarded Lahmeyer International with the contract for the elaboration of a master plan for Kuwait’s demand for electricity and water until 2040. The demand gap is to be closed with appropriate measures. This marked the project start of five technical feasibility studies for power stations and desalination plants established using a BIM process. The layouts of the power stations and the desalination plants are designed as 3D models.
Strategic Environmental Assessments for Renewable Energy Projects

Lahmeyer International is carrying out Strategic and (Cumulative) Environmental and Social Assessments (SESA) for renewable energy projects in Egypt. Among other things, the experts conduct observations in the field which incorporate environmental and social considerations in the development plans for renewable energy projects as a basis for permitting and financing of wind and solar power projects.

Environmental and Social Assessment (Strategic) Studies are starting to play a more important role for the development of renewable energy projects. They support and facilitate obtaining environmental permits for individual projects and they often reflect the requirements of international financing organisations regarding environmental topics to be considered for the financing of the projects. In recent years Lahmeyer has been involved in a larger extent in such studies.

Study in Gulf of Suez Area
One important example is a study performed for the Gulf of Suez region by Lahmeyer together with its joint venture partner, ecoda Umweltgutachten GbR. Our client in this project is the Regional Center for Renewable Energy and Energy Efficiency in Egypt, handling the execution on behalf of the involved local stakeholders like NREA, EEAA, EETC and the project developers. The assessment is targeting to:

- Determine any likely significant impact caused by wind energy project development in a 797 km² area based on the monitoring of breeding and resting birds as well as observations of bird migration;
- Assess, whether such impacts can be mitigated, or whether they require a restriction or cancellation of wind power development;
- Define necessary mitigation measures and environmental and social management requirements; and
- Assess the effects of possibly required mitigation and environmental and social management measures regarding the overall viability of wind power development in the area.

Study in East Nile region
At the moment, a further study including a similar analysis is being executed together with our colleagues from Tractebel. It is located in the Egyptian East Nile region and covers an area of 2,200 km². The study is prepared for the New and Renewable Energy Authority of Egypt (NREA) and financed by EBRD.

In addition to wind energy projects, this study is also covering the assessment of solar PV projects. The scope includes the full scoping stage as well as the coordination of the stakeholder participation, up to the organization and execution of the public hearing. The project will result in the identification of the best possible locations for development of wind and solar facilities. Furthermore, our services include a training component for the Client’s staff, starting from technical training for wind and solar technology up to detailed workshops focusing on environmental and social impact of the projects.
Joint Operation of Large Battery Energy Storage and Pumped Storage Scheme

The increasing complexity of energy networks necessitate the use of rapid and powerful storages. Driven by high investments in the field of electric mobility, the prices for lithium-ion batteries have dropped massively in recent years, and large-scale storage systems for network stabilisation have become competitive. Lahmeyer International has been awarded the contract to support the implementation of ENGIE’s first battery energy storage system in Germany.

**Battery Energy Storage for Network Stabilisation**
ENGIE Deutschland is developing an innovative battery energy storage system (BESS) at the site of the Pfreimd group of power stations. This system is intended to provide additional balancing power for network stabilisation.

The battery energy storage system will supplement the existing systems of the pumped storage power station, which today already contribute to a secure energy supply with the provision of primary and secondary balancing power as well as tertiary reserve.

ENGIE Deutschland awarded Siemens AG with the contract for delivering the battery storage unit.

The lithium-ion storage with a capacity of 12.5 MW and an energy capacity of 13.5 MWh is intended to be pre-qualified for providing primary balancing power.

BESS are characterised by their fast controllability, and are thus ideally suited for the stabilisation of electricity networks with high proportions of renewable energy.

Production and demand fluctuation may be compensated locally, which can reduce otherwise necessary measures for network expansion.

**Engineering Consulting Services**
Lahmeyer engineers consult ENGIE in the implementation and testing phase of the facility. The services of our specialists include the evaluation of the overall technical concept, the testing of the electrical, I&C and safety technology as well as the electrochemical components regarding the use of balancing energy. In addition, the experts examine safety functions for the prevention of effects on the environment and support workshop acceptance and load tests during the test run.

**Lahmeyer Expert Presentation at HYDRO**
Over the course of a study regarding the characteristics and advantages of the combination of battery energy storage and pumped storage systems, Lahmeyer specialists held an expert presentation at Europe’s largest hydropower trade fair HYDRO in Sevilla in October 2017.

Download available at: www.lahmeyer.de/downloads

---

**Concept design for 12.5 MW battery energy storage**  
*Image source: Siemens*

**Graphic source: EU energy trends to 2020**

**BESS operating regime in primary balancing power market**

- Minimum requirement
- Admissible operation

<table>
<thead>
<tr>
<th>Time</th>
<th>Power Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>t0</td>
<td>0%</td>
</tr>
<tr>
<td>t1</td>
<td>25%</td>
</tr>
<tr>
<td>t2</td>
<td>50%</td>
</tr>
<tr>
<td>t3</td>
<td>75%</td>
</tr>
<tr>
<td>t4</td>
<td>100%</td>
</tr>
<tr>
<td>t5</td>
<td>0%</td>
</tr>
</tbody>
</table>

**BESS Benefits**
Due to the growth of the global lithium-ion battery market as part of the global development of electro-mobility and the related cost reduction effects, battery systems are increasingly becoming competitive in the primary and secondary balancing power market.

**The minimum requirements for participation in the R1 primary balancing power market are shown in the illustration below to the right.**

---

The Authors: Ralf Bucher, Achim Schreider

---

GLOBAL
Brackish Water Desalination using Renewable Energy for South Tunisia

TUNISIA

97.5 % of the world’s water is ocean water or saline groundwater. According to the UN, 14 % of the world’s population will depend on desalinated water by 2025. At present, over 18,000 desalination plants are in operation in 150 countries. Only 0.02 % of the plants are operated with renewable energy. In southern Tunisia, with low precipitation, the national water company SONEDE relies on sustainable desalination plants. The National Water Quality Improvement Program (PNAQ) aims at reducing the salinity of drinking water to below 1.5 g/l. GKW Consult was awarded with the evaluation of the results of Phase 1 and the feasibility study for Phase 2 of the Program.

Drinking Water for an arid Region

With the growing awareness of the man-induced climate change and the associated negative impacts such as drought, storms and other climatic disasters, the use of renewable energy becomes increasingly important.

Tunisia is characterised by a dry climate. The unequal geographical distribution of freshwater resources provides particular challenges to the National Water Distribution Utility SONEDE. Only 54 % of the national resources have a salinity of less than 1.5 g/l.

In the south of the country, the salinity of the scarce groundwater resources is growing. To supply 11 million people with drinking water, SONEDE has the choice either to transfer enormous amounts of fresh water from the north to the south, or to construct desalination plants directly in the south.

In 2011, desalination plants in Tunisia had a production capacity of 73,500 m³/d of treated water and supplied almost 430,000 inhabitants. According to the National Development Plan, this capacity is intended to be increased to 300,000 m³/d, to supply 2.4 million inhabitants in total, by 2030.

National Program to improve Water Quality

The first phase of the National Water Quality Improvement Program addressed regions with a salinity of over 2 g/l. The required desalination capacity is to be achieved through 10 desalination plants with a total capacity of 36,200 m³/d. These plants are currently under construction. GKW Consult was awarded with the evaluation of the results of the first phase of the PNAQ, as well as with the realisation of a feasibility study for the second phase.

The purpose of the second phase is the improvement of the water quality in regions with salinities of between 1.5 and 2.0 g/l. As was shown by the study, the actual salinities were up to
10 g/l. Due to the results of the study, plans now comprise the construction of six brackish water desalination plants at 20 sites and over 500,000 inhabitants in 5 governorates. Apart from the desalination plants, the program also includes the associated infrastructures like boreholes, reservoirs, transfer systems and teleprocessing systems.

The picture shows the regions that benefit from the PNAQ and its breakdown in phases I and II.

To assess the available water resources in relation to demand, GKW Consult performed a hydrogeological study. The study also identified new brackish water resources that are sufficient to cover the demand until 2035.

Using Renewable Energies
Due to the scarcity of conventional energy sources such as oil and gas and their impact on the climate change, the study also investigated the use of renewable energy sources such as solar energy, wind power and geothermal energy. GKW analysed the different technologies with the objective of finding the optimum combination of renewable energies and various desalination processes. Photovoltaic and wind turbines proved to be the best options.

The analysis of climatic data (global irradiance and average wind speed) showed significant deviations between sites. The evaluation of the data available for this study and the calculated Levelized Energy Costs (LEC) revealed that the site of Ben Guerdane in the governorate of Medenine is most suitable for the installation of renewable energy:

- The irradiance is the highest of all the sites studied (1,875 – 1,970 kWh/m²/y).
- The average annual wind speed is the highest of all sites studied (6.5 – 7.0 m/s at an altitude of 100 m above the ground).
- The LEC of the wind turbine option at Ben Guerdane is the lowest of all the LECs in all the sites studied.

It showed that covering the desalination plant’s base load by wind energy and peak demands from the national power grid would be the most advantageous option in terms of investment and in relation to cost (LEC). Possible excess capacities in energy production could in turn be supplied to the power grid.

In the case of Ben Guerdane, the electricity consumption is highest because of the relatively high salinity of brackish water (9 g/l) in combination with the large volumes of drinking water to be produced (9,000 m³/d in summer). For this reason, most of the electricity can be consumed locally.

Cost and Prices
Energy prices are highly subsidised in Tunisia. At only 0.063 €/kWh (2014), the prices are very low compared with European prices. This is one of the reasons why the market for renewable energy is still comparatively small.

Water prices in Tunisia depend on water consumption and range between 0.200 DT/m³ (small consumers up to 20 m³ per trimester) and 1.315 DT/m³ (consumers with more than 500 m³ per trimester). Nevertheless, the feasibility study showed that the production of desalinated drinking water by use of renewable energy will be possible at competitive costs. The results convinced SONEDE to continue on this path, even if the cost for energy from renewable sources may now be equal, or even slightly higher than for energy from conventional sources.

To prove the theoretical assumptions of the feasibility study and to obtain more accurate data, solar insolation and wind measurements are being carried out at the selected location in Ben Guerdane. At present, the measuring plant is in operation at the site to measure wind speeds over a minimum period of 12 months. The collected data will be the basis for a wind certificate. This certificate will support the decision on the nominal speed of the wind turbine.

The follow-up project comprising the final design, construction and technical support for the six desalination plants has already started. Commissioning of the plants is scheduled for 2022.

“As soon as the price for “conventional” energy increases, renewable energies will become more and more attractive for the desalination market, especially in countries with limited fossil fuel resources that wish to reduce their dependency from the big oil countries.”

Author Julia Seitter, GKW Consult Project Manager
2,070 MW Laúca Hydropower Plant Operational

ANGOLA

The Laúca Hydropower Project in Angola is presently one of the largest hydropower projects in Africa. After the successful completion of the first project phase of the river diversion (closing of river diversion tunnels and start of impounding in March 2017), now, five years after starting construction in June 2012, the first two power generating units of this 2,070 MW hydropower plant were commissioned.

Within an international consortium, Lahmeyer International is, among other tasks, responsible for the complete design review and construction supervision of the waterway system – from the intake structure via headrace tunnels, to the underground hydropower station – and the supervision of the installation and commissioning of the complete electro-mechanical equipment.

The 132 m high roller compacted concrete (RCC) dam will create a 188 km² large reservoir with a storage capacity of about $5.5 \times 10^9$ m$^3$. A total of six headrace tunnels, each approximately 2 km long, will bring water to the underground power house, which will be equipped with six Francis turbines, each with a rated capacity of 340 MW. Additionally, a separate “Ecological” above ground power house will be located at the toe of the dam using the minimum required ecological flow rate of the Kwanza River of 60 m$^3$/s to generate additional electricity.

The rigidly timing of the start of impounding was a result of the need to use the expected peak flows in the months of March and April. The bottom outlet of the dam and the intake gates had to be closed and operable in spite of the fact that construction of the dam’s crest had not yet been finalized. The commissioning tests were started while the final construction activities for the other headrace tunnels continued. In addition, the power house had not been fully completed during this stage. Therefore, reorganisation of accesses to the work fronts and re-planning of these work activities had to continue in parallel.

The operation for the first power generating unit started at the end of July 2017. The second 340 MW power generation unit was commissioned and connected to the electric grid in the middle of October 2017 to meet the critical energy needs of the country. Half of Angola’s energy production is now coming from the Laúca HPP, underlining the importance of this hydropower plant as the future backbone for energy generating in Angola.

The completion of the overall project is scheduled for the autumn of 2019.
After a construction time of three years, the Neuwürschnitz flood retention reservoir in Saxony was inaugurated on 20 June 2017. The special feature of this project was the inclusion of a full ecological passage in the dam structure. Animals of all species are able to pass through it at any time. Lahmeyer Hydروprojekt has performed all major design and construction supervision tasks for the project worth EUR 20 million since 2008. The Client was the Landestalsperrenverwaltung (LTV, State Dam Administration) of the Free State of Saxony.

Location and components
The site of the flood retention reservoir, determined in accordance with the analysis of the extreme flood of 2002, is located on the Beuthenbach stream in the catchment area of the Würschnitz River near the city of Chemnitz. The dam structure is a rockfill dam with an inner asphalt sealing layer. The dam structure also comprises the sill wall, underground injection and embankment. The culvert structure, which is integrated into the dam, is a solid structure including the pass channel, stilling recess and discharge marker.

Ecological Culvert
For the passage of the Beuthenbach stream, Lahmeyer Hydروprojekt designed the culvert structure as an open ecological channel in order to ensure that aquatic, amphibious, terrestrial and airborne wildlife, as well as macrozoobenthos, can pass. This was also the reason for the decision in favour of a special feature, i.e. the stilling recess, as an energy dissipation system.

Two oil-hydraulically driven outlets and the spillway were integrated into the dam wall of reinforced concrete. As the first flood retention reservoir with an ecological culvert of this magnitude in Saxony, the design and construction of the Neuwürschnitz project is trendsetting.

Key parameters:
- With a dam height of 18.9 m above the lowest foundation level and a crest length of approx. 530 m, a volume of 923,000 m³ can be retained when the reservoir is filled.
- The rated flood inflows at the dam locations amount to HQ100 = 14.1 m³/s (BHQ3), HQ500 = 20.8 m³/s (BHQ1), HQ5,000 = 32.2 m³/s (BHQ2), and HQmax = 47.4 m³/s.
- Retention starts from an inflow of 5 m³/s (approx. HQ5).

Milestones
Several components were optimised hydraulically in a model test at the Technical University of Dresden in November 2010. After the planning permission had been granted in July 2012, construction work on the dam and ancillary structures started in February 2014. The structure was completed in spring 2017. A test run is foreseen when the necessary hydrological conditions arise.

Conclusion
The implemented solution presents a successful and balanced compromise between flood protection and the objectives of the EU Water Framework Directive. The structure’s intervention in the nature and landscape could be compensated by appropriate measures. The cooperation between Lahmeyer specialists, the Client and the joint venture partner ARCADIS was very successful.
18 years of Baglihar Hydropower Station

Baglihar hydropower station, located near Chanderkote in the north of India, is presently Hydropower & Water Resources’ longest running project. As early as 1999, Lahmeyer took over the construction supervision and design approval as a consultant for Stage 1. Work on Stage 2 started in 2012. Lahmeyer will presumably be active as a consultant on site until at least March 2018.

Review: Stage 1

18 years ago, in 1999, construction work began on Baglihar hydropower station, located on the Chenab River, on behalf of the Client, the Jammu & Kashmir State Power Development Corporation (JKPDC), Srinagar.

In the subsequent years, the construction companies, supervised by Lahmeyer, built a 143 m high massive concrete dam with various spillways, designed for a maximum flow of 16,500 m³/s.

At the same time, a cavern power station with a capacity of 450 MW, containing three turbine units, was constructed. The hydropower station was commissioned in 2008 and has been in normal operation since then.

Adverse conditions

During the construction of the concrete dam, problems occurred due to the extreme local climatic and special geological conditions, which had to be solved.

In winter 2005/2006, the mountains of the Indian state Jammu & Kashmir experienced extraordinarily heavy snowfall. The subsequent snowmelt caused an over-dimensional rise of the Chenab River water levels. The situation was aggravated by the fact that both bypasses were blocked by a landslide, so that water flowed over the lower dam that was still under construction.

In order to be able to continue construction work on the partly constructed dam, an outlet with a diameter of approx. 6 m and a length of 100 m was constructed in the dam wall by breaking into the existing structure at a low level from the downstream side towards the reservoir. The water flowed rapidly through the outlet, unfortunately undercutting the concrete slab of the stilling basin that was also still under construction.

An extension to the existing powerhouse, which was originally foreseen, could not be constructed for geological reasons. After a redesign, a 1:1 copy of the caverns and galleries of Stage 1 was constructed for Stage 2 a short distance upstream.

The project was inaugurated by the Indian Prime minister, Narendra Modi, in November 2015.

Prospect

Stage 2 was finally completed in May 2016, but Lahmeyer is still on site in Chanderkote. Lahmeyer specialists continue to support the Client during the warranty period of Stage 2, as well as in the operation of Stage 1. After several renewals, the end of Lahmeyer’s contract is scheduled for March 2018.

But who knows whether Lahmeyer’s engagement on the Chenab River will indeed be terminated after over 18 years? Discussions with the Client regarding the continuation of cooperation during operation have already started – a never-ending story?
Doğançay Weir and Hydro Power Plant

The Doğançay Weir and HEPP, developed for the generation of electricity, consists of a weir structure, a 6.9 km headrace tunnel and an underground powerhouse. The Lahmeyer company Hidro Dizayn was engaged as consultant and designer for this project after landslides occurred on the right bank slopes.

The Doğançay project is located about 500 m downstream of the Kavşakbendi HEPP on the Doğançay River in the Adana Province in the Eastern Mediterranean.

The project consists of a 30 m high weir structure, a headrace tunnel about 6,860 m in length, a 514 m long penstock tunnel and an underground powerhouse. Construction time was about 5.5 years, and the project operates with a head of 305 m.

A tunnel-boring machine (TBM) was used to construct the headrace tunnel in lieu of traditional drill and blast methods.

With 62.6 MW installed capacity and 169 GWh of annual generation capacity, the project was planned to meet the annual requirements of about 50,000 people in the region. Commercial generation started on the 31st March 2017.

Hidro Dizayn was contracted after landslides, reaching 4 to 5 m in the rainy season, occurred on the right bank slopes during construction of the closure dam.

The concept of an “Overfilled Dam” was recommended from several evaluated options for the stabilization of the creeping slopes and completion of the Doğançay project.

Both main project objectives, the right bank slope stabilization and the construction of the dam, which were equally important, were achieved by the filling of the thalweg area.

Extensive monitoring and geotechnical investigations were performed for the design of the closure dam and the construction/long term risks are evaluated to ensure the safety and success of the project at the most economic cost.

Nominal capacity (MW) 62,6
Tunnel length (km) 6,86
Tunnel diameter (m) 3,50
Multipurpose Project at Upper Atbara for Irrigation, Energy and Drinking Water

The Dam Complex of Upper Atbara Project (DCUAP) in the north of Sudan was designed to provide irrigation, flood protection, electrical energy production and a potable water supply for the 450,000 inhabitant city of Al Qadarif [Gedaref]. After the successful commissioning of two 80 MW units, 50 % of the total plant capacity is already available for the Client. Lahmeyer International provided extensive design modifications/optimizations and currently provides construction supervision. A potable water pipeline, which is currently under construction, will connect the reservoir to the 75 km distant capital of the identically named federal state of Al Qadarif. The Lahmeyer subsidiary GKW Consult participated in the “Gedaref Water Supply Project” (GWSP) and provided its comprehensive experience to the mechanical equipment planning.

The Atbara River is the northernmost branch of the Nile. The Atbara is, itself, fed by the two rivers mentioned in the full-text project name “Upper Atbara and Setit Dam Complex”. The Atbara River and the Setit River have their sources in the highlands of Ethiopia and Eritrea. Specifically, the term “dam complex” refers to the approximately 13 km long unit of the DCUAP dam, which dams both waterways into a single reservoir around 20 km upstream of the confluence of the Upper Atbara River and Setit River.

In a broader sense, however, the DUCAP is economically and functionally linked with the Kas Kashm el-Girba Dam which is located 80 km downstream since it will also contribute additional reservoir capacity for Kas Kashm el-Girba Irrigation Scheme.

The dam complex spans both river valleys and adapts to the local topography which required specific construction solutions along its meandering course.

Irrigation and Flood Protection
Both dams together form the “Atbara Dams Complex”. During over 40 years of operation the retention capacity of Kashm el-Girba Reservoir has been seriously reduced by sedimentation. The retention capacity of the area will now be increased by the active volume of 2.5 billion m³ of the DCUAP reservoir. This additional capacity will not only allow for an expansion of the existing irrigation system of New Halfa, but will, additionally, also permit the new development of 300,000 ha of irrigated land planned in the “Upper Atbara Irrigation Project”. Simultaneously, flood protection has been significantly improved.

Hydropower Station
The 320 MW hydropower station is a core aspect of the DCUAP project. The first of four Kaplan units, in a semi-umbrella arrangement, has successfully completed the one-month test run earlier this year and has been in regular operation since then. The test run of the second 80 MW unit was also completed successfully recently.

Consequently, 50 % of the power station’s capacity is already available to the Owner, Dams Implementation Unit (DIU), a department of the Sudanese Ministry of Water Resources, Irrigation & Energy. This electricity production capacity contributes to the decentralisation of the national electricity grid.
The contractors for this project are two Chinese companies HEI (machinery) and CWE (construction).

**Optimised Concept**
Lahmeyer International reviewed the existing tender documentation and then prepared a technical design concept which significantly optimised major parts of the tender design. Lahmeyer engineers are also responsible for construction supervision and the contract management of this project.

**Secure Water Supply**
The DCUAP is located in a region with a hot, semi-arid climate. The rainy season, which is frequently accompanied by extreme rainfall and flood events during the approximately three summer months, is then followed the rest of the year by a nearly rainless period which dries up the rivers.

The capacity of local deep well fields drilled by the city of Al Qadarif, which are located at a distance of 75 km, together with the capacity of a pipeline that was commissioned in 1970 to transmit water from the 100 km distant Atbara River was not sufficient to meet the demand of the current, approximately 450,000, inhabitants.

The motivation and necessity of the DCUAP to provide a secure year round water supply was self-evident. The construction company’s (CWE) design provides for two construction stages under an EPC contract, with an year-round capacity of 75,000 m³/d of water treated according to WHO standards. Just as the DCUAP, the related Gedaref Water Supply Project GWSP will also mainly be financed by Arab funding organisations. The Owner is also DIU.

In addition to the contractual administration and construction supervision, Lahmeyer International is in charge of the validation of the technical design. GKW Consult analysed the process of water treatment and the hydraulic system of the water treatment plant.

**Water Treatment**
Apart from the pipeline, the water treatment plant is one of the main components of the project. It is located near the intake structure for the Kashm el-Girba Irrigation Channel on the site of the DCUAP. The irrigation intake will be used, simultaneously, for the raw water inlet.

After flowing through different mixing, flocculation and filter stages, as well as a disinfection stage, the treated water is fed through the primary pumping station and the pipeline. Another pumping station, equipped with four centrifugal pumps, is located halfway along the pipeline. The elevation difference between the inlet and a reservoir located on a hill near the city of Al Qadarif is about 150 m.

**Installation of Pipeline Started**
The first kilometres of the pipeline were installed in the first half year of 2017. It consists of flexibly connected DN1000 spheroidal graphite pipes to ensure the permanent adaptability to the substantial swelling/shrinking behaviour of the prevailing “black cotton soil”.

The commissioning of the first stage of the Gedaref Water Supply Project is scheduled for the first half year of 2018. The distribution network within the city of Al Qadarif is presently being enlarged and extended so that the new and enlarged capacity pipeline can be utilized effectively.
Frankfurt International Airport is the largest commercial airport in Germany. In 2016, 60.8 million passengers used the airport hub in the metropolitan Rhein-Main region. Many of them started and landed at Terminal 1, which is being renovated while remaining in normal operation. Lahmeyer Deutschland was awarded with the project management of the comprehensive project “Weiße Flächen” (White Areas) by Fraport AG.

Airport of the Future
Terminal 1 of Frankfurt Airport, comprising the passenger areas A, B and C, was constructed in 1970 in order to handle continuously increasing passenger volumes. The construction cost of the project “Airport of the Future” amounted to around DM 1 billion. A variety of innovations were integrated into this large project with over 200,000 square metres of built-over area. The new appearance and the guidance system for passengers were trendsetting for airports worldwide.

Fire Protection in Focus
More stringent statutory requirements and new operational requirements now necessitate the extensive refurbishment of parts of the Terminal. This primarily affects fire protection. The renovation project “Weiße Flächen” comprises the optimisation of the entire fire protection equipment on Level 0 between the individual passenger areas A, B and C, plus the adjacent workshop and storage areas. The gross floor area is 19,230 m². The tasks to be performed by the relevant contractors include, but are not limited to, the design, dimensioning and provision of escape and emergency routes, and the installation of sophisticated technical fire protection systems.

Coordination during Normal Operation
During normal operation, Lahmeyer Deutschland will ensure the proper coordination of a large number of interfaces between adjacent construction projects by optimum project management. This requires an especially high level of organisation of the construction activities and the coordination of all project participants.

In order to ensure the smooth progress of the project, Lahmeyer uses the project communication platform AWARO as specified by Fraport.

Using strict timing and comprehensive management, Lahmeyer Deutschland ensures the completion of the “Weiße Flächen” project in compliance with the time schedule and budget.

Lahmeyer’s Scope of Work
- Project control according to AHO
- Organise / inform / coordinate / document
- Quality / Quantities
- Meeting management
- Complex interface coordination between numerous neighbouring construction projects
- Review of accounts and follow-up orders
- Time scheduling and controlling
Fürstenwalder Seewinkel am Dämmeritzsee OHG develops and constructs an attractive residential quarter in a preferential area in Berlin’s Treptow-Köpenick district. Two hundred and sixteen apartments will be constructed on a total area of 12,885 square metres. Lahmeyer Deutschland was appointed as project controller. The ground-breaking ceremony took place on 26 June 2017.

**Urban Living at the Lake: Lahmeyer manages the Construction of 216 Apartments in Berlin**

**Good Start**
The fürstenwalder seewinkel am Dämmeritzsee (fsD) residential construction project reached an important milestone last summer: The construction activities of the first stage started with a ground-breaking ceremony on 26 June 2017.

The festive ceremony was opened by the senator for urban development and living, Katrin Lompscher, the district mayor of Treptow-Köpenick, Oliver Igel, and the managing director of the state-owned building society Stadt und Land, Ingo Malter, as well as the fsD managing directors Rene Staud and Gustav Moritz. They made a good start for the project.

**The Project**
The area is a part of a 7.74 ha quarter that is being developed on a former conversion area in the direct vicinity of Dämmeritz lake. It is impressive by its attractive landscape with short and direct transport connections to the city centre of Berlin via the regional railway and the urban railway, as well as via the motorway ring.

The 5 buildings with 3 full storeys and a penthouse each, which are constructed here in a first construction stage, offer space for 216 apartments. The buildings are constructed for the state-owned building society, Stadt und Land, according to plans elaborated by Wiechers Beck Architects.

The future-oriented design integrates the conception of renewable energy supply. Completion is scheduled for mid-2019.

The investment volume for the construction project is about €31 million. Over 31% of the apartments will be subsidised by the government.

**Solid Ground**
The construction site was cleared in advance. This included felling and clearance work, deep rubble clearance, contaminated site examinations, explosive ordnance clearance, early replacement and compensation measures as well as archaeological prospections. The site was already attractive for inhabitants in the past: Over 4,000 years ago it accommodated a settlement which left Mesolithic artefacts on the lakeside.

**Challenging Task**
Lahmeyer Deutschland is the controller for the construction project. Initially, the development plan procedure was supported to resolution. At the same time, Lahmeyer arranged for the diversified and time-consuming investigations related to the construction site clearance.

Lahmeyer specialists also supported the marketing of another area and managed the different procedures such as the tendering of the general contractor services and the expression of interest procedure for a nursery.

The challenging and versatile project is not only about compliance with deadlines, but also ensuring financial and cost aspects. The experienced Lahmeyer project team will now accompany the implementation phase.

**Author:** Karina Köhler
At the helm of the Energy Transition, Tractebel provides a full range of engineering and consulting services throughout the life cycle of its clients’ projects, including design and project management. As one of the world’s largest engineering consultancy companies and with more than 150 years of experience, it’s our mission to actively shape the world of tomorrow. With about 4,500 experts and offices in 33 countries, we are able to offer our customers multidisciplinary solutions in energy, water and infrastructure.

Since December 2014, Lahmeyer belongs to Tractebel and thus is part of the international ENGIE group headquartered in Paris. Tractebel, which is based in Brussels, and Lahmeyer, which is based in Bad Vilbel near Frankfurt, cooperate on numerous international projects and keep growing closer as one company.