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THE LAST VISIT TO AFRICA OF THE FORMER GERMAN
FEDERAL PRESIDENT, JOHANNES RAU

NEPAL: ESTABLISHMENT OF A GEOGRAPHIC
INFORMATION STRUCTURE

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COVER

Industrial Power Station "Cogénération Gonfreville", France – From 2004, the new industrial power station will supply TOTAL-owned Normandy Refinery with process steam. Consisting of two identical units with one 125 MW gas turbine and one waste steam boiler each, the station replaces part of the previous steam generators in the refinery.

MASTHEAD

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FAREWELL TO AFRICA

Impressions and Reflections from the Last Visit to Africa of the Former German Federal President, Johannes Rau



The former German Federal President Johannes Rau and Thomas Kraneis on a state banquet of the President of the Tanzanian Federation in State House, Dar Es Salaam, on March 21, 2004.

In Africa, Johannes Rau's primary intention was to "open doors" for German medium-sized companies and thus encourage German enterprises to become active in Africa. The accompanying delegation was specifically chosen in such a way that medium-sized companies were strongly represented. At intermediate stops in Nigeria, Tanzania and Zanzibar, Johannes Rau aroused sympathy with his sincere and genuine manner, and he reminded the Africans of their own responsibility in the continent's development. The journey was unfortunately clouded by various terrorist threats. For this reason, Johannes Rau, with heavy heart and following much deliberation, was forced to cancel a stay in Djibouti, after the Secret Services of various nations feared the risk of an attempt on his life.

There is much to indicate that the German economy is addressing the various challenges in Africa. Consulting enterprises such as Lahmeyer International assume a particularly relevant role in this regard. They pave the way for German industry to offer services for infrastructural projects in the fields of energy, water and transport. In this respect, it was not only an honour to be invited on the journey, but also a special opportunity to establish new contacts.

Lahmeyer International was able to successfully utilise this opportunity. This counts as one of many reasons, why we reflect on the past five years with deep respect and gratitude, a term during which Germany was represented by a highly sensible man of great integrity.

Thomas Kraneis

It is always a great honour when corporate representatives are invited to accompany our high-ranking politicians on visits abroad. Lahmeyer International (LI) was requested to accompany the former German Federal President, Johannes Rau, on his last international visit, to the African continent. The journey lasted from 16th to 24th of March, 2004 and included visits to Nigeria, Tanzania and Djibouti. Lahmeyer International was represented by Mr. Thomas Kraneis, Head of the Energy Division, who himself has been able to acquire vast experience and in-depth knowledge of the African continent over many years.

Travelling with the 73-year old Johannes Rau one had the impression of a certain air of nostalgia, as he has developed a particular affinity with the African continent. This attachment was expressed in his sometimes very political speeches, which drew far more than simply praise and applause. It is indeed an experience to witness Nigerian President Obasanjo and Johannes Rau in discussion over daily and African politics or general issues. During the entire journey, the extremely discrete attitude of his wife Christina contributed to maintaining a very relaxed atmosphere during discussions, on which occasion Johannes Rau frequently took the opportunity to relate one of several humorous incidents in his life.

During his almost 80 journeys abroad as the German Federal President, Johannes Rau was very plain-spoken. It is well known, for example, that he pressed for compliance with human rights in China, more so than any previous German Chancellor or President. Before Tanzania's parliament and the foreign ambassadors in Dar Es Salaam, he cautioned the African states on the dangers inherent in following dictatorships out of misunderstood solidarity as occurred in Zimbabwe.

Johannes Rau, now the former German Federal President, also gave evidence of his political understanding by visiting Israel on almost 50 occasions and speaking in German to the Israeli parliament, Knesset, in February of 2000, the first German Federal President ever to do so. For him, it was a matter of course to ask forgiveness for the Holocaust and thus bring a certain degree of normality to the German-Israeli relationship.

As a devout Protestant, the recently resigned Rau believes that the State stands on a Christian foundation. Nevertheless, during the so-called "head scarf controversy" he delivered a speech against the prohibition of head scarves, which represented both the most liberal and religious sides of the controversy.

FRANCE

New Industrial Power Station put into Operation

Lahmeyer International (LI) was entrusted with representing the owner and site monitoring for the construction of the industrial power station "Cogénération Gonfreville" by ENEVIA, Paris, in October 2001. The scope of services included, but was not limited to the review of supply contracts, the factory acceptance tests, the construction progress supervision, the claim management, the supervision of final tests and several special tasks. The contract language for all services was French.

The new industrial power station consists of two 125 MW gas turbines and two heat recovery steam generators. The station supplies up to 450 t/h of process steam to Normandy Refinery. The owner, ENEVIA, is a subsidiary of TOTAL, the refinery operator.

The continuous supply of the refinery with process steam was ensured by constructing two identical units. The boilers are equipped with supplemental duct burners and fresh air fans. If required, one unit alone is capable of producing up to 350 t/h of steam. The possibility of producing around 110 t/h of steam with each of the two boilers (without gas turbine) by using supplemental firing and the fresh air fan provides for additional reliability.

Since the new plant did not dispose of an own water treatment system, the refinery had to supply water for both its own steam demand and the commissioning of the new station.

At peak times, water consumption exceeded the water treatment capacity. In order to avoid water

shortages, the refinery provided a 5,000 t water tank, and ENEVIA installed a mobile water treatment system. One of LI's special tasks was to find a supplier for the mobile water treatment system and to ensure its frictionless operation on site.

On June 30, 2004, ENEVIA awarded LI with the contract for technical support and consulting during the first three years of operation. This follow-up order covers the establishment of a maintenance schedule, the spare parts management, the control of the station's efficiency as well as a 24-hour availability for problems on the gas turbines and the process control technique.

Klaus Hermening

PAKISTAN

Construction and Extension of Electrical Transmission System

Karachi Electric Supply Corporation (KESC), Karachi, awarded the consortium Lahmeyer International - NESPAK (Pvt) Ltd. - ACE (Pvt) Ltd. a contract for engineering services regarding the extension of the electrical transmission system, the retrofitting of the load dispatch centre, the planning of a distribution system as well as a geographical information system (GIS). The project is financed by the Pakistani government.

KESC is the licensed provider for electrical power for an area of over 6,000 km² in Karachi and its suburbs.

Karachi as an economic and trade centre has grown from half a million to over 11 million inhabitants since 1974.

The peak demand for electrical energy is approx. 1,880 MW. KESC disposes of 1,700 MW from power stations at four different locations. The additional power is purchased

from independent power station owners and the state-owned Water and Power Development Authority (WAPDA), Lahore.

The transmission voltages are 220 kV, 132 kV and 66 kV in a network with a length of 1,095 km – mainly overhead lines – and 51 substations.

The demand for electrical power increases by 4 % annually. Since the existing network can no longer handle the present and foreseeable demand, an extension is inevitable.

The extension and upgrading measures comprise:

- Extension and reinforcement of the transmission network overhead lines, underground cables and substations
- The retrofitting of the SCADA/EMS system, construction of a new load dispatch centre, telecontrol systems and information transmission

- The mapping of the distribution system and computer-supported studies for the system's extension and retrofitting

The services provided by LI are listed below:

Study preparation stage:

- Data collection
- Review and adaptation of existing studies
- Load flow, short-circuit and stability studies for the KESC network
- Determination of protective relay setting values and relay coordination

Implementation stage:

- Preparation of technical specifications
- Definition of contract packages
- Preparation of tender documents
- Tender evaluation
- Assistance in contract negotiations and contract awarding

Ronald Roulston

SUDAN

2 x 50-MW_{el} Sponge Coke-fired Power Plant Garri 4

The existing 190 MW CHP station Garri 1

In February 2004, the National Electricity Corporation (NEC), Khartoum, awarded Lahmeyer International (LI) the contract for the Garri 4 power plant. The contract comprises the elaboration of a concept, design study and the preparation of tender documents as well as the evaluation of bids, contract negotiations, design reviews and approvals, progress and design meetings, quality assurance and site supervision. Additional support services from the LI headquarters are also part of the contract.

The existing Garri power plant is located 70 km north of the Sudanese capital Khartoum. The area is large enough for the erection of additional power plants. The location was selected based on its vicinity to the refinery of Khartoum in order to take advantage of direct fuel supply.

The refinery will be extended by which also sponge coke will be produced in the future. Sponge coke (petroleum coke) is a by-product of the refinery process. This solid fuel has a low reactivity and rather bad combustion properties.

NEC intends to install a circulating fluidized bed (CFB) combustion boiler in order to utilize the energy from sponge coke as low cost fuel. The circulating fluidized bed combustion boiler for sponge coke is based on the latest experience of various users worldwide. It has

proven to be an excellent economical and ecological technology.

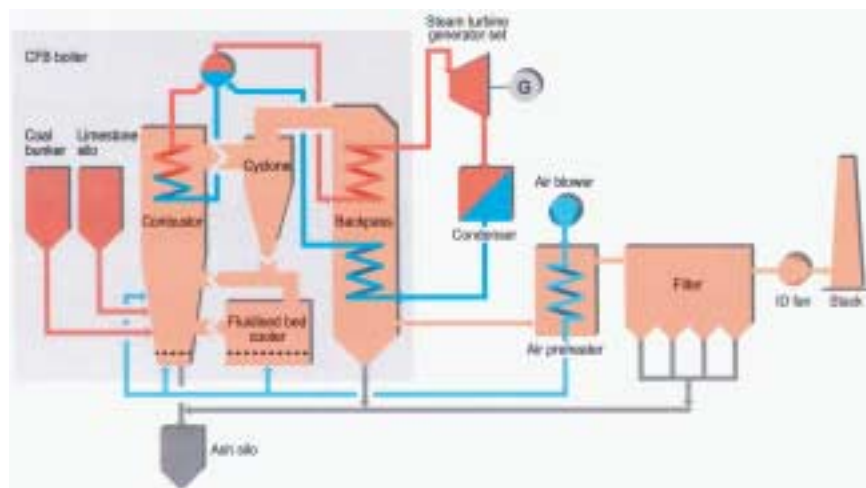
The extended retention period of sponge coke particles in the circulating fluidized bed combustion boiler results in a high combustion efficiency.

Low combustion temperatures (850 to 900 °C) result in high sul-

phur capture efficiency by blowing limestone into the combustion process. Low NO_x emission values are also achieved.

boiler, as well as a waste gas and ash treatment system. The steam produced will drive a steam turbine generator for the generation of electrical power which will be fed into the electrical grid via a 220 kV sub-station.

Garri 4 is a turnkey project with a fixed price including infrastructure and all required transport, storage



Scheme of a sponge coke-fired circulating fluidized bed combustion power plant

phur capture efficiency by blowing limestone into the combustion process. Low NO_x emission values are also achieved.

NEC intends to build the Garri 4 power plant in two units with a total capacity of approx. 2 x 50 MW_{el}. Each unit will consist of a circulating fluidized bed combustion system, a

and operation facilities for incoming and outgoing material flows.

Garri 4 power plant will be commissioned in early 2007.

Paul Broedermann,
Burkhard Hofrichter

IRAN

Wind Potential in Iran

In order to determine the wind potential in Iran since June 2004, a detailed, inter-active wind map will be established by Lahmeyer International (LI) on behalf of the Ministry for Energy (SUNA), Tehran, and in cooperation with Moshanir, the Iranian state engineer consultant.

It is difficult to make a general statement on the potential for wind energy utilization in Iran. It must be assumed that large parts of the country are currently not eligible for wind utilization due to adverse wind conditions or insufficient infrastructure. On the other hand, however, there are several so-called 'Hot Spots' where wind speeds are among the highest in the world.

The wind map will not only provide a general overview of the wind conditions in Iran. The high resolution of the map can also be used to identify preferred areas for wind energy utilization and to perform detailed investigations of wind conditions at suitable locations.

The common data basis for the preparation of wind maps is existing but in most cases of low-quality, supplemented by individual wind measurements at selected locations. The available data, exclusively restricted to measurements on ground, could be used for the establishment of a wind map using the computer program WASP. Since WASP is insufficient for complex terrain LI applies KLIMM, a program for wind potential calculation in semi-complex and complex terrain. KLIMM is based on a three-dimensional mesoscale atmospheric model for the forecast of three-dimensional wind distribution. In addition to local wind data measured near the ground, input data for the influencing factors as listed below are considered, since these have a strong effect on ground-near flow conditions:

- Direction and speed of flow in free atmosphere
- Thermal lamination (vertical temperature distribution) of atmosphere
- Topography (digital terrain model)



Wind park in Manjil, located approx. 220 km north-east of Tehran in Gilan province.

- Ground utilization in the form of various roughness parameters

The calculation results are calibrated on the basis of ground wind measuring data. Both long-term representative data of meteorological stations – approx. 90 airports with meteorological data records of varying quality – and temporary wind measurements can be taken into account.

This procedure allows for considering the influence of the variability of terrain height and surface utilization on the wind conditions, which is particularly decisive for wind conditions in complex terrain. LI's experience with numerous applications for wind maps (Sardinia, Panama, Eritrea, Nigeria) and precise expert wind opinions for wind parks in complex terrain (Greece, Sardinia) have shown an excellent match between long-term wind forecasts and wind measurements over several years.

In a first phase, LI establishes a zero wind map to obtaining a general understanding of wind conditions in Iran. For this purpose, all wind data available in Iran from airports and other meteorological stations are evaluated and correlated as required. Such data is then used to establish initial calibration values for KLIMM calculations.

On basis of the results of this zero wind map, 50 to 70 wind measuring masts with a measuring height of 40 m are installed at suitable locations all over the country. The data from this measuring campaign are used for calibrating the KLIMM calculations in order to complete the final wind map. The result is a data base with extensive wind measuring data and accurate information on wind conditions in the entire country. In addition it will be possible for selected areas to provide good forecasts for energy yields from wind parks. By providing an interface between KLIMM and WindPRO, an easy to operate user surface is established. In this regard, accurate forecasts even for energy yields at complex terrain are possible.

Bert Hagenkort

RWANDA

Analysis and Forecast of Electrical Power Demand

Rwanda suffered from a considerable energy deficit in the past few years. The previous energy supply on the basis of hydropower has been exhausted. For this reason, large investments will be required for thermal energy generation plants in future years.

In autumn 2003, Lahmeyer International (LI) took over the management of Electrogaz, a public utility, for a period of five years. The investment plan for future energy projects of the country depends on the development of energy demand in the next few years. The analysis of the current and a forecast of the future energy demand are therefore the key tasks in the initial stage of the Electrogaz project.

ELECTROGAZ CLIENTS

First of all, the usefulness of the existing sales statistics was analysed, the client data were restructured, and the customer categorisation was extended by standardized client sectors. Finally, a regional relocation of clients according to provinces was performed.

In general, two groups of clients can be categorised:

1. Medium high voltage (MV), 15 to 30 kV, no. of clients: approx. 300;
2. Low voltage (LV), 220 to 380 V, no. of clients: over 59,000.

At present, both groups require half of the power consumption each and – due to the uniform tariff – also provide for half of the turnover each.

FOCAL POINTS OF MODELLING

In order to be able to forecast the power demand, the trends in the different client sectors and regions were analysed. The potential and the need for new connections of MV and LV clients were determined on the basis of inquiries. The consumption behaviour of LV and MV clients was represented for four different phases of the day. The power supplied to household

Detailed breakdown of power consumption. Rwandan tea and coffee producers, the textile, cement and sugar industry, hotels as well as the broadcasting station of Deutsche Welle represent only 1 % of clients, however account for 56 % of power consumption, while private households, representing 70 % of the clients, account for only 14 % of the total consumption.



clients, commercial and small (agro) industrial as well as institutional clients was determined on the basis of monthly consumption as well as consumption-related characteristics (working hours, opening hours, sunshine periods, etc.). For the individual load diagrams of MV clients, production times and shift systems as well as the type and utilisation of installed consumer devices was recorded.

Electrogaz has not been able to meet the entire energy demand since the late 1990ies. The period between 18:00 hrs and 22:00 hrs is particularly critical.

Various groups of clients and/or regions must regularly be cut off the supply. In 2003, this suppressed demand amounted to approx. 5 MW. The model of future power demand includes the individual projections and determinants listed below:

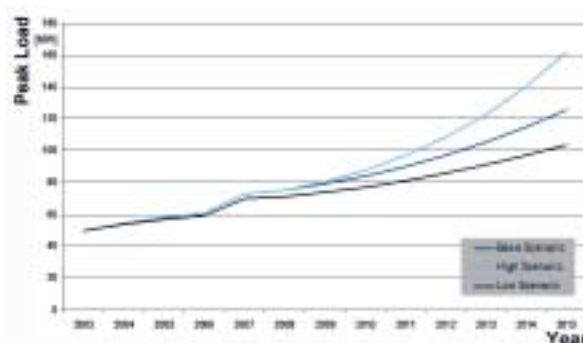
- Growth of gross domestic product (GDP); development of inflation and price indices;
- growth of population; extent of urbanisation and development of economic situation of population;

- development of new connections in consideration of a decreasing deficit of material and coordination;
- development of new connections according to rural and urban areas with different power consumption;
- development of measuring and invoicing procedures to be used in future;
- forecasts of large clients and industrial associations;
- individual large-scale projects (e.g. industry, tourism, trade, banks and education)

In the course of modelling the client behaviour, an additional tool was developed which can be used for evaluation measures regarding demand optimisation ("demand side management").

Dr. Alexis Bonneschky

The result of the demand forecast showed an increase in the peak load from approx. 50 MW today to 125 MW in 2015. This corresponds to an average annual growth of 8.1 percent. A strong increase in peak load is forecasted for 2007; this particularly reflects the plans of the cement-producing industry.



CENTRAL AND EASTERN EUROPE

Joint Implementation – Potential

Lahmeyer International (LI) was entrusted by an international financial institution with the investigation of the strategies of large European energy suppliers in the field of Joint Implementation (JI) projects in Central and Eastern Europe. This analysis also comprises a general study with regard to the relevant institutional framework conditions as well as to the current market trends in selected Central and Eastern European countries.

International climate change mitigation projects between industrial countries designated as "Joint Implementation" represent one of two project-based mechanisms described in the Kyoto Protocol for international cooperation in climate change mitigation. Investors from countries which agreed on the achievement of binding emission reduction targets under the Protocol are given the chance of implementing emission reduction projects in so-called host countries. The emission reduction achieved by these projects is then transferred onto the investor's emission allowance account as an emission credit. The motivation for this kind of cooperation is the utilization of existing cost differences in the emission reduction potentials of different countries for the derivation of cost-efficient emission reduction strategies. Particularly countries on the threshold to adopting a market economy show considerable potential for energy efficiency increases and thus CO₂ emission reductions at little cost. Central and Eastern European countries are therefore frequently presented as particularly important host countries for JI projects.

While this general evaluation is still valid today to a very far extent, it will continuously require more detailed examination in future in the course of the EU enlargement. As soon as their accession is completed, the EU candidate countries' participation in the European emissions trading scheme will be obligatory. The European emissions trading scheme, however, shows only restricted compatibility with the project-based approach of JI. The



presently discussed proposal for a European "Linking" directive calls for a clear elimination of possible double accounting of emission reductions in JI projects as well as of direct or indirect emission reductions in plants subject to emissions trading. Plants covered by emissions trading scheme are therefore no longer eligible for JI projects. This also affects energy generation plants as of a thermal capacity of 20 MW, i.e. almost all significant CO₂ emission sources in the electricity sector. The integration of energy generation plants in accession countries in the European emissions trading scheme will therefore considerably reduce the JI project potential of these countries.

The so-called "Acquis Communautaire", i.e. the set of EU laws and regulations to be transposed to national law in the course of the EU accession, too, will prove to have significant impact on JI projects. For every project, a baseline study must be established. This baseline consists of an assessment of what the reference emission development would have been in the absence of the envisaged project. Any emission reductions resulting from technical measures implemented to comply with the transforming EU regulations will be considered as part of this baseline. Accordingly, these reductions cannot be claimed as an additional climate change mitigation effort henceforth.

The JI market development in most Central and Eastern European accession countries is currently still characterized by the political intention of the national governments to advance the JI mechanism. At the

same time, however, there is uncertainty in view of possible mutual impairment between JI and the European emissions trading scheme with regard to the actually expectable volumes of emission reduction units from JI projects.

Project types in the energy sector which still most probably are eligible for JI projects comprise:

- Reconditioning of district heating systems by investing in new equipment
- Measures on the demand side regarding an increase in energy efficiency
- Biomass-fired district heating plants
- Reconditioning and rehabilitation measures of hydropower plants
- Wind parks unless they are developed under another support program
- Rational use of energy in steam, heat and electricity supply at industrial locations

Apart from technical and economical know-how, the development of successful JI projects in Central and Eastern Europe therefore also requires detailed knowledge of the valid approval guidelines as well as the recognized methods for baseline assessment methodologies.

Dr. Norbert Enzensberger

VIETNAM

500 kV Transmission Line from Pleiku to Phu Lam

In Vietnam, the demand for electrical energy annually rises by between 15 and 17 %. In order to transmit power from a newly installed power station to the load centres, an upgrading of the existing 500 kV north-south transmission line was required.

In May 2000, the Electricity of Vietnam (EVN), represented by the Central Vietnam Power Projects Management Board, awarded Lahmeyer International (LI) the contract for the planning, tendering, assistance in contracting, approval of documents and construction supervision for a 544 km long overhead line from Pleiku in the central highlands to Phu Lam near Ho Chi Minh City in the south. The project is financed by the World Bank.

LI's consulting services comprised the following:

- Load flow, short circuit and stability studies for the Vietnamese 500 kV and 220 kV network
- Preparation of specifications and tender documents for six different supply lots: transmission line towers, conductors, insulators and fittings, optical ground wire, optical communication devices, substation extensions by 500 kV

serial capacitors, parallel compensation, protection, control and PLC equipment

- Coordination of interfaces between supply lots, review and approval of all calculations, drawings, installation and operation manuals of manufacturers and suppliers
- Workshop acceptance tests of systems and material
- Construction and commissioning supervision
- Training of client staff in project management and network planning

The network studies were commenced in May 2000. Upon confirmation of the operational behaviour of the network with the new line and the determination of the required reactive power compensation systems the tender documents were prepared and submitted for approval to EVN, the Ministry for Energy and the World Bank in December 2000.

Offers received in October 2001 from a total of 44 tenderers were evaluated by LI. Upon the release of the contract award recommendations by EVN, the Ministry and the World Bank, LI accompanied the



contract award negotiations. Supply contracts were executed with seven different contractors.

The project was implemented between March 2002 and October 2003. All foundation and installation work was carried out by local companies under separate contracts. The project was successfully completed in December 2003.

Walter Buckow



The existing, 544 km long 500 kV overhead transmission line was upgraded and reaches from Pleiku in the central highlands to Phu Lam in the south near Ho Chi Minh City.

IRAN

1,000 MW Pumped Storage Power Plant Siah Bishe



Hydraulic system of the pumped storage station with upstream and downstream reservoirs.

In 1982, the Iranian Ministry for Energy awarded Lahmeyer International, together with our local partner, Moshanir, Tehran, the contract for the review of an existing feasibility study, the preparation of international tender documents, the tendering and contracting of the works, the preparation of the construction design as well as the project management and construction supervision of the Siah Bishe pumped storage plant.

Upon completion of the construction design, the construction of two river diversion tunnels as well as the partial excavation of the cavern access tunnels, further construction for the Siah Bishe pumped storage plant was suspended in 1991 for financing reasons.

Due to strong economic growth in the past five years, and high demand for peak power, the Iranian Ministry for Energy recently decided to complete the construction of this hydropower station. The appropriate turnkey construction contracts were awarded to two Iranian general contractors in autumn 2003.

The main structures, as well as the corresponding electro-mechanical equipment, can be summarized as follows:

- Upstream and downstream reservoirs with 90 m and 120 m high concrete face rockfill dams;

- two 54 m long inlet/outlet structures, as well as two headrace tunnels running in parallel with inner diameters of 5.6 m each and a total length of approx. 4,300 m;
- two steel lined pressure shafts each designed for a head of approx. 650 m;
- two surge tanks, each with a height of about 120 m, with upper and lower surge chambers;
- powerhouse and transformer caverns accommodating four power generating units (pump-turbine motor-generators) with a capacity of 250 MW each;
- two approx. 230 m and 290 m long tailrace tunnels, each with an inner diameter of 7.5 m, and inlet/outlet structures as well as
- various auxiliary systems.

Lahmeyer International (LI) was selected as the designer and engineer for all underground structures as well as the consultant for construction supervision of the general contractor, Farab-Tablieh-Consortium, due to LI's particular project knowledge, more than 20 years of successful cooperation with the Iranian Ministry for Energy and their leading expertise in the field of pumped storage systems. The Siah Bishe pumped storage power plant is scheduled to be commissioned in 2009.

Although Iran is frequently thought of as a hot and dry "desert" country, temperatures below -20°C as well as snow depths of up to 3 m during the winter months are not unusual in the project area, which is located at an altitude of between 1,800 m and 2,500 m. On the one hand this makes work on the project much more difficult, on the other hand this "northern European" climate allows for winter sports activities, which sometimes reminds our German staff in Iran of their home country. The leisure time activities also include mountain tours to the Damavand peak, which reaches to an altitude of 5,700 m.

Egon Failer



Spring idyll in the project area, with view of the highest mountain in Iran, Damavand (5,671 m).

PEOPLE'S REPUBLIC OF CHINA

Shiplift Three Gorges

The Three Gorges Hydropower project in the People's Republic of China is the largest hydropower project in the world, featuring an installed capacity of 18,200 MW (26 x 700 MW). For cargo ships there are two flights of shiplocks with five locks each, which bypass the more than one hundred meters high dam on the Yangtse River. The duration of a passage is three to four hours. For passenger ships, a vertical shiplift is planned which allows the transfer of the ships from the upstream side to the downstream side – and vice versa – in less than one hour.

In May 2004, the China Yangtse Three Gorges Project Corporation (CTGPC) awarded a contract to a joint venture of German engineering firms, with Lahmeyer International as lead firm, to prepare designs and technical specifications for the shiplift. The engineering services will be rendered within a time period of 18 months. As an option, the contract also comprises consultancy services during the fabrication, construction and installation phases.

Mainly for reasons of operational safety, the Chinese Government decided in 2003 in favour of a shiplift with a cogwheel/toothed rack drive (drive shaft), with a threaded spindle as safety device, and against a rope winch system, which had been implemented in the PR of China before. This decision was based on a feasibility study prepared by the German Federal Waterways and Research Institute, which took into consideration experience gained in Germany with shiplifts in general and the former type of drive and safety system in particular.

Presently, Germany's Niederfinow shiplift is being designed, also by a joint venture with Lahmeyer International as lead firm¹. In principle, both shiplifts are very similar. However, the maximum lift height of 113 m for a 3,000 ton passenger ship for which the Three Gorges shiplift will be designed, lets the lift height of the Niederfinow shiplift (38 m) appear as rather moderate. Indeed, the Three Gorges shiplift will



Total view of Three Gorges Project. Structures (from left to right valley flank): flight of locks, shiplift, auxiliary lock for construction period, concrete dam and left-hand powerhouse, spillway, concrete wall and right-hand powerhouse.

be the largest of its kind in the world. Technical challenges for the engineers are numerous. Especially the behaviour of the shiplift during earthquakes, the limitation of the deformations of the civil works structures to fulfil the required tight dimensional tolerances of the drive and safety systems, and the overall safety concept should be mentioned here. Moreover, considerable water level differences on the upstream side as well as on the downstream side of the shiplift have to be taken into consideration.

The main technical data of the Three Gorges Shiplift are as follows:	
Type	Vertical shiplift (with counter weights)
Maximum lift height	113 m
Minimum lift height	71.2 m
Service load	3,000 tons
Inner trough dimensions	120 x 18 x 3.5 m (L x B x H)

Upstream water level	145 - 175 m
Downstream water level	62 - 73.8 m
Earthquake	Magnitude VI
Lift rate	0.2 m/s

The left section of the concrete gravity dam, as well as the transition structure to which the shiplift will be connected at the upstream side, have already been completed. The majority of the 14 Francis turbines of the left bank powerhouse, as well as the two flights of ship locks, are in operation. The construction pit for the shiplift is excavated and the slope support has been installed. Therefore, construction of the shiplift can commence immediately after the tender design has been completed and the respective supply and construction contracts have been awarded. Commissioning of the shiplift is planned for the year 2009.

Rolf Wigand

Powerhouse and excavation of dam foundation, right side (from upstream)



¹ We reported on this in our previous issue, no. 47, of December 2003, page 16.

Inauguration of Kukule Ganga Hydropower Plant

On September 19, 2003, Kukule Ganga hydropower plant in Sri Lanka was inaugurated in the presence of Prime Minister Hon. Ranil Wickremesinghe and the Japanese ambassador H. E. Seiichiro Otsuka. Other guests were the Minister for Power and Energy as well as leading personalities from politics, economy and religions. Pursuant to a strict rite, the highest Buddhist monk had determined the official time of inauguration as 16:11 hrs. Several thousands of persons participated in the event accompanied by traditional dances and music.

The project site is located approx. 70 km south-east of Colombo, the capital of Sri Lanka, in the district of Ratnapura. The Client was Ceylon Electricity Board on behalf of the Government of Sri Lanka.

As a partner in a joint venture with Nippon Koei, Tokyo, as its leader, and Electrowatt, Zurich, Lahmeyer International (LI) was involved in the preparation of studies and design works from 1991 to 1993.

The tender documents had been prepared and contract negotiations had taken place between 1997 and 1998, while construction work started in August 1999.

Due to the small reservoir volume of only 1.67 million m³, the operation of the power station was designed for two different modes:



Dam with sectional gates

- Base load operation during the Monsoon period with reservoir full since the discharge usually exceeds the turbine capacity;
- peak load operation during the dry season.

The operation of the hydropower plant ensures energy supply for the south of Sri Lanka; this contributes to the country's economic development.

Rainer Klett



Interior view, powerhouse

Technical data

1. Hydrology	
Catchment area	312 km ²
Annual rainfall	3,750 mm
Annual inflow	30.4 m ³ /s
2. Diversion Facilities	
Regulating pond	1.67 million m ³
Pond area	0.88 km ²
Spillway gates	4 radial gates, 10 m height/12 m width
Design flood	2,000 m ³ /s
Settling basin	2 x 15 m width/90 m length
3. Hydropower Plant	
Headrace tunnel	length 5,710 m, diameter 6.4 unlined, diameter 5.4 m lined
Pressure tunnel	length 121 m, diameter 4.8 m
Power cavern	shotcrete-line cavern
	length 52 m, width 16 m, height 29 m
Tailrace tunnel	length 1,600 m, diameter 6.4 m
4. Performance	
Gross head	186.4 m
Turbines	2 vertical Francis turbines, capacity: 40 MW each
Plant discharge	47.5 m ³ /sec. for 2 turbines

NEPAL

Establishment of a National Geographic Information Structure



Every ten years, the kingdom of Nepal holds a census for the collection of demographic data to be used as the essential basis for planning and programs regarding the economic and social development of the country. In preparation of the performance and distribution of this regular census, the entire country has been newly mapped and digital maps have been produced in the past few years in order to provide a uniform national geographical information system (GIS).

In May 2002, Lahmeyer International was entrusted by the European Union (EU) with the establishment of a National Geographical Information Infrastructure (NGII) and the census distribution on the basis of this GIS and the internet.

EU funds particularly contribute to the capacity provision of the Survey Department (SD) and the Central Bureau of Statistics (CBS) in the field of GIS, databases, networking and internet application. Four other Ministries are also equipped with appropriate GIS units, and together with the SD and the CBS they act as the basic consortium for a uniform geographical information infrastructure in Nepal. Another significant contribution to the project is consulting with regard to the provision of a legal and administrative infrastructure as well as a pricing strategy for the exchange of digital data.

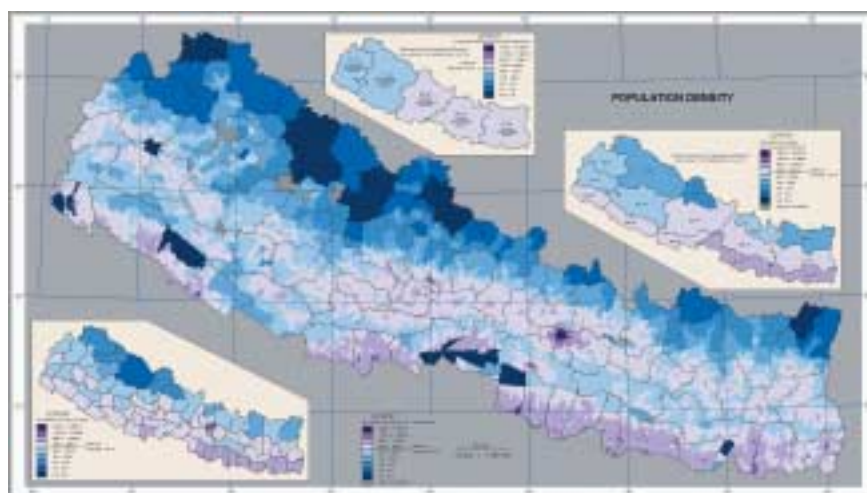
The NGII is an open system for researching and distributing spatial

and other digital information for the private and public sectors. In order to ensure an efficient data exchange, international standards and formats are applied. In addition, guidelines and compliance on a national level are given in more detail.

One of the system's central functions is a meta database providing important information on

The development stage primarily comprises strategic planning, implementation planning and detailed design of hardware and software. A prototype system is to be used as the basis for the development of various databases and the application software, as well as the provision of a web portal with a clearing house and an intranet. The core system, which primarily consists of computer hardware and network, is to be installed together with the relevant project partners in mid 2004. The subsequent migration stage includes the installation of the completed database systems and applications with the ministries involved, the CBS and 33 nationwide-spread CBS district offices.

With the implementation of the project, Nepal followed global efforts to establish uniform spatial data infrastructures. The improvement of information infrastructure and a user-friendly access to GIS data for the public and private sec-



The latest census performed in 2001 showed an average population density of 157 inhabitants per square kilometre. The highest and lowest numbers of inhabitants were counted in the capital Kathmandu (2,739/km²) and in the district of Dolpa (4/km²) respectively.

existing data in a catalogue format. The purpose of this central information system is the future avoidance of superfluous work; apart from this, uniform data formats ensure smooth exchange.

The technical implementation of the project is divided into two main stages: the system development and the migration.

tors as well as for countless relief organizations represents an important contribution to the country's development.

Jürgen Stadel

EGYPT

First Milestone in the Construction of Nile River Barrage Naga Hammadi

The completion of the river diversion in December 2003 at Naga Hammadi, after the successful commissioning of the Mubarak pump station, represented a major milestone and is at present the largest infrastructure development project in Egypt.

After more than ten years, during which Lahmeyer International provided extensive engineering services, including a feasibility study, the preparation of tender documents, complete tendering and contracting services and the completion of the construction design, the diversion of the Nile in December 2003 was a significant contractual milestone in the Naga Hammadi project.

Both Clients, the Ministry of Water Resources and Irrigation (MWRI) and the Ministry of Electricity and Energy (MEE), Cairo, awarded four construction and supply contracts with a total value of around 211 million Euro and 651 million Egyptian pounds in the years 2001/2002. This infrastructure project is funded by the KfW banking group (Kreditanstalt für Wiederaufbau, KfW), Frankfurt, the European Investment Bank (EIB), Luxemburg, and the Egyptian government. The construction works on the barrage commenced on the 3rd of June, 2002.

The Naga Hammadi Project, located some 120 km north of Luxor, contains the following three main components:

- Four bulb turbines, each with a maximum flow of 460 m³/sec. This hydropower station will have a total capacity of 64 MW and an average annual energy production of approx. 460 GWh; this corresponds to the average annual energy consumption of



Compaction work in the diversion canal river bed.

more than 200,000 Egyptian households.

- A weir containing seven sections, each with a width of 17 m, a height of 13.5 m and designed for a maximum flow of 7,000 m³/sec. Each section will be equipped with a radial gate.
- A double navigation lock, with a length of 170 m and a width of 2 x 17 m; large ships will be lifted up eight metres in 11 minutes.

As part of a system of barrages along the Nile, the new construction of Naga Hammadi Barrage will not only be used for energy generation, but also for the irrigation of approx. 286,000 hectares of fertile land, whose cultivation will represent an

important economic factor and will provide a livelihood for around 300,000 families of farmers.

In June 2004 a concrete cut-off wall with a length of 1,800 m and a depth of up to 60 m around the excavation pit was completed, allowing the excavation of approx. 1.75 million m³ of soil. The massive concrete works (approx. 380,000 m³) will commence in December 2004. The present construction progress indicates that the project will be commissioned as scheduled, i.e. on the 31st of May, 2008.

This hydropower station will be another contribution to the protection of the global climate by facilitating environmentally friendly and sustainable energy generation.

Bernd R. Hein

EGYPT

Commissioning of Mubarak Pumping Station



View into the 140 m-long, 14 m-high and 17 m-wide northern pump hall.

design developed by Lahmeyer Hamza Engineering Consortium (LHEC).

The 140 m-long island-type pump station is submerged by Nile water up to 50 m deep. In order to ensure the station's long-term serviceability, it was designed as a monolithic reinforced concrete structure, i.e. without arrangement of any joints. The design provided for an adequate control of crack widths by application of advanced concrete technology, in conjunction with a corresponding minimum reinforcement. During impoundment, this concept proved to be successful, since no significant leakage was observed.

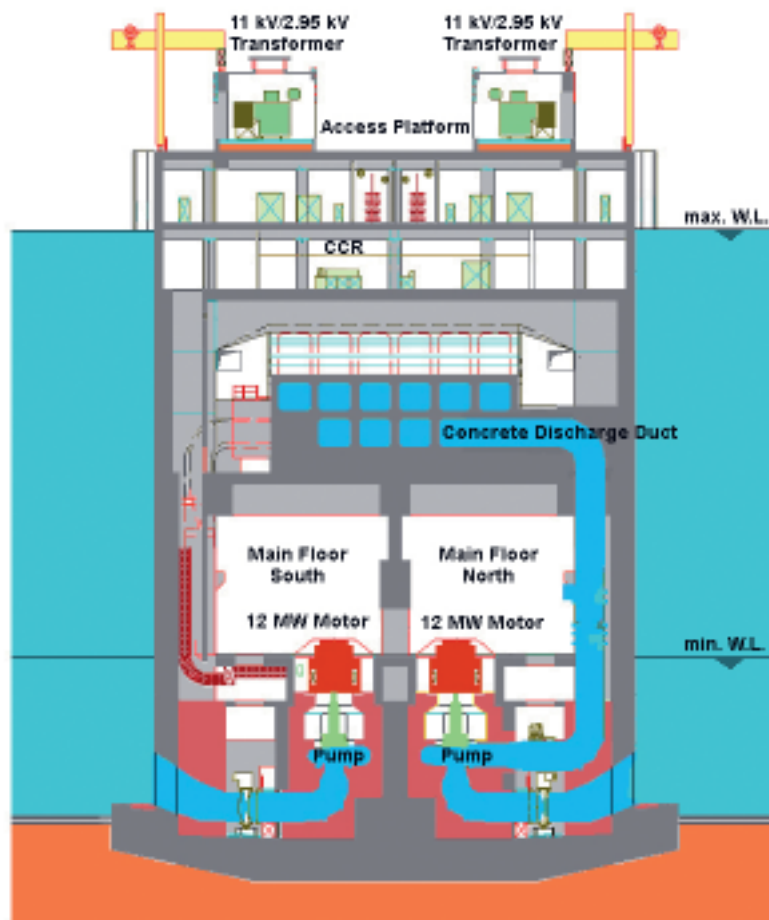
Dr. Roland Schmidt

The commissioning of the Mubarak Pumping Station in Upper Egypt was successfully completed in spring 2004, after a construction period of almost six years. By twenty-one centrifugal pumps equipped with variable speed drive systems, up to 334 m³/s of water are pumped at a geodetic head of up to 51.5 m. This corresponds to 29 million cubic metres a day, or the average flood discharge of the river Elbe at Dresden. This renders the Mubarak Pumping Station near the famous Rock Temple of Abu Simbel one of the largest pump stations in the world.

The water is primarily used for irrigation and is pumped from Lake Nasser to the plateau of the Nubian Desert. By 2015, an area of more than 200,000 hectares is planned to be developed for agricultural use within the Toshka project.

Lahmeyer International together with their local partner Hamza Associates were responsible for the entire tender and detailed design of this outstanding project. The Client was the Egyptian European Japanese Consortium (EEJC), awarded with the "design & build" contract for the turnkey construction of the project by the Egyptian Ministry of Water Resources and Irrigation (MWRI) in March 1998.

The decisive reason for the contract award to EEJC was the tender



Cross-section of the 40 m-wide and approx. 65 m-high pumping station.

ETHIOPIA

Feasibility Studies for New Hydropower Projects



The Blue Nile near Karadobi

On May 17, 2004, the Ethiopian Ministry of Water Resources entrusted Lahmeyer International (LI) together with the Norwegian partners Norplan and Norconsult with the preparation of studies regarding two new hydropower projects:

- The Baro project is located in the extreme west of the country and includes the Baro I and Baro II schemes, which operate in a cascade. A pre-feasibility study carried out in 1999, showed a total exploitable head of nearly 700 m and a capacity of around 600 MW for these schemes. Baro project shall now be subject to a detailed feasibility study.
- Karadobi project for which a pre-feasibility study is to be performed, is located on the Abay Wenz river, better known as Blue Nile. It is the most

important Ethiopian river and forms the outflow from Lake Tana. Its route to Sudan, where it joins the White Nile near Khartoum, follows a wide bend through the west of Ethiopia. The Karadobi Hydropower Project should have a head of 200 m and an installed capacity in the range of 1000 to 1500 MW.

These new projects are part of the Ethiopian government's efforts to further develop its enormous, mostly still unharnessed hydropower potential, to meet its increasing energy demand. The studies are financed by a Norwegian grant.

The East African country forms one of the key areas for LI's hydropower activities. With the Awash III Hydropower Project in the 1960s, LI's history in Ethiopia dates back to the early years of the company. Apart from the new studies for Baro and Karadobi, experts from LI are presently also working on a masterplan for the Genale-Dawa River Basin and further feasibility studies for the hydropower schemes of Chemoga Yeda, Beles and Halele Werabesa.



Karadobi site camp

Dr. Gerhard Eickmann

ECUADOR

New Road Construction in Guayaquil

In mid September 2003, Lahmeyer International (LI) was commissioned by the municipality of Guayaquil to perform a feasibility study for a new road connection 'San Eduardo Tunnel' between Av. Barcelona and Av. del Bombero in the city of Guayaquil.

The junction of two principal roads connecting the residential areas in the south west and the industrial area in the north of the city is located at a mileage point of 4.5 km on Av. del Bombero. This junction is a bottleneck resulting in travel times of up to one hour for a distance of just under eight kilometres from the south to the north.

The socio-economic cost and environmental damage caused the municipality to review the possibility of a direct connection between Av. Barcelona in the south and Av. del Bombero in the north using the above-mentioned junction.

The feasibility study to be performed by LI comprised:

- Land survey
- Geological and geotechnical investigations
- Hydrology, drainage concept
- Traffic study
- Road design
- Tunnel design
- Tunnel equipment
- Economic efficiency study



Project layout

Re-studies headed by LI and supported by Consulsismica and Conyfis of Guayaquil were carried out in a relatively short period of only two months, which represented a particular challenge. The feasibility study including an estimate of construction cost was used as the basis for the credit application with Cooperación Andina de Fomento (CAF) which has now been approved. The construction of a 3.74 km-long 6-lane principal road including two parallel tunnels with a length of approx. 1,320 m each

passing the San Eduardo ridge, as well as the modification of the junction on Av. del Bombero are to be implemented by the end of 2007.

Klaus Pollmeier,
Dr. Herbert Risch

GREECE

Extension to Athens Metro

In October 2003, Attiko Metro appointed Lahmeyer International together with three other partners for the provision of consulting services for the Athens Metro extensions. These extensions are to be implemented in two phases. Phase I comprises four line extensions covering a distance of approx. 11.5 km and ten stations. Phase II covers

five other sections being extensions of existing lines and new sections respectively. The total section length of both phases amounts to approx. 34 km with total 33 stations.

In February 2004, the contract was extended with an order for the Metro project in Thessaloniki. Pursuant to present plans, the dis-

tance covered will be approx. 9.5 km with 14 stations.

Services to be provided include the preparation of tender documents, design review, coordination of all work sections in their implementation planning as well as consulting with regard to special problems in tunnelling and under-

ground construction. Particular attention is to be drawn to the supervision of the system integration tests and the Trial Runs for the phase I extensions. These tasks are to be completed by the start of the Olympic Games in August 2004, requiring utmost effort by all parties involved. To reach this ambitious goal, the experts involved have been integrated into the Client's organisation, Attiko Metro.

The project shall be completed by October 2005. A term extension option has been agreed upon.

Adalbert Gering



GREECE

Optimisation of Railway Infrastructure

In order to harmonise the different traffic infrastructure in the European Union, Brussels reviewed the conditions existing in the different member countries and concluded that countries such as Ireland, Portugal and Greece should adapt their railway systems to comply with European standards.

Since 1996, the EU has spent enormous funds on the construction of new and the improvement of existing railway sections in Greece.

In particular with Greece the EU has invested heavily in the construction of new railways and upgrading the Existing network.

There are three major projects:

- The replacement of the narrow gauge line from Patras in the Peloponnese to Athens by a new, electrified standard gauge line.
- A new suburban line from Athens city centre to Athens airport Eleftherios Venizelos.
- Straightening measures and electrification of the Athens–Thessaloniki aorta. This has reduced travel time

between the cities by over one hour.

Almost all existing lines are currently operated with diesel engines. Their electrification shall be completed by 2010.

In mid 2003, a contract was concluded between Lahmeyer International and ERGOSE, a subsidiary of the Greek railway. The object of this contract was to review the proposed equipment for the above projects as well as to study whether state-of-the-art technology is appropriate. An important aspect is to ensure that the technology used allows for trouble-free transnational transportation (inter-operability).

Only recently has the new European Train Control System (ETCS), developed to achieve inter-operability, using the new GSM-R radio system, has been successfully tested on the Berlin–Halle–Leipzig route. This system will also be installed in Greece.

The utilization of modern signal and telecommunication technology could prove difficult as the Greek railways could only afford minimum

system maintenance. This also applies to large parts of the power supply network and has to be addressed.

Among other things, the approaching Olympic Games this year in Athens also put pressure on the timely completion of several large-scale projects in Greece. Since the number of experienced railway staff available is insufficient, support by consulting enterprises is required.

Roland Albert

GERMANY

Project Control Services for Extension and Reconditioning Measures on Frankfurt/Main Airport

As the largest commercial German airport, Frankfurt airport handles around 50 million passengers and 1.8 million tons of freight every year. Due to the increase in air traffic to be expected for the future as well as more stringent requirements of quality and safety standards, extension and reconditioning measures have become necessary.

In this respect, the existing pier A was modified and extended between 1996 and 2000. Apart from further terminal positions, the building now comprises offices, lounges, facilities for concessionaires as well as baggage handling and technical rooms. The high-quality standard resulted from the requirements of Deutsche Lufthansa AG. Lahmeyer International (LI) and Lahmeyer Rhein-Main (LRM) were in charge of considerable project management services for Fraport AG for the construction of this building complex.

Another project is the fire protection modification of terminal 1, built in 1972, for which LRM has been involved in the planning and implementation stages for the retrofitting of the approx. 580 m long junction between the airport building and adjacent car park since 2002. In late 2003, the contract was amended by section C of the level "under the airport". The modification measures require a general fire protection concept in consideration of the adjacent areas – the regional station of the German railway is located under the areas mentioned – and continuous passenger operation.

Further project management services have been provided by LRM since 2004 in the course of the refurbishment of building 394 on the airport apron; this building is used by the ground handling services and is subject to general reconstruction due to static defects. An interim solution for the building

users must be provided for the duration of the refurbishment works.

LRM supports Fraport AG in all these projects with regard to project organisation as well as the planning and control of time schedules and cost. The high complexity of the measures furthermore requires a thorough interface management.

Apart from the measures on the existing buildings, LRM is also involved in the planned airport extension. In cooperation with LI and two joint venture partners, LRM plans the future traffic connection. Besides, LRM and ERM Lahmeyer International support Fraport AG with the approval procedure.

Christian Schorn
Lahmeyer Rhein-Main

View on the retrofitted junction at 50 % completion.





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