

# GNS

English Edition

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The Corporate Magazine of the GNS Group



**40 years of GNS  
and CASTOR®**

A double anniversary at the  
turn of the year

**Interim storage  
handed over**

Federally owned company  
launched in Essen

**Premiere on the  
Neckar river**

CASTOR® transports by  
barge for the first time



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Title: Casks of the CASTOR® HAW28M series (orange) for retrieval of vitrified reprocessing waste as well as CASTOR® V for spent fuel elements at the GNS cask production in Mülheim.

## News

### GNS still remains “Safe with System”

During the second half of 2016, following the premiere in 2010, GNS voluntarily underwent a second external occupational safety review. Directly afterwards, the professional association of raw materials and the chemical industry (BG RCI) confirmed to GNS General Management that the certificate had been extended until 2019. The certificate was officially handed over during the session of the occupational safety committee on 13th December 2016.

“An occupational safety management system is becoming ever more important as a competitive factor. It enhances trust among customers and partners and plays an increasingly significant role as a criterion in awarding of contracts, especially in the international environment”, explains Robert Wisniewski, senior safety engineer at GNS. “The extension is the result of a joint team effort in systematic occupational safety and lastingly contributes to reinforcing safety culture at GNS”.



In addition to central administration at the company headquarters in Essen, the Ahaus, Jülich and Mülheim/Ruhr sites were selected on a spot check basis.

The “Safe with System” quality label is an occupational safety management system of the professional associations which is based on the national guideline for safety management systems and implements the requirements of British standard OSHAS 18001:2007. The “Safe with System” quality label is a permanent fixture in GNS’ integrated management system and testifies to an efficiently organised occupational safety system within GNS.

### Acta merged with GNS

The former GNS subsidiary Acta Technologien GmbH from Alzenau has been merged with GNS Gesellschaft für Nuklear-Service mbH. On entry of the merger in the commercial register on 23rd March 2017, the merger became legally effective retroactively as of 1st January 2017. The former Acta employees have been taken over, and the former Acta site in Alzenau will be retained as a GNS plant. The tasks relating to handling and dispatching of spent fuel casks will also be coordinated from Alzenau in future. This includes, among other aspects, drafting of test specifications and operating procedures for the use of transport and storage casks, participation in and management of loading and handling of transport and storage casks for spent fuel assemblies as well as the supply, maintenance and functional testing of casks accessories, handling equipment and drying facilities.

# Editorial



**Dear readers,**

in this 10th edition of our GNS magazine – which is the first one to be published also as a separate English version – you will find reports about events of historic importance for us, our company and the entire disposal situation in Germany.

Firstly, we will be celebrating not just one, but two anniversaries at the coming turn of the year: both the registration of our company as GNS in the commercial register and the birth of the CASTOR® cask will be celebrated for the fortieth time. Whereas GNS has made a name for itself mainly within the nuclear industry since that time, “CASTOR” has become one of the symbols for nuclear energy in Germany over many years. As much as it may be something of a myth to many, for us and our customers it is one thing above all: a guarantee of the safe storage and transport of spent fuel assemblies that has proven its worth well over a thousand times – in Germany as well as for a long time now far beyond our borders.

Restructuring of the responsibility for nuclear waste management in Germany with the extensive new legal regulations over the past few months marks a decisive historic turning point for our entire sector. A central component of this is the

assumption of responsibility for interim storage by the Federal State.

Handing over our interim storage activities to the Federation as of 1st August 2017 marks the end of an era for us. GNS has been operating the central interim storage facilities in Ahaus and Gorleben on behalf of the German energy suppliers since 1990. Since then, over more than 27 years we have not only been guaranteeing on our own safe and reliable operation of both storage facilities at all times with our on-site operating teams. Based on our experience as a cask manufacturer and waste management experts too, we have developed the methods applied in all German interim storage facilities and also at the power plant sites and have introduced them in everyday operation. During all these years, no incidents whatsoever or even impermissible releases of radioactivity have ever occurred in our facilities. We can be proud that as part of restructuring of the disposal situation in Germany, our tried and trusted interim storage organisation including all its previous employees, will now be able to continue this success story as a Federal undertaking.

However, even after interim storage has been handed over, with our still approximately 450 employees in the remaining business sectors involving management and disposal of radioactive residual materials and waste in Germany as well as for international customers, we still have our hands full. Over the past year, our loading teams with nearly 100 CASTOR® loadings in the German plants set a unique record. In by now four of the German nuclear power plants that were shut down in 2011, all spent fuel assemblies have therefore been packed in CASTOR® casks and placed in storage in the on-site interim storage facilities. With a similarly intensive pace, work relentlessly continues until the last German plant is free of fuel and ready for dismantling.

At other power plant sites, dismantling measures have long been in full swing. Our tried and trusted containers and facilities are employed in many places here for treatment and packing of the wastes. What is more, the large volumes are yet to come!

Right now, we must also make an intensive effort to position our company and our business in a stable position even beyond German requirements. The initial orders from Belgium and Switzerland for our CASTOR® innovations prove that we are on the right track. We are focussing outside Europe on the Asian markets. Particularly from South Korea, we are witnessing major interest in our containers and disposal systems.

Together with interim storage, we have also given up a major portion of our activities as an “operator”. This now makes us all the more a “supplier” and “service provider”. This is something we wish and intend to embed even more firmly in our processes and in our self-image. Backed with 40 years of experience, the time has come for us to position ourselves securely for the coming decades as a new GNS!

A handwritten signature in blue ink, appearing to read 'H. Wimmer', with a long horizontal stroke extending to the right.

Dr. Hannes Wimmer  
Chairman of the Board  
of Managing Directors

GNS and the CASTOR® are celebrating their 40th anniversary

# Safety over four decades

Around the turn of the year 2017/18, GNS will have a double cause for celebration: Both the registration of the current company name and the original order for development and hence the “birth” of the CASTOR® casks will be forty years old. It is no coincidence that both dates are so close together.



Today an exhibition item in Mülheim: One of the first 1:1 drop test casks.

planned at that time – a world first. The GNT developers also opted for ductile cast iron for such a considerably larger container.

Within less than three years, the company originally founded primarily for nuclear transports had further developed into a container developer and supplier in addition to a waste management provider. In order to cope with the new scope of duties, the GNT shareholders' meeting decided on 14th December 1977 to substantially increase in the share capital and rename the company “GNS Gesellschaft für Nuklear-Service mbH”. The new name was officially entered in the commercial register on 29th December 1977.

At the same time, the registered purpose of the company was supplemented among other aspects with “repair and decommissioning of nuclear facilities in addition to disposal of large components”. Alongside planning and development, research work was also explicitly added.

## Birth of the CASTOR® cask

A mere few days after it was renamed, the newly fledged GNS was officially commissioned in January 1978 by the DWK (Deutsche Gesellschaft zur Wiederaufarbeitung von Kernbrennstoffen mbH/

The origins of today's GNS Gesellschaft für Nuklear-Service mbH date back even to 1974. On 20th September 1974, the GNT – Gesellschaft für Nukleartransporte mbH, jointly founded by the German companies STEAG and Gelsenberg, was entered in the commercial register by the District Court of Essen. The purpose of the company was in the first instance recorded as “transport of radioactive substances and services related thereto”. This was joined by “waste service for nuclear power plants and nuclear facilities” in addition to “carrying out planning and development work in

these fields”. The latter also especially included new packaging concepts for radioactive substances.

As early as 1975, a first shielding cask made of ductile cast iron for intermediate level waste, weighing around 5 tons, was created in this context: the ancestor of the MOSAIK® cask which has meanwhile been tried and tested thousands of times over. Around about the same time, the German utilities came up with the idea of using a container for both transport and dry interim storage of spent fuel to supplement the wet storage facilities



BAM test site in Lehre in 1978: Initial 1:1 drop tests with a CASTOR® 1a prototype.

German Corporation for Reprocessing of Nuclear Fuels) with developing a transport and storage cask for spent fuel assemblies – subsequently the CASTOR® 1a. The DWK had been founded in 1977 to implement the reprocessing predominantly established in the Atomic Energy Act by the German Federal Government in 1976.

Just a few months later, the initial prototype passed the radiation protection tests of the PTB (Physikalisch-Technische Bundesanstalt/German National Metrological Institute). Both the ductile cast iron and the moderator material met all requirements. Then on 30th November 1978 already, experts from all over the world were invited to be present at the first drop test on the newly developed transport and storage cask. In Lehre near Brunswick, a spent fuel cask of this size was to be tested for the first time in original scale: weighing approximately seventy tons, just under six meters long and with a diameter of almost two metres. In this case, also, the cask met its developers' expectations.

Following further trials and initial test loadings, the first regular deployment of a CASTOR® cask began in 1983 when a CASTOR® 1c DIORIT was loaded with spent fuel assemblies from a research reactor at the Paul-Scherrer Institut (PSI) in Switzerland.

### Waste and its data

At the same time, the activities for the disposal of intermediate and low level operational and decommissioning waste also developed. Through efficient methods for volume reduction and vacuum drying, GNS laid the bases for the interim storage and ultimately repository-compatible packing of the wastes already being striven for at that time. For decades, the GNS supercompactors of the FAKIR series and likewise the PETRA and FAVORIT drying facilities have proven their reliability in both stationary use in the GNS plants and in mobile deployment in power plants.

With the AVK system introduced in 1988 (“waste tracking and documentation system”), the GNS developers also set a standard that still applies today in administration and documentation of radioactive waste in Germany. The electronic accounting system ensures traceability at all times of the type, condition, packaging and whereabouts of radioactive waste and residual materials from the operation and decommissioning of nuclear power plants, right from their origin, in accordance with the German Radiation Protection Ordinance. It has been used for almost three decades in all German nuclear power plants, the interim storage facilities and among conditioners in Germany. Moreover, it will still continue to play a crucial role for at least as long again for the future provision of repository-compatible packages for the German Konrad repository.

### Tradition and progress

A tremendous amount has been done over the past four decades in terms of design of facilities and casks and likewise in calculation and production methods. The prototype construction from the very beginning has long become a serial production. More than 1,100 CASTOR® casks and even well over 7,000

MOSAIK® casks have been loaded in the meantime and are reliably in use.

Furthermore, while the CASTOR® casks together with the GNS loading teams have become the mainstay of spent fuel management in Germany, the disposal situation in Germany is no longer conceivable without the packagings, facilities and services offered by GNS for intermediate and low level wastes.

### Also in use on an international level

It is not only in Germany though that GNS has made a name for itself over the decades. Among the total of 1,500 casks for highly radioactive waste that GNS has delivered up to now, more than 300 are employed outside Germany in twelve countries on four continents. To this very day, the first CASTOR® cask ever placed in storage stands loaded – now together with some of its great-grandchildren – in the Swiss ZWILAG in Würenlingen. It will be joined there by still further CASTOR® and MOSAIK® casks: deliveries to Switzerland have already been firmly contractually agreed up to the year 2045. By that time, the success stories of GNS and its best-known products, the CASTOR® and MOSAIK® will have been marked again by some further round-figure anniversaries.



In use thousands of times over: the GNS MOSAIK® casks (picture from the ALG in Gorleben).

Restructuring of responsibilities in nuclear waste management

# GNS interim storage activities handed over to the German Federation

GNS handed over its interim storage activities to the German Federation as of 1st August 2017. GNS and the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) had signed the purchase contract on 24th July 2017 for the BGZ Gesellschaft für Zwischenlagerung mbH, Essen founded specifically for this purpose by GNS.



On 8th May 2017, the Federal Minister for the Environment, Barbara Hendricks, visited GNS to inform the future BGZ employees about the scheduled takeover of interim storage by the German Federation.



The new BGZ-Website.

The sole shareholder of the BGZ is the Federal Republic of Germany, represented by the Federal Ministry for the Environment. Since 1st August, the BGZ has been represented by the technical managing director Wilhelm Graf and the commercial managing director Lars Köbler and likewise since 1st November by the chairman of the management board, state secretary Jochen Flasbarth.

## **BGZ is also taking over the on-site interim storage facilities**

BGZ comprises the approximately 150 employees required for organisation of interim storage in Ahaus, Gorleben and at the Essen site, where the company's headquarters are located, as well as the former GNS interim storage facilities

in Ahaus and Gorleben. Thus, the on-site interim storage facilities at the power plant sites that will likewise be transferred to the German Federation in the coming years will be organisationally and technically managed from Essen in future alongside both the Ahaus and Gorleben central interim storage facilities.

#### Utilities finance disposal funds

The BGZ was taken over without payment of a purchase price and without any burdens on the German Federation. Handover of GNS' former interim storage activities to the German Federation forms part of the extensive restructuring of responsibilities in nuclear waste management. According to the latter, responsibility for interim storage and final disposal is in future to be the business of the State. The financial burden will be borne by the German utilities as waste producers, who paid the necessary liquid resources for this purpose into a fund under public law in early July 2017.



The future BGZ employees in Essen during the speech by the Federal Minister for the Environment.

## To be part of the Federal Company for Radioactive Waste Disposal

# DBE also sold to the Federation

As part of restructuring of responsibilities in nuclear waste management, GNS already handed over the 75% of the shares that it holds in the Deutsche Gesellschaft zum Bau und Betrieb von Endlagern mbH (German Company for the Construction and Operation of Final Repositories/DBE) to the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB). The shares in the company were taken over retroactively as of 1st January 2017 without payment of a purchase price and without any burdens on the German Federation.



It is subsequently planned to transfer the DBE based in Peine to the Bundesgesellschaft für Endlagerung mbH (German Federal Company for Radioactive Waste Disposal/BGE). The BGE is a Federally owned company likewise founded in Peine in July 2016. It is to take over all the tasks involved in planning, setting up, operating and decommissioning repositories that were formerly performed by the Bundesamt für Strahlenschutz (Federal Office for Radiation Protection/BfS) as the operator as well as the DBE and Asse GmbH as providers of administrative assistance. As designated project sponsor of the site selection procedure and future operator of repositories for radioactive waste, the BGE falls within the scope of the Federal Ministry for the Environment.

In the wake of sale of the DBE shares and integration in the repository organisation of the German Federation, the

approximately 900 DBE employees are to be taken over in their entirety.

#### GNS a DBE shareholder since 1990

GNS had been a shareholder in DBE since 1990 when it simultaneously took over the interim storage activities of the DWK (Deutsche Gesellschaft zur Wiederaufarbeitung von Kernbrennstoffen mbH/German Corporation for Reprocessing of Nuclear Fuels) and the 25% share in the DBE held up to that point by the DWK. A further 25% share in the DBE was transferred to GNS in 1998 by the IVG mbH and another 25% by the RAG Saarberg AG in 2001. The remaining 25% of the shares in the DBE were ultimately retained by the Federally owned EWN Entsorgungswerk für Nuklearanlagen GmbH (formerly Energiewerke Nord GmbH) and has in the meantime also been taken over by the Federal Ministry for the Environment in preparation for transfer to the BGE.

Nearly 100 CASTOR® loadings on the way to fuel-free status

# A record year in 2017

In late 2016 already, the last CASTOR® V casks in unit A in Biblis as well as in unit 1 in Philippsburg respectively were loaded, followed by those in Brunsbüttel and Krümmel during 2017. Thus, in four of the German nuclear power plants shut down in 2011, the spent fuel assemblies have already been completely packed into CASTOR® casks and placed in the on-site interim storage facilities. During the past year, the now seven GNS loading teams carried out more CASTOR® cask loadings than ever before: Nearly 100 loaded casks for spent fuel assemblies in 2017 alone represent a unique value on an international level too.



The last CASTOR® loaded in Biblis A on the way to the on-site interim storage facility.

At around 9.30 a.m. on 22nd November 2016, the moment had arrived: the airlock door to the reactor building in unit A of the shut down power plant Biblis closed behind the last CASTOR® V/19. “This makes our unit A the first fuel-free power plant among those shut down in 2011”, power plant manager Horst Kemmeter reported. The CASTOR® was subsequently transferred to the on-site interim storage facility and connected to the cask monitoring system.

A total of 24 casks of the CASTOR® V/19 series for pressurised water reactor fuel assemblies were loaded in Biblis A during 2016 by a motivated and experienced team of the power plant’s in-house radiation protection and handling experts assisted by specialists from GNS and other partner companies working in shifts around the clock.

“Already at the beginning of the campaign about a year ago, we set ourselves the goal of achieving fuel-free status of unit A by the end of 2016. This we achieved”, Roger Miesen, the competent divisional board member of RWE Power, was happy to say. Since early 2017, the loading campaign in unit B, which should be completed by mid-May 2018, is now under way.

## **KKP 1: First BWR power plant fuel-free**

A few days after Biblis A, the EnBW Philippsburg 1 plant (KKP 1) also





The loading team loaded a total of 24 casks in Biblis A in 2016.

followed: With emplacement of the 17th and last CASTOR® V/52 in the on-site interim storage facility on 14th December 2016, KKP 1 had also achieved fuel-free status. The starting signal for preparing the final loading campaign in BWR unit KKP 1 was given on 24th February 2016 with granting of Atomic Energy Act approval for use of the CASTOR® V/52(96) series in the KKP on-site interim storage facility. Loading operations began on 18th July and the 17 loading and emplacement processes were completed in less than five months. “All without any hitches, idle periods

or failures”, recalls Robert Gartz from the GNS cask service department. “On the contrary: with a throughput time of less than 9 days per cask, it was even possible to take a three-week break in the autumn after eight casks during which the 4-shift loading team could get its breath back and periodic inspections could be performed on the equipment”.

#### **Brunsbüttel and Krümmel fuel assembly-free too**

The loading marathon pursues its course unchanged in 2017. Further

long-term campaigns have also been completed in the meantime in Brunsbüttel in June and in Krümmel in October. All in all, eleven CASTOR® V/52 casks in Brunsbüttel and even 22 in Krümmel were to be loaded with the last spent BWR fuel assemblies by the GNS teams. “In total, we will be loading and handling some 100 CASTOR® casks in German nuclear power plants this year” commented Konrad Dreesen, the head of the GNS cask service. “It is a unique record!” 2018 will continue to be a high-level year too. In the words of Konrad Dreesen: “a total of 79 loading operations are already scheduled at 10 sites. This means that there is still nothing standing in the way of reliably achieving the next milestones in ‘mission fuel-free’.”



The 17th CASTOR® V/52 with the last FAs of KKP 1 on their way to the KKP on-site storage facility.

CASTOR® transports by barge for the first time

# Premiere on the Neckar river

In the German state of Baden-Württemberg, transfer of spent fuel assemblies from the shut down Obrigheim nuclear power plant to the interim storage facility of the Neckarwestheim nuclear power plant has begun. CASTOR® 440/84 mvK-type casks are being used for transport and storage of the total of 342 fuel assemblies. The casks are transported along the Neckar in groups of three by tug and barge.



First functional test in February 2017: In Obrigheim, an unloaded CASTOR® cask is driven on a universal transport frame on to the transport vessel. (Picture: EnBW Kernkraft GmbH)

To avoid delays in decommissioning the Obrigheim nuclear power plant (KWO), EnBW is transferring fuel elements stored there to the interim storage facility of the Neckarwestheim nuclear power plant (GKN). This also eliminates the need to build and operate an interim storage facility in Obrigheim. Based on a transport and handling study, EnBW had opted for ship transport on the Neckar River as its preferred means of transport. Since both power plants are situated on the banks of the Neckar, ships can be directly loaded and unloaded. Considerably fewer individual measures are required compared to road transport (e.g. bypassing bottlenecks such as underpasses and roundabouts) and road traffic remains to a great extent unhindered.

Special push ships and barges that are suitable for the special requirements of this kind of transport are employed. Three CASTOR® casks respectively are driven over the loading ramp located in Obrigheim with the aid of specially designed GNS universal transport frames (UTG) and on to a push barge before



The loaded tug and barge on the way to Neckarwestheim. (Picture: EnBW Kernkraft GmbH)

being secured. After mooring and berthing the tug and barge in Neckarwestheim, the three vehicles bearing the containers can drive over a mobile ramp on to the power plant grounds and into the on-site interim storage facility there. Once arrived, the casks are placed in storage at their final positions.

## Extensive training programmes

Another part of GNS' scope of delivery and service involves training the colleagues on site in the nuclear power plants in handling the three universal transport frames. Lukas Ix, who has been present during every transport cycle in the GKN to assist in operating the UTGs, can therefore draw a positive intermediate conclusion: "The fact that the universal transport frames underwent extensive trials in cold tests performed jointly by EnBW and GNS has paid off. Our colleagues at EnBW have been thoroughly trained by us, so that now every move is perfect".

The first transport took place on 28th June 2017. Not only the operator EnBW, but also the Baden-Württemberg Minister for the Environment reached an initial positive conclusion after the transport: "There is nothing to complain about from the nuclear regulation standpoint". In the meantime four of the five transports have already been completed smoothly.

Operators file applications for interim storage of vitrified reprocessing waste

# Four transports to four locations

Return of the last vitrified waste from reprocessing of German fuel assemblies abroad is drawing closer. At the end of September 2017, the operators of the Biblis, Brokdorf, Isar and Philippsburg interim storage facilities filed applications for storage of the total of 26 CASTOR® HAW28M casks. The transports are expected to take place from 2019 onwards.

It was initially intended to place the last 26 casks containing intermediate and high level reprocessing waste in the Gorleben interim storage facility too. Stored there already are 108 casks containing high level vitrified reprocessing waste that were returned from France between 1995 and 2011. As part of the political consensus in 2013 on restarting the site selection process for a final repository, it was agreed however to no longer place any further

casks containing reprocessing waste in storage in the interim storage facility in Gorleben. The Repository Site Selection Act subsequently amended the Atomic Energy Act (AtG) accordingly. Pursuant to the latter, the German utilities must ensure that the remaining vitrified residues originating from reprocessing of spent fuel assemblies outside Germany are taken back and emplaced in on-site interim storage facilities at nuclear power plant sites.

In order to meet this obligation, PreussenElektra, RWE, EnBW and Vattenfall filed applications for emplacement of waste from reprocessing of German fuel assemblies in on-site interim storage facilities before the Federal Office for the Safety of Nuclear Waste Management (BfE) on 29th September 2017. The applications are based on the retrieval concept agreed upon by the operators and Federal Environment Minister Barbara Hendricks on 19th June 2015. According to this, the five casks containing intermediate level waste from La Hague are to be placed in storage in Philippsburg and the 21 casks containing high level waste from Sellafield are to be emplaced in Biblis, Brokdorf and Isar.

## GNS is organising the transports

As was the case with previous return transports from La Hague, GNS not only supplies the necessary casks; rather it also accompanies the loading operations and organises the transports from the reprocessing plants to the interim storage facilities. From today's perspective, the four transports are scheduled from 2019 onwards. The on-site interim storage facilities for spent fuel and high level waste at the power plant sites will already fall within the competence of the Federation at that time.



A CASTOR® HAW28M for retrieval of vitrified reprocessing waste next to CASTOR® V casks for spent fuel assemblies in the GNS cask production in Mülheim.

New designs and creative solutions for international CASTOR® customers

# Innovations for the global market

Based on the CASTOR® design, GNS is also developing tailored solutions to meet the needs of international customers even more closely. The design has just been completed for the first two types in the new CASTOR® geo family and compilation of the application documents has begun. In addition, several variants for pressurised and boiling water reactors are in the design and development phase. A highly innovative loading system is furthermore designed to extend the application possibilities of the fuel assembly casks even in plants with restricted crane capacities.

For the fuel assemblies from the Belgian pressurised water plants Doel und Tihange, their operators have commissioned GNS with developing, licensing and manufacturing initially 30 casks of the CASTOR® geo24B and CASTOR® geo21B series (compare GNS magazine 9). The first casks are scheduled for delivery to Belgium from 2021 onwards. In October 2017, the GNS developers were able to define the design for both innovations according to schedule during the so-called “design freeze”. “The design freeze’ is one of the most important milestones in any cask development project”, explains Roland Hüggenberg, the GNS cask development manager, “since it serves to confirm that the constructional design of the cask is consistent with the design specifications and customer requirements and that the optimisation process on the development side is completed. Based on this cask design, we can now start to compile the approval documents”.

Alongside the casks intended for Belgium, development of the CASTOR® geo32CH for Switzerland also commissioned last year is making major headway. The “design freeze” of this cask designed for up to 32 PWR fuel

assemblies is scheduled in December 2017. The contract covers the supply of 51 casks.

## CASTOR® geo for BWRs too

Particularly for target markets in Asia, GNS is also currently developing

CASTOR® geo variants for fuel assemblies from boiling water reactors. The CASTOR® geo69 for example is intended to accommodate 69 BWR fuel assemblies, of which up to 16 can contain MOX fuel.

## CASTOR® CLU

GNS will in future offer a completely new system for achieving higher cask capacities even with limited crane capacity. Instead of loading the spent fuel assemblies into the cask under water in the storage pool, as was standard practice up to now, the fuel assemblies are to be retrieved from the pool using a “Cask Loading Unit”, CLU for short, before being loaded into the CASTOR®.

“We have presented our innovations over the past few months as part of several international symposia”, recalls Dr. Linus Bettermann, the head of cask sales at GNS. “The listeners’ and visitors’ reactions have proven to us that technologically we are exactly on the right track”.



The “Cask Loading Unit” (CLU) is mounted on the CASTOR® outside the pool.

## Two major milestones for the cask business

# International approvals

The CASTOR® V/19-type casks already used many hundred times over in Germany are also arousing great interest in Switzerland. A prerequisite for use of the casks for fuel assemblies from pressurised water reactor power plants in Switzerland is an own Swiss approval under traffic regulations in addition to usage clearance for interim storage in the Swiss ZWILAG central interim storage facility. On 28th March 2017, the Swiss Federal Nuclear Safety Inspectorate ENSI decided upon CASTOR® V/19 (CH) approval in Switzerland a good year after the application was submitted. Usage clearance for interim storage of the casks immediately followed in April. "Trouble-free approval of the CASTOR®

V/19 provides an excellent starting point for future approvals in Switzerland, such as the new development CASTOR® geo32CH", Dr. Linus Bettermann, the head of cask sales at GNS, says with conviction.

### **CASTOR® receives transport approval in the USA for the first time**

On 17th February 2017, the U.S. Department of Transportation granted validation of approval for the CASTOR® THTR/AVR-type cask based on the expert appraisal by the U.S. NRC (Nuclear Regulatory Commission). "This is particularly noteworthy, as this is the first time that we have been able to obtain accept-

ance under transport regulations of a cast iron CASTOR® cask in the USA", Dr. Bettermann explains. "The U.S. NRC had rejected this material up to now as a matter of principle".

Acceptance for transport in the USA is necessary in order to keep the option open of repatriation of the former AVR fuel assembly spheres from Jülich to their country of origin, the USA. A decision has not yet been made concerning the actual further disposal of the total of 152 CASTOR® AVR casks stored in Jülich. In addition to transport to the USA, transfer to the interim storage facility in Ahaus and construction of a new interim storage facility in Jülich are also being studied.

## External conditioning of a high-pressure turbine rotor

# The SCO bonbon

Based on many years of experience from a large number of disposal projects, GNS enables rapid and economical external conditioning of contaminated large components. The tremendous weight and the contamination of the component posed a major challenge during removal of a high-pressure turbine rotor from Krümmel.

Krümmel nuclear power plant (KKK) originally intended to prepare the entire high-pressure stage of the turbine set for release with its own resources, in a similar manner as for the low-pressure stages. Once GNS had been able to explain the technical and economic advantages of external disposal of the large component, Vattenfall Europe Nuclear Energy GmbH (VENE) commissioned GNS in May 2017 with external conditioning of the high pressure turbine rotor weighing a total of 80 t, which had already been dismantled in 2005.

Within a planning phase of just seven months, GNS not only organised and coordinated the campaign procedure, radiological characterisation, classification according to transport regulations and heavy goods transport, but also the on-site work within the controlled area of the KKK.

"In order to comply with the requirements of SCO-I classification for transport and owing to the specific shape of a turbine rotor, we needed to develop an innovative and func-



tional design for cladding subareas with metal sheet as well as additional wrapping with highly tear-proof shrink film" Boris Westerwinter, the responsible project manager at GNS explains. "Following smooth transfer to Sweden by heavy-duty truck and ferry at the end of October, safe recycling and release of the materials are now on the programme".

Handling concept has proved its worth

# Four out of six caverns in Brunnsbüttel cleared

Recovery of the drums containing low and intermediate level waste from the caverns in Brunnsbüttel power plant is progressing well. Four out of six of the underground storage caverns have now been completely cleared.



Overpacks with evaporator concentrate drums placed in type IV Konrad containers.



Already in GNS magazine 9: clearing of caverns 2 and 4.

Between November 2016 and September 2017, a total of 194 drums containing low and intermediate level waste, mainly evaporator concentrates and filter concentrates, was raised from caverns 1 and 3 and underwent repository-compatible conditioning. The recovered evaporator concentrate drums were placed in overpacks and dried before they could be placed in type IV containers. The filter concentrates were sucked into GNS Yellow Box® type VI cast iron containers and dried beforehand if necessary.

As during the clearance of caverns 2 and 4 already completed in 2016 (compare GNS magazine 9), GNS employees as well as the GNS mobile conditioning facilities PUSA and FAVORIT were also employed in caverns 1 and 3. A total of 382 drums as well as 20 type IV containers and 6 GNS Yellow Box® type VI cast iron containers have now been filled from the four completely emptied caverns.

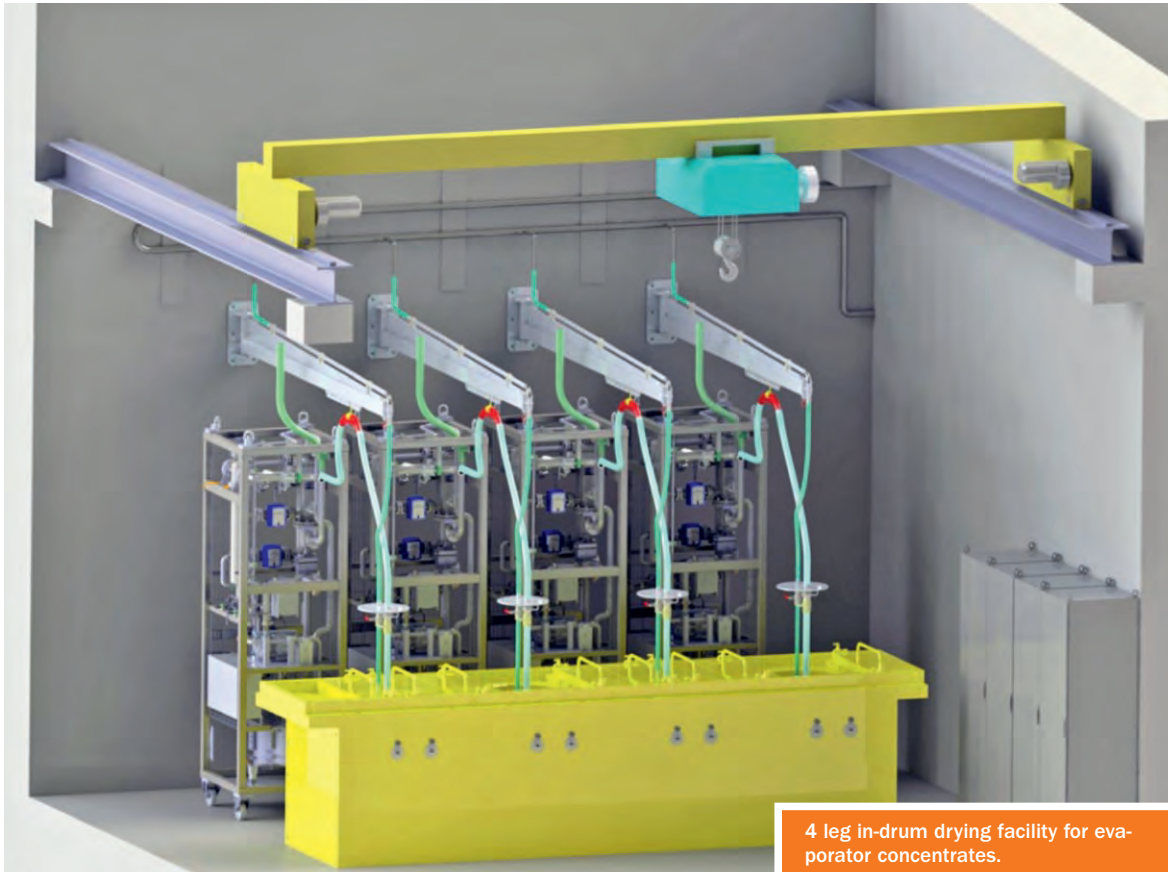
As the next step, Vattenfall will tackle emptying the largest cavern, number 6.

Once these again more than 200 further drums have been packed in repository-compatible containers by late 2018, salvage of the drums from the caverns of the KKB will be completed. This is because still remaining cavern 5 does not contain any more concentrate drums, but merely components from the time of reactor operation.

Waste treatment centres at two EnBW sites

# Technology for waste conditioning

GNS has received contracts from EnBW for technical infrastructure for the waste treatment centres at the Philippsburg and Neckarwestheim sites.



4 leg in-drum drying facility for evaporator concentrates.

“We are pleased that we were once again able to assert ourselves in the face of close competition in this reference project with one of the core competencies of GNS, namely technology for conditioning of decommissioning and operating waste”, is how Ingmar Koischwitz, the head of the GNS plant engineering and equipment department, assesses incoming orders in August 2017.

For the materials accruing during decommissioning and dismantling, EnBW Kernkraft GmbH is constructing a waste treatment centre (RBZ) and an on-site waste storage facility at its Philippsburg and Neckarwestheim power plant sites respectively. The RBZs are to be equipped with several conditioning facilities. These include, among others, wet and dry blasting cabins, thermal cutting devices and high-pressure compactors.

During an intensive tendering process, GNS was able to win contracts for both sites for planning, production and commissioning of a 4 leg in-drum drying facility for evaporator concentrate including a sampling device and two drying chambers in addition to a filling facility for Konrad containers respectively. Delivery and subsequent commissioning at both sites are scheduled in separate lots in 2018.

VATESI issues licence for “industrial operation”

# Routine at last in Ignalina

The Ignalina project has made considerable progress over recent months. Following inauguration of the storage facility last autumn, the GNS casks were able to demonstrate their capabilities as part of “hot commissioning”. The Lithuanian State Nuclear Power Safety Inspectorate VATESI subsequently issued licence for serial loading and emplacement of the around 180 remaining CONSTOR® RBMK 1500/M2-type casks.



The loaded CONSTOR® RBMK 1500/M2's in the interim storage facility in Ignalina.





GNS magazine 9: the inauguration of the interim storage facility.

“Hot commissioning”, i.e. the first spent fuel assembly loading operations, marked a key milestone towards acceptance of the casks to be supplied by GNS. Eight reference loading operations all in all took place under supervision by GNS specialists between September 2016 and the end of March 2017. Among other aspects, proof of the contractually agreed functional guarantee “loading of a cask within 18 calendar days” was provided and acknowledged by the customer. “The period actually achieved is even markedly below the contractually agreed 18-day limit”, reports Sascha Edwards, who accompanied the loading operations on site as GNS “commissioning manager”. “The guaranteed values for dose rate and temperature have also been verified on all eight casks”.

**Already 31 casks loaded and placed in storage**

After the customer INPP had subsequently loaded a further two containers without difficulty on its own, the Lithuanian State Nuclear Power Safety Inspectorate VATESI granted on 4th May 2017 the “industrial operation licence” for serial loading, handling and emplacement of the CONSTOR® RBMK 1500/M2-type casks. Based on this licence, it will also be possible to employ all further 180 casks as scheduled. Between four and six casks per month have now been delivered to Ignalina since June 2017. The on-site loading team is now so well trained that one cask can be handled per week. By the end of October 2017, a total of 31 casks had already been loaded and emplaced in the ISFSF interim storage facility.

Licensing and delivery contract for MOSAIK® II-15 casks

Switzerland relies on MOSAIK®

In the course of disposal of radioactive waste from the Swiss Beznau, Gösgen, Leibstadt and Mühleberg nuclear power plants, transports of already conditioned or yet to be conditioned drum packages from the nuclear power plants to the Swiss interim storage facility and also subsequently to final disposal are pending. Owing to the radiological characteristics of these drum packages, casks with type B(M) approval are required for the transports. The Swiss nuclear power plant operators are relying on the tried and trusted GNS MOSAIK® casks for this purpose.



Following intensive contractual negotiations, GNS has concluded a contract with Axpo Power AG, BKW Energie AG, Kernkraftwerk Gösgen-Däniken AG and Kernkraftwerk Leibstadt AG for obtaining of type B(M) approval for the EI series MOSAIK® II-15 casks with a 40-mm lead lining. GNS already holds a valid German type B(U) approval D/2090/B(U)-96, rev. 8 for this cask. Power plant-specific inventories that are not included in the German approval will also be taken into account for the application for Swiss type B (M) approval. GNS submitted the documents for obtaining approval to the Swiss authorities in September 2017. The Mühleberg nuclear power plant is already planning the first transports with the approval to be obtained and has initially ordered eight MOSAIK® casks for this purpose.

End of supercompaction in Duisburg

# F 19824 – the last of its kind from Duisburg

Preparations are progressing for the planned withdrawal from the GNS plant in Duisburg by the end of 2019. Manufacture of the last puck in the FAKIR VIII supercompactor in January marked the end of an activity that has been one of the main tasks of the Duisburg plant for three decades.



One of the central treatment stages in conditioning low level radioactive waste involves volume reduction by high-pressure compaction. It allows a three- to ten-fold reduction in waste volume, thereby saving packaging materials as well as valuable interim storage and final repository volumes.

Supercompaction in hall 1 in Duisburg – with the FAKIR IV until 2007 and subsequently with the FAKIR VIII since 2008 – has played a key role in waste treatment by GNS for almost 30 years. It was used for the last time in early January in preparation for withdrawal from the plant by the end of 2019.

The last puck produced by the FAKIR VIII bore the number “F 19824”. In addition to old waste from conversion of mobile conditioning facilities from 1999 to 2015, it contained the last compactable waste that had been accruing in Duisburg until the end of 2016 as part of sorting and dismantling of GNS facilities and casks.

A total of 80,282 pucks were produced in Duisburg over the years. “The Duisburg plant has thus achieved a remarkable performance over the past three decades”, sums up Dr. Holger Spann, GNS divisional director waste management. “With an average of 3.5 pellets

per 200-l drum, this results in around 23,000 drums which in turn, packed in almost 900 Konrad type V containers would total nearly 10,000 m<sup>3</sup> of Konrad final repository volume”. Even the FAKIR VIII, which has been used to the last moment, is far from being outdated with the end of conditioning operations in Duisburg. According to Dr. Spann: “We have already found a new user for the reliable plant: A few days ago, the FAKIR VIII was taken from Duisburg to its new point of use in Biblis”.

GNS trainee honoured in Berlin

# Germany's top trainee

The annual award for best Chamber of Industry and Commerce trainee in all Germany was held for the eleventh time in Berlin last December. Dr. Eric Schweitzer, the President of the Association of German Chambers of Industry and Commerce (DIHK), and the Federal Minister of Family Affairs Manuela Schwesig presented the award winners with certificates and trophies. A GNS trainee was also among the prize-winners.



Dr. Eric Schweitzer, the President of the Association of German Chambers of Industry and Commerce (DIHK) hands Dennis Leber his prize as the best in all Germany.

Dennis Leber, who underwent training as a materials inspector (specialising in systems engineering) at GNS between 2013 and 2016, is the best in all Germany in his training vocation for the 2016 graduation year. Leber completed his training at the Essen and Mülheim sites and tested among others components of the CASTOR® casks assembled in Mülheim. He will also be continuing this in the future: In recognition of his outstanding achievements, he was given a permanent position at GNS ahead of time and is now working in the cask production in Mülheim where he supervises assembly of the MOSAIK® casks and inspects a wide range of vendor parts such as for example CASTOR® cask lid screws.

Among the more than 300,000 nationwide participants in the chamber of commerce examinations in winter 2015/2016 and summer 2016, the chambers commended a total of 219 trainees in 211 training vocations for their excellent achievements.

Cooperation with NGK Europe GmbH

# Process engineering for the Japanese market

GNS has conducted analysis and development work on charging and discharging of a pyrolysis plant as part of a concept study for the Japanese market.

NGK Insulators Ltd., whose head office is in Nagoya, with an annual turnover of approx. 2.93 billion Euros in 2016 and approx. 16,200 employees is a Japanese provider of ceramic products in various different industrial sectors all over the world. For the Japanese market, NGK develops and distributes among other products conditioning technology for operational and decommissioning waste, also including for instance high-pressure compactors, grouting and blasting facilities. An intensive exchange of information has been established during recent years between NGK and GNS through NGK Europe GmbH based in Germany, resulting in emergence of an order for a concept study.

NGK has developed a complex “pebble-bed pyrohydrolysis system”



Martin Hoffmann with those in charge of the “pebble-bed pyrohydrolysis system” in the NGK “Chita Plant”.

for the Japanese market with which it is intended in future to process ion exchange resins into ash – a process fundamentally different to the conditioning methods established to date in Germany. In a very similar manner however to the practice in Germany, the resin mixture is also mixed with water as the transport medium and pumped through piping to the pyrolysis plant.

The GNS concept study took account in this case of two aspects in the entire pyrolysis process: firstly charging of the pyrolysis plant with separation of the water load before feeding into the pyrolysis plant (dewatering) and secondly subsequent extraction of the ion exchanger resins transformed into

ash as well as additionally capping of the waste container.

Following completion of the preliminary studies, the tests performed in a laboratory in Essen by the GNS engineering and equipment department (TPA) using inactive ion exchange resins also showed positive results and it was therefore possible to complete and present the study to NGK. Martin Hoffmann from TPA visited NGK in Japan in this connection in October 2017. He was also able to inspect the pyrolysis plant on site in the so-called “Chita Plant” and clarify the technical interfaces to promptly prepare the offer requested by NGK for supply of the components developed in the concept study.

Manufacturing and handling the quivers calls for special qualifications

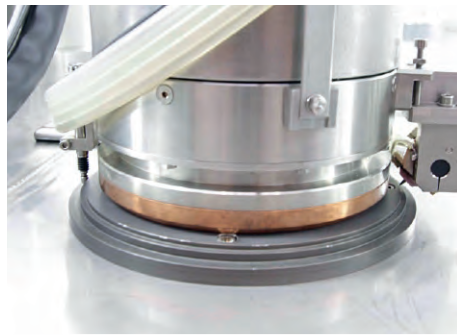
# GNS is a welding manufacturer

GNS has developed the IQ quiver system for safe packaging of special fuel rods. GNS has to provide evidence of special qualifications as the manufacturer of the quivers and themselves in addition to the lid seal seam during handling of the quivers in German nuclear power plants. As part of certification as a welding manufacturer according to DIN EN ISO 3834-2, GNS was able to fulfil the extensive quality requirements for welding-related production.

The purpose of the quivers developed by GNS is to safely enclose special fuel rods that cannot for example owing to leakage be directly stored in CASTOR® V casks. The quivers need to be dewatered, dried

and sealed gastight before being placed in the CASTOR® V casks. Gastight sealing of the quivers is performed by means of a so-called lid seal seam.

tion of GNS for manufacturing the lid seal seam of the boiling water reactor quivers is planned.



Automatic sealing device for the lid seal seam of the quiver.

As part of the quiver system approval procedure, the Federal Institute for Material Research and Testing (BAM) required GNS to obtain qualification as a welding manufacturer. The qualification procedure was to be conducted according to DIN EN ISO 3834-2 "Comprehensive quality requirements". GNS was able to fulfil this requirement regarding manufacture of the lid seal seam and for meeting the demands of the authorities in October this year the pressurised water by obtaining the certificate. As the next step, certifica-



## GNS has a real Ironman

3.86 km of swimming in the Pacific Ocean, 180.2 km of cycling over scorching asphalt through the lava desert and 42.2 km of running without any shade in the midday heat. It is not for nothing that the IRONMAN world championship on the volcanic "Big Island" of the Hawaiian archipelago is considered the most legendary and hardest IRONMAN international triathlon. The words with which each athlete is greeted on crossing the finishing line is also part of the legend: "You are an Ironman!".

On 14th October 2017, Jan Seewald heard it too as he reached the finishing

line after only 09:26:40 hours during his debut in Hawaii: "I will never forget that indescribable rush of adrenaline!". He was proud of and a little astonished himself at his outstanding performance: In the entire starter field of more than 2,300 participants, including professionals, he achieved 114th place and among his age groupers (30-34) even 18th place.

Perseverance and determination also serve him well in his job at GNS: Following his mechanical engineering degree at the Ruhr University in Bochum, he had initially worked for more than four years on the KONRAD project in the



"Transport and Logistics" area; since early 2017, he has been working as a project manager in the engineering and equipment department, in charge among other aspects for developing a qualified concept for a primary lid changing station as well as developing an ultrasound-assisted tightening method for screws on the new CASTOR® geo casks.



# Maintaining competence



In 2017, the GNS group once again made an extensive contribution to the conference programme at the German Annual Meeting on Nuclear Technology in Berlin jointly organised by the German Atomic Forum (DAF) and German Nuclear Society (KTG). Particular emphasis was placed this year on the challenges faced by nuclear technology

in Germany in sustainably maintaining nuclear expertise and competence. In addition to six technical lectures, GNS once again organised a focus session and took part in the nuclear energy campus for interested school pupils and students. The GNS booth was traditionally one of the most popular meeting points at the industrial exhibition.



# Present in Korea

With a total of 25 nuclear reactors and more than 150 TWh of annual electricity generation, Korea ranks fifth in the world in terms of nuclear energy. Following the political decision not to build any further reactors and to refrain from extending the service lives of the existing plants, the

preparations for disposal and dismantling are beginning. A forefront position is occupied in particular by the spent fuel assemblies kept in wet storage up to now, which are to be transferred to dry interim storage in future until a final repository becomes available. This makes Korea an attractive

market for the tried and trusted CASTOR® system. GNS representatives recounted the success stories of the CASTOR® casks and presented solutions specifically optimised for use in Korea during several symposia.

## KAP 2017

The GNS booth at the 32nd Korea Atomic Power Annual Conference in Gyeongju on 5th and 6th April 2017.



## WRFPM 2017

Dr. Linus Bettermann and Ralf Schneider-Eickhoff at the Water Reactor Fuel Performance Meeting, which took place between 10th and 14th September 2017 on Jeju Island.

## GLOBAL 2017

Roland Hüggenberg at the GNS booth talking to visitors to the GLOBAL 2017 International Nuclear Fuel Cycle Conference, held between 24th and 29th September in Seoul.



GNS and WTI at the KONTEC

# New exhibitor record in Dresden

Eighty-four exhibitors from eleven nations and once again more than 1000 specialists from industry, research and authorities took up the invitation to the 13th international symposium "Conditioning of Radioactive Operational & Decommissioning Wastes". GNS and WTI were prominently represented with a large exhibition booth and 16 contributions to the conference programme.



Philipp Diekmann (2nd from right) with the Chairman of the KONTEC Programme Committee, Michael Szukala as well as other prize-winners.



With two lectures in the plenary hall, ten contributions to the poster session and two KONTEC *Direkt* lectures on two posters each, the GNS Group had a major share in the KONTEC's specialist programme this year too. At the end of the symposium, the programme

committee once again honoured the best technical contributions: among them as the best KONTEC *Direkt* lecture was the GNS paper by Philipp Diekmann on the topic of "Experience from Dismantling, Decontamination and Release of Thick-Walled Casks and Containers".

The GNS booth was once again one of the central meeting hubs for this year's specialist exhibition and served as a background for many discussions between GNS and representatives of customers, energy supply companies, authorities and experts.



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