

GNS

English Edition

Issue 11 – March 2019

The Corporate Magazine of the GNS Group



Growing Jointly
GNS Acquires Stake
in Höfer & Bechtel

Acid Test Passed
First Quiver Campaign
Completed

Backbone of Dismantling
Significantly Rising Demand
for MOSAIK®



Inhalt

- 2 100 CASTOR® Casks in Czech Interim Storage Facility Dukovany
- 3 Editorial
- 4 Organisation Streamlined
- 5 Retirement after 15 Years at GNS
- 6 Growing Jointly
- 8 Free of Fuel Through Quiver
- 9 German Quiver Project
- 10 Major Order from EnBW
- 10 CASTOR® Casks for Swiss Nuclear Power Plants
- 11 Approvals in Germany and Abroad
- 12 Significant Increase in Demand for MOSAIK®
- 13 Core Component Campaign for Krümmel
- 14 Conditioning Facilities for Residue Processing Centres of EnBW
- 15 Workload for More than Ten Years
- 16 GNS Forum 2018
- 17 3D Measurements
- 18 AVK: 30 Years Old and up to Date
- 19 Requalification and Reconditioning of 1,484 Drums
- 20 Co-operation Projects for the Asian Market
- 21 Pilot Plant for Japan
- 22 Meetings and Conferences
- 24 New Buildings for Dismantling
- 27 Two Times Forty
- 28 GNS Sport Activities
- 28 Imprint



Title: Installation of the primary lid of a CASTOR® 1000/19 for irradiated fuel assemblies of the Czech nuclear power plant Temelin in the GNS cask assembly in Mülheim.

News

100 CASTOR® Casks in Czech Interim Storage Facility Dukovany



Handling in the interim storage facility.

CASTOR® casks have been stored in the interim storage facility of the Czech nuclear power plant Dukovany since December 1995. By 2005, GNS had delivered 60 casks of type CASTOR® 440/84. The modified CASTOR® 440/84M series followed from 2006 onwards. In December 2018, the 100th CASTOR® cask was connected to the cask monitoring system of the storage facility. The cask holds fuel assemblies that were discharged from reactor block 1 in the years 2011 and 2012.

Despite adverse weather conditions and sub-zero temperatures confronting the employees of the nuclear power plant due to the onset of winter, transport to the interim storage facility was smooth.



Employees of the Czech nuclear power plant Dukovany in front of the 100th CASTOR® cask in the interim storage facility.

Editorial



Dear readers,

two anniversaries marked the year 2018 for our company: 40 years of GNS and 40 years of CASTOR®. Besides all the nostalgia, it was rather a year of departure and renewal for us. In the first year after handing over interim storage to the Federal Government, we reallocated our tasks within the company and reorganised GNS – also due to the retirement of our management colleague Holger Bröskamp.

Our focus is on meeting the needs of our customers – against the background of the progressive phasing out of nuclear energy in Germany and as part of the further globalisation of our business.

We are geared for growth overall. To meet the expectations of our customers in the long term, GNS hired 50 new employees in 2018 alone. With the gradual acquisition of stakes in Höfer & Bechtel, a specialist in nuclear technology, we are also strengthening our capabilities across our entire portfolio.

On behalf of the German utilities and already in collaboration with Höfer & Bechtel, we have succeeded in developing a disposal solution until series maturity for the special fuel rods kept in nuclear power plant pools until the end. At the end of last year, our quiver system passed the acid test at the first campaign in Unterweser and will now enable all German nuclear power plants to be fuel-free in the coming years.

Just like the spent fuel assemblies, the quivers are loaded into our proven CASTOR® V-casks for further interim storage. More than 600 of these units are already in German interim storage facilities alone. In addition, our loading teams for processing in German power plants are fully booked for the next couple of years.

To date, more than 1,650 large casks by GNS have been loaded and stored worldwide. To respond even better to the needs of international customers, we are constantly improving our proven products. The new cask series CASTOR® geo is also attracting growing interest in other parts of the world following initial orders from European customers. To make the strength of CASTOR® casks available for older power plants with limited crane capacities, we have the CLU system in our portfolio. We present our innovations regularly at international symposia where they are very well received by operators from all over the world.

The first order from Japan for GNS plant engineering as well as several partnerships in Asia show that we are on the right track in the globalisation of our waste management and plant engineering business. The progress made in dismantling the first nuclear power plants in Germany, which GNS is actively supporting, for example, in the dismantling of reactor internals or reactor pressure vessels, are excellent references.

While we are finally saying goodbye to our location in Duisburg this year after almost 35 years, we have our hands full with waste processing in Jülich. Many of the new residue processing centres at the power plant sites are using our systems and processes before loading the waste in casks supplied by us. Especially our MOSAIK® casks are perennial favourites, at home and abroad.

Our activities in the field of safe nuclear waste disposal have always been diverse. How diverse? – See for yourself in our GNS magazine.

Dr. Hannes Wimmer
Chairman of the Board
of Managing Directors

Organisation Streamlined

With the departure of Holger Bröskamp, the responsibilities in the management of GNS have been redefined and the organisation has been adapted as a result of transferring interim storage to the Federal Government last year.



Dr. Jens Schröder, Georg Büth, Dr. Hannes Wimmer.

In addition to strategy, communications and sales, Dr. Hannes Wimmer (CEO) has assumed responsibility for Holger Bröskamp's most recent activities relating to waste management and the retrieval of waste from reprocessing as well as radiation protection. Dr. Jens Schröder (CTO) is now responsible for spent fuel management together with manufacturing, engineering services, projects and quality assurance. Georg Büth continues to handle controlling,

finance, taxes, purchasing, information systems, human resources and legal affairs.

Waste management reorganised

Clear responsibilities, robust processes and improved planning and control were key requirements considered when defining the new organisational structure in the division waste management LLW/ILW. The new organisational

structure is based on the objective "processing customers orders" and the functions needed to achieve this. Against this background, project management for all client orders was bundled in the newly created department "orders/waste management projects". Consequently, customers orders in the business area waste management are processed now by two GNS divisions: The division "Waste Management Projects", headed by Elisabeth Ebert, is responsible among other things for controlling all waste management projects and orders. Under the management of Dr. Holger Spann, the division VA "Waste Management" handles the operative processing and treatment of low- and intermediate-level waste and residual materials at GNS.

"The new organisational structure offers customers the advantage of a clear definition of the GNS employee responsible as the customer contact for a specific order," explains Elisabeth Ebert. "The focus on tasks allows for greater specialisation of employees and reduces internal overlapping." Capacity planning is now possible within functional areas instead of across the boundaries of individual organisational units. The stronger focus on core competencies also allows the introduction of standards in individual functional areas," says Ebert.

Ceremonial farewell to Holger Bröskamp

Retirement after 15 Years at GNS

At the end of April 2018, Holger Bröskamp retired after 15 years in the management board of GNS. From March 2003 to September 2011, he was spokesman of the GNS management board and then deputy chairman.



Holger Bröskamp



Dr. Hannes Wimmer hands over a very special type plate to Holger Bröskamp: his personal CASTOR® BRK.

“During his one and a half decades at the helm of GNS, Holger Bröskamp always gave top priority to safe disposal and the wellbeing of his employees,” said Dr. Hannes Wimmer, CEO of GNS, praising the departing colleague during a ceremony. “He has shaped GNS for the future and laid the foundations for our success today by applying these principles.”

Under the responsibility of Holger Bröskamp, GNS teams loaded more than 500 casks with fuel assemblies and stored them in on-site interim storage facilities as well as 81 HLW-casks in Gorleben that GNS brought back from La Hague

with seven transports between 2003 and 2011. Bröskamp was also responsible for the operation of the two central interim storage facilities in Ahaus and Gorleben until they were handed over to the Federal Government in 2017.

Chairman of the GNS Supervisory Board Dr. Guido Knott: “Holger Bröskamp enjoys an excellent reputation among politicians, experts as well as domestic and foreign GNS customers in all crucial waste management issues. In a tense period between the phase-out of nuclear energy, life-time extension and second phase-out decision, his contribution to objectifying the debates was decisive.

On behalf of all GNS shareholders and the Supervisory Board, I would like to thank Mr. Bröskamp for his outstanding commitment.”



GNS acquires stake in Höfer & Bechtel

Growing Jointly

For quite some time, GNS and the nuclear technology specialists at Höfer & Bechtel GmbH in Mainhausen have been cooperating on many projects. The two companies will grow even closer together in the future.



A Frankfurt Crown Cake to celebrate the agreement: GNS managing directors Georg Büth and Dr. Jens Schröder together with Hagen Höfer and Sascha Bechtel (front) as well as the negotiation team Christoph Kohn, Dirk Schlauch and Jens van der Loo (GNS) and Thorsten Lotz of law firm Patzina Lotz for Höfer & Bechtel (second row from left).

At a first glance, their corporate histories could hardly be more different: Höfer & Bechtel GmbH, second generation owner-managed; GNS, founded by industrial companies and utilities and a company of nuclear power plant operators for 30 years. Both companies share decades of experience in the nuclear industry. In all these years, the specialists of the two companies have not only run into each other by chance in nuclear power plants, but have also regularly worked hand in hand on a number of spent fuel and waste management projects.

Current highlight of the cooperation is the quiver for special fuel rods developed jointly by GNS and Höfer & Bechtel to series maturity and used for the first time at the Unterweser NPP in November 2018 (see Page 8). The specialists of Höfer & Bechtel could use their many years of experience in handling and packaging nuclear fuels and even in handling CASTOR® casks to complete the project. The cooperation also extended abroad. Höfer & Bechtel supplied a device for monitoring the drying process for CASTOR® casks delivered by GNS to the Czech nuclear power plant Dukovany.

Gradual acquisition of shares

Plans are in place to further intensify the cooperation between the two companies. Therefore, management of GNS and the two Höfer & Bechtel owners and managing directors Hagen Höfer and Sascha Bechtel have agreed on a gradual acquisition of shares by GNS. With this approach, the current owners want to secure their succession and the preservation of the company in the long term. Höfer & Bechtel will continue to exist both as a brand and as an independent company at the



The company building of Höfer & Bechtel in Mainhausen, southern Hesse.

Mainhausen location in the long term. All approximately 40 jobs are retained.

Both parties also agreed that the two existing shareholders will remain in the management of the company, supported in future by the technical managing director of GNS, Dr. Jens Schröder.

Stronger abroad

“Höfer & Bechtel rightly enjoys a high reputation in the market,” explains Dr. Schröder. “We know and appreciate the company and its employees very much and consider it an excellent addition to our portfolio. We expect a valuable strengthening of our joint capabilities in the business segments waste management, dismantling, plants and casks. This is all the more true in view of the challenges we face in globalising our business.”

“Our focus so far has been on the German market,” explains Hagen Höfer.

“Together with GNS, we can also apply our expertise to international projects beyond the phase-out of nuclear energy in Germany.” Sascha Bechtel adds: “GNS is therefore the ideal partner for us to further develop the company we have built up keeping continuity and long-term stability in mind.”

Organic growth

Contrary to the market development in Germany, the joint projects should generate additional growth. “This will not only increase sales but will also enable us to achieve organic growth by recruiting additional employees, particularly for sales, engineering and services,” Dr. Schröder continued. “Existing resources such as the technical centre of Höfer & Bechtel will be used jointly in the future. We also expect valuable mutual impulses in the development of new, customised solutions and innovations.”

HÖFER & BECHTEL

Höfer & Bechtel GmbH, headquartered in Mainhausen, southern Hesse, is a medium-sized company with approx. 40 employees.

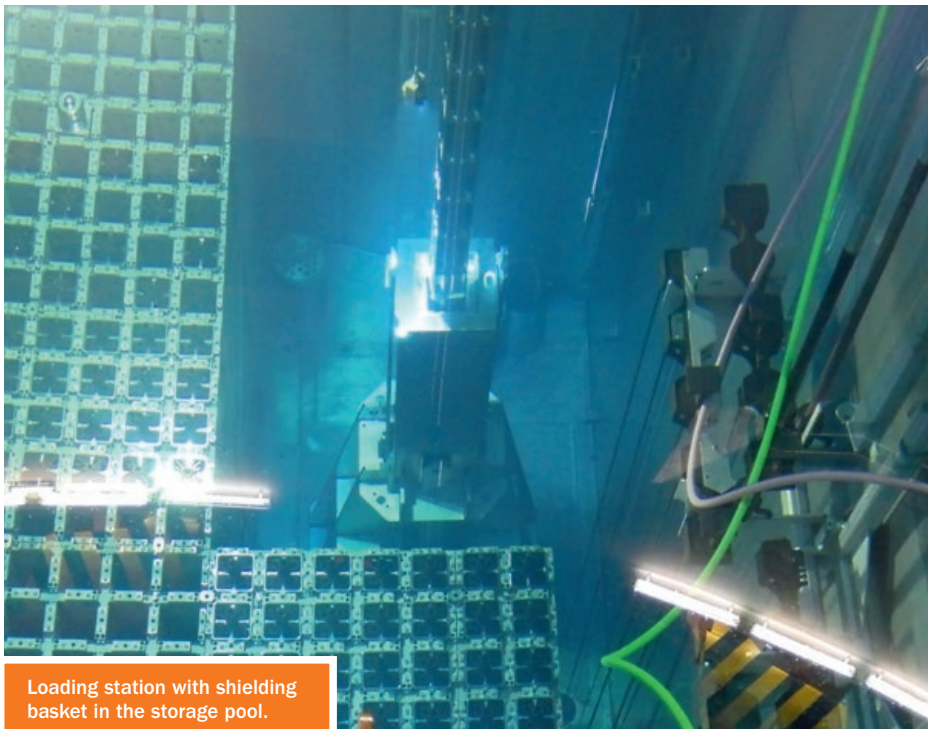
The company focuses on nuclear technology, especially in the optimisation of process flows, in the development, construction and operation of complex and specialised machines and measuring equipment for nuclear power plants, but also in radiology and radiation protection.

High-quality technical IT services complete the range.

First campaign with quivers for special fuel rods completed

Free of Fuel Through Quiver

At the Unterweser nuclear power plant (KKU), a campaign was carried out for the first time using the quiver system for special fuel rods developed by GNS and Höfer & Bechtel. The innovative process was developed for series production in just seven years.



Loading station with shielding basket in the storage pool.

Complete defueling is a prerequisite for the dismantling of a nuclear power plant. To achieve this, not only the fuel assemblies but also the so-called special fuel rods – usually damaged fuel rods collected separately in the pool during operation – must be removed. The development and implementation of a safe and risk-free disposal concept for the special fuel rods were necessary to start the dismantling of the German plants.

Together with Höfer & Bechtel, GNS has developed a quiver system for special fuel rods on behalf of the German utili-

ties (see box) for the casks CASTOR® V/19 and V/52. The quiver fits – with the same dimensions and masses as complete fuel assemblies – into the standard fuel basket positions of transport and storage casks for pressurised and boiling water fuel assemblies. The quiver can hold special fuel rods, regardless of their damage patterns including loose pellets or segments.

Quiver in use

The first use of the quiver was for an internal transport within the Biblis

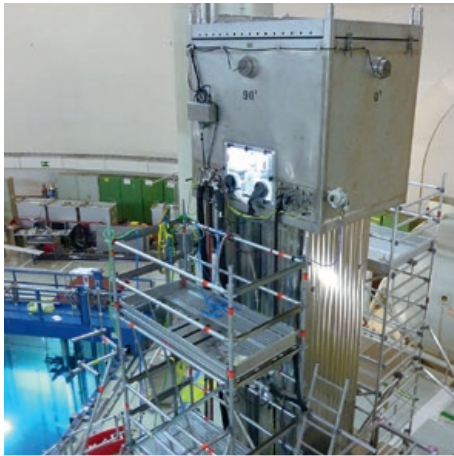
nuclear power plant from Block A to Block B (see GNS Magazine 9/2016).

In November 2018, the first full campaign was completed with the dispatch of three PWR-quivers in the nuclear power plant. “This means that GNS carried out the world’s first handling of special fuel rods on the pool floor,” says Bernhard Kühne, Divisional Director Projects at GNS, stressing the importance of the campaign.

The first campaign was preceded by months of preparations, also on site: Already in April 2018, the individual fuel rods in the pool had been loaded into three PWR quivers. In July 2018, the equipment required for handling was transferred and set up. The service station with shielding block, mobile hot cell and the additional equipment such as the drying facility and the welding power source on the reactor floor required around 40 m² of floor space; the loading station with shielding basket in the storage pool needed another 8 m².

Following the installation, Höfer & Bechtel carried out a cold trial. Each handling step of the process plan specific to the quiver was carried out and checked by an independent expert.

At the end of September, the Lower Saxony Ministry of Environment, Energy, Building and Climate Protection approved the handling of the three quivers.



Service station with shielding block and attached mobile hot cell.

“It took almost a month for the three quivers to be dewatered, dried, screwed and welded one after the other in the KKU,” recalls GNS project manager Martin Kaplik, who was on-site as a supervisor and also in charge of welding supervision. GNS was certified as a welding shop for handling the quivers (see GNS magazine 10/2017).

Seven years to the series maturity

“Only seven years have passed between the start of planning in 2011 and the first campaign in 2018,” says Dr. Jens Schröder, technical managing director of GNS. “During this time, we not only developed the quiver together with Höfer & Bechtel but also completely new handling equipment and brought it to series maturity.”

“The first campaign showed that the qualified processes for handling, drying and welding are robust and reliable and that it is possible to dry special fuel rods on site,” summarises Bernhard Kühne. “In addition, out-of-pool handling results in very low radiation exposures for service personnel.”

The story continues almost seamlessly with the already started quiver campaign at the Biblis nuclear power plant.

The German Quiver-Project

The German quiver project was already triggered almost 20 years ago. With the ban on transports of spent fuel to reprocessing as part of the agreement on the first nuclear phase-out in 2000 in Germany (“Atomkonsens”), the disposal route originally planned for damaged fuel rods also ceased to exist from mid-2005. The first shutdowns were then planned for 2011 and the damaged rods collected in the pools should normally be removed after the regular fuel elements have been removed – i. e. from approx. 2016 onwards.

With a time frame of more than ten years, the first project work began to develop a solution for the storage of damaged rods in the new interim storage facilities to be built on-site. As early as 2006 GNS was brought in to ensure compatibility with the transport and storage casks. The development and approval of the solutions initially worked out in the following years were postponed in view of the new lifetime extensions in 2010, as the first shutdown was now only scheduled for 2020.

The second and final German phase out decision of June 2011 gave new impetus to the project, as the oldest plants taken off the grid only days after the Fukushima accident in March should not be put back into operation at all. The time remaining to develop a solution for the damaged rods had thus been almost halved. As early as July 2011, the utilities commissioned GNS to resume development work and prepare a solution tailored to the tight schedule.

Regarding these new time constraints, GNS revised the requirements for a quiver solution. Top priority was now a very robust disposal system that should

go through the approval process faster and more reliably than an economically optimised concept. During a workshop in early 2012 with five potential developers, the utilities finally agreed to adopt a hot-vacuum drying system with a quiver being able to accommodate several fuel rods as it was presented by Höfer & Bechtel. The quiver should regulatorily be treated as part of the cask and, to facilitate timely licensing, cask-loading only with quivers was foreseen.

This design and the accompanying dispatch equipment have been verified by a series of tests and qualification processes supervised by the German authorities, and have proven to be a reliable solution within the specified period of only five years. The package design approvals for the quiver for CASTOR® V/19 and V/52 have been issued by the German authorities in 2017 and 2018, respectively. This first of its kind quiver solution is thus able to assure the dry interim storage of all non-standard fuel rods from the German NPPs in standard transport and storage casks.



The quivers for fuel rods from PWR- (left) and BWR-reactors.

GNS supplies 41 CASTOR® casks for the nuclear power plants Neckarwestheim and Philippsburg.

Major Order from EnBW

A total of 41 CASTOR® V/19 transport and storage casks will be supplied by GNS between 2020 and 2025 for the spent fuel assemblies from the pressurised water reactors in Neckarwestheim (GKN I and GKN II) and Philippsburg (KKP 2). This major order covers the demand by EnBW for spent fuel casks until the middle of the next decade.

“The operation of our interim storage facilities will be transferred to the responsible federal company at the turn of the year. In addition, we will continue to be responsible for the careful and safe packaging of the fuel assemblies,” explains Jörg Michels, Chairman of the Management Board of EnBW Kernkraft GmbH. “This major order covers our

demand for spent fuel casks until the middle of the next decade.”

The scope of supply also includes – for each of the two sites – a CASTOR® V/19 that is prepared with quivers for damaged fuel rods. The quivers developed by GNS provide an independent containment for the rods.



CASTOR® Casks for Swiss Nuclear Power Plants

Three CASTOR® V/19 loaded and stored in Switzerland, contract for eight CASTOR® V/52 concluded

In February 2018, the first CASTOR® V/19 (CH) cask approved for use by the Swiss Federal Nuclear Safety Inspectorate (ENSI) was loaded by a power plant team in cooperation with a GNS supervisor in the storage pool of Beznau NPP. Emplacement in the ZWIBEZ interim storage facility followed at the end of March.

In the summer of 2018, loading and emplacement of the second and at the end of 2018 of the third cask took place. The order includes seven casks in total; the last two will be delivered in 2020.

CASTOR® V/19 (CH) had obtained the approval revision and the revisions of the type approvals for ZWIBEZ and ZWILAG beforehand.

Further order from Switzerland

GNS and BKW Energie AG of Switzerland signed a contract for the delivery of eight CASTOR® V/52 January 2018. The casks to be delivered in 2021 are intended for the remaining fuel assemblies of Mühleberg nuclear power plant in Switzerland to be decommissioned at the end of 2019.

With these casks, GNS supports the first decommissioning project in Switzerland in optimised dismantling: By removing the last fuel assemblies, the boiling water reactor becomes fuel-free and a decisive prerequisite for efficient dismantling is ensured.

The delivery contract was preceded by a contract signed last year for the licensing of CASTOR® V/52 for Switzerland.

CASTOR® and MOSAIK® casks

Approvals in Germany and Abroad

GNS obtained several approvals for CASTOR® and MOSAIK® casks both in Germany and abroad.



CASTOR® MTR3 with individually adapted fuel baskets.

New development CASTOR® MTR3 obtains package design approval

On 17 January 2019, the Federal Office for the Safety of Nuclear Waste Management (BfE) issued the package design approval for transport and storage cask CASTOR® MTR3 as type B(U)F packaging. The cask has been developed specially for spent fuel elements from research reactors. This cask will initially be used for the transport and storage of spent fuel elements of the FRM II research reactor of the TU Munich. It will also be able to accommodate further fuel assembly types from other research reactors (e.g. TRIGA, MTR) in the future by using individually adapted fuel baskets.

Swiss type B(M) approval for MOSAIK® II-15

As reported in GNS Magazine 10/2017, GNS had signed a contract with Axpo Power AG, BKW Energie AG, Kernkraftwerk Gösgen-Däniken AG and Kernkraftwerk Leibstadt AG to obtain Type B(M) approval

for the MOSAIK® II-15 cask of type EI with a lead lining of 40 mm. In September 2017, GNS submitted the documents to the Swiss authority and received approval on 1 September 2018.

Type B(M) approval filed in England for MOSAIK® II-15

Type B(M) approval has been filed for the MOSAIK® II-15 cask also in England. GNS submitted the necessary documents; approval is expected in 2019.



MOSAIK® II-15

Transport approval granted for CASTOR® V/52 with BWR quiver

After package design approval for CASTOR® V/19 for loading with PWR quivers, the Federal Office for the Safety of Nuclear Waste Management has also granted the revision of approval for CASTOR® V/52 (96 design) for loading with up to 20 BWR quivers for special fuel rods. The BWR-quiver can hold up to 18 special fuel rods as well as fuel rod sections or loose fuel in filter cartridges in three alternative inner basket variants.

BfE issues approval extensions for four CASTOR® casks

Within two weeks at the end of 2017, the Federal Office for the Safety of Nuclear Waste Management (BfE) extended the certificates of approval for four type B(U) F-85 packages (CASTOR® V/19 up to serial number 05, CASTOR® V/19 from serial number 06, CASTOR® V/52 and CASTOR® IIa).

The extensions of the approvals for the three CASTOR® V types were extended by a further five years and for the CASTOR® IIa by a further ten years.

Further approvals in Japan and the USA are in preparation.

The backbone of dismantling

Significant Increase in Demand for MOSAIK®



Dismantling is gaining momentum in most of the German nuclear power plants that have already been decommissioned. At GNS, this is also reflected in the significant increase in demand for MOSAIK® casks. These versatile shielding casks are needed in dismantling, among other things, for packaging the reactor internals and the most highly activated parts of the reactor pressure vessel.

Firm orders have already been received for 300 casks this year, a further 350 have been pre-ordered in the form of letters of intent and orders for another 250 casks have already been announced. Sales of the yellow cask are also running very well abroad: 60 MOSAIK® casks have already been ordered from Switzerland and the United Kingdom for 2019 to 2021, and orders for a further 100 units are expected.

To meet the large demand reliably and targeted, GNS has decided to gradually increase the production capacities at its Mülheim plant by 50 per cent to 300 casks per year by mid-2019. "In addition, the schedule of the domestic demand is coordinated among the energy suppliers," says Jörg Viermann, Head of Sales Waste Management. "The MOSAIK® cask is the backbone of dismantling. If demand continues to rise, we can react flexibly." Overall sales of nearly 8,000 casks show how important MOSAIK® is.

Conditioning of movable core components at KKK

Core Component Campaign for Krümmel

The once most powerful boiling water reactor in the world, the Krümmel nuclear power plant (KKK), is being dismantled. For this to begin, 50 t of movable core components from the spent fuel pool must first be disposed of from the nuclear power plant on the Elbe river. These are mainly control elements, fuel assembly channels, fastenings of fuel assembly channels, measuring probes and various small scrap that accumulated during operation and inspections.

After intensive preparation, GNS received the order in December 2017 to condition these core components. The order volume amounts to more than EUR 5 million excluding costs of casks.

GNS started the conditioning with a project manager and six employees at the end of November 2018. Due to a large amount of various operational waste and other planned activities at KKK to achieve a fuel-free state, conditioning will be carried out in several sub-campaigns.

The operational waste is first dismantled remotely under water for radiation protection reasons. Among other things, the cutting and packaging facility developed by GNS is used for dismantling. This flexible conditioning facility that is now being used at the KKK for the sixth time cuts the highly activated and contaminated controls, fuel assembly channels and fuel assembly frames into small sections.



Cutting and packaging facility developed by GNS.

The GNS team packs the dismantled or rearranged movable core components in baskets and loading magazines that are at a later date placed in almost fifty MOSAIK® casks or over 30 sheet steel containers in a separate campaign. The sections collected in basket inserts are compacted to reduce the volume resulting in a high packing density.

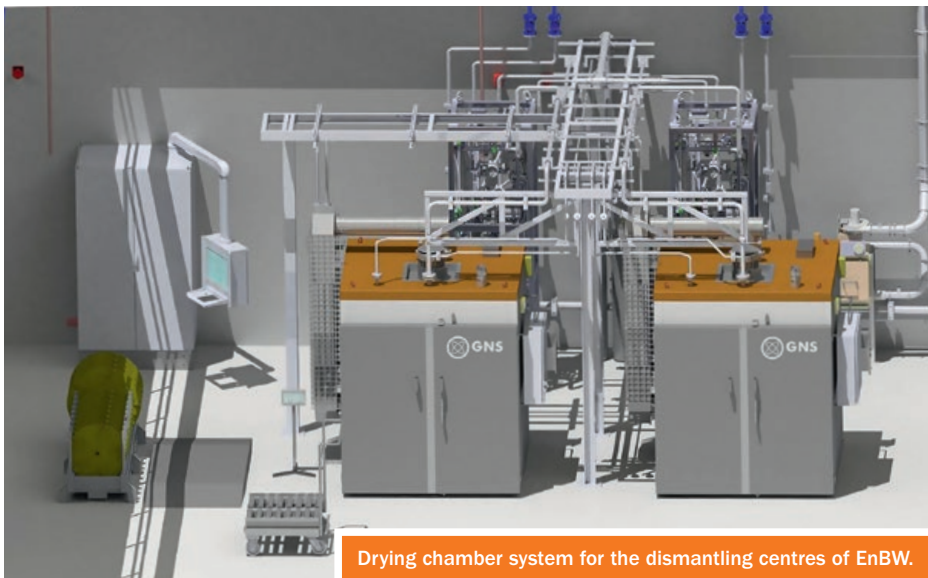
Completion is planned already for 2019, which is why work is being carried

out on site in two shifts. "In addition to the proven experience of GNS, the speed of implementation was decisive for awarding the contract," reports Jörg Viernann, Head of Sales Waste Management.

A follow-up project is already in the planning phase: The cutting and packaging facility will be deployed next in block B of the Gundremmingen nuclear power plant.

Conditioning Facilities for Residue Processing Centres of EnBW

For the residue material processing centres (RBZ) of EnBW at the Neckarwestheim and Philippsburg sites, GNS supplies proven GNS conditioning technology as well as to a large extent new and further developments of known systems. GNS has taken over the planning, supply and commissioning of conditioning facilities for the two centres and further developed the plants for this purpose.



Drying chamber system for the dismantling centres of EnBW.

GNS has developed a new type of sampling device for the in-drum-dryers at both sites that can take samples outside the shielding from the dried 200-litre drum. Sampling is visually displayed on the display workstation by two cameras in the suction cup, while individual axes and components can be manually controlled by using a joystick.

Also the first of its kind in Germany is the Konrad Container Filling Station (KCB) to be delivered to the GKN and KKP sites. The KCB, in which a rail car

can be moved on a track system to the various working positions within a large shielding cell, is used to load Konrad containers (KC) with drums and pellets as well as remaining building rubble.

The building rubble is conveyed by using a pendulum bucket conveyor and loaded evenly into the KC. A locking system prevents the release of contaminated building rubble from the screening hood. "A special feature of targeted filling is the positioning device that can be controlled with a joystick

to position the filling tube precisely inside the KC," explains Lukas Ix, GNS project manager for both KCBs. Several cameras monitor the position of the filling tube continuously.

Ingmar Koischwitz, Head of Plant Engineering and Equipment, sees great potential for the new developments of GNS: "The systems developed for the RBZs can be used in other national and international dismantling projects and of course further adapted to client specifications."



GNS-led consortium wins bid for major dismantling project

Workload for More than Ten Years

After several months of negotiations, PreussenElektra awarded a major contract in mid-December 2017 for the disassembling and packaging of the reactor pressure vessel internals in six of its nuclear power plants due for dismantling. The contract was awarded to the consortium ZerKon, consisting of the three companies GNS Gesellschaft für Nuklear-Service, Westinghouse Electric Germany and Westinghouse Electric Sweden.

For more than ten years, the ZerKon consortium will work on the dismantling and packaging of the reactor pressure vessel internals in six Preussen-Elektra nuclear power plants. Within the framework of this challenging project, GNS is taking over the leadership of the consortium and is responsible particularly for packaging the waste for final disposal. Westinghouse is primarily responsible for the dismantling of reactor pressure vessel internals using proven dismantling technology.

“The award of this contract is an important milestone for us: The removal of the internals in the reactor pressure vessels is of crucial importance for the successful implementation of our dismantling strategy for every single dismantling site and for the entire fleet,” said Jan



Cornelis Homan, Managing Director responsible for decommissioning and dismantling. “Disassembling and

packaging these internals represent one of the most technically demanding and complex projects in dismantling.

For this reason, we need experienced and proven partners to carry out this work safely and reliably in our sense given the complexity of the project and the critical occupational safety. We are convinced that we have found these partners with the chosen companies.”

The internals in the reactor pressure vessel mainly include equipment that fixes the fuel assemblies in the cask and ensures the flow of coolant. Disassembly and packaging are carried out remotely under water. For the six PreussenElektra nuclear power plants, a total of approx. 900 t have to be packed into around 1,100 casks and containers suitable for final disposal.

GNS-Forum 2018

Every two years, GNS invites customers and representatives of important partner companies to the GNS Forum on the disposal of low-level and intermediate-level radioactive waste. A record number of 140 attendees learned about current dismantling topics, the path to G2 and recent changes at GNS.



As an introduction, Dr. Jens Schröder gave a review of the events and changes in the German economy, nuclear technology and GNS since the last forum two years ago. Elisabeth Ebert continued by presenting the new organisational structure for project management in the LLW/ILW area (see Page 4 "Organisation Streamlined").

With the lectures "Disposal of Waste from EVU in Germany" by Dr. Holger Spann, "Status of the Approval Procedures for Casks" by Dr. Sascha Klappert and "Status of the Disposal of Waste in Germany" by Peter Hart, Federal Ministry for the Environment (BMU), the audience received a comprehensive overview of the current situation of the disposal scene.

The topic block "dismantling" where Dr. Luc Schlömer, WTI, seamlessly connected to the 2016 GNS Forum with his presentation "Use of Activation Calculations in Practice – a Suitable Tool for Time- and Cost-optimised Dismantling of Power Reactors?" was a move from calculation to practice. In his presentation, Schlömer proved the accuracy of the activation calculations for the current project "Dismantling of Activated Components (DaB) in the Joint Nuclear Power Plant Neckarwestheim Block I".

"Square a Circle – How to Get an RPV Including Internals in a Konrad Container?". The lecture also took up the DaB project divided in three parts:

Dr. Bernhard Wiechers, Westinghouse Electric, and Thorsten Bente, Uniper Anlagenservice, reported on the disassembly technology for RPV internals at the Neckarwestheim joint venture power plant, while Jörg Viermann represented the packaging side.

The second day of the meeting was devoted entirely to the "path to G2", i.e. the construction of product-controlled waste packages suitable for final disposal. Sascha Edwards offered "Everything from One Source: GNS Technology for Residue Material Processing Centres", Dr. Thorsten Schliephake presented "Waste Tracking and Documentation System (AVK) and More: Competent Packaging



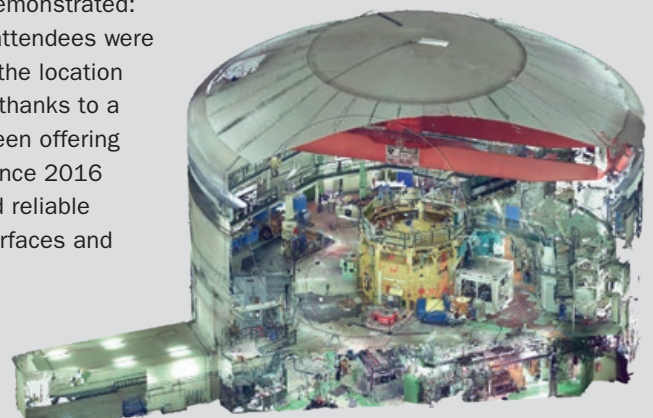
Thanks to Software from GNS”, and Souad Pederzani informed about the “Requalification/Reconditioning of Radioactive Waste”.

Martina Kößler pointed out the “Optimisation potential of product control” and Dr. Jörg Bertram gave a field report on the “Material Description of Radioactive Waste Packages” before Dr. Martin Berthold reported on the “Backfilling of Repository-compatible Waste Packages with Concrete”.

As usual, attendees and speakers, as well as GNS employees, used the opportunity to enlarge upon the topics presented and to discuss further questions in personal talks.

3D Measurements

At the GNS Forum, the use of the 3D laser scan was demonstrated: During the session, attendees were given an insight into the location of the evening event thanks to a 3D scan. GNS has been offering 3D measurements since 2016 to show accurate and reliable actual images of interfaces and building structures (see GNS Magazine 9/2016).

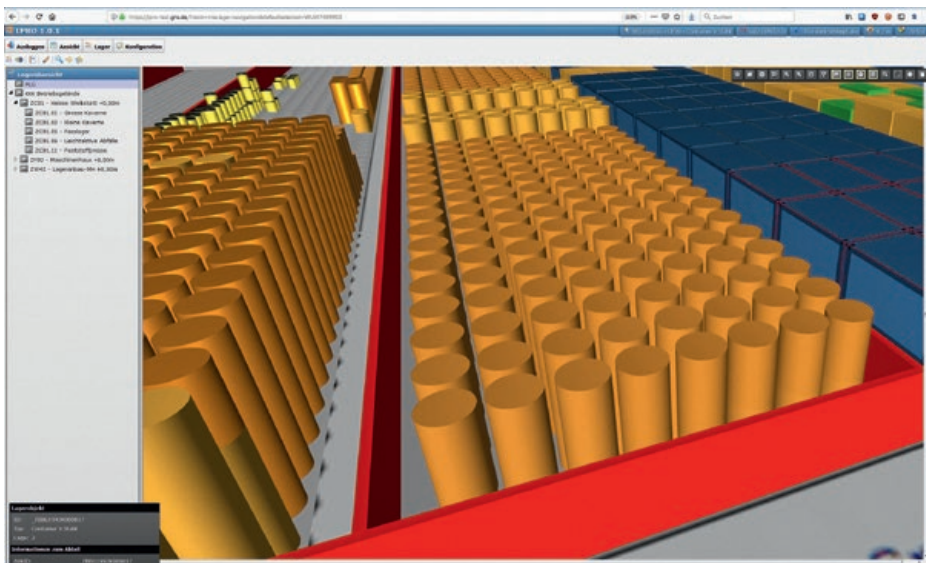


New modules facilitate the preparation for final disposal

AVK: 30 Years Old and up to Date



For 30 years, German nuclear power plant operators have been using the waste tracking and documentation system AVK in conjunction with conditioning and interim storage facilities to meet existing legal requirements reliably. Radioactive waste is recorded and its origin, condition, treatment, packaging, change of location, interim storage and whereabouts are fully documented until it is handed over to a final repository. The exact extent of the data to be recorded is regulated by the German Radiation Protection Ordinance and the Waste Control Directive of the BMU. In addition, further requirements may arise from the approvals of the interim storage and conditioning facilities.



Virtual view of an interim storage facility using the LPro storage programme.

“The module offers the possibility of tracking all the steps to be taken until the packages are handed over to a federal interim storage facility, thus enabling a better estimation of the time until they are handed over.”

BPro before MoPro

“A further module called Loading Planning (BPro) has been added for the loading of Konrad containers that is also enjoying increasing popularity,” Dr. Schliephake continued. A loading list for loading teams can be created by selecting container types, assigning a loading pattern, adding inner containers and filling. Each time the virtual load changes, the centre of gravity position, dose rate on the container, remaining cavity volume, filling and total mass are recalculated and the calculation results are mirrored against the limit values.

With the module Process Final Repository Konrad (PrEnKo), the formal, administrative processes in connection with the dismantling and shipment of waste and residual materials for interim storage or release can be

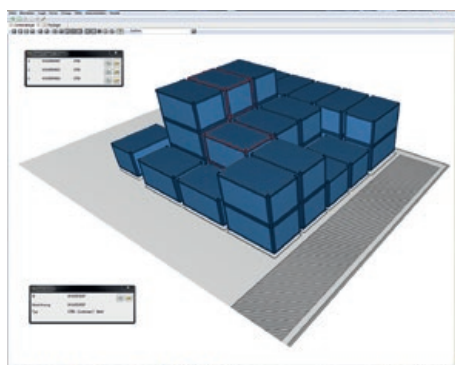
A large amount of data and information must be collected, documented and kept up to date on the various stages of waste, from its generation, treatment, conditioning and transport through to interim storage to check the origin, safety-related nature and whereabouts of the waste. In addition to pure waste tracking, AVK offers the possibility of declaring the activity of waste and residual materials based on extensive, officially recognised calculation methods.

Especially the Product Control Module (MoPro) has gained in importance since the federal government assumed responsibility for interim storage. It offers the possibility of calculating activity and checking the packages for compliance with Konrad final repository conditions. “MoPro will be increasingly used by German nuclear power plants from the start of the dismantling phase,” reports Dr. Thorsten Schliephake, Project Manager AVK.

mapped. This enables a good time estimate of the waste amount delivered at a certain time.

Soon also in the cloud

In addition to the 30th anniversary, further milestones will soon be reached: According to Dr. Schliephake, one million data records will soon be stored in AVK. Additional information such as photos and scans of documents stored in the data records can easily generate data volumes of several terabytes. Version 5 of AVK enables storage in the cloud still in 2019 and replaces decentralised power plant solutions. "This enables the distributed processing of waste data from any location. This is particularly valuable for the efficient preparation of the upcoming waste package documentation," summarises Dr. Schliephake. "Before one day all waste will be stored in the Konrad final repository, AVK will certainly be able to celebrate its 60th anniversary."



Federal state collecting depot Lower Saxony

Requalification and Reconditioning of 1,484 Drums

The Lower Saxony Ministry for the Environment, Energy, Building and Climate Protection (NMU) awarded a contract to GNS in July 2018 following a Europe-wide invitation to tender for the requalification and reconditioning of the 1,484 drums from the former federal state collecting depot Steyerberg.

Since the closure of the former federal state collection depot Steyerberg in 2000, 1,484 barrels of low-level and medium-level radioactive waste from the fields of medicine, research and technology have been temporarily stored in Leese (Nienburg district).

NMU had awarded the contract with a volume of Euro 10 to 15 million in a tender process to GNS. Over a period of approx. ten years, the drums are to be transported in individual batches from Leese to the GNS plant in Jülich, where they will be treated and packed in Konrad containers.

The contract includes requalification, i.e. particularly checking and supplementing the material and radiological declaration of waste as well as reconditioning, for example by treating the barrel contents through drying or their containment and fixation. The drums are then packed in containers approved for the Konrad final repository.

All operations must be carried out according to a qualified procedure based on flow charts requiring

approval by Federal Company for Radioactive Waste Disposal (BGE). Following approval by BGE, approx. 150 drums per year will be treated at the GNS site in Jülich from the end of 2019.

Finally, the waste is returned to a storage facility in Lower Saxony in the containers approved for the Konrad final repository.

The planned completion date for the entire project is 2030.

The Atomic Energy Law (AtG) states, among other things, that radioactive waste must be disposed of in an orderly manner to protect life, health and property. To this end, the federal states must set up state collection depots in their territory for the interim storage of radioactive waste from the fields of medicine, research and technology.

The state of Lower Saxony is therefore obliged to temporarily store this radioactive waste until it is delivered to a federal facility for final disposal.

Co-operation Projects for the Asian Market

Following the decision of Korea to phase out nuclear energy, number five of the countries with nuclear energy is preparing for disposal and dismantling: Until a final repository is available, the spent fuel assemblies previously stored in wet storage facilities will be stored in dry interim storage facilities. Other Asian countries are also showing great interest in the experience and services of GNS in the field of dry interim storage.



The joint booth of Max Aicher and GNS at DECOMEX Korea.

DECOMEX Korea took place in 2018 with a focus on interim storage, where GNS and the Max Aicher Group had a joint booth. Together with GNS, the Max Aicher Group presented solutions for interim storage.

In addition, Dr. Linus Bettermann, Head of Sales Spent Fuel Management, gave the lecture "Comprehensive Solutions for Spent Fuel Management and D&D". Dr. Jürgen Skrzyppek,

Divisional Director Sales and Marketing, presented GNS, products and services at a press conference.

Great potential in the Asian market

GNS is already represented on the Asian market in the field of plant engineering (see adjacent article) and is increasingly working with local partners to take the proven CASTOR® system to Asia as well. A letter of

intent for cooperation has already been signed with the Korean company

BHI Co Ltd. Contracts with further partners for Taiwan and China are in preparation. In addition, two roadshows with potential clients and energy suppliers took place in 2018, and further roadshows are planned for 2019. Numerous delegations gained an impression on site at the GNS production facility in Mülheim.

Pilot Plant for Japan

GNS supplies plant engineering to Asia for the first time. NGK INSULATORS, LTD. had already commissioned GNS with a concept study in 2017. The contract to implement the concept followed last year. This also includes on-site supervision of installation and commissioning as well as training of operating personnel.

At the beginning of 2017 GNS was commissioned by the Japanese company NGK INSULATORS, LTD. to investigate and develop a suitable concept for loading and unloading a newly developed pyrolysis plant. GNS presented the concept study in October 2017 (see GNS Magazine 10/2017) and was commissioned in February 2018 to implement the conceptual systems for the pilot plant in Japan. "The implementation includes detail engineering as well as the production, testing and delivery of plant technology to Japan," explains Ingmar Koischwitz, Head of Plant Technology and Equipment. "This is the first time we have been delivering GNS plant technology to Asia."

In 2019, GNS will also supervise the installation and commissioning by NGK in Japan and train the operating personnel.

NGK INSULATORS, LTD. has been successfully operating in the Japanese market for over 30 years, including the conditioning technology segment for LLW/ILW waste. NGK INSULATORS, LTD. is active in various market segments worldwide with an annual turnover of approx. Euro 3 billion.



Coverage on Korean news pages.

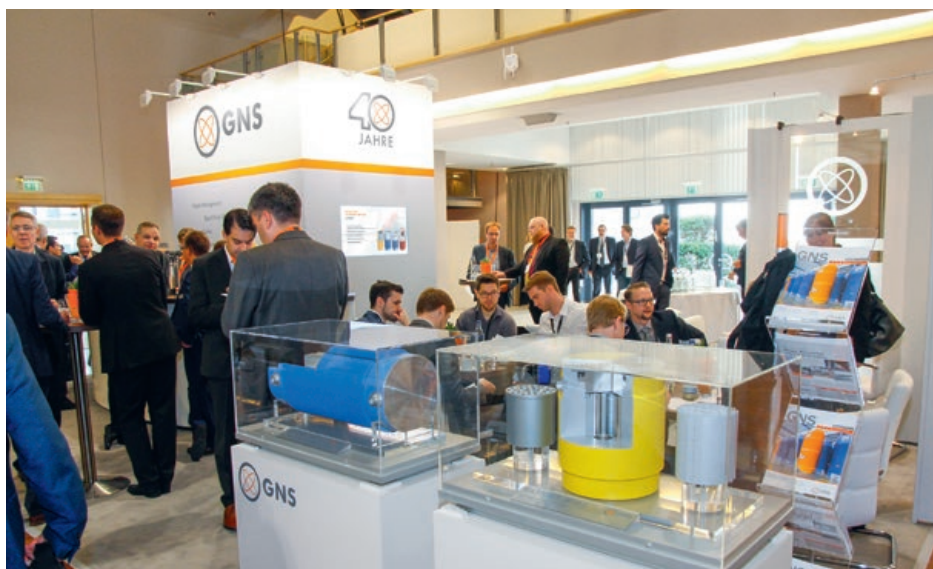
The order from Korea Nuclear Engineering & Services Corporation (KONES) shows that the expertise of GNS is in demand in Asia. GNS drafted a report for the customer on the requirements for containers to store LLW/ILWW waste in Germany and the United Kingdom. Dr. Jürgen Skrzypek: "We receive confirmation from many parties that GNS has great potential in the Asian market."



Takahiro Oike, Ryohei Iwasaki (NGK), Martin Hoffmann, Jan Seewald, Ingmar Koischwitz (GNS) (from left).

Meetings and Conferences

In 2018, GNS was again represented internationally at meetings and conferences in Europe, Asia and America.



AMNT 2018

As in previous years, the GNS Group was represented with a stand at the industrial exhibition and with various lectures. In addition to the automatic ultrasonic testing for CASTOR®, information was provided about GNS products such as MOSAIK®, S-Box and the quiver for special fuel rods.



49th

Jahrestagung Kerntechnik
Annual Meeting
on Nuclear Technology

At the focus sessions organised by GNS, lectures were held on the topic “Paradigm Shift in the Disposal of Low-level and Intermediate-level Radioactive Waste”. In addition to the GNS lectures on “Means and Ways of Product Control” and “Material Description of Radioactive Waste Packages – Field Report”, Peter Hart from the Federal Ministry for the



Award ceremony at the GNS-supported Young Scientists Workshop of KTG.



Philip Diekmann at the Campus of the Young Generation of KTG.



Jörg Frank presents the automated ultrasonic testing system of GNS in Mülheim.



Jörg Viernmann during his lecture at NDC.

Environment gave an overview of the disposal situation in practice. Dr. Jörg Aign, TÜV Nord EnSys, showed paths to the G2 package and Hartmut Grunau, EWB, reported on the construction of repository-compatible packages by backfilling with concrete.

GNS also participated in the Nuclear Energy Campus, an information

event of the young generation of the German Nuclear Society (KTG) for interested pupils and students, with its own station on the subject of waste management and final disposal.

GNS also sponsored the AMNT 2018 Young Scientists Workshop with prize money for three young scientists.

International

GNS was also represented with lectures at Waste Management in Phoenix, USA, Integrated Waste Management Conference in Penrith, United Kingdom, DECOMEX/KAP in Korea (see page 20) and RAMTRANSPORT 2018 in London.



Bernhard Kühne reports on the progress of the quiver project.



GNS stand at NDWM.



Leonard Synder during his presentation on CASTOR® MTR3 at RRFM.

WTI GmbH – the engineering company of the GNS Group

New Buildings for Dismantling

The German energy supply companies are currently planning the decommissioning and dismantling of their nuclear power plants. Dismantling has already started at some decommissioned nuclear power plants. To enable dismantling optimised in terms of radiation protection, costs and deadlines, sufficient space must be created inside the reactor building for dismantling operations. Radioactive waste that is already in repository-compatible packaging must be placed in an interim storage facility before removal. In recent years, WTI GmbH has provided planning and engineering services for various locations to create additional storage capacities and is thus actively supporting the German utilities in their dismantling projects.



3D representations of storage facility planning by WTI.

As early as 1991, engineers from WTI GmbH began planning the Interim Storage Facility North (ZLN) at the site of the former GDR nuclear power plant Greifswald. Since its commissioning in 1996, ZLN holds spent fuel assemblies from former GDR reactors on site as well as radioactive waste and residues from the dismantling of the reactors and other nuclear facilities.

“We like to refer to the ZLN as the mother of all fuel element and waste storage facilities planned by WTI as to this day the main planning features of the ZLN, such as the basic hall layout with one overhead crane per hall and a common loading area for all halls, have also been incorporated into new storage projects to be planned,” explains Dr. Hannes Wimmer, Managing Director of GNS and WTI. “It is also of great advantage that the then WTI project manager Matthias Baumann is now in charge of planning at WTI as head of the department for system planning & construction projects,” adds Birgitt Sentis, authorized signatory and commercial manager of WTI.

Dismantling needs space

All German utilities have started planning the dismantling of their power reactors. In some cases, applications for decommissioning and dismantling have already been submitted to the responsible licensing authorities. In others, dismantling operations have already started.

An essential component of the dismantling plans is the creation of sufficient (buffer) storage capacities for dismantled plant components to free up sufficient space within the reactor building for dismantling operations. Radioactive waste that is already in repository-compatible packaging must be placed in an interim storage facility on site before transport to the final repository Konrad.

Interim storage facility instead of final repository

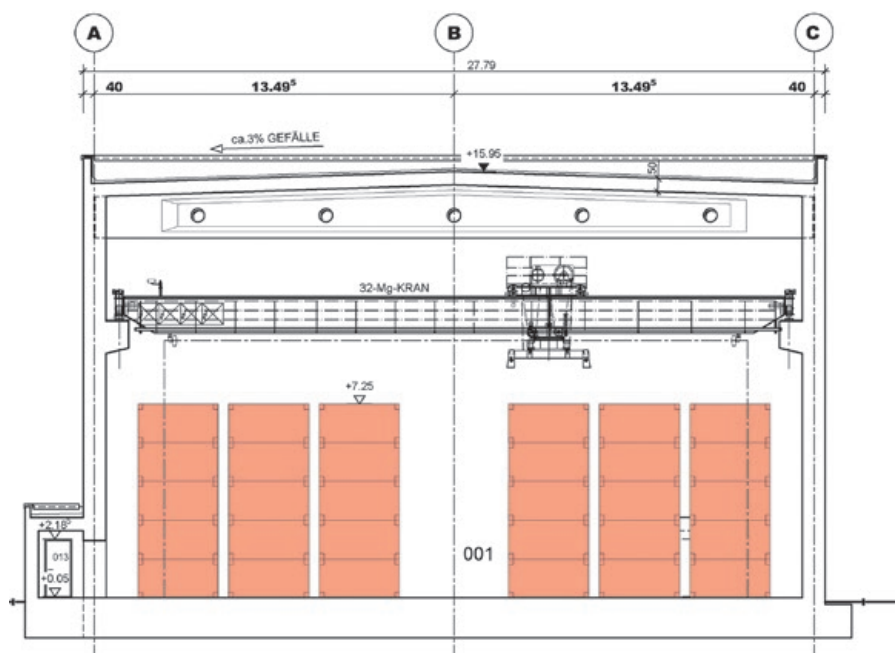
The delays in the commissioning of the Konrad final repository increase the pressure on the utilities to create sufficient storage capacities for their dismantling waste at the power plant sites. “The framework conditions of the KfK Act regarding the transfer of ownership of the waste storage facilities from the utilities to the state from 2020 increase the planning pressure on the utilities. By handing over their waste packaged for final disposal to a state interim storage facility, the utilities transfer ownership and responsibility for the waste packages to the state,” explains Roger Vallentin, authorised signatory and technical director of the WTI.

Storage planning from one source

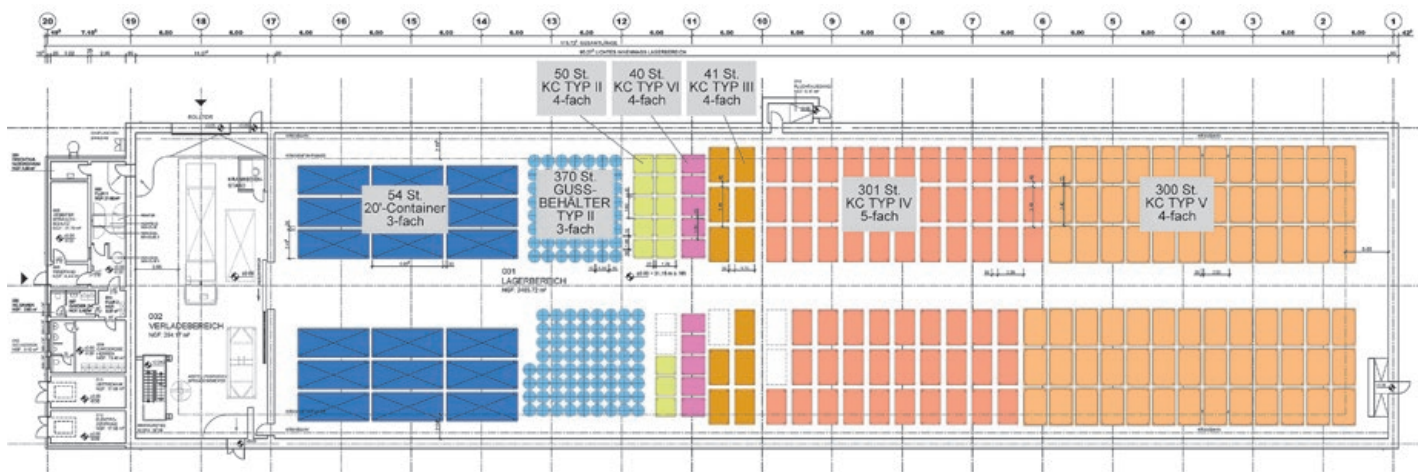
WTI's planning work of a new storage facility for low-level and intermediate-level radioactive waste usually starts with determining the fundamentals for the storage facility to be planned.

The boundary conditions of planning are worked out and defined in close cooperation with the client. This mainly includes the volume of waste and the radiological, material and chemical properties of the waste as well as the type and number of waste packaging intended for interim storage. Furthermore, the design of the building and the verifications presumably required by the nuclear authority must be coordinated and a suitable area on the power plant site determined for the planned storage facility. Clients involve WTI often in the preliminary stages of project planning to determine the fundamentals, for example by preparing a feasibility study or a variant analysis.

This is followed by preliminary and design planning for the storage facility. The main result would be the graphic representation of the structural design of the storage building, considering all specialist planning, for example, technical building equipment, structural design and traffic facilities as well as a cost calculation.



Sectional drawing of a storage building planned by WTI.



Floor plan of a storage building planned by WTI.

Application documents under nuclear law

Once the design planning has been agreed with the client, work on the approval planning starts. In contrast to conventional storage buildings, application documents under nuclear law must be prepared in addition to the building application documents according to the respective state building regulations. These application documents under nuclear law must demonstrate the nuclear safety of the storage facility under normal operating conditions, in case of incidents and under conditions exceeding the design limits, as well as plant safety.

“WTI specialises in the preparation of application documents under nuclear law as our strong calculation department carries out all computational nuclear proof, for example for radiation shielding and for activity retention after an assumed incident,” explains Dr. Sven Tittelbach, Head of Calculations.

After the competent authorities have issued the approvals according to the building and nuclear law, WTI personnel complete the planning. This means that the execution planning

is detailed to such an extent that specifications can be drawn up for tenders of individual subsections to construction contractors or for the entire section to a general contractor. If desired, WTI will also support the client in the tendering process, for example by reviewing and evaluating bids and by participating in tender negotiations.

“In reality, the processing of a planning project for a new storage facility is of course much more complex as WTI must process individual planning phases almost always in parallel instead of sequentially due to scheduling constraints at the client,” says Matthias Baumann, giving an insight into the day-to-day business at WTI. He adds: “This concerns, for example, the implementation of the nuclear verification and the preparation of the application documents under nuclear law that often must be started at the client’s request without the radiological boundary conditions being defined by the client in the preliminary and design planning with the corresponding potential for recalculations not affecting costs and schedules as well as report revisions from the client’s point of view.”

In recent years, in addition to feasibility and concept studies for various utilities, WTI has, on behalf of Preussen-Elektra GmbH among others, prepared the application documents under nuclear law for the storage facility of radioactive waste at the Unterweser site (LUnA) and for the supply hall to receive radioactive waste and residues (BeHa) at the Grafenrheinfeld site and supported the client in the respective approval procedures.

On behalf of RWE Power AG, WTI is currently preparing the design planning as well as the application documents under the building and nuclear law for the logistics building (LOGE) at the Emsland site. RWE Power AG has also commissioned WTI as an option to prepare the implementation planning and support the award procedure for 2019.

Parallel to this RWE contract, WTI is also currently preparing the application documents under nuclear law for the planned (transport) supply halls at the sites Isar (KKI), Grohnde (KWG) and Brokdorf (KBR) on behalf of Preussen-Elektra GmbH.

Impressions of the 40th anniversary celebration

Two Times Forty

The turn of the year 2017/18 marked the 40th anniversary of both the registration of the current company name and the original order for the development and thus the “birth” of the CASTOR® cask. Reason enough to look back together with shareholders, business partners and long-time companions, but also to look to the future.



Chairman of the GNS Supervisory Board **Dr. Guido Knott**: “On behalf of my fellow partners, I would also like to thank all current and former employees with great respect for their outstanding commitment in a highly complex and challenging topic that has written and will continue to write German industrial history.”



Dr. Hannes Wimmer, CEO of GNS, paid special tribute to the accomplishments of the GNS workforce: “My very special thanks – and I say this also on behalf of the entire management board – go to the employees who have built up this company over 40 years. Without their engineering skills, commitment and quality awareness, GNS would not exist today in this form. The objectives of 'quality' and 'transparency' could only be achieved with their help.”



The former Federal Minister for the Environment, **Prof. Dr. Klaus Töpfer**, congratulated as the keynote speaker who, more than 30 years ago, has been instrumental in determining the role of GNS with the “Töpfer Concept” named after him: “I wish your company every success, especially in the international arena. I would be delighted if you would continue to do such a great job with your employees and I would be very grateful if you could be a good conversational partner for us and all interested parties.”



GNS Sport Activities



For GNS, 26 runners competed in the 8th Essen Company Run and achieved excellent results: 63rd place in the ladies' and the 11th place in the men's race. Among the teams, GNS finished 65th. Registered were 13,000 runners in 1,796 teams, more runners than ever before.



GNS runners also took part in the Duisburg Lichterlauf. The race around the Duisburg regatta course took place for the 16th time and GNS was represented with a team for the 6th time. The four-man GNS team finished 13th out of 43 teams.

With a highly motivated football team, GNS took part in the fifth AOK Company Cup. The proceeds of the event went to the Hundertwasserhaus in Essen's Grugapark. The GNS team came onto the field under the Peruvian flag. Because of the football World Cup, the company teams were allocated countries by lot, and the match schedule also corresponded to that of the World Cup.



The Corporate Magazine of the GNS Group

Imprint

Publisher:

GNS Gesellschaft für Nuklear-Service mbH
Frohnhauser Straße 67
45127 Essen · Germany

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Design and Layout:

together concept Werbeagentur GmbH
Schinkelstraße 30-32 · 45138 Essen