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iC&ND DIGITAL 2020

9th International Conference
on Nuclear Decommissioning

NOVEMBER 24TH - 26TH

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THE DATE



Aachen - Germany
19th - 21st October
Pre-Conference
Workshop 18th October

iCOND 2021

10th International Conference
on Nuclear Decommissioning

ORGANIZER



IN COOPERATION WITH



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IMPRINT



Aachen Institute for Nuclear Training

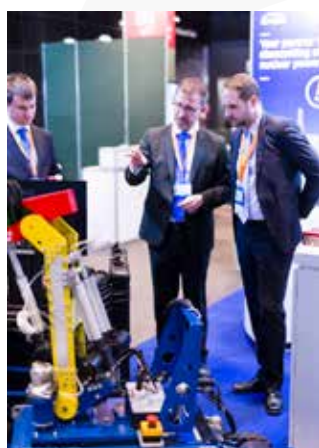
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HINTERGRUND

Die Stilllegung und der Rückbau kerntechnischer Anlagen stellen alle Beteiligten vor hohe planerische und genehmigungstechnische Anforderungen. In der laufenden Dekade werden sowohl in Europa als auch weltweit zahlreiche Kernkraftwerke aufgrund ihrer Laufzeit und politischen Entscheidungen außer Betrieb genommen. Dieser Umstand erfordert optimierte bzw. zwischen allen Beteiligten abgestimmte Rückbaustrategien.

Die Fachveranstaltung fokussiert den rechtlichen Rahmen in Deutschland, vergleicht Stilllegungsstrategien im In- sowie Ausland und nimmt die verschiedenen Teilaufgaben des Rückbaus in den Blick. Neben den unterschiedlichen Genehmigungs- und Finanzierungsstrategien spielt das Personalmanagement beim Übergang vom Kernkraftwerksbetrieb zum Rückbauprojekt eine wichtige Rolle. Ebenfalls wird die Zwischenlagerung und Entsorgung radioaktiver Abfälle thematisiert, die für den Rückbau eine wesentliche Randbedingung darstellt.

ZIELGRUPPE

Die Konferenz richtet sich an Betreiber von kerntechnischen Anlagen, die die Verantwortung für die Projektsteuerung und die Reststoffentsorgung von Rückbauprojekten haben. Weitere Zielgruppen sind Unternehmen, die mit der Planung und Durchführung von Rückbauprojekten beauftragt sind. Es werden Behörden und Sachverständigenorganisationen adressiert, die in Genehmigungs- sowie Aufsichtsverfahren und die Begutachtungen von Rückbauprojekten eingebunden sind.

Ausgehend von Fachvorträgen diskutieren die Teilnehmer/-innen die Herausforderungen des Rückbaus sowie Planungsvarianten für individuelle Rückbauaufgaben. Alle Beiträge werden simultan übersetzt (Deutsch/Englisch/Russisch).

BACKGROUND

The closure and decommissioning of nuclear power plants, particularly power reactors, present high demands regarding planning and authorization to all parties involved. In the ongoing decade several nuclear power plants will be shut down due to their operating life and political decisions, not only in Europe, but also worldwide. As a result, optimized decommissioning strategies will need to be well-coordinated among all participants.

The ICOND focuses on the relevant legal parameters in Germany and compares decommissioning strategies worldwide. This includes roles of authorization, financial planning, and change management in the transition from nuclear power plant to decommissioned project. Furthermore the different options for interim storage and disposal of radioactive waste are discussed.

AUDIENCE

ICOND addresses operators of nuclear plants and companies who are working on the planning, implementation and supervision of decommissioning projects; authorities and technical experts whose focus includes the approval and supervisions procedure of decommissioning projects; and research institutions which are responsible for the dismantling of research reactors and the storage and/or disposal of radioactive hazardous waste.

ICOND will enable participants to proficiently discuss the challenges of the decommissioning of nuclear plants in a practical way, and to define optimal planning variants for decommissioning implementation. Simultaneous translation (German/English/Russian) will be available.



RÜCKBLICK **ICOND 2019** REVIEW

Die 8. Ausgabe der ICOND fand im November 2019 im Eurogress Aachen in Kooperation mit der Firma ENGIE statt. Über 370 internationale TeilnehmerInnen besuchten die diesjährige ICOND und ließen sich von 32 fachkundigen RednerInnen über aktuelle Marktentwicklungen informieren. Parallel präsentierten 48 Unternehmen in der wesentlich vergrößerten Ausstellung ihre Produkte und Dienstleistungen.

Die Konferenz wurde durch Herrn Henry Cordes, Vorsitzender der Geschäftsführung der EWN, mit einem Vortrag über die Abfallbehandlungsstrategien der EWN und das zu errichtende Zwischenlager ESTRAL eröffnet. Etwas mehr als die Hälfte der Beiträge kamen aus dem Ausland, beispielsweise präsentierte Herr Martin Andreasson von NND die Stilllegungsplanung kerntechnischer Anlagen in Norwegen, während Herr Dr. Cédric Carasco von der CEA in Frankreich über aktuell in Entwicklung befindliche Techniken zur Charakterisierung radioaktiver Abfälle referierte.

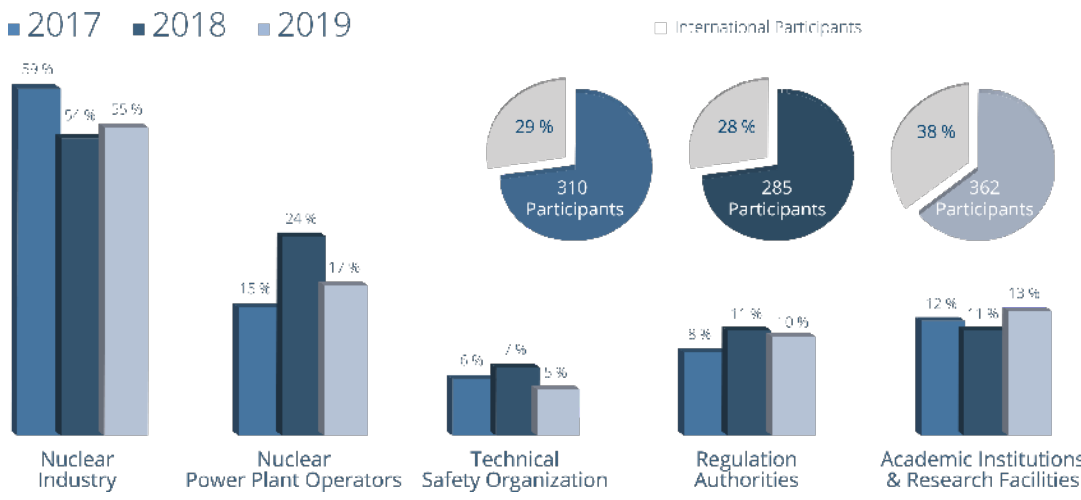
Auch die Möglichkeit zur Erschließung neuer Kontakte kam durch die Durchführung unseres bewährten Business Speed Networkings und anschließendem Get Together nicht zu kurz, während sich die Aussteller bei einer Road Show gezielt einzeln geführten Gruppen präsentieren konnten.

The 8th edition of ICOND took place in November 2019 at the Eurogress Aachen in cooperation with ENGIE. More than 370 international participants visited this year's ICOND and were informed about current market developments by 32 expert speakers. In the accompanying and significantly enlarged exhibition, 48 companies presented their products and services.

The conference was opened by Mr. Henry Cordes, Chairman of the EWN Management Board, with a presentation on EWN's waste treatment strategies and the planned ESTRAL interim storage. Slightly more than half of the contributions came from abroad, for example Mr. Martin Andreasson from NND presented on the decommissioning planning of nuclear facilities in Norway, while Dr. Cédric Carasco from the CEA in France gave a lecture on techniques currently under development for the characterization of radioactive waste.

Our Business Speed Networking and the ensuing Get Together enabled participants to make new contacts and get in contact with other experts, while the exhibitors were able to present themselves to individually guided groups during an Exhibitor Road Show.

FAKTEN FACTS





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TUESDAY

November 24th, 2020



STRATEGIES & MARKET DEVELOPMENTS

Decommissioning Strategy for the Power Plant Fleet of PreussenElektra
Rückbaustrategie für die Kraftwerksflotte der PreussenElektra

Dr. Guido Knott – PreussenElektra GmbH

Decommissioning of the Nuclear Power Plant Mülheim-Kärlich
Rückbau des Kernkraftwerks Mülheim-Kärlich

Dr. Thomas Volmar – RWE Nuclear GmbH - Anlage Mülheim Kärlich

Retrieval, Treatment and Interim Storage of radioactive Waste from the Asse II Mine
Rückholung, Konditionierung und Zwischenlagerung der radioaktiven Abfälle aus der Schachanlage Asse II

Jens Köhler – Bundesgesellschaft für Endlagerung mbH

Competence Development and Networking - Supporting Young Professionals
Kompetenzentwicklung und Vernetzung - Förderung junger Fachkräfte

Dr. Katharina Stummeyer – Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) gGmbH

PROJECT STATUS & EXPERIENCES

Decommissioning of the Nuclear Power Plants – Monitoring by the Expert Organisation
Die Begleitung des Rückbaus durch die Sachverständigenorganisation

Dr. Matthias Nuding – Verband der Technischen Überwachungs-Vereine

Disposal of Dismantling Materials from Nuclear Facilities – A Legal Inventory
Die Entsorgung von Rückbaumassen aus kerntechnischen Anlagen – Eine rechtliche Bestandsaufnahme

Dr. Christian Raetzke – Attorney at law

Planning and Construction of a Dismantling Hall for Large Components
Planung und Errichtung einer Zerlegehalle für die Großkomponenten

Bernhard Olm – Entsorgungswerk für Nuklearanlagen GmbH

Remote Dismantling and Packaging of activated Corewaste and Reactor-Internals
Fernhantierte Zerlegung und Verpackung von aktivierten Abfällen und Kerneinbauten

Ralf Oberhäuser – ORANO GmbH [&] Ronald Strysewske – Entsorgungswerk für Nuklearanlagen GmbH

LIVE EVENTS (ONLINE)

14:30 - 15:00 Q&A SESSION STRATEGIES & MARKET DEVELOPMENTS

Dr. Erich Gerhards – PreussenElektra GmbH

Dr. Thomas Volmar – RWE Nuclear GmbH - Anlage Mülheim Kärlich

Jens Köhler – Bundesgesellschaft für Endlagerung mbH

Dr. Katharina Stummeyer – Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) gGmbH

15:30 - 16:00 Q&A SESSION PROJECT STATUS & EXPERIENCES

Dr. Matthias Nuding – Verband der Technischen Überwachungs-Vereine

Dr. Christian Raetzke – Attorney at law

Bernhard Olm – Entsorgungswerk für Nuklearanlagen GmbH

Ralf Oberhäuser – ORANO GmbH

Ronald Strysewske – Entsorgungswerk für Nuklearanlagen GmbH

16:30 - 17:30 BUSINESS MEETING SESSIONS 1:1 ONLINE

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WEDNESDAY November 25th, 2020



DECOMMISSIONING & DIGITALISATION

Preparation of the Decommissioning of the Nuclear Power Plants Doel 3 and Tihange 2 in Belgium
Vorbereitung der Stilllegung der Kernkraftwerke Doel 3 und Tihange 2 in Belgien
Marc De Vleeschhauer – ENGIE

Opportunities and Risks of the Digitalisation of Processes in Nuclear Decommissioning
Chancen und Risiken der Digitalisierung der Prozesse im nuklearen Rückbau
Fritz Leibundgut – Paul Scherrer Institut

Software for Cost-optimized Decommissioning Planning Considering Material Flows for Resource Planning
Software für die kostenoptimierte Rückbauplanung unter der Berücksichtigung von Stoffströmen zur Ressourcenplanung
Peter Stängle – RODIAS GmbH

Tracking of Radioactive Waste Packages
Rückverfolgung von radioaktiven Abfallgebinden
José García – JE Project

DECONTAMINATION & DECOMMISSIONING TECHNOLOGIES

Advanced Decontamination of Metal and Concrete Surfaces by Laser
Fortgeschrittene Laserdekontaminationsverfahren für Metall- und Betonoberflächen
Dr. Marion Herrmann – Technische Universität Dresden

Experience and Benefits of a Full System Decontamination (FSD) as a Comprehensive Measure for Source Term Reduction prior to Decommissioning
Erfahrungen und Vorteile einer Full System Dekontamination (FSD) als umfassende Maßnahme zur Minimierung des Aktivitätsinventars vorlaufend zum Rückbau
Dr. Christian Topf – Framatome GmbH

Deconstruction of the Highly Reinforced Concrete Structures of the High-Temperature Reactor AVR
Rückbau der hochbewehrten Betonstrukturen des Hochtemperaturreaktors AVR
Marco Steinbusch – JEN Jülicher Entsorgungsgesellschaft für Nuklearanlagen mbH

Introduction of a Modern Production Control System for the Decontamination and Clearance of Building Parts
Einführung einer modernen Produktionssteuerung bei der Dekontamination und Freigabe von Gebäudeteilen
Ferdinand Bartels – PreussenElektra GmbH

LIVE EVENTS (ONLINE)

10:00 - 12:00 BUSINESS MEETING SESSIONS 1:1 ONLINE
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14:30 - 15:00 Q&A SESSION DECOMMISSIONING & DIGITALISATION
Marc De Vleeschhauer – ENGIE
Fritz Leibundgut – Paul Scherrer Institut
Peter Stängle – RODIAS GmbH
José García – JE Project

15:30 - 16:00 Q&A SESSION DECONTAMINATION & DECOMMISSIONING TECHNOLOGIES
Dr. Marion Herrmann – Technische Universität Dresden
Dr. Christian Topf & Luis Sempere Belda – Framatome GmbH
Marco Steinbusch – JEN Jülicher Entsorgungsgesellschaft für Nuklearanlagen mbH
Ferdinand Bartels – PreussenElektra GmbH

16:30 - 17:30 BUSINESS MEETING SESSIONS 1:1 ONLINE
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THURSDAY November 26th, 2020



CHARACTERIZATION & WASTE MANAGEMENT

Robot-assisted sorting of radioactive waste for volume-optimized conditioning - VIRERO

Robotergestützte Sortierung radioaktiver Abfälle zwecks volumenoptimierter Konditionierung - VIRERO

Andreas Blank - Friedrich-Alexander Universität Erlangen-Nürnberg

Spatially Resolved Gamma Spectrometry of Waste Drums for the Reduction of Artificial Activities (ASGS)

Ortsaufgelöste Gamma-Spektrometrie von Abfallfässern zur Reduzierung von Scheinaktivitäten (ASGS)

Dr. Matthias Fritzsche - Mirion Technologies (Canberra) GmbH

Clearance Measurement Technology

Freigabemessanlage

PDr. Matthias Richter - Mirion Technologies (Canberra) GmbH

Non-destructive Material Characterization of Radioactive Waste Packages with QUANTOM®

Zerstörungsfreie Materialcharakterisierung von radioaktiven Abfallverpackungen mit QUANTOM®

Dr. Laurent Coquard - Framatome GmbH

The Squaring of the Circle - Packaging Germany's Nuclear Heritage

Die Quadratur des Kreises - Deutschlands nukleares Erbe wird verpackt

Jörg Viermann - GNS Gesellschaft für Nuklear-Service mbH

Management and Characterization of RAW from Activated Large Components

Charakterisierung und Behandlung von radioaktiven Abfällen aktivierter Großkomponenten

Peter Tatransky & Martin Launer - Jacobs Slovakia s.r.o.

MICADO Project - Harmonization of Measurement and Instrumentation for Cleaning and Decommissioning Operations

Rückbau des Kernkraftwerks Mülheim-Kärlich

Dr. Erica Fachini - CAEN S.p.A.

Spent Fuel Characterization - 50 Years of Experience at the OECD Halden Reactor Project

Rückbau des Kernkraftwerks Mülheim-Kärlich

Dr. Scott Holcombe - Institute for Energy Technology

Characterization of Systems for Spectrometry Measurements in Environmental Monitoring, Security and Safety Applications

Charakterisierung von Systemen für spektrometrische Messungen in der Umweltüberwachung, Sicherheit und Sicherheitsanwendungen

Dr. Giacomo Mangiagalli - CAEN S.p.A.

Measurement Technology for the Radiological Evaluation of Building Structures

Messtechnik für die radiologische Bewertung von Gebäudestrukturen

Timo Göhlich - NUVIA GmbH

LIVE EVENTS (ONLINE)

10:00 - 12:00

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14:30 - 15:00

Q&A SESSION CHARACTERIZATION & WASTE MANAGEMENT PART I

Andreas Blank - Friedrich-Alexander Universität Erlangen-Nürnberg

Dr. Matthias Fritzsche - Mirion Technologies (Canberra) GmbH

Dr. Matthias Richter - Mirion Technologies (Canberra) GmbH

Dr. Laurent Coquard - Framatome GmbH

Timo Göhlich - NUVIA GmbH

15:30 - 16:00

Q&A SESSION CHARACTERIZATION & WASTE MANAGEMENT PART II

Jörg Viermann - GNS Gesellschaft für Nuklear-Service mbH

Peter Tatransky & Martin Launer - Jacobs Slovakia s.r.o.

Dr. Giacomo Mangiagalli - CAEN S.p.A.

Dr. Erica Franchini - CAEN S.p.A.

Dr. Scott Holcombe - Institute for Energy Technology

16:30 - 17:30

BUSINESS MEETING SESSIONS 1:1 ONLINE

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**ABSTRACTS
TUESDAY**

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SPEAKER

Dr. Guido Knott

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SPEAKER

Dr. Thomas Volmar

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56218 Mülheim-Kärlich - Germany

Website www.group.rwe



The Nuclear Fleet approach of PreussenElektra GmbH within the Decommissioning and Dismantling of it's Nuclear Power Plants

According to the German atomic law, PreussenElektra GmbH (PEL) has to shut down the nuclear power plants (NPP) Brokdorf (KBR) and Grohnde (KWG) until end of 2021 and Isar-2 (KKI-2) until end of 2022.

With the final shut-down of KKI-2, PEL has to finalize the already ongoing change from an extremely successful operational company to a top in class performer in the field of nuclear decommissioning.

"Safety First" remains unchanged the basic principle of all PEL activities.

The future nuclear decommissioning fleet consists of Würgassen (KWW) and Stade (KKS) NPP's, which already are in the last stage of their decommissioning program, KKI-1 and KKG NPP's, in which the decommissioning program started just several years ago and the upcoming programs of KBR, KWG and KKI-2 NPP's.

PEL is going to perform the nuclear decommissioning of the fleet according to a convoy-strategy, which already was successfully approved in the phase of new build (inverse convoy-strategy).

Within the pilot programs KWW and KKS, PEL has won important experiences, based on the already running

pre-convoy programs KKI-1 and KKG have been optimized. The optimization includes all significant aspects of a decommissioning program, such as licensing procedure, overall decommissioning sequence, program and project management, human resources and organization, process management, contractual management and technical solutions. Totally, these optimizations led to an overall reduction of budget of approx. € one billion in the fleet.

In the next step, PEL – in cooperation with suitable strategical partners - is going to develop innovative solutions for selected topics with high specific cost, such as decontamination and release of materials/buildings, strictly using automatization/digitalization. Furthermore, PEL will continuously optimize all the already running programs as well as the upcoming future convoy programs in all dimensions by using modern management tools, such as "Operational Excellence" and "Continuously Improvement Process" and strictly align all activities on the fleet approach. Hereby, PEL expects an additional cost reduction of several hundred million € and is going to develop the company as the international benchmark in field of nuclear decommissioning.



Decommissioning of the Nuclear Power Plant Mülheim-Kärlich

Two years ago an account of the decommissioning project Mülheim-Kärlich was given. Now a progress report is given.

The nuclear power plant Mülheim-Kärlich has a diverse history. Planning and construction started in the 1970s. Influenced by the shift of public perception in terms of nuclear in Germany start of commercial operation was delayed until 1987. Because of legal actions against the plant operation needed to stop in 1988 already. Legal proceedings followed for the next ten years resulting in a verdict of the German Federal Administrative Court against restart. In the course of the first German nuclear phase out decision was taken to apply for a decommissioning license that was granted in 2004.

Since then decommissioning and dismantling is ongoing. In Germany it is the first decommissioning project of a 1300 MW class NPP. Following a holistic decommissioning approach the project focused on reaching fit for purpose service operations, a significant dismantling rate and reducing radioactive waste. Milestones were the minimized plant area, small operating systems on industrial level and a dismantling rate of up to 1000t/a so that some building areas of the RCA have already reached the status of cold and dark. Such a dismantling rate can only be achieved by using modern industrial approaches.

This was achieved by a small number of staff. A key success factor to achieve this is the change of staff culture coming from an operational regime towards a strict project and process thinking. A small site in terms of staff, systems, area etc. has the advantage that there are reduced running costs making the project robust against unforeseeable challenges.

During the last two years highlight in terms of public reception was the demolition of the cooling tower in summer 2019. Internally the steam generators have been dismantled and the procedure to retreat the RCA was established. Additionally the project and the organization was restructured following the guidelines of the "Integrated Decommissioning Process" as part of a board department wide change process.

Next milestones will be the dismantling of the reactor pressure vessel and the reduction of the RCA in parallel to industrial like dismantling of systems and components.



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SPEAKER

Dr. Katharina Stummeyer

Company GRS gGmbH
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Website www.grs.de



Retrieval, Treatment and Interim Storage of Radioactive Waste from the Asse II Mine

The Asse II mine is located in Germany in the state of Lower Saxony. From 1967 to 1978, low and intermediate-level radioactive waste was emplaced in the salt mine. Since 1988, groundwater seeps into the mine.

Given the current state of knowledge, the required long-term safety can only be guaranteed by the retrieval of the radioactive waste. Retrieving the waste from the Asse II mine is a complex and difficult project on the technical level.

To this end, BGE explore the emplacement chambers and plans the technical implementation of the retrieval. BGE is still searching for locations for a new shaft and the required interim storage facility. At the same time, BGE stabilise the mine and take precautions against possible flooding.

It is not yet clear where the waste will finally be emplaced.



Competence Development and Networking - Supporting Young Professionals

Germany will phase out nuclear energy for commercial generation of electricity by the end of 2022, however, challenges and tasks remain that extend far beyond 2022 and that require expertise and specialist personnel for many years.

The German government has recently published its "Strategy for Competence Building and the Development of Future Talent for Nuclear Safety". The strategic paper is based on an in-depth analysis of needs, objectives and activities currently in place.

It identifies main areas of action to maintain and build expertise and specialist capacities and provides guidance and recommendations on measures to be taken.

This presentation introduces the strategy paper and gives a brief overview on its key contents. In addition, some already ongoing activities in the area of competence building and talent development in nuclear safety are presented. The selected activities are managed by the project management agency of GRS on behalf of the Federal Ministry of Economic Affairs and Energy (BMWi) and the Federal Ministry of Education and Research (BMBF). They are addressing a broad range of topics relevant in the context of nuclear safety and are open for universities, research organisations, TSO, industry as well as small and medium-sized commercial enterprises.



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SPEAKER

Dr. Matthias Nuding

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Decommissioning of the Nuclear Power Plants – Monitoring by the Expert Organization

It is the task of the expert organizations to assess the fulfillment of the protective goals during the post operation phase and the decommissioning of a nuclear power plant and therefore to contribute to a safe operation and decommissioning. In this regard, the experts united in the VdTÜV have a great wealth of experience from the past. During the decommissioning of, for example, the nuclear power plants Gundremmingen (unit A), Greifswald, Stade and Würgassen, the Obrigheim nuclear power plant, various experimental reactors on the site of the former Karlsruhe Nuclear Research Centre and the Kahl nuclear power plant as well as the AVR reactor extensive experience was gained by accompanying the development of decontamination, dismantling and separation processes. In the assessment of applications for decommissioning and dismantling, the expert organizations benefit from many years of accompanying the power operation of the nuclear power plants.

radiological and the technical initial condition of the plant are evaluated in terms of safety. Likewise, an evaluation of the basic procedure during the dismantling as well as an examination of the measures planned within the framework of the dismantling regarding their mutual influence and the assessment whether subsequent steps could be complicated or hindered take place. The scope of the assessment also includes the evaluation of the suitability of the intended decontamination, dismantling and disassembling techniques.

The systems and plant components intended for dismantling are assessed regarding impermissible feedback effects on systems still required. An evaluation of the working areas required for the dismantling and the storage areas of radioactive materials as well as the planned transport routes and the planning for the disposal of the radioactive residues and waste produced are also carried out.

Within the scope of decommissioning and dismantling of a nuclear facility, the corresponding applications of the operators are first examined. Both the

The essential component of an expert assessment of decommissioning and dismantling are the evaluation of the planned maximum values for the



emission of radioactive material with air and water and the evaluation of the events still to be assumed in the post operation phase as well as during the dismantling. In addition, the operating regulations must be checked for their suitability for decommissioning and dismantling of the plant

The Atomic Energy Act (AtG), the Radiation Protection Act (StrlSchG), the Radiation Protection Ordinance (StrlSchV), the Nuclear Waste Disposal Ordinance (AtEV) and the Nuclear Licensing Procedure Ordinance (AfVfV) are the superordinate evaluation standards.

The nuclear rules and guidelines, the BMU decommissioning guideline and the ESK decommissioning guidelines are taken into account as sublegal nuclear regulatory guidelines to specify the requirements of these superordinate evaluation standards. In addition, the safety requirements for nuclear power plants and the relevant KTA safety standards - where still applicable - are used to assess the post operation phase of plants in decommissioning where fuel elements are still being stored. Individual KTA safety standards are also applied in further decommissioning in accordance to the BMU decommissioning guideline. Furthermore, the relevant provisions of the conventional technical standards, such as DIN and DIN EN standards, general health and safety regulations and workplace regulations apply as far as they are relevant to the licensing procedure.

After approval by the supervisory authority, the post operation phase and the decommissioning will be accompanied as part of the supervisory procedure. In this regard, the detailed planning for the decommissioning of systems and components, for the sampling of systems and room areas, for the

radiological health and safety protection, for the treatment of residues and for the waste disposal target as well as for the dismantling of the systems and components or building structures are examined. Within the framework of this more detailed examination, the systems or system areas to be dismantled are assessed regarding any necessary interfaces to systems required for the post operation phase and regarding any necessary system adaptations as well as regarding the absence of repercussions on the protective goals still to be considered. It is examined whether aspects of the radiation protection, the physical protection or the building law are sufficiently considered. Depending on the specifications in the licensing procedure, tests for the discharge of radioactive materials are also carried out. As in power operation, any necessary modifications to the plant and its mode of operation are also assessed.

In order to obtain continuous information about the constantly changing state of the plant, in-service inspections are accompanied and plant inspections are carried out, in the frame of which compliance with the specifications of the operating or dismantling manual etc. is also checked.

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Disposal of dismantling materials from German nuclear facilities - legal issues

The German nuclear fleet is being shut down in stages from 2011; the last nuclear power plants will cease operation at the end of 2022. Decommissioning and dismantling of these installations results in the need to dispose of a considerable amount of dismantling materials. Only a small fraction of these materials is actually activated or contaminated to an extent to be classified as nuclear waste and destined to be delivered to a deep geological repository; the remainder, displaying no activity at all or a level of activity below 'de minimis' limits, can be disposed of as "conventional waste" after clearance.

German radiation protection law contains extensive provisions on the clearance of materials stemming from nuclear installations. Even after clearance, however, such material may present issues in further disposal. A specific clearance may impose certain conditions on the materials which continue to apply under the rule of conventional waste management law, e.g. that they have to be disposed of in a specific manner. In some cases, it is not entirely straightforward to define how this junction between radiation protection and "normal" waste management law works.

Another issue is public perception: even after clearance, debris from nuclear installations are often considered to be "nuclear waste" and to present a risk for human health and the environment. Municipal waste disposal facilities, which are basically obliged to accept waste from their region, have in some cases refused the processing of waste materials from nuclear power plants. This issue may become a major bottleneck for the dismantling process.

The problems linked to disposal of waste materials from German nuclear installations are already apparent now; they will become even more pressing in the future when the bulk of the nuclear power plants will actually be torn down and a huge flow of debris will arise. It is therefore imperative to find a solution which is both quick to implement and sustainable in the long term.



Design and construction of a facility for cutting large components at the Lubmin site of the Entsorgungswerke für Nuklearanlagen

Design and construction of a facility for cutting large components at the Lubmin site of the EWN Entsorgungswerke für Nuklearanlagen GmbH

For the conditioning of radioactive residue and waste, which are stored in the Interim Storage Facility North (ISN), EWN plans the construction and operation of a facility for dismantling large components at the Lubmin/Rubelow site. Layout and design features of the facility as well as planned activities are presented.

The facility is constructed as annex to the already existing buildings south of the Central Active Workshop (CAW) and east of the Central Decontamination and Water Treatment Plant (CDW). Constructional and technologically connected with the both aforementioned buildings, together the three buildings form the residue and waste treatment center.

The facility for cutting large components consists of a dismantling area with an upstream air lock, an assembly area with an upstream air lock, the personnel air lock (changing area inactive and active) with access to the controlled area, sanitary facilities, a common room, offices and the ventilation control

centers as well as further infrastructure rooms and traffic routes.

The construction and the operation of the facility for cutting large components was applied for as modification license under § 12 of the law on radiation protection.

From the technological and radiological point of view, four expansion stages are foreseen:

- Expansion stage 1: Dry cutting (Steam generators)
- Expansion stage 2/1: Dry cutting extension (Annular water tank)
- Expansion stage 2/2: Wet/Dry cutting (Reactor pressure vessels, partly with internals)
- Expansion stage 3: Repackaging (from interim storage vessels to final storage vessels)
- Expansion stage 4/1: Dry cutting (Reactor internals unit 5)
- Expansion stage 4/2: Wet cutting (Core basket, core components)

The structural engineering started with the construction of the bottom plate in summer 2020, the completion of the building is planned until the end of 2022, the operation is planned to start at the end of 2023.



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Remote Remote Dismantling and Packing of Reactor Internals at Brunsbüttel NPP Dismantling and Packing of Reactor Internals at Brunsbüttel NPP

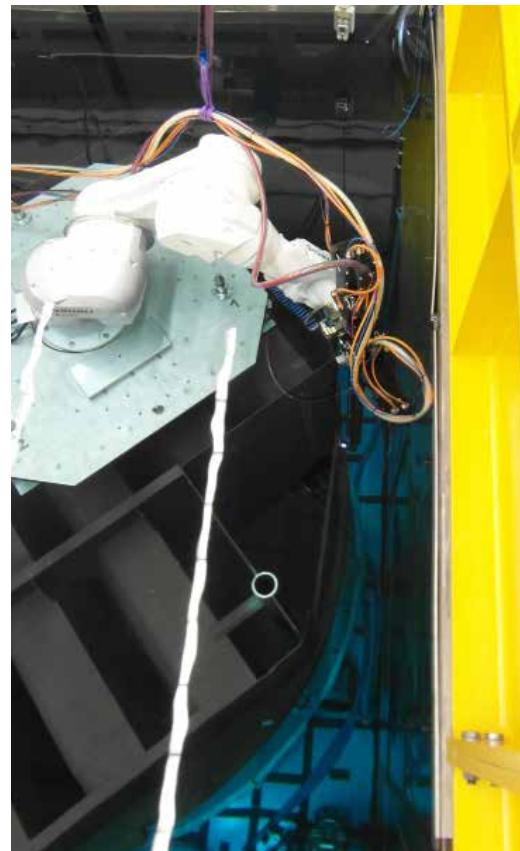
Within decommissioning of Brunsbüttel Nuclear Power Plant the cutting and packing of the reactor pressure vessel (RPV) internals is one major step to further reduce the remaining radiological inventory of the plant.

The RPV internals of this boiling water reactor comprise – amongst others – the major components steam dryer, steam-water-separator, upper and lower core grid, control rod guide tubes and core shroud. All of these components with an overall mass of approximately 180 tons need to be cut and packed into final storage containers. Due to their radiological characteristics this needs to be done remote handled or controlled under water applying a safe and reliable but also flexible process.

Prior to the on-site activities the deployed concept was elaborated and approved by authorities and independent experts within supervisory processes. The required tooling for segmentation and packing was planned, manufactured and commissioned within this 2 years lasting in-depth engineering phase.

After a general introduction of the applied concept, focus of the presentation is laid on the on-site activities starting with the preparatory works and equipment installations on site. Furthermore, the

cutting and packing of the steam dryer is described using an underwater-robot and remote-handled packing equipment. Special attention is given to packing of cut segments and respective radiation protection measures as well as draining of containers. To conclude, processing of the steam-water-separator is introduced and the removal of the circulation pumps is presented.



Konsortium



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Preparation of the Decommissioning of the Nuclear Power Plants Doel 3 and Tihange 2 in Belgium

According to the Belgian Law, there will be a gradual withdrawal of nuclear energy for the industrial production of electricity. The final shutdown dates of the Electrabel Nuclear Power Plants on the Doel and Tihange are respectively:

- Doel 3: 1st of October 2022
- Tihange 2: 1st of February 2023
- Doel 4: 1st of July 2025
- Tihange 3: 1st of September 2025
- Tihange 1: 1st of October 2025
- Doel 2: 1st of December 2025

As the Belgian NPPs are reaching their end of operation, the preparation of the dismantling of the NPP's is gaining momentum. The dismantling organization is being reinforced, transition plans are being developed, strategic choices related to the dismantling scenario's and options are being made,

new infrastructures are being planned for, waste management treatment and evacuation routes are being developed, Licencing and Final Decommissioning Plan are being established.

During the presentation, Electrabel will give a view on the current status of the dismantling preparation project and on the way forward. Some general dismantling project topics will be highlighted, as well as some specific constraints, related to the Belgian context.



Opportunities and Risks of the Digitalization of Processes in Nuclear Decommissioning

Decommissioning of a nuclear facility usually aims at releasing the facility from the nuclear legislation. It is a complex and lengthy process, which includes a wide range of tasks (e.g. cutting of the reactor pressure vessel) and can easily last more than 20 years after the facility shutdown.

During that time, all actors of the decommissioning project face complex challenges, which need to be captured and synchronized in a joint approach whose main objectives are: guaranteeing the safety of the personnel and the population, minimizing radioactive waste and optimizing costs and deadlines.

The holistic approach to nuclear decommissioning presented here aims at developing a platform that covers all aspects of the work to be carried out, from updating the decommissioning plan during plant operation to issuing a final report after the decommissioning objective has been achieved.

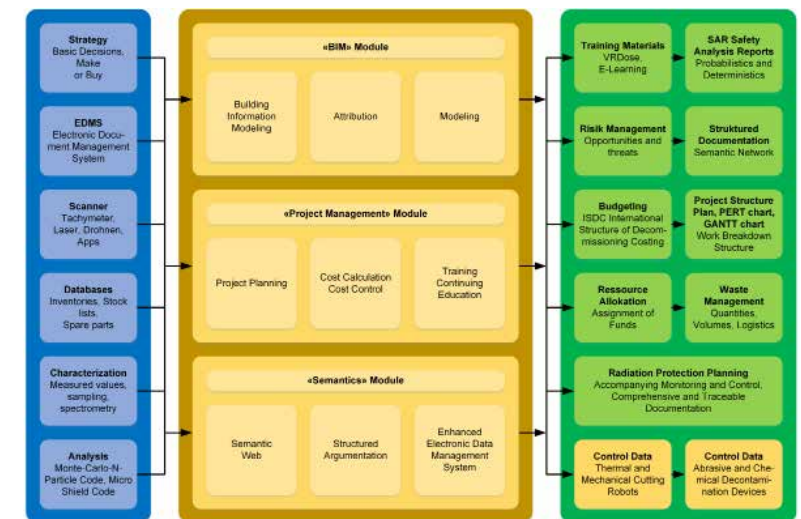
This platform is based mainly on the interaction of three modular components: Building Information Modeling BIM, Integrated Project Management and Semantic Web. This approach enables the digitization of all relevant data for the decommissioning project execution, a process we try to establish at PSI in the best possible way.

This holistic approach offers great opportunities in terms of cost and schedule optimization and waste minimization in nuclear decommissioning.

Data that can be used and processed using information technology enable digital conversion of input data into output data for direct use, for example as control data in dismantling robots.

However, the holistic approach also presents more acute cyber-security challenges since all project data is stored centrally ("Single Source of Truth"). This is all the more relevant when the nuclear fuel is still located on-site. In this approach to decommissioning IT-security therefore becomes of central importance.

It is therefore advisable to digitalize rather cautiously during the presence of nuclear fuel in general, while in the absence of such fuel one can draw on the full potential of digitalization.



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Software for Cost-Optimized Decommissioning Planning Considering Material Flows for Resource Planning

The planning of complex large-scale projects, such as the dismantling of a nuclear power plant, is a challenging task. Already with a few hundred activities it is hardly manually manageable to guarantee optimal resource utilization. All current project planning tools resolve resource conflicts by moving the activities into the future. This creates gaps in resource utilization and at the end, the project ends far beyond an optimal target date.

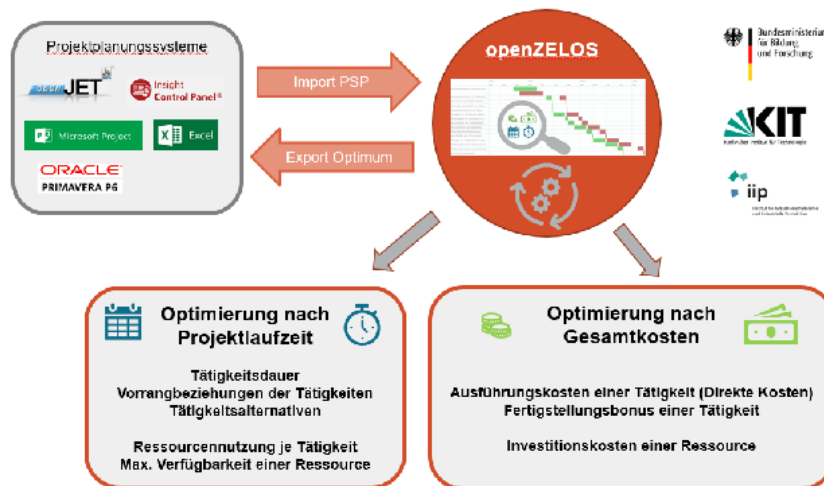
As the project progresses, it is even more challenging to keep the plans up to date. There is always shifting of tasks and conflicts of priorities in projects. The continuous planning optimization is often unattended in everyday project busi-ness. Very soon, the full reliability of the project plan is void.

Together with the Karlsruhe Institute of Technology (KIT), GIS is developing the openZELOS solution. Our goal is to optimize complex planning projects in terms of time or overall cost with the help of artificial

intelligence (AI). This software development initiative is promoted by the Bundesministerium für Bildung und Forschung (BMBF). The AI method is a specially developed search heuristic representing a compromise between optimum and practical project duration.

OpenZELOS was deliberately designed as an add-on to common project planning tools to be easily integrated into existing infrastructure.

With the help of import tools, any existing project plan can be imported into openZELOS. This serves as basic data for optimization in terms of time or total cost. The openZELOS algorithm identifies the bottlenecks in resources and by changing the input data, such as resource availability, the simulation of several scenarios is possible. The optimization results can be compared with the input data and based on this this insight the project planner can transfer the best optimization result back into the project plan for further processing. This optimization can be repeated cyclically and as often as required.



Benefits of Tracking Radioactive Waste and Other Assets Inside a Nuclear Facility

Safety and security are of the utmost importance for any nuclear facility as well as for waste management, interim storage and final disposal. This is why JE Project Ltd., in collaboration with Aachen Institute for Nuclear Training (AiNT) have created a system that allows us to track radioactive waste packages from beginning to end.

The software tracks radioactive waste from the moment it enters the facility until the moment that is cleared. It is able to create radiation maps for the storage area or any other area with radioactive waste, due to our knowledge of the location of the waste and its radioactive material. The benefits of tracking assets in today's world are endless.

Two of the most important factors are:

1. Improving workflow, safety and security by analysing assets movements.
2. Intercommunication (IoT) and automation of systems in order to increase overall efficiency and productivity.

Other benefits are:

1. Collision avoidance
2. Geo-fencing
3. Visitor and personnel security
4. Area monitoring
5. Test and execute emergency protocols
6. Access control for restricted areas
7. Distance control (COVID-19)
8. Many other custom uses

In this lecture we will be discussing about all the benefits with real live cases in order to better understand the advantages of asset tracking. Some industries currently using asset tracking.

1. Hospitals
2. Hotels
3. Smart buildings
4. Retail shops
5. Sports venues
6. Factories
7. Warehouse
8. Military facilities



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Advanced Decontamination of Metal and Concrete Surfaces by Laser

M. Herrmann, T. Kahl, A.-M. Reinecke, G. Greifzu, W. Lippmann, A. Hurtado

Advanced Decontamination of Metal and Concrete Surfaces by Laser

The dismantling of nuclear power plants poses great challenges for the previous operators of nuclear power plants. Among other things, this includes, the decontamination of large concrete or metal surfaces.

In the past, a laser-based technology for the decontamination of surfaces has been developed at TU Dresden. This technology enables a significant reduction in the volume of waste generated and at the same time a significant reduction in the physical strain on the personnel, since the effect of restoring forces and the radiological exposure can be significantly minimized.

In the presentation, the different mechanisms of laser ablation on concrete or metal surfaces are presented

and illustrated by results of practical tests. In particular, attention is paid to the fact that the laser process can efficiently decompose PCB-containing decontamination paints. In this way, more than 98 % of the originally existing PCBs could be removed from a test area of painted concrete surfaces at the Mehrzweckforschungsreaktor (MZFR) in Karlsruhe. The practical experiments also showed that paints can be selectively removed with almost no residue from metal surfaces that are difficult to access.

Finally, open scientific and technical questions are explained. The current work is aimed at qualifying and quantifying the process-related secondary emissions in order to select the necessary filters. In addition, it should be demonstrated that highly radioactive radiation does not impact the performance of the laser-optical components. These investigations are intended to transfer the laser-based technology for decontamination to nuclear facilities as well as to hot cells.



Experience and Benefits of a Full System Decontamination (FSD) as a comprehensive measure for Source Term Reduction prior to Decommissioning

Worldwide the average age of nuclear power plants continues to increase with more and more of them reaching the end of their operational life. Besides specific shut down scenarios e.g. in Germany or Japan, utilities worldwide change their strategies towards nuclear power due to economic or political reasons. The consequences are shut downs of NPPs earlier than previously expected. This poses great challenges for utilities in planning and implementing economical decommissioning and dismantling (D&D) programs. Immediate decommissioning directly after the operational phase soon emerged as the favored option to approach D&D by most of the utilities.

However, a high activity inventory in the plant often limits the flexibility for decommissioning and leads to complex and expensive dismantling techniques (e.g. for large components). Furthermore, D&D personnel are subjected to high dose accumulation during the D&D performance, as well as during the planning phase.

The experience gained during D&D in Europe over the past decades, especially in Germany, has established Full System Decontamination (FSD) - the simultaneous decontamination of the complete primary circuit and auxiliary systems - as a key element for immediate decommissioning.

Over the last few decades Framatome -with its proprietary CORD Family Technology - has made major contributions to the advancement of decontamination becoming the world leader in this field.

The following contribution will focus on different conceptual approaches for customized tasks and specific materials (e.g. 1690 steam generator tubing). The experiences and results of these recently applied decontamination campaigns prior to decommissioning will be presented.



SG Water Chamber prior to (left) and after (right) Full System Decontamination



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Deconstruction of the Highly Reinforced Concrete Structures of the High-Temperature Reactor AVR

In the years 1967 to 1988, the Arbeitsgemeinschaft Versuchsreaktor GmbH (AVR) operated a helium-cooled high-temperature reactor with an electrical output of 15 MW in the immediate vicinity of Forschungszentrum Jülich. In addition to generating electricity and conducting physical experiments, the research reactor also served for practical testing of various types of spherical (ball) fuel elements.

In the years 2014/2015 the reactor vessel was pulled out and moved to its interim storage facility. The dismantling measures with regard to the mechanical and process engineering required for reactor operation have now been almost finally completed. Now the next step will be the dismantling of the remaining concrete structures in the containment.

For the dismantling of the concrete structures with a mass of 1,470 Mg in the AVR reactor building, a remote controlled robot specially built for this purpose is used. Due to the structure and its materials and geometry, different tools will be used for the complete dismantling of concrete structures and containment. Because of the fact, that a part of the concrete structures - 320 Mg - consists of heavy concrete, the conventional wire saw method would be only suitable on a limited scale, especially if a speedy procedure under the existing radiological conditions is required. In a first step, the wall surfaces of the internal concrete structures were roughly removed up to 10mm to keep cross-contamination at a minimum. Initially, the concrete was demolished using hydraulic demolition hammers with different types of chisels. To cut the reinforcement hydraulic shears are used. The steel shell of the containment is cut with a tank cutter adapted and reinforced for the intended use.



Introduction of a Modern Production Control System for the Decontamination and Clearance of Building Parts

For multiple decades PreussenElektra has been and still is an operator of nuclear power plants with an outstanding safety record. Now with the transformation from an operator to a decommissioning company there are new challenges ahead - but this also brings many opportunities. Building modern production control systems and introducing industrial standards will be the key factors for a successful continuation of our journey to becoming the leader in decommissioning.

exchanged there. The next step will be to prepare our waste treatment processes and creating a production plan for the waste streams and setup the facilities accordingly. From our key learnings we will also work on suitable contract forms and include our key suppliers over the entire process. We can only be truly successful in a team together with our suppliers, and therefore we will be including them every step of the way. With this holistic approach covering legal, nuclear, and operational aspects we will ensure both output and controlled costs.

Die entscheidenden Dimensionen zur Maximierung der Mitarbeiterpotentiale



The needs and challenges with this task are the following:

- Managing this shift and creating underlying processes of „production“
- Introduction of targets in the mean of industrial standards
- Development of the people to support the system
- Following-up on the processes using PDCA-Cycles and the KATA-approach

In our initial project with Stades building parts we managed to increase daily output by 50% while removing work on Saturdays. We created a whole new understanding of how we execute our work and how we exchange information over the course of two months. Our control board has become our tool of choice and all vital information can be found and is

Einheitliche Arbeits- und Pausenzeiten sowie eine jährliche Planung führen zu Prozessstabilität

1. Unternehmensabstimmung von Ressourcen mit allen Teams am 20.05.20
2. Entwicklung von Arbeitsmodellen für die 3 Bereiche im DSO:
 - mit inhaltlichen Pausenmodellen wird
 - inkompletten Überstunden
 - Schichtübergabe
3. Pausenzeitlichkeit im Ist und geplant wird durch eine jährliche Fortschrittsplanung ermöglicht
Sondergeplant wird inkomplette auf 3 Sonntage innerhalb von 5 Wochen

Der neue Planungsprozess ist standardisiert, visuell und wird mit allen Disziplinen durchgeführt

Bausleiter und Koordinatoren zum Tagesstart an der Planungstafel

- Bausleiter, Koordinatoren und AVWs treffen sich zum Tagesstart und besprechen **grundsätzlich die Planung** für die Schicht.
- **Wichtige Informationen**, z.B. Instandhaltungs- oder Lieferarbeiten für den Tagesstart kommuniziert und entsprechend eingepflegt
- **Besondere Vorkommnisse** vom Vortag werden besprochen
- **Alte und Koordinatoren checken nach den Pausen gemeinsam an der Tafel aus**, um den aktuellen Status zu prüfen und ggf. Änderungen zu planen
- **Schichtübergabe** zwischen Ist- und Spätschicht findet zwischen dem Ist- und Koordinatoren an der Tafel statt.

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THURSDAY**

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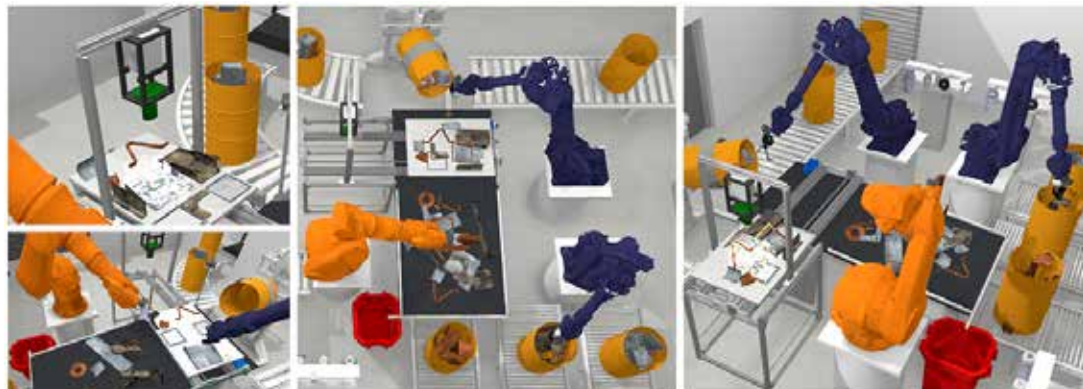


Robotic Technologies for Volume-Optimized Conditioning of Radioactive Waste – VIRERO

An appropriate conditioning of radioactive waste is in the focus of institutions responsible for disposal. In 2018, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety provided an overview of the existing stock of radioactive waste respectively waste to be disposed. Therein a forecast is given regarding the expected volume of waste, indicating that the disposal volume of Konrad repository (303.000 m³) is just sufficient. Due to limited capacities a volume-optimized conditioning is advantageous and preferable. However, post-conditioning of waste, especially of waste with higher dose rates, requires remote handling. Thereby, compliance to the waste acceptance criteria for disposal of Konrad must be ensured. In cases without an adequate waste declaration or if discrepancies are detected by a non-destructive characterization, waste contingents must be extracted, characterized, re-sorted and re-packaged. Even for properly documented contingents, reconditioning may save costs by increasing packing densities.

Within the R&D-project VIRERO (VlRtual REMote Robotics for Radiometric Sorting, 10/2020 – 09/2023) a robot-based system for volume-optimized conditioning and testing is realized. The utilized disruptive robotic and radiological technologies enable efficient dismantling, handling and radiological waste sorting. Thereby, a spatially resolved radiological characterization is combined during image processing with complementary cameras. An augmented virtuality teleoperation provides the accurate simultaneous control of multiple robots through a single operator. For improved efficiency while maintaining high safety standards, the automated conditioning of highly individual waste and the relieve of operator workload are within the research scope of this project.

The project is funded by the Federal Ministry of Education and Research (BMBF). The project reference code is 15S9422 A / B / C. The authors are solely responsible for the content of the abstract.



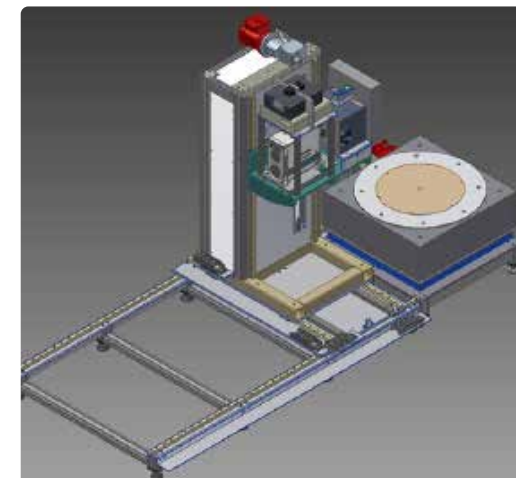
Spatially Resolved Gamma Spectroscopy of Waste Drums for the Reduction of Artificial Activities (ASGS)

For waste handling and treatment as well as for final storage and decommissioning nuclide specific characterization is an important method to determine the activity inventory of waste drums. Current methods typically use Germanium Detectors (HPGe) which are placed in front of a waste drum to acquire one or more different spectra in one or more different positions.

The data are analyzed by applying different a-priori information about matrix and spatial activity distributions. If one of these parameters is not completely known or defined, uncertainties need to be added to cover the worst case scenario which leads to additional artificial activities and therefore at the end to higher handling costs for qualification for transportation, intermediate- or final storage.

In a cooperation project Mirion and AiNT have developed a method to determine the spatial activity distribution inside the waste drum by applying an innovative measurement and analyzing method called Advanced Sectorial Gamma Scanner (ASGS). This new approach allows determining the spatial activity distribution inside waste drums and therefore helps reducing uncertainties and artificial activities.

The ASGS system has been designed, tested and validated. This presentation outlines the advantages of ASGS versus conventional measurement approaches and gives an outlook to future applications.



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Reduced uncertainty in clearance measurements using spectroscopy with plastic scintillators

Clearance monitors are designed to release material out of the scope of nuclear regulation. That border position induces a quantity of technical and regulatory requirements like low detection limits, high sensibility, use of Bayesian statistics for the calculation of uncertainty and high reproducibility.

The use of large area plastic scintillation detectors in gamma spectroscopy mode as active elements offers superior precision, stability and ease of maintenance compared to the traditional counting mode. Modern clearance monitors combine it with simulation-based geometry modelling.

Beside improved mass and energy correction of the detection efficiency, it also allows the verification of the nuclear vectors, real time gain stabilisation and facilitates the periodical monitor maintenance. More

advanced features include the real time tuning of the nuclide vectors and Co-60 detection in NORM material using coincidence.

We demonstrate how the spectroscopy approach used in novel Mirion Technologies clearance monitor designs helps to reduce the safety margins, enabling the release of material with activities close to the regulatory limit.

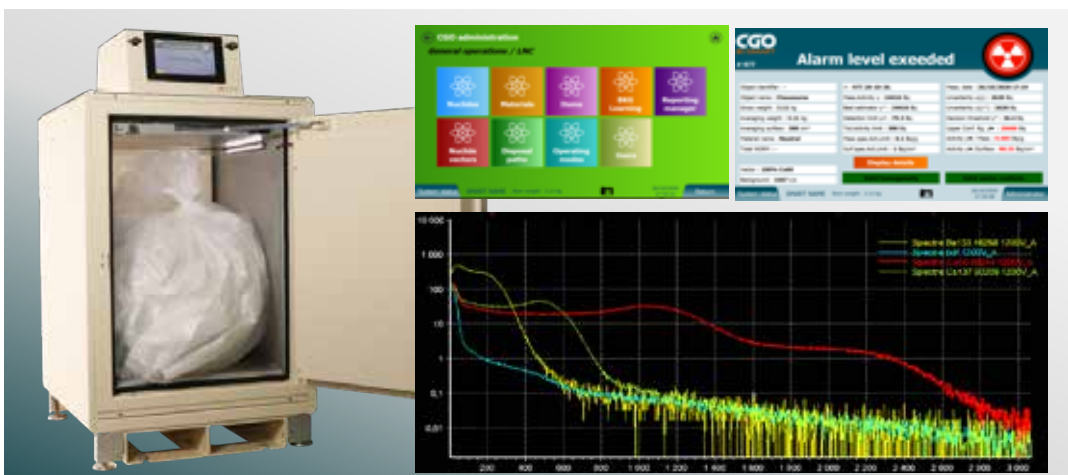
Non-destructive Material Characterization of Radioactive Waste Packages with QUANTOM®

During the last decades, the nuclear and non-nuclear industry has produced a considerable amount of low and intermediate level radioactive wastes (LLW and ILW). In Germany, such waste will be finally disposed underground in the geological repository Konrad, which is planned to go into operation in 2027.

The national licensing and supervisory authorities defined strict waste acceptance criteria (e.g radiological characterization, material characterization) for these waste. The material characterization is a real challenge for waste producers especially for legacy waste. The material characterization of waste packages can be performed on the basis of existing documentation or, if the documentation is insufficient, on further destructive or non-destructive analysis. Non-destructive methods are to be preferred to minimize radiation exposures of operating personnel as well as costs. The speaker presents an innovative non-destructive technology

called QUANTOM® (QUantitative ANalysis of TOxic and non-toxic Materials) based on prompt and delayed gamma neutron activation analysis (P&DGNAA). This technology is able to identify, verify and quantify the amount of hazardous and non-hazardous substances in 200-l radioactive drums, which is required for a final disposal characterization. The main benefits of QUANTOM® are summarized below:

- Non-destructive multi-element analysis with high sensitivity (ppm-range) of the entire matrix
- Minimizing the transportation of radioactive waste drums and radiation exposure of the operation staff
- Fast measurement process (2h-4h per waste drum) with high measurement precision
- No repackaging and no increase of waste volume
- Reduction of costs (min. 50% per waste drum) compared to destructive analysis processes.





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The Squaring of the Circle - Packaging Germany's Nuclear Heritage

GNS Gesellschaft für Nuklear-Service mbH, world leading supplier of casks for spent fuel, HLW and ILW, also offers comprehensive services for management and disposal of spent fuel and all types of radioactive waste. Design and supply of treatment facilities and all kinds of engineering support round off the GNS portfolio.

Being in charge of all operations regarding the disposal of the waste and residual materials from all nuclear power plants in Germany, GNS also handles waste management projects abroad.

Since the late 1980s, starting with the decommissioning of the Niederaichbach nuclear power station in Bavaria, GNS has been involved in all major nuclear decommissioning projects in Germany. At first by processing scrap from dismantled systems together with industrial partners and by treating decommissioning waste with mobile facilities or waste treatment facilities in its central workshops, later also by doing D&D work on site. At the beginning of the new millennium GNS gained substantial D&D experience being in charge of the complete

dismantling of research reactors like the MERLIN reactor in Juelich or the two TRIGA reactors of the German Cancer Research Centre in Heidelberg.

Since then GNS has more and more specialised in taking care of the parts of a nuclear station that are the highest contaminated and activated components, calling these decommissioning steps the „Big Five“.

In close cooperation with its subsidiaries Eisenwerk Bassum, Höfer & Bechtel and WTI, GNS is now able to offer and perform the whole spectrum of work required to prepare the above mentioned components and resulting waste for disposal.

The presentation will focus on the current situation on the decommissioning market in Germany and will highlight some case studies from ongoing decommissioning projects, such as the current dismantling operations at the EnBW sites Neckarwestheim and Philippsburg and the PreussenElektra site Unterweser.

Management and Characterization of RAW from Activated Large Components

Actual status in decommissioning of V1 NPP in Slovak Republic is progressing with dismantling and processing of Reactor Large Components, especially with cutting of highly activated reactor components. Fragmentation of activated components is carried out in two newly built Wet Cutting Workshops (WCW) inside the reactor hall. Activated components (RPV and Reactor internals) are cut into fragments and loaded in baskets underwater.

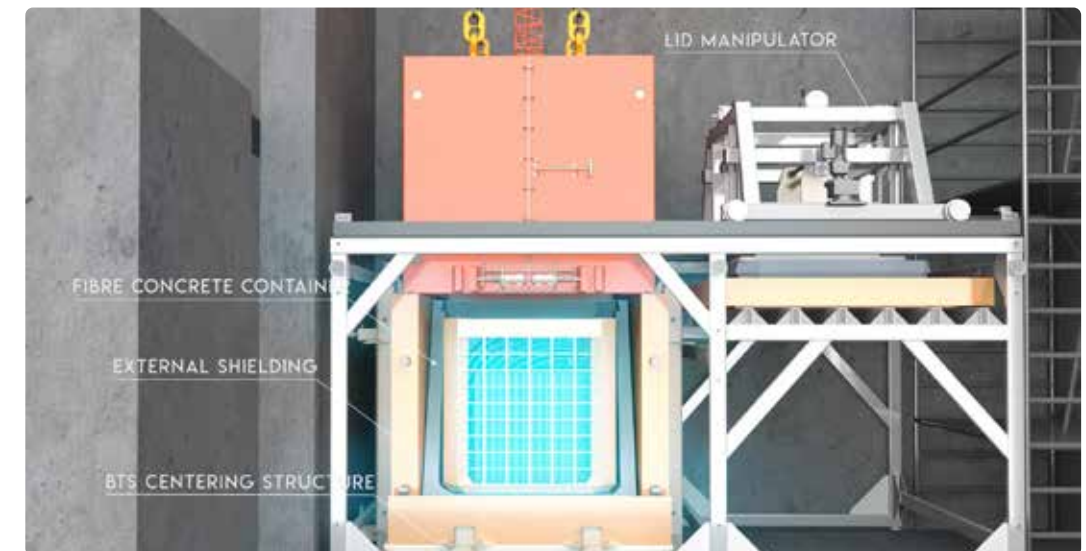
In Slovak Republic we have a National Radioactive Waste Repository (for LLW and VLLW) near Mochovcce. The only acceptable package form for disposal of LLW is Fibre Concrete Container (FCC). All technology for RAW processing and treatment in Slovakia is set-up for FCC, therefore, the baskets were designed for FCC applicability.

Before any fragment loading to basket, it is radiologically characterized underwater to validate initial waste stream and further waste management.

Disposability for each fragment is verified after the characterization. Full basket is additionally measured by Octopus equipment to validate the compliance with limits for transport.

Once basket is full it is extracted and manipulated to the Basket Transfer Station (BTS) located in reactor hall by Shielding Bell equipment to ensure ALARA principle. The Shielding Bell is a device for remote controlled manipulation of full basket from the WCW to the BTS. In BTS is basket transferred to the FCC which, if necessary, can be complemented with one of three external shielding options based on the characterization and dose rate measurement.

Baskets that meet the limits and conditions for disposal in NRWR are transported by standard or modified ISO container. Other baskets are transported to the Integral Storage of RAW in the Jaslovské Bohunice site by BU type container PK90 which was designed and licensed specially for the V1 decommissioning purposes.



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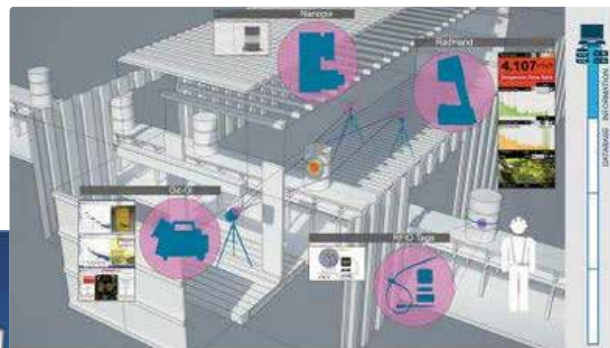


MICADO Project - Measurement and Instrumentation for Cleaning and Decommissioning Operations

The goal of the MICADO project is to propose a cost-effective solution for non-destructing characterization of nuclear waste by implementing a digitization process that could become a referenced standard. This standard will facilitate and harmonize the methodology used for the in-field Waste Management and D&D operations. In fact, the D&D process of nuclear infrastructures demands methods for a full traceability of waste material to improve quality management and operational safety. Precise procedures provide twofold benefits: the optimization of costs associated with D&D, and the minimization of the dose exposure to operators and personnel. The absence of a consistent and straightforward solution to characterize all types of materials, along with the lack of an integrated solution for digitizing the enormous amount of data produced, is today a critical issue. In fact, today the systems rely on the operator's ability to maintain the quality assurance with precision measurements that, unfortunately, are very often associated with high uncertainties, not allowing

therefore a real optimization of the waste. The utilization of several un-automatized instruments implies taking many notes and inserting them manually into specific ad-hoc format on a basic database.

This procedure precludes the possibility to combine data, including previously available legacy data, if present. The RCMS Digi-Waste solution proposed in the MICADO project will result in a proven modular solution offering an opportunity to develop a unified and standardized Waste NDA Characterization Procedure and Method. This could become an international reference allowing all Nuclear Operators, Research Laboratories and Safety Authorities to facilitate their exchanges. The MICADO project involves some key EU players with major knowledge in nuclear waste having all in common the interest to converge in technologies, methods and implementing a full digitization process applied to nuclear waste management.



Non-destructive spent fuel characterization capabilities at the Norwegian nuclear facilities

The Halden and JEEP II research reactors in Norway were permanently shut down in 2018 and 2019, respectively. Norway has yet to decide on a final disposal solution for the spent nuclear fuel, but regardless of the disposal solution, characterization of Norway's spent fuel will be necessary. Much of the spent fuel is unlike commercial reactor fuel, and many failed fuel rods are stored in sealed capsules, thus existing calculation methods may not be valid for the Norwegian fuel. This may necessitate measurements to assess, e.g.:

- Fuel rod integrity for spent fuel stored in sealed containers
- Isotopic inventory for:
 - Source term quantification
 - Safeguards verification
 - Burnup determination for criticality safety
- Decay heat

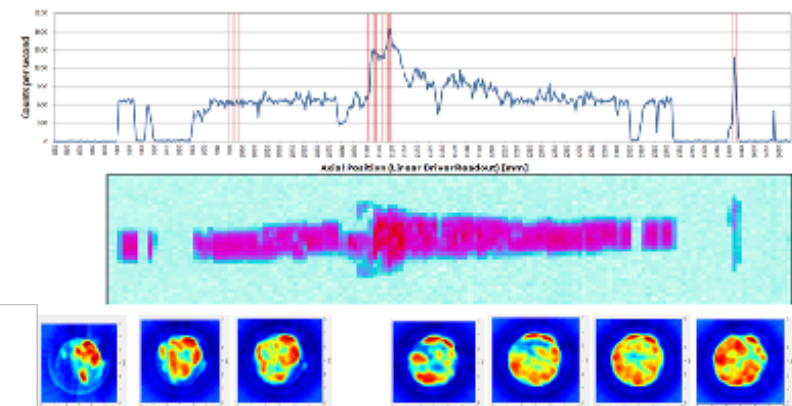
• Gamma scanning measures the intensity of gamma radiation emitted from the fuel. This corresponds to the isotopic inventory, which in-turn corresponds to the irradiation history. Such equipment exists at both of the research reactor sites.

• Gamma emission tomography measures gamma-rays emitted by the fuel and uses tomographic reconstruction techniques, to render detailed cross-sectional images of the fuel representing the spatial distribution of gamma emitting isotopes. This technique is well-suited for e.g. investigating the integrity of failed fuel in sealed capsules. Such a system exists at the Halden reactor site.

• Calorimetry measures the amount of heat released by the fuel thus measuring the fuel's decay heat. Previous power calibration methods applied to experimental fuel can be adapted for decay heat measurements on spent fuel.

The following methods have previously been used for characterizing experimental fuel, and is either already available at the Norwegian nuclear facilities, or has been previously demonstrated there, and could be re-implemented and adapted for the above characterization needs:

This paper describes the measurement methods available and the capabilities of this equipment for characterizing the Norwegian spent fuel.



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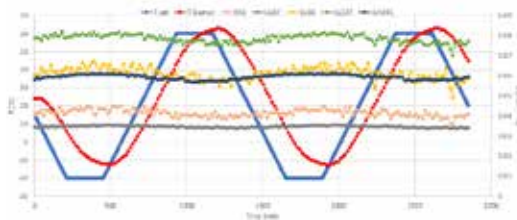
Website www.nuviatech-instruments.de



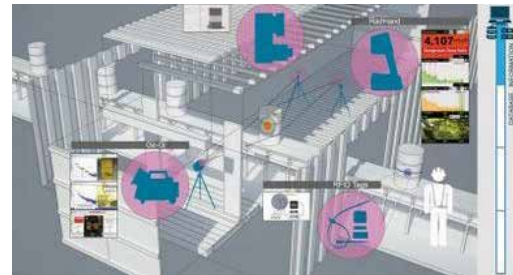
Characterization of Systems for Spectrometry Measurements in Environmental Monitoring, Security and Safety Applications

Radiological measurements are one of the most sensitive measurement related to safety and security applications. When a detection system is deployed in the field, the real time response has to be reliable to better evaluate the situation and its evolution, especially in case of accidents.

When an alarm occurs, there is the necessity to verify the alarm and identify the cause. For this reason, spectroscopic, or combined such as dosimetry and spectroscopy systems are becoming more and more important.



This feature enables benefits like automation of the procedures, fast measurement and alarm reporting, diagnosis reports... The most important characteristics of all these automated systems is the capability to detect, identify and quantify, the radiological threat detected.



To achieve the required performances, it is important to fully characterize all the elements of the systems. In this paper will be described the laboratory tests done to validate the performances of an automated system in harsh environments and its detection and alarm responses. The analysis will cover the temperature compensation algorithm and underwater measurements performed to validate the equipment for each application. Other than the characterization of the sensors with different detector types, a review of the characterization process and the application in different use cases will be presented.

To cover most of the environmental monitoring application was created a family of autonomous and versatile radiological systems to address multiple CONOPS (Concept of operations), the GAMON's. The GAMON platform allows to choose between different systems like spectroscopic or dosimetry sensors with temperature compensation of the energy spectra and high rate compensation.

These systems are designed for different use cases depending on their enclosure type (underwater, vehicle mountable, IP68, drone shell...) and can be easily combined in a network configuration to be deployed in different emergency scenarios.



Measurement Technology for the Radiological Evaluation of Building Structures

Presentation on Measurement Technology for the Radiological Evaluation of Building Structures with special focus on :

- Splinter Protection Stones
- Walls/Ceilings
- Cranes
- Pipes
- Storage Container
- Floors



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Competences in Nuclear Services

Our nuclear services focus on the radiological and material characterization of nuclear residual and waste materials. We offer wide-ranging knowledge in nuclear technologies such as radiation measurement techniques, waste management concepts and nuclear simulations.

As a contractor to waste producers, we have carried out numerous measurement campaigns since 2012 in order to characterize radioactive waste. The documentation for final disposal was generated for qualification of the waste packages in line with the regulatory requirements. AiNT has the license to dispatch staff to undertake on-site measurements in controlled area and has technical qualified personnel for radiation protection. Several expert statements from the TSOs confirm the suitability of the applied measuring methods and performed campaigns by AiNT for the radiological characterization according to the regulatory requirements.



CHARACTERIZATION OF RADIOACTIVE WASTE

- Radiological characterization
- Inventory of hazardous materials
- Waste package documentation
- Re-qualification of legacy waste
- Non-destructive measurements
- Uncertainty evaluation and quantification



MEASUREMENTS FOR CLEARANCE

- In situ gamma spectroscopy
- Development of measurement protocols
- Statistical sampling methods
- Radiological mapping

AiNT develops decommissioning strategies and concepts for the conditioning and packaging of radioactive waste in which we particularly highlight opportunities for cost savings. We support our customers in preparation of application documents and campaign related process plans for process qualification and provide expert advice in the licensing and authorization process.

Furthermore, we perform nuclear simulations based on precise modeling for applications such as radiation transport calculations, determination of activation of materials and modeling of non-destructive measurement systems. With high expectations to our work, we are open to support our customers in their challenging tasks and offer engineering and nuclear services for the safe, effective and efficient management of radioactive waste.

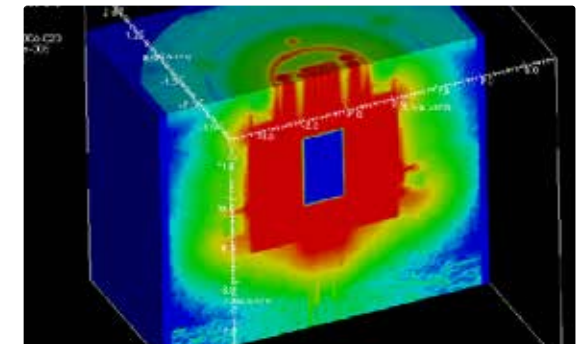
DECOMMISSIONING STRATEGIES & PACKAGING CONCEPTION

- Identification of relevant framework conditions
- Waste package load planning
- Planning of technical realization and resources
- Preparation of schedules and test sequences
- Project controlling



NUCLEAR SIMULATIONS

- Calculation of dose maps
- Activation calculations, e.g. for reactor components
- Simulation of measurement systems
- Design of shielding against neutron and / or gamma radiation



Experts in Nuclear Training

AiNT offers a modular based training program covering fundamental knowledge like „Basics of Nuclear Technology“ as well as advanced modules to specific topics such as „Decommissioning and Dismantling of Nuclear Facilities“ or „Conditioning, Release and Final Disposal of Radioactive Waste“.



Since 2011, more than 1000 people have participated in the modular training program. Our customers include representatives from utilities, nuclear industry research institutions and regulatory authorities. We cooperate with more than 70 lecturers with outstanding professional expertise in our seminars.

Our customized inhouse trainings are well appreciated by authorities and renowned companies such as Siemens, Westinghouse, CNNC, ROSATOM, German regulations authorities and research institutions like the University of Basel.

SNC-Lavalin / Atkins

Founded in 1911, SNC-Lavalin is a global fully integrated professional services and project management company and a major player in the ownership of infrastructure. From offices around the world, SNC-Lavalin's employees are proud to build what matters.

Our teams provide comprehensive end-to-end project solutions to clients in nuclear, oil & gas, mining & metallurgy, infrastructure and clean power.

In 2017 we acquired Atkins and became one of the most complete nuclear services companies in the world. With more lines of business, we now provide complete end-to-end offerings for the entire nuclear life cycle.

Our combined Nuclear team of close to 3,000 talented people are part of one of the most complete nuclear services companies in the world.

We're well positioned to design and engineer the next generation of nuclear power plants, including CANDU® reactors and SMRs. Alongside this, we continue to maintain existing

generating fleets, project manage and perform life extensions, design, advise and install technology upgrades, and safely decommission and manage the waste from legacy facilities.

Together with Holtec International in 2018 we've formed Comprehensive Decommissioning International, LLC (CDI) with the express purpose of creating a company to provide all-encompassing project solutions for the accelerated decommissioning of retired nuclear power plants. By leveraging strong financial histories, technical and project management capabilities, depth in life-cycle fuel experience, and innovation through first-to-market technologies, CDI has positioned itself as a solution provider and leader in this exciting and growing market in the US and is now embarking into Canada and Europe.

Through our subsidiary Atkins Energy Germany GmbH we are providing products and services in radioactive waste management and decommissioning of nuclear facilities including large component removal and segmentation and packaging of reactor pressure vessels and internals.



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Automess GmbH

Our company has approximately 30 employees and has been active in development, production, and sales of nuclear radiation meters since 1970. Our main activity is development and production of portable radiation meters like Dose Rate Meters and Personal Dosimeters. With the various models dose rates in the range of 1 nSv/h (0.1 µR/h) to 10 Sv/h (1000 R/h) can be measured. Our robust, waterproof, aluminium die cast housings allow use of the instruments even in tough environmental conditions.

Our instruments serve radiation protection purposes in the fields of industry, research, working place safety, civil defence, disaster control, and fire brigades.

Many years of experience in the field of nuclear radiation measuring techniques has ensured a high level of development and production based on

state-of-the-art technology. Already in the year 1978 we produced the Scintomat 6134A as the first portable, battery-powered radiation meter which was equipped with a microprocessor.

In 1984 we produced the Dosimeter 219.1 as the first Electronic Personal Dosimeter which was equipped with a microprocessor.

Where required and applicable, our radiation meters are PTB certified (Physikalisch-Technische Bundesanstalt, German National Institute for Standardisation).

In 1995 our quality management system was certified according to DIN EN ISO 9001 and KTA 1401.

Representatives in many countries ensure world-wide sales and service of our products.



Designers and Manufacturers of Systems Based on Semiconductor Detectors and Nuclear Electronics

Baltic Scientific Instruments (BSI) was established in 1994 on the basis of Riga Research and Development Institute for Radio-Isotope Apparatus (RNIIRP, est.1966). RNIIRP had a responsibility for the development of instruments for radiation detection and measurement for the atomic energy industry, mining, oil and gas industries, space and military applications. RNIIRP developed a broad range of products, and the highest level of technical knowledge and skills to meet the most sophisticated technological demands of that time. These are the foundations of the capabilities that BSI now brings to global markets.

Since its founding as a private enterprise BSI has specialized in the development and fabrication of devices for spectrometric analysis based on semiconductor and scintillation radiation detectors. Our products are applied in multiple industries: nuclear power; environmental monitoring; geophysics and the mining industry; medicine and healthcare; research including space sciences; security systems and customs control; and other spheres. To succeed in global markets for radiation detection and analysis equipment BSI has mastered the most demanding quality standards in each market where we have chosen to compete.



Radiation protection is one of the most important parts in industrial safety and is subject to strict legal regulations. Exactly for this sensitive area BERTHOLD TECHNOLOGIES provides highly sensitive and reliable instruments.

The Berthold radiation protection division supplies advanced and reliable detection technology for measurement of radioactive contamination, dose and dose rate, activity and airborne radioactivity concentrations. The portfolio ranges from handheld instruments up to large customer-tailored systems for research, nuclear medicine, nuclear energy and decommissioning.

For many decades, customers have trusted Berthold to support their efforts in creating a healthier world, a safer environment and more efficient manufacturing processes. Our deep understanding of science combined with leading-edge technology empowers our clients with tools and solutions to pursue the most challenging applications -

we improve life in meaningful ways.



The Innovators in Surface Preparation- Surface Preparation Machines and Accessories

Blastrac is the leading international developer and manufacturer of surface preparation equipment. We have a full range of over 50 different machines for preparing & maintaining floors and other surfaces of all kinds of materials. Our innovative techniques are developed in-house, on demand through our strong R&D Department. Our range of equipment includes:

Shot Blaster, Horizontal Steel Blasters, Vertical Steel Blaster, Scarifiers, Multi-task Vehicles, Hand Held Equipment, Single Disc Floor Grinder, Floor Stripper, Dust Collectors. When looking at the use of our equipment we make a distinction between several industries. In these industries some of our machines have specific applications.

These industries are: Remediation, Industrial Flooring, Decorative Flooring, Airports, Highways, Steel.

Blastrac Green Technology- Blastrac offers eco-friendly surface preparation solutions in several industries. Our machines don't use chemical substances or waste valuable drinking water. For a clean environment and future.



Brenk Systemplanung GmbH (BS)

BS has been active in the consultancy business for 40 years now. The services cover the areas of radiation protection, nuclear technology, software development, plant and process engineering as well as radwaste disposal, mining and environmental management. Founded at Aachen, BS has now additional branches in Hamburg, Bruchsal and Andernach, with about 50 engineers and scientists in total.

Our work in the nuclear field is executed under contracts mainly with the nuclear industry as well as with administrative bodies of the EU, international organizations like IAEA and OECD/NEA, national governments and responsible licensing authorities of Federal States of Germany. It covers all aspects of radiation protection, like dose assessments, activation and shielding calculations, calculation of dispersion of radionuclides in the environment, and a large variety of services in the area of decommissioning and dismantling, such as planning, execution of licensing procedures (both in the nuclear and the conventional sector), radwaste management, measurements, decontamination, clearance of materials and buildings and release of sites. We provide

a broad set of measurement devices for radiological characterisation and clearance, including nine in-situ gamma spectrometers, several laboratory gamma spectrometers, contamination monitors etc. Our extensive software packages installed at several NPPs in Germany support clearance processes considerably.

We also deal with NORM and radioactive materials discovered in scrap or waste loads. Our license for handling radioactive substances allows us to offer complete waste management solutions from a single source.

Our activities in the field of radwaste disposal cover the entire (project) life cycle of a disposal facility for radioactive waste: site selection, execution of (long-term) safety analyses, planning and construction as well as operation and management issues of repositories and their decommissioning and dismantling, both for deep geological and near-surface repositories.

Several of our employees are appointed members of advisory bodies like SSK (Commission on Radiation Protection) and ESK (Nuclear Waste Management Commission) as well as and of international working groups of IAEA, EU and OECD/NEA.



CAEN SpA spectroscopy division - Innovative Nuclear Measurement Systems

CAEN SyS is the new Spectroscopy Division of CAEN SpA. Such division relies upon an extremely strong foundational knowledge of nuclear measurement instrumentation in developing Radiation Measurements Systems and Spectroscopy Solutions.

These systems and solutions are perfectly suited to operations involving Nuclear Fuel Facilities, Nuclear Power Plants, Measurements Laboratories, and Security Applications. CAEN SyS is committed to delivering exceptional nuclear measurement instrumentation, expertise, and technical support.

The Gamon Platform is a global measurement platform for Nuclear Safety and Security whose goal is maximize public security response capability, rapid assess of risk and action in the case of accident or terrorist threat. Gamon Platform empowers authorities and institutions with the ability to respond to a wide range of operational activities and complex radiological situations in a single, simple, reliable solution. SNIPER-GN is a compact and transportable instrument which integrates a Special Nuclear Material isotope identifier with a

high-resolution hand-held gamma detector.

It integrates the identification of gamma ray emitters and NORM sources together with the unique features of neutron source identification with discrimination between fissile material, alpha-n source, Plutonium and Uranium. The Digiwaste platform is the first fully comprehensive solution which provides seamless digitization of D&D activities but it is not limited to them because the system offers easy tracking of any type of radioactive material or object produced via various kind of operations thanks to the use of specialized, radiation tolerant UHF RFID tags.

In addition to these 3 families CAEN SyS is also able to provide complete solution in other fields like:

- Low-background measurement field (WBC system @JRC Ispra)
- Fresh fuel bars assembly qualification (FNCL system to the IAEA)
- Complete HPGe spectroscopic chain with Digital MCA (Hexagon) and our SW „QUANTUS“



Zero carbon transition as a service.

Our diversity is what makes us unique: at ENGIE Deutschland GmbH, we combine competence from the areas of technology, energy, and service to create an overall portfolio which allows us to tackle even the most demanding tasks. Our well-founded knowledge in all areas of construction technology is the basis for our outstanding solutions in complex plant engineering and technical building management, and for innovative energy services in the areas of energy contracting, energy management, and energy efficiency. Our portfolio is rounded off by the competence in refrigeration technology offered by ENGIE Refrigeration GmbH.

We use our know-how, our technical infrastructures, and our individual services, to help our customers make their buildings, facilities, and core processes more efficient. This means: increased availability and greater quality whilst maintaining reliable operational readiness and improved flexibility - and without sacrificing the valuable cost advantages we offer compared to competitors.

The more than 100 years of experience that our companies boast, and the power of the global ENGIE Group make us a partner who knows how to best utilise energy every day - including the energy of the people working with us.



Building services for NPP dismantling We are your partner for building services systems when dismantling nuclear and radiation-protected plants.

Technical building equipment in the fields of radiation protection and nuclear technology is held to very high standards: here, only 100 percent counts. If a radioactive waste storage facility is to be conditioned or a pressure differential system is to be implemented in a reactor building, the technology must function with absolute reliability.

We are experts in complex supply and disposal systems in nuclear plants. We concentrate our know-how particularly on the dismantling of nuclear plants and their associated auxiliary facilities. We promise engineering, execution and commissioning and all downstream maintenance work from a single source: on time, with cost transparency and responsibility.

Trades in which we are proficient

- Air conditioning
- Electrical engineering
- Fire protection technology and sprinkler systems
- Heating technology
- Industrial sanitary technology
- Measuring and control technology, building automation
- Process technology: Water (supply and disposal), compressed air
- Refrigeration



Nuclear Service Provider, Experienced in D&D

Tecnubel is an international provider of integrated services for the decontamination and decommissioning of nuclear installations, with over 30 years of experience in providing advanced solutions for the nuclear industry.

We provide a wide range of services such as the maintenance and clean-up of nuclear installations, including waste management and decommissioning. Through our subsidiary Transnubel, we transport radioactive material and provide engineering services, including the design and construction of transport and storage containers. An example of this last is the developed and licensed high integrity cask CAROLINE we presented last ICOND 2019. This packaging is a type B(U) with a large cavity for the transport and (interim) storage of high activated radioactive

material and/or waste. CAROLINE can be equipped with extra shielding and/or drainage to also allow underwater loading. Next to this cask, dedicated manipulation and transportation means have been developed and are available.

We also support various nuclear players in their development of a complete Safety Culture by offering radiological protection, consultancy and safety training services.

At Tecnubel, health and safety, physical control, nuclear security and quality assurance departments are integrated, which enables to share experiences and skills. Therefore, we rely on the Transnubel physical control department to circulate the principles of a good Nuclear Safety Culture throughout the

complete organization. We also benefit from the training expertise, to meet internal requirements for the development of the staff. The introduction of a single Human Resources department and implementation of a «training and skills» procedure that applies to the whole company, enables exchange and a faster availability of skills.

Tecnubel has become the contractor for Nuclear Safety Culture training at the Belgian Doel nuclear power plant. From the beginning of 2020, we are operating a prevention fire service at Doel. This service is assured by a team of 40 Fire Safety Officers, operating 24h/24.

We obtained authorization to operate a nuclear installation in Dessel (Belgium) in order to carry out maintenance, decommissioning and decontamination works, as well as to store contaminated radioactive materials there. In 2018, we received an operating license for a second installation, equipped as a workshop and located at Villers-le-Bouillet (close to the Tihange NPP), to decontaminate and condition equipment and material from nuclear installations from Belgium, Germany and wider abroad. With these different installations, Tecnubel also has additional controlled areas for storing the equipment needed for overhaul of the Belgian and German NPPs.

With the successful decommissioning of the Belgonucleaire MOX fuel facility and dedicated preparation works for the own fleet of NPP's, both in Belgium, Tecnubel gained useful and practical experiences that are used by engineers and operators to help German operators and institutions in their decommissioning challenges, such as in Duisburg, Karlsruhe and Biblis.

To conclude, Tecnubel is your partner from the beginning of your project until the end and offers a full spectrum of technical skills and capabilities in the field of decontamination and dismantling. We gained a lot of experience in D&D due to our active participation in planning and successful execution of decommissioning projects, such as ONSF (old Best Medical production site) at Fleurus and Framatome FBFCi in Belgium, as well as on different German sites. We own a wide range of materials and tools for executing D&D projects, including remote controlled equipment (robotized vehicles, electric and mechanical master/slave manipulators, etc.).



More than 60 Years of Nuclear Experience by your Side

Tractebel provides a full range of engineering and consulting services. As one of the world's largest engineering consultancy companies and with more than 150 years of experience, it's our mission to actively shape the world of tomorrow. With about 4,400 experts and offices in 33 countries, we are able to offer you multidisciplinary solutions in energy, water and infrastructure.

For over 60 years, Tractebel has been developing reliable and innovative solutions in nuclear engineering. Our high-level engineering and consulting services offer added-value, with an uncompromising approach to safety, across the full lifecycle of nuclear installations, from design to decommissioning. Developing your decommissioning project cost-effectively.

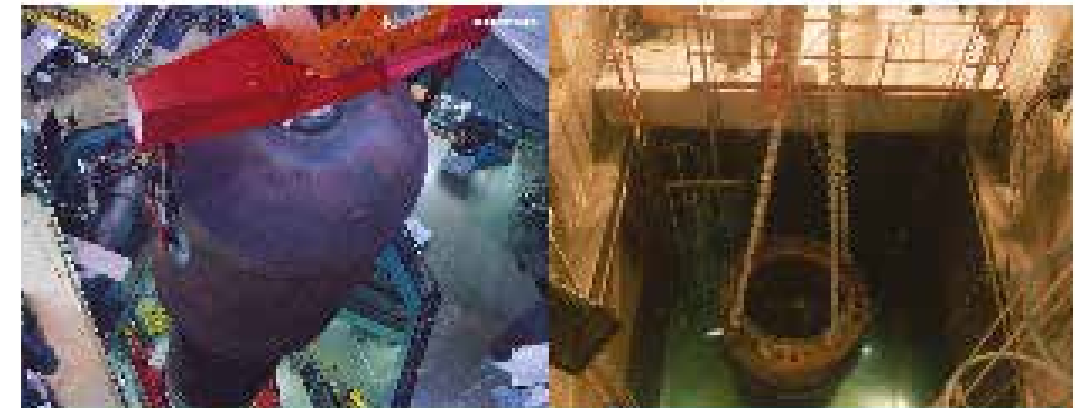
We offer tailor-made and cost effective services for preparing the post-operational and decommissioning phases. We act as project manager or architect / owner's engineer to support the implementation of your decommissioning activities and to follow-up the execution. Our integrated approach encompasses safety & licensing, civil works, nuclear systems, mechanics and handling, radiation protection and waste management.



Our main services

- Inventory of Equipment and Structures;
- Radiological Characterization of Systems and Equipment;
- Design of Waste Management Facility dedicated to the processing of decommissioning waste;
- Definition of Decommissioning Scenarios:
 - o Selection of decommissioning techniques;
 - o Drafting of decontamination and decommissioning procedures;
 - o Feasibility studies for the removal of Large Components, including structural and lay-out studies, mechanical studies (e.g. pre-cutting activities, handling operations ...) and definition of removal sequence and schedule;
- o Cost-benefit analysis & Schedule Optimization;
- o Evaluation of quantities of waste generated;
- Decommissioning Plans, Safety Analysis Reports, Environmental Impact Reports;
- Development of Decommissioning Radiation Protection/ALARA Program.

Developing your decommissioning project cost-effectively



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change

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Website www.framatome.com



Fortum – Join the change

Fortum is a leading clean-energy company developing and offering solutions for our customers in electricity, heating, cooling, as well as solutions to improve resource efficiency.

For the nuclear industry, we offer outstanding expertise and innovative solutions across technical disciplines and for all phases of the nuclear power plant life cycle. From the design and licensing of a new plant through safe operation of the nuclear power plant all the way to the decommissioning and final disposal of nuclear waste, our 40 years of experience gives us world-leading capabilities.

Expertise over the nuclear waste lifecycle - As both a nuclear power plant and nuclear waste facility licensee and operator, we have unique experience in optimising strategies and solutions for nuclear waste management. We can help our customers to significantly reduce the waste volumes and waste management costs at nuclear power plants by optimising the entire process, from waste collection to final disposal.

We offer nuclear waste management solutions for new builds, operating nuclear power plants and plants under decommissioning. Tailored to customers' needs, the scope of our delivery can vary from small scale consultancy assignments to turnkey deliveries of waste management solutions.

Unique customer value by innovations - Our proprietary technologies, like NURES® for nuclide removal, Apros® for dynamic process simulation, ADLAS® for licensing and ReMaint® for maintenance optimisation, enable us to deliver unique customer value and benefits.

We are also pioneers in the nuclear industry in the utilisation of 360° videos, digitalisation, virtual and augmented reality in our daily work to boost efficiency of power plant maintenance, as well as engineering and personnel training.



Framatome in Germany - Our customers' performance is our everyday commitment!

Framatome is a major international player in the nuclear energy market recognized for its innovative solutions and value-added technologies for designing, building, maintaining, and advancing the global nuclear fleet. The company designs, manufactures, and installs components, and fuel and instrumentation and control systems for nuclear power plants and offers a full range of reactor services.

With 14,000 employees worldwide, every day Framatome's expertise helps its customers improve the safety and performance of their nuclear plants and achieve their economic and societal goals.

Framatome is owned by the EDF Group (75.5%), Mitsubishi Heavy Industries (MHI – 19.5%) and Assystem (5%).

Framatome in Germany also offers a competitive solutions portfolio for the post-operational-phase and dismantling of nuclear power plants which contains: studies, engineering, system decontamination, sampling, characterization, radiation protection, waste management, waste treatment and backfitting of (mobile) operating systems.



Competence for Nuclear Services

GNS Gesellschaft für Nuklear-Service mbH offers comprehensive solutions for the management and disposal of spent nuclear fuel and all types of radioactive waste from the operation of nuclear power plants based on its nuclear expertise of more than 40 years.

For more than three decades, GNS has been responsible for the management of all the radioactive waste and the spent nuclear fuel resulting from the operation of the German NPPs. Its products and services comprise the design and manufacturing of casks and containers for intermediate level waste (ILW) and high level waste (HLW), the construction of equipment for conditioning and packaging of wastes as well as the operation of conditioning facilities and preparations for final disposal. For nearly three decades GNS also operated the central interim storage facilities for HLW, ILW and LLW at Gorleben and Ahaus.

MOSAİK® casks and GNS Yellow Boxes® for ILW are in use today in a number of countries on four continents. This makes GNS the world's top supplier of shielded transport and storage casks.

GNS treats both solid and liquid radioactive waste and applies suitable treatment processes to ensure acceptability of the waste for interim storage and final disposal. In this context a large number of data and information needs to be acquired, documented and updated. For that GNS offers comprehensive software and database solutions, e.g. for tracking operational waste or residues from decommissioning.

For all phases of decommissioning GNS offers solutions from defueling to dismantling and packaging of RPVs and their internals and also other primary circuit components. Experienced activation calculations facilitate efficient cutting and packaging as well as minimal dose rates.

More than 1.800 spent fuel/HLW casks of the CASTOR® and CONSTOR® type and around 8.000

With its 450 employees GNS achieves a turnover of more than 250 million Euros.



HEBETEC Engineering Ltd - Partner for Nuclear Decommissioning - Lifting - Lowering - Moving - Support Heavy Loads

Hebetec offers comprehensive services in the lifting engineering area being supported by long lasting experience of its employees.

Thanks to the large variety of specialists, such as mechanical and civil engineers, hydraulic experts, mechanics and experienced assembly supervisors, the company can revert to an extensive knowhow on most different sectors of the lifting engineering and thus appear as a competent partner.

The field of activities ranges from the preparation of concepts over execution like lifting, lowering or sliding heavy loads down to leasing of hydraulic equipment which largely has been developed in house.

Hebetec Engineering AG offers solutions for the safe and efficient decommissioning of Nuclear power plants.

The minimisation of the collective dose rate is of paramount importance to our professional and proper dismantling always in the foreground. Experienced engineers advise, work out proposals for solutions, plan and accompany our customers' projects until their successful completion.

Hebetec Engineering AG takes over the overall planning and the coordination of the specialized partners for individual works. Through detailed planning as well as close and timely coordination we minimize delays and security risks.

Our services:

- Engineering - Customized Solutions - Planning
- Coordination - assembly and disassembly - moving, lifting, lowering of components
- Crane work - Road transport - Specialized expert and assembly teams



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Track your Nuclear Waste, Everywhere it Goes

JE Project is a tech company specialized in creating custom software built around your business needs. We build easy to use and robust databases, which provide key information in real time to personnel in order to maximize their time and efficiency. We also automate many systems and procedures, saving you time and money.

Our tracking system has gained fast recognition in the health and safety departments due to its ability to track the propagation of COVID-19. It is a very reliable tool for today's safety.

The main purpose and goal of the system is to analyze the behaviors and patterns of people and objects in order to improve safety, workflow and efficiency at the workplace.

Nuclear facilities, logistical centers, health care facilities (hospitals and clinics), retail, warehouse, factories, sports venues and tourism are only some of the sectors from our customer list.

Our software can communicate with other databases and IoT devices making them fully adaptable to your current system. The goal of our system is to adapt to your system and work seamlessly alongside your current system, to expand its capabilities and functions.

Feel free to contact us at info@jeproject.gr for any questions. Let's discuss how we can increase your safety, security and efficiency. We'll be happy to share with you our ideas.



Konecranes Nuclear Lifting Expertise

Konecranes is a world-leading group of Lifting Businesses™, serving a broad range of customers, regardless of your lifting needs, Konecranes is committed to providing you with lifting equipment and services that increase the value and effectiveness of your business.

The Konecranes organisation brings the expertise of Konecranes Nuclear Equipment and Service (KNES) providing cranes designed specifically for nuclear applications combined with our experience in providing cost effective designs with shorter delivery periods using our state of the art COTS crane components (especially suited to Decommissioning Applications).

Our quality control program ensures that each nuclear crane and component is designed to meet or exceed all mandated standards.

Service & Modernization - our extensive network services all makes and models of material handling equipment worldwide to support the nuclear industry. Services include outage support, inspections, repairs, and maintenance. We provide any OEM parts for any brand of overhead crane or hoist including re-engineered & re-manufactured parts (motor rewinds, brakes, etc.).

RailQ generates 3D and 2D graphs of the runway rails and identifies misalignment and other problems of your cranes.

RopeQ wire rope inspection - visual and Non-Destructive (NDT) rope inspection service that examines what you cannot see with a visual only inspection.





Only development makes us who we are.

Krantz develops, designs and manufactures air distribution systems, cooling and heating systems for ceiling and facade installations as well as exhaust gas filtration, dampers and clean air solutions.

We are the expert partner at your side at all times, especially concerning plant construction and ventilation services for nuclear power stations.

Our products enjoy an excellent reputation and are used where quality and reliability matters, in both public and in commercial buildings. Examples are clean rooms, nuclear installations, high security laboratories and isolation wards.

Krantz designs, manufactures and sells Filter Systems and Dampers for HVAC systems in areas with highest tightness requirements as nuclear facilities, bio-safety laboratories, isolation wards, decommissioning of chemical weapons etc.

The department Krantz Air Technologies is responsible for the business areas of nuclear technology, process air technology and specialized technical solutions.

This includes three nuclear and conventional business units:

- > Plant Engineering and Construction
- > Service and Maintenance
- > Measurement and control technology

Thanks to over 45 years of experience in planning, installation and maintenance of air distribution systems in, for example nuclear power stations and laboratories, Krantz is able to serve the entire life cycle fulfilling the highest requirements and quality standards. As a result of the focus on specialized solutions for very sensible areas with exceptional high requirements, the nuclear industry became a very important client sector. participated in the construction of many nuclear power plants and hence gained comprehensive in depth knowledge, which can also be utilized for the dismantling of nuclear power stations.



Your Radiation Shielding Production Facility

Nuclear Shields is a manufacturer of radiation shielding based in the Netherlands with more than 40 years of experience. The production facility is designed to meet the requirements of long term serial production and one-off custom projects.

Lines of communication are short due to our small team of sales and engineering personnel. The focus on good and fast communication with the client helps us improve our services every day and makes sure the customer is satisfied.

Our production facility includes all departments needed to fully complete long term serial production and one-off custom projects. Departments include:

- Lead casting department
- Full CAD/CAM design
- CNC machining department (5-axis, milling and turning)

- Spray-painting department
- Assembly department
- QC department, including CMM and gamma cameras

Next to the standard solutions, we manufacture radiation shielding solutions based on customer specific requirements and drawings. Communication lines during this process are short to make sure all needs are satisfied. Our standard products can be found on our website.

We manufacture a wide array of radiation shielding solutions, such as:

- Nuclear waste containers / casks
- Shielded glove boxes
- Shielded shutters
- Shielded storage boxes
- Custom lead parts





Mirion Technologies: your preferred Partner for D&D Challenges and Safety in Radiation Measurements

Mirion Technologies is a leading provider of products and services related to measurement, detection and monitoring of radiation. Mirion is built on 60 years of experience in research, problem-solving and product development. We approach our work through a lens of curiosity and rigor, with a spirit that compels us to question and constantly drive innovation in our field.

As one of the global leaders in radiation measurement with over 1800 talented professionals, the mission is driven to protect people, property and the environment from the harmful effects of ionizing radiation.

To serve our customers all over the world Mirion maintains locations on different countries. Therefore, we can provide local support according to the country specific requirements for radiation safety.

The portfolio of Mirion Technologies embraces a large variety of solutions for spectroscopy, radiation detection health-physics and camera applications.

For D&D and especially for NDA applications Mirion has broadened their portfolio to provide solutions also for challenging projects. By applying state of the art of technology and science and following the customer's needs, these products are constantly developed further.

Mirion works with great partners to always be able to provide the best solutions and expand possibilities. Especially automatization and robotics applications are a new, exciting field for D&D applications.

Visit our booth to learn more about our capabilities for D&D and radiation safety. We are looking forward exchanging with you!





NucTecSolutions GmbH - Radiation Protection, Decommissioning and Emergency Management

NucTecSolutions GmbH was founded in 2006 as a radiation protection services and decommissioning company. As a multidisciplinary service company, we have the possibility to provide services of all kind with radioactive substances in all areas. Our passion is radiation protection and measurement technology. Every day we deal with radioactive and other hazardous substances. We continuously pursue one goal: always provide our customers with the best, most innovative and most efficient radiation protection solutions.

We are characterized by a strong innovation performance and an enormous willingness to develop. Our own measuring technology, new decontamination processes or special shielding techniques are part of our everyday life and are topics that we master.

This combination provides an efficient service in radiation protection, decommission and renovation at the highest level of cost effectiveness. A direct connection between planning, radiological analysis, dismantling, decontamination and measurement for the release of radioactive material is quite useful for small- to medium-sized projects.

Our main services are:

- Measuring technology
- Dismantling and decommissioning
- Waste management and waste treatment
- Decontamination procedures
- Radiation protection engineering
- Radiological analysis
- Project engineering

After several incidents, NucTecSolutions GmbH decided in 2014 to include services for nuclear emergency into the portfolio. Since 2019 the services for nuclear emergency are outsourced to the newly established SENS (Special Forces Nuclear Safety) to further improve the capability to handle nuclear emergencies.

NucTecSolutions GmbH stands for high-level radiation protection combined with efficient decommissioning. This is the principle of the Radiation Protection Act, which we live in our company. Everyone in our team acts according to this maxim - day after day, project for project!



NUKEM Technologies Engineering Services – Your Partner for Nuclear Engineering Solutions

The NUKEM Technologies Group is world-wide active in the areas of radioactive waste management, the decommissioning of nuclear facilities and engineering.

Our engineers offer the entire range from concepts and feasibility studies up to development, procurement and supply of waste processing facilities as well as construction of complete waste treatment plants.

The decommissioning, decontamination and dismantling of nuclear facilities require not only a comprehensive technical know-how, but primarily a solid understanding of legal approval procedures.

Our long-standing experience is instrumental in determining the needs of the operators of nuclear power plants or other nuclear facilities.

We offer our customers a broad spectrum of services in engineering and consulting as well as radiation protection.

Consistent customer focus and quality management are fundamental to our corporate policy. We place a high premium on personalised customer service, timely project completion, providing our customers with clear and comprehensible documentation and superior quality products. A visible sign of our emphasis on quality is our quality assurance system based on DIN EN ISO 9001:2015. German energy suppliers have also confirmed our compliance with the quality assurance standards set forth in KTA 1401. Furthermore, we are certified pursuant to DIN EN ISO 14001:2015 and OHSAS 18001:2007.

Our project quality management is certified through our compliance with ISO 10006. In addition, we hold other international certificates issued in Russia, Lithuania and France.



Alpha-tight Housings and Protective Systems from PEDI Ensure the Personal and Environmental Safety during Dismantling Procedures.

Since more than 60 years, PEDI AG is a competent partner for the nuclear industry all over Europe. The company is specialized in developing, manufacturing and selling of protecting and shielding products for persons and environment. During the dismantling process of radioactive contaminated equipment, components or building structures, the use of tight housings or encasements is necessary, stopping the distribution of airborne particles and dust. For this purpose, PEDI uses flexible housing materials with high mechanical properties and certified for the use for alpha-tight encasements. A so called dismantling tent serves as a work place for cleaning or maintenance or dismantling activities. Particularly, it can be used for storage or handling of radioactive substances in solid, liquid or gaseous condition. The decontamination tent includes a solid frame structure and a flexible housing. The frame structure remains completely outside of the tent, so it remains free of contamination. The inner space of the housing is completely empty and easy to clean. The housing is

permanently evacuated down to -200 Pa. After use, the tent housing will generate a minimum of waste in weight and volume.

In the field of Personal Protective Equipment, a vast range of established protective suits and auxiliaries is available: Depending on the method of operation, the suits are designed for integral ventilation or to wear with mask, for single or multiple use, for light or heavy works.

For the ventilated suits, a breathing air supply is needed. The PEDI air supply and air distribution components are engineered for high reliability, durability and long live cycle. Due to these characteristics, PEDI products assure an immediate readiness for operation at every time. Airborne particles can be collected with a variety of air samplers, test swabs (smear tests) and screening tests, allowing an efficient air monitoring right around the clock. More information on www.pedi.ch



SENS (Special Forces Nuclear Safety) – Nuclear emergency preparedness and response

NucTecSolutions GmbH has founded the task force SENS (Special Forces Nuclear Safety) due to several incidents involving radioactive substances.

SENS benefits of the know-how, first-class personnel and equipment from the NucTecSolutions GmbH. The focus of SENS is the development of decontamination methods, as well as decontamination and the measurement of radioactive substances after an accidental spread in buildings and urban terrain.

Specially developed systems, such as mobile negative pressure maintenance, mobile fully automated environmental monitoring systems and mobile waste treatment stations are just a few components for the accident-related handling of radioactive materials. In areas without any infrastructure, you can easily attach our radia-

tion protection systems to buildings. Since our components are built as dual systems, it is also possible to easily set up adequate infrastructure for normal dismantling.

The combination of continuous activities in radiation protection, decommissioning activities and nuclear emergency protection is optimal for NucTecSolutions GmbH and SENS, since in case of emergency there is sufficient material, measurement equipment and a well-trained team available for deployment. As for the decommissioning, a team with emergency protection experience in case of unpredictable events during work, is quite reasonable.



Specialist for Decommissioning and Waste Management in Nuclear Facilities

ROBUR ENERGY is part of ROBUR, an industrial service provider with more than 2,000 colleagues. With more than 25 years of experience as a successful service provider and about 250 employees we support nuclear power plants, nuclear facilities and manufacturing firms. Experienced, specialized teams

for maintenance, inspection, decommissioning and waste management, as well as our well-established proprietary EAM software (incl. operations management/waste tracking systems for NPPs) ensure successful projects.

Regarding the NPP services we are focused on following services:

Post-operation & dismantling

- Decontamination, gutting and demolition of components and buildings/NPP as well as entire sites ("greenfield")
- Removal and decommissioning of highly contaminated systems, machines and plants using powerful equipment and remote-controlled appliances
- Cross-departmental decommissioning projects
- Operating residual material processing centers
- Provision of specialist personnel to support post-operation and decommissioning as well as operation of residual material processing centers

Handling and conditioning

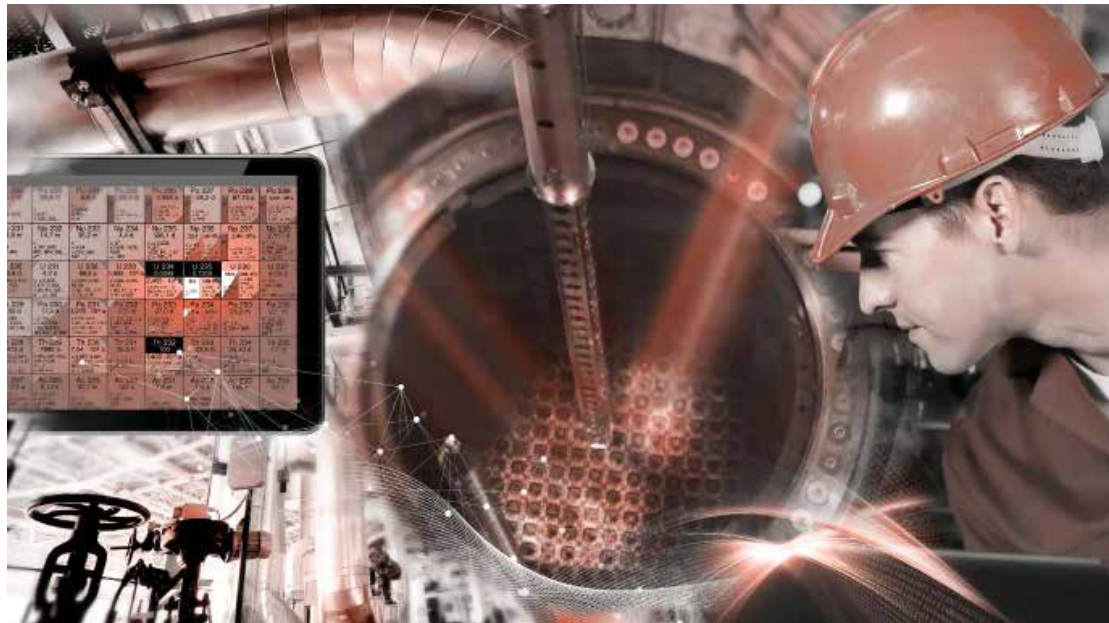
- Disassembly and sorting of contaminated waste with consideration to nuclide vectors and acceptance criteria
- Assessment and radiological characterization of historical waste according to waste disposal legislation
- Conditioning and waste package production for the final repository, incl. disposal documentation
- Planning/implementation of waste treatment systems, special machines, remote controlled systems

Waste management

- Disposal planning for waste material eligible for clearance
- Complete solutions for the operation of waste management facilities
- Disposal/handling solutions for (TE)-NORM waste
- Clean up of hazardous waste from industrial sites

Extract of our certificates

- Permission in accordance with § 25 StrlSchG
- SCC^p/SCC^w/SCP
- DIN EN ISO 9001 & KTA 1401
- Handling agent for hazardous waste (KrWG)
- Asbestos and man-made fiber removal, work in contaminated areas



Sweco is an International Consulting Company Offering Services in the Fields of Consulting, Engineering, Environmental Technology and Architecture. We are No. 1 Architecture and Engineering Consultancy in Europe.

Having accurate inventory of the nuclear plant for planning and execution, including up to date quantities, materials, locations and radiation levels, creates basis for a successful and safe decommissioning. Digital twin of the plant can provide that information and it can be utilized throughout the project. The 3D presentation of the plant makes it easy to communicate and understand what, where, how, who and when. Visualization of the present, options and what-if scenarios, makes the digital twin a powerful tools for optimization, making informed decisions and ensuring compliance as well as safety.

SMART SOLUTION FOR NUCLEAR DECOMMISSIONING - Digital Twin Platform for Decommissioning Planning and Execution

Sweco's solution utilizes fast laser scanning technology to create a point cloud of the plant. The point cloud is then turned into a digital twin of the plant. This usually is a very time-consuming manual process but with Sweco's AI solution we can speed up the process and create digital twins to the required level of detail.

- Deliver Business Success: Optimize planning, costing, verification, simulation, execution and tracking of decommissioning using 3D and augmented/virtual reality
- Going Beyond Compliance: Up to date and visual information that is easy to understand and use for training, risk management and safety planning
- Circular Economy Leadership: Enables maximizing of deconstruction waste recycling, turning recyclable deconstruction waste also into value



TS Quadrat GmbH - Your Strong Partner for Nuclear Technology / Waste Management

TS Quadrat GmbH - a spin-out of Liese GmbH - is a nuclear engineering specialist for materials handling technology and special purpose system construction.

We provide in-depth, comprehensively planned and documented systems and components for safely handling radioactive waste during operations or decommissioning of nuclear facilities.

These include:

- Conveying and handling systems for drums, pellets and containers
- Gamma measurement stations in cooperation with Marschelke Messtechnik (software engineering) and ORTEC® AMETEK® GmbH (nuclear instrumentation)
- Flame cutting systems
- Drum and pellet scanners
- Lidding stations
- Filling stations
- Cementation stations
- Supercompaction systems
- Weighing systems
- Gantry crane systems
- System control and monitoring solutions
- Special and bespoke processing plants

Many of the above systems can be designed as mobile solutions to suit the customer project.

We offer our customers full-service support from planning, design and documentation to production/execution.

As our customer, you benefit from the experience and expertise our team has gained from the large number of projects we have successfully completed over the past decade - plus our quality management system that has been certified in accordance with DIN EN ISO 9001:2015.

For more information, please visit www.tsquadrat.com or reach out to us directly for a more detailed conversation on how TS Quadrat GmbH can solve your problem.



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Die richtige PSA zur richtigen Zeit am richtigen Ort

Die UniTech Services Group ist mit zwei Verarbeitungsanlagen und Forschungs- und Entwicklungsstandorten der führende Anbieter von Schutzkleidungsmanagement-Dienstleistungen für die Nuklearindustrie in Europa. Der Hauptzweck dieser Dienstleistung besteht darin, sicherzustellen, dass der Kunde die richtige PSA zur richtigen Zeit am richtigen Ort hat.

Seit 2012 bietet die UniTech Service Group auch einen Gerüstmonitoring- und Dekontaminationservice an. Für weitere Informationen zu unseren internationalen Kapazitäten besuchen Sie bitte unsere Website www.unitecheu.com.

UniTech bietet auch eine Mobile Supply Store-Lösung an, bei der Produkte in einem rollenden Lagerhaus direkt an Ihren Standort geliefert werden.

UniTech bereitet derzeit den Bau einer neuen Verarbeitungsanlage im französischen Haute Marne vor, die im November 2019 eröffnet werden soll. Diese Anlage wird zusätzlichen Service-Support durch einen eigens errichteten Zwischenlager- und Leasingbereich für kontaminierte Materialien und eine eigene Arbeitszone für TMD-Arbeit bieten.



VND – The nuclear decommissioning experts

The last nuclear power plant in Germany will be shut down in 2022, thus completing the nuclear phase-out. But even without being on the political agenda, nuclear power plants around the world are reaching the end of their technical lives and have to be decommissioned and dismantled.

Dismantling these nuclear facilities, as well as dealing with radioactive waste and residual materials and treating them prior to clearance and final disposal, necessitates extensive know-how and compliance with a wide range of regulations. This will pose great challenges for operators of nuclear facilities in the future. In October 2017, VPC therefore decided to create the Nuclear Services business line with the goal of accompanying the administrative and technical process of decommissioning and dismantling nuclear facilities, and implementing it safely and efficiently end-to-end.

The success of the business line on the market and its strong growth led to it being separated from VPC GmbH on 1 January 2020 and spun off to form an independent company, VPC Nukleare Dienstleistungen GmbH (VND). With their knowledge of the treatment of residual materials and the final storage of radioactive waste, the VND staff continue to bring their experience and expertise to bear in dealing with the complex tasks facing their clients.

VND is a member of the Dornier Group and can thus also apply its expertise in energy-related tasks in the important infrastructure areas of plant engineering and operation, energy and environmental technology, renewable energies, mobility, aviation, water and real estate, and, conversely, can access the resources of these Dornier Group business lines.

