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International Conference on
Nuclear Decommissioning

6th
Edition



BOOK *of* ABSTRACTS

November 2017

Organizer



in cooperation with



TÜVRheinland®
Genau. Richtig.

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ICOND

International Conference on Nuclear Decommissioning

7th
Edition

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aachen

**NOVEMBER,
06TH - 08TH 2018**

PRE-CONFERENCE WORKSHOP ON NOVEMBER, 05TH

THEMATIC OVERVIEW

- ☒ **Strategies & Decommissioning Management**
- ☒ **Licensing & Supervisory Procedure**
- ☒ **Economical Optimization**
- ☒ **Waste Management & Final Disposal**
- ☒ **Experiences & Perspectives in Decommissioning**
- ☒ **Dismantling Technologies**



ORGANIZATION

AiNT
Aachen Institute for Nuclear Training

IN COOPERATION WITH

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IMPRINT

AiNT

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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 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 eingebunden sind.

Ausgehend von Fachvorträgen diskutieren die Teilnehmer/-innen die Herausforderungen des Rückbaus sowie Planungsvarianten für individuelle Rückbaufaufgaben. Die Vorträge werden überwiegend in deutscher Sprache gehalten. Alle Beiträge, außer beim Pre-Conference Workshop werden simultan übersetzt (Deutsch/Englisch).

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 International Conference on Nuclear Decommissioning (ICOND) focuses on the relevant legal parameters in Germany. ICOND also compares the scope of the decommissioning task in Germany with that in other countries (e.g., South Korea); considers the roles of authorization, financial planning, and change management in the transition from nuclear power plant to decommissioned project; and examines the options for interim storage and disposal of radioactive waste, a decisive concern for future decommissioning projects.

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 supervision procedures 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) will be available.



RÜCKBLICK

ICOND 2016

REVIEW

Die nunmehr fünfte ICOND - „International Conference On Nuclear Decommissioning“ – wurde im November 2016 in Kooperation mit dem TÜV Rheinland und der belgischen Firma TECNUBEL im Eurogress in Aachen durchgeführt. Von den ca. 290 Teilnehmern/-innen kamen in diesem Jahr 32% aus dem Ausland, womit der Trend einer immer stärkeren Internationalisierung der ICOND weiter anhält. Darüber hinaus präsentierten mehr als zwanzig Firmen während der Veranstaltung neue Produkte und Dienstleistungen im Ausstellerbereich und nutzten die Möglichkeit, Kontakte zu knüpfen und zu pflegen.

Der Fokus der ICOND 2016 lag auf aktuellen Entwicklungen in den Bereichen des Rückbaus und der kerntechnischen Entsorgung sowie auf Erfahrungen aus laufenden Rückbauprojekten im In- und Ausland. Frau Heinen-Esser, Geschäftsführerin der neugegründeten Bundesgesellschaft für Endlagerung mbH (BGE), stellte die Ergebnisse der Kommission Lagerung hoch radioaktiver Abfallstoffe vor. Herr Homan, Geschäftsführer von PreussenElektra, berichtete über die Planung der eigenen Rückbauprojekte und zukünftigen Entwicklungen.

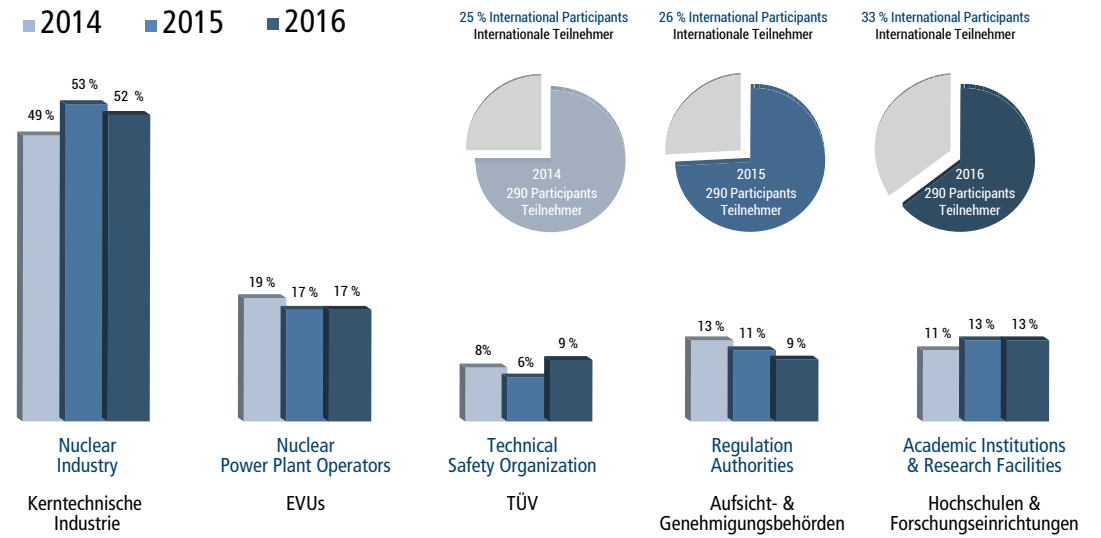
Im Rahmen des Pre-Conference Workshops wurden neuartige Technologien und deren Einsatz in nationalen und internationalen Rückbauprojekten vorgestellt. Zu Beginn der ICOND standen die aktuellen gesetzlichen Regelungen sowie Erfahrungen aus laufenden Rückbauprojekten im Fokus.

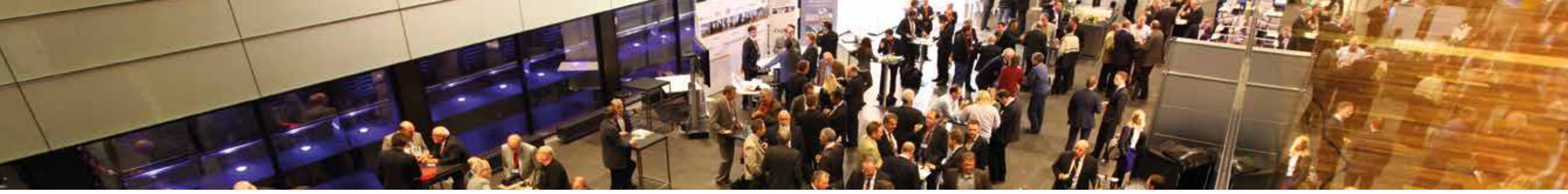
The fifth International Conference on Nuclear Decommissioning (ICOND) was held in November 2016 in cooperation with TÜV Rheinland and the Belgian company TECNUBEL in the Eurogress in Aachen. Of the approximately 290 participants, 32% came from abroad, underscoring the trend of an increasing internationalization of ICOND. In addition, more than twenty companies presented new products and services throughout the event and used the opportunity to cultivate or establish contacts.

The focus of the 2016 ICOND was on the latest developments in the fields of decommissioning and nuclear waste disposal, as well as on experiences from ongoing decommissioning projects in Germany and abroad. Ms. Heinen-Esser, Managing Director of the newly founded Bundesgesellschaft für Endlagerung (BGE), presented the results of the "Commission on the Storage of High-level Radioactive Waste." Mr. Homan, Managing Director of PreussenElektra, reported on the planning of their own decommissioning projects and future developments.

At the Pre-Conference Workshop, new technologies and their use in national and international decommissioning projects were presented. At the beginning of ICOND, the focus was on current legal regulations as well as experiences from ongoing decommissioning projects.

FAKTEN FACTS





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CREATEC

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JEN
Jülicher Entsorgungsgesellschaft
für NuklearanlagenCaverion
KranzKÜMMERLEIN
RECHTSANWÄLTE & NOTAREMIRION
TECHNOLOGIES

Munich RE

NRG

NUKEM
TechnologiesPreussen
ElektraPAUL SCHERRER INSTITUT
PSITECNUBEL
ENGIEVEOLIA
NUCLEAR SOLUTIONSVPC
Sustainable Engineering & Consulting

VTT

MONDAY
PRE-CONFERENCE WORKSHOPNovember 27th, 2017

13:15 **Welcome**
Dr. John Kettler –
Aachen Institute for Nuclear Training GmbH

DECOMMISSIONING OF NUCLEAR RESEARCH FACILITIES

- EN** 13:30 **Decommissioning Research within the OECD HRP and Opportunities for Application**
Dr. István Szöke – Institute for Energy Technology IFE – OECD HRP
- EN** 14:00 **Progress in Decommissioning of the Low Flux Reactor in Petten**
Dr. Renate De Vos – NRG Nuclear Research & Consultancy Group
- EN** 14:30 **Characterization and Remediation of Sites in the Course of the Decommissioning of Nuclear Facilities**
Dr. Hagen Gunther Jung & Felix Langer – Nukem Technologies Engineering Services GmbH
- EN** 15:00 **Decommissioning and Dismantling of Nuclear Research Facilities in Switzerland: Lessons learned**
Fritz Leibundgut – Paul Scherrer Institut (PSI)
- 15:30 **Coffee Break**
- EN** 16:00 **New Developments of Autoradiography Techniques to Improve Alpha and Beta Measurements for the Decommissioning of Facilities**
Dr. Pascal Fichet – Commissariat à l'énergie atomique et aux énergies alternatives (CEA)
- EN** 16:30 **FiR 1 TRIGA Research Reactor Decommissioning Project**
Antti Rätty – VTT Technical Research Centre of Finland Ltd
- EN** 17:00 **Planning and Performing Decision Measurements with the Objective of the Clearance of a Nuclear Facility Building for later Demolition**
Dr. Dominik Winter – Jülicher Entsorgungsgesellschaft für Nuklearanlagen mbH
- EN** 17:30 **Integrated Planning from Residual Material to Released Final Storage Containers**
Dr. Anton Philipp Anthofer – VPC GmbH



**TUESDAY
ICOND** November 28th, 2017

10:00 **Registration**

12:00 **Lunch**

D 13:00 **Welcome**
Dr. John Kettler – Aachen Institute for Nuclear Training GmbH

BEGINNING OF A NEW AGE OF DECOMMISSIONING

D 13:15 **Decommissioning & Waste Management under a new Regulatory Framework – What has changed?**
Gesetz zur Neuordnung der Verantwortung in der kerntechnischen Entsorgung – Was hat sich verändert?
Dr. Ruth Welsing – Kümmerlein, Rechtsanwälte & Notare

EN 13:45 **D&D Waste Management „Rip and Ship or not?“**
Vorteile der standortfernen Zerlegung und Dekontamination
Gerard Laurent – IN Solutions

D 14:15 **Decommissioning of the EnBW-NPPs**
Rückbau der EnBW-Kernkraftwerke
Wolfgang Honetschläger – EnBW Kernkraft GmbH

EN 14:45 **The Challenges of Nuclear Decommissioning in Taiwan**
Die Herausforderungen beim Rückbau der Kernkraftwerke in Taiwan
Yun-Chung Chi – Atomic Energy Council

15:15 **Coffee Break**

EN 16:00 **The Decommissioning of Leningrad Nuclear Power Plant (LNPP)**
Der Rückbau des Kernkraftwerks LNPP bei St. Petersburg in Russland
N.N. – Leningrad Nuclear Power Plant - Rosenergoatom

D 16:30 **Lessons learned from EnBW's Decommissioning Strategy**
Erfahrungen anhand der Stilllegungsstrategie von EnBW
Dr. Oliver Wilhelm – EnBW Kernkraft GmbH

D 17:00 - 17:45 **Panel Discussion:**
Speed up under new legal boundary conditions
Podiumsdiskussion:
Äußere Einflüsse und Hindernisse für den zügigen Rückbau der Kernkraftwerke
Participants / Teilnehmer:
Dr. Ruth Welsing
Walter Hackel
Prof. Dr. Bruno Thomauske

18:45 **Conference Dinner at the TIVOLI Business Lounge – Soccer stadium –**
sponsored by TECNUBEL & TRACTEBEL





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WEDNESDAY ICOND

November 29th, 2017

PLANNING, FINANCING & RISK MANAGEMENT

- D** 09:00 **Decommissioning Cost Overrun Coverage for Nuclear Facilities**
Absicherung der Kostenüberschreitung beim Rückbau kerntechnischer Anlagen
Markus König – Center of Competence for Nuclear Facilities at Munich Re
- D** 09:30 **Development of an Optimizing Project Planning System for Nuclear Decommissioning Projects**
Entwicklung eines optimierenden Planungssystems für kerntechnische Rückbauprojekte
Felix Hübner & Dr. Rebekka Volk – Karlsruhe Institute of Technology (KIT)
- D** 10:00 **Financing of Nuclear Decommissioning and Final Disposal of Radioactive Waste in Switzerland**
Die Finanzierung der Stilllegung der Kernkraftwerke und Entsorgung der radioaktiven Abfälle in der Schweiz
René Scholl – BKW Energie AG
- 10:30 **Coffee Break**
- D** 11:00 **Decommissioning Planning with Residue Tracking and Control Software – Practical Experiences**
Stilllegungsplanung mit ReVK – Erfahrungen aus der Praxis
Jürgen Lang – PreussenElektra GmbH
- EN** 11:30 **Knowledge Management for Decommissioning – The International Decommissioning Network of IAEA (IDN)**
Bewahrung von Wissen im Rückbau – Das internationale Netzwerk IDN der IAEA
Masanori Hirota – International Atomic Energy Agency
- 12:00 **Lunch**

REACTOR INTERNALS & LARGE COMPONENTS

- D** 13:00 **Remote Dismantling of the Biological Shield of KNK Research Reactor**
Fernhantierte Zerlegung des biologischen Schildes des KNK Forschungsreaktors
Ulrich Scholl – Kerntechnische Entsorgung Karlsruhe GmbH
Peter Berben – TECNUBEL GmbH
- D** 13:30 **Dismantling of Reactor Internals with the Wire Saw - Cost Optimization by Means of Optimized Tool Guidance**
Seilsägen von Reaktorkerneinbauten – Kostenoptimierung durch standzeitoptimierte Werkzeugführung
Lukas Tatzig – Institute of Production Engineering and Machine Tools, Leibniz University Hannover
- D** 14:00 **Several Ventilation Concepts for Decommissioning of Nuclear Facilities**
Lüftungskonzepte für die Stilllegung kerntechnischer Anlagen
Dr. Peter Hausch – Krantz - Caverion Deutschland GmbH
- 14:30 **Coffee Break**
- D** 15:00 **Optimized Planning for the Dismantling of Reactor Internals**
Optimierte Planung für den Rückbau von Kerneinbauten
Dr. Luc Schlömer – WTI Wissenschaftlich-Technische Ingenieurberatung GmbH
- D** 15:30 **Conditioning and Packaging the Pressure Vessel and Reactor Internals at GKN I**
Endlagerechte Konditionierung von Kerneinbauten
Dr. Philipp Kruse – GNS Gesellschaft für Nuklear-Service mbH
- 16:15 **Business-Speed-Networking**
Get in touch with the ICOND participants!
- 17:15 **Get together**
sponsored by TÜV Rheinland Industrie Service GmbH



**THURSDAY
ICND**November 30th 2017**CHARACTERISATION & WASTE MANAGEMENT**

- D** 09:00 **Advanced Segmented Gamma-Scanner**
Innovative segmentierte Fassmessanlage
Dr. Matthias Fritzsche – Mirion Technologies (Canberra) GmbH
- D** 09:30 **Accident with Significant Activity Release - Experiences with Immediate Measures and Decontamination**
Unfall mit bedeutsamer Aktivitätsfreisetzung - Erfahrungen bei Sofortmaßnahmen und Dekontamination
Martin Rathgeber – NucTec Solutions GmbH
- EN** 10:00 **Innovative Vitrification Technologies of the Treatment of Low- and Intermediate-level Waste**
Innovative Verglasungstechnologien zur Behandlung von schwach- und mittelradioaktiven Abfällen
Jean-Marie Thierry – Veolia Environnement S.A.
- 10:30 **Coffee Break**
- EN** 11:00 **Concrete Core Sampling Tool Coupled with Robotic ANDRO Solution**
Robotergestützte Probennahme von Betonkernen
Dr. Clere Béragère – ALTRAN
- EN** 11:30 **3D Radiation Detection of Contaminations in Nuclear Facilities**
3D Strahlungsdetektion von Kontaminationen in kerntechnischen Anlagen
Neil Owen – Createc
- EN** 12:00 **QUANTOM – Quantitative Analysis of (non-)toxic Material for Nuclear Waste Management**
QUANTOM – Quantitative Analyse (nicht-)toxischer Materialien für die Abfallcharakterisierung
Dr. Hendrik Wiesel – Advanced Nuclear Fuels GmbH – AREVA
- 12:30 **Final Statement and Outlook**
- 12:45 **Lunch to conclude the Event**

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SPEAKER

MONDAY 13:30

EN

Dr. István Szöke

Company Institute for Energy Technology IFE, OECD HRP
Os alle 5
1777 Halden - Norway

Website www.ifeam.de



SPEAKER

MONDAY 14:00

EN

Dr. Renate De Vos

Company NRG Nuclear Research & Consultancy Group
Westerduinweg 3
1755 ZG Petten - The Netherlands

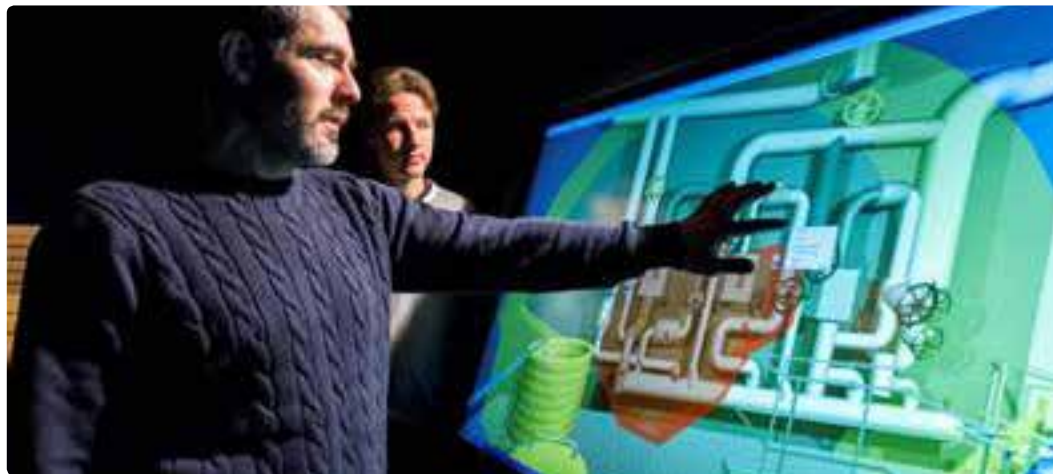
Website www.nrg.eu

Decommissioning Research within the OECD HRP and Opportunities for Applications

The OECD Halden Reactor Project (OECD HRP) is an international research project under the auspices of the OECD Nuclear Energy Agency, supported by national organisations in 20 OECD countries. The aim of the project is ensuring safe and reliable operation of nuclear plants by taking advantage of R&D advances and related technical innovations. One topic of the OECD HRP research programme is focusing on improving the member organisations' capabilities for safe and effective implementation of nuclear decommissioning projects. Since decommissioning presents interconnected challenges with human, technical and organisational aspects, research within the OECD HRP fosters application of a systemic approach to addressing national decommissioning projects. In order to find out where gaps in current practices are from an MTO (man, technology, organisation) perspective, the project performed numerous interviews with utilities, contractors, research organisations and regulatory bodies. The OECD HRP also promotes adoption of modern analyses, communication and information concepts for integrating

stakeholders into a coherent team, and enabling informed safety and feasibility assessments. The project team has evaluated different solutions enabled by advanced information technology in terms of human and team performance in nuclear decommissioning related tasks.

The Institute for Energy Technology (IFE) hosting the OECD Halden Reactor Project has been providing direct support for a number of decommissioning project teams to take advantage of the innovations resulting from the OECD HRP decommissioning research. Lessons learned from these projects collected by the OECD HRP will help ushering into a new age of decommissioning, where modern concepts for safety planning and training, and team information become every day tools, and experience from completed projects is preserved and transferred in a way compatible with the expectations of new generations of decommissioners.



Progress in decommissioning of the Low Flux Reactor in Petten (Netherlands)

The Low Flux Reactor in the Netherlands was operated for approximately 50 years for research and education purposes. In 2010 the reactor was taken out of business for economic reasons. After a period of 6 years of preparation in which the radiological inventory was determined, the decommissioning license was received, and working procedures were established, the actual decommissioning started in 2016 with the removal of the operating console.

The decommissioning approach is to divide the decommissioning into 12 discrete work packages. Each work package consists of a detailed work plan, a Task Risk Assessment (TRA) and a radiological risk inventory & evaluation (RI&E). After the completion of each work package the activities are evaluated and the lessons learned are applied in the next activities. To perform such a graded approach in decommissioning project good arrangements with the authorities is necessary. To facilitate the decommissioning

process NRG developed a sensitive measuring system and a 'track and trace' device in-house to characterize and track all waste resulting from decommissioning LFR. The radioactive waste was declared with the central waste management organization in the Netherlands (COVRA) by using the fingerprint method and radiochemical analyses for confirmation. With the acceptance of the waste by COVRA the ownership of the waste is transferred from NRG to COVRA. The majority of the waste is stored in Konrad containers which is new in the Netherlands. The reactor will be completely removed by the end of 2017 and in the first half year of 2018 all waste will be transferred to COVRA and the reactor hall will be released. In this presentation these subjects will be treated as well as the current status and the lessons learned so far.



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SPEAKER

MONDAY 14:30

EN

Dr. Hagen Gunther Jung / Felix Langer

Company Nukem Technologies Engineering Services GmbH
Industriestr. 13
63775 Alzenau - Germany

Website www.nukemtechnologies.de



SPEAKER

MONDAY 15:00

EN

Fritz Leibundgut

Company Paul Scherrer Institut (PSI)
5232 Villigen PSI - Switzerland

Website www.psi.ch

Characterization and Remediation of Sites in the Course of the Decommissioning of Nuclear Facilities

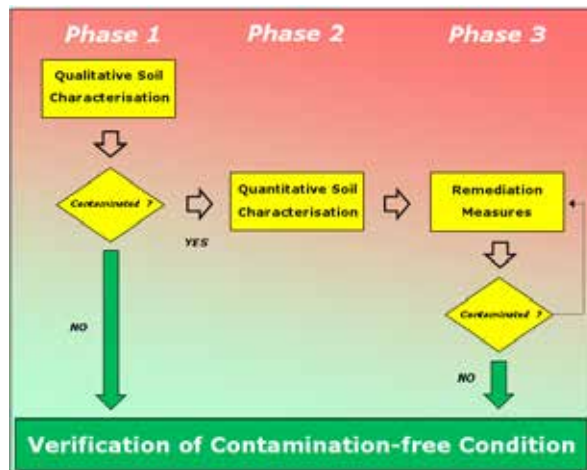
For the release of nuclear sites from respective regulatory control in the course of decommissioning, a contamination-free condition has to be verified.

NUKEM's decommissioning experiences find continuation in further advancement of relevant technologies, e.g. in the course of remediation measures at a nuclear site in Dessel (Belgium). The belt conveyor monitoring technology employed there for excavated soil combines characterisation and remediation.

For optimizing the overall efficiency of decommissioning activities at nuclear sites, an overarching phased approach has been developed: stepwise radiologic characterisation of the soil (1. qualitative characterisation and 2. quantitative characterisation) followed by, if indicated, 3. remediation measures.. Overall purpose is to provide evidence of an (ultimately) contamination-free site condition. Thus, provided the success of

conducted remediation measures can be verified, the release of the treated site, which is not anymore (impermissibly) contaminated, is possible.

Worldwide nearly 150 nuclear power plants will undergo decommissioning in the next 15 years as well as a considerable number of other nuclear facilities. All these sites need to be characterised qualitatively to verify the desired contamination-free site condition, but assumingly a significant number will require additional remediation, before those sites can be finally released from nuclear control.



Decommissioning and Dismantling of Nuclear Research Facilities in Switzerland: Lessons learned

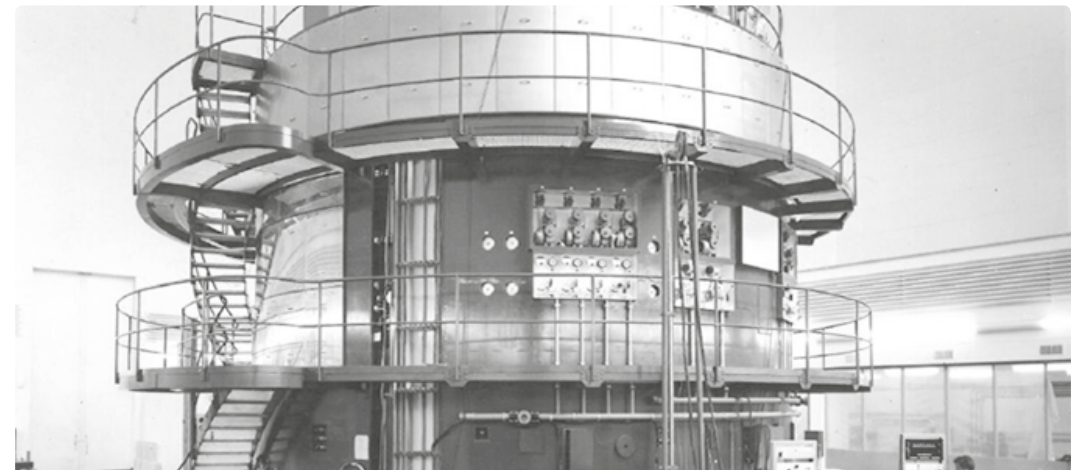
The era of nuclear power in Switzerland started in 1955, when Prof. Paul Scherrer from ETH and Walter Boveri from BBC (nowadays ABB) developed the idea of a proprietary Swiss nuclear reactor concept. For that purpose, a company named „Reaktor AG“ was founded in 1955, and the development of a research reactor started. The result was the first time criticality in 1960 with 20MW thermal power, in 1968 upgraded to 30MW.

Meanwhile, in Geneva, a conference was held on „Atoms for peace“, where the USA exhibited a swimming-pool reactor of 5MW thermal power. This reactor was purchased by Switzerland and transferred to the site of Reaktor AG. A third reactor was built in the early 60ies. The reactors were operated from 1957 to 1993 (Saphir), from 1960 to 1977 (Diorit) and from 1968 to 2011 (Proteus).

Decommissioning started in 1994 (Diorit), 2000 (Saphir) and 2017 (Proteus). From the beginning, strategy of PSI was, to perform all decommissioning

work with its own staff. First, a planning group, consisting of engineers was established. So, planning of decommissioning Diorit started in 1992, whereas decommissioning itself started as of 1994. Due to financial shortage, progress in work was limited. So, dismantling of Diorit lasted until 2012, when the reactor block was completely dismantled. In 2000, dismantling of Saphir started. Dismantling of the reactor was completed in 2008. Dismantling of Proteus started in 2017 and will be expected to be completed in 2020. Since funding is definitely solved, financial shortage will no longer occur.

We have learned several lessons: Most interesting for the nuclear community are probably the treatment of aluminum and of graphite. Aluminum was melted in crucibles of approx. 25 liters. 4 x 9 crucibles were filled in a concrete container of 4.5 cubic meters. Remaining space was filled with graphite mortar, consisting of grains < 5mm mixed with conventional mortar.



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SPEAKER

MONDAY 16:00

EN

Dr. Pascal Fichet

Company Commissariat à l'énergie atomique et aux énergies alternatives (CEA)
Bât 459 PC171
91191 Gif Sur Yvette - France

Website www.cea.fr



SPEAKER

MONDAY 16:30

EN

Antti Rätty

Company VTT Technical Research Centre of Finland
Otakaari 3 A
02150 Espoo - Finland

Website www.vttresearch.com

New Developments of Autoradiography Techniques to Improve Alpha and Beta Measurements for the Decommissioning of Facilities

Characterization is essential to prepare, control, and finish the decommissioning of a nuclear facility. This research presented is localized in CEA Saclay near Paris in a laboratory called LASE (Analytical Support to Facilities Laboratory) mainly dedicated to destructive analysis of nuclear wastes. Destructive analysis require digestion process considering approximately 0.5 g of matter. Analytical values provided by the laboratories using destructive techniques are very accurate however the problem of sampling process is essential to investigate hot spots of radioactivity in decommissioning facilities.

Since several years, Autoradiography Technique first developed commercially for biological measurements has been studied in the LASE laboratory to investigate difficult to measure radionuclides on solid surfaces such as concrete, wood, metals...

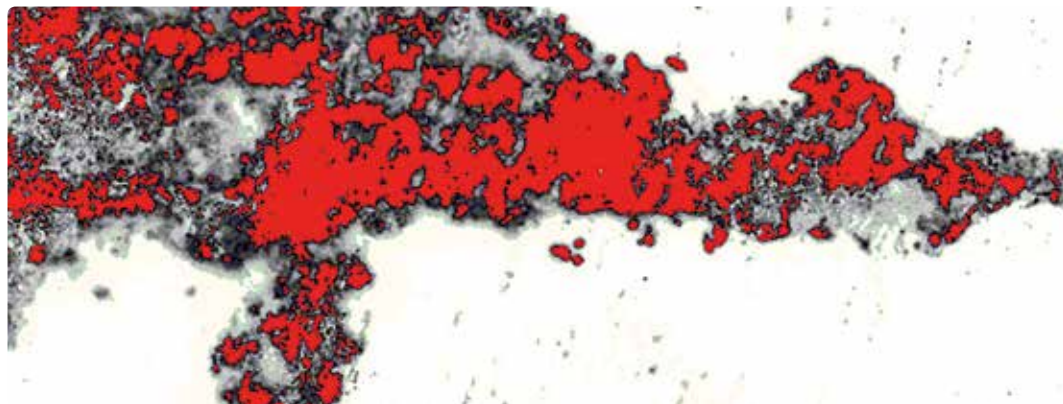
Digital Autoradiography is:

- A radioactivity-imaging technique
- Performed through the in-situ exposure of 2D screens
- Non destructive technique (no wastes produced thanks the use of reusable screens)
- Sensitive to all types of radioactivity (alpha, beta (including H-3), gamma)
- Sensitive to both labile and fixed radioactivity
- Semi quantitative (activity in Bq/cm²) after calibration by sources

Different applications will be shown on characterizations that can be found in dismantling facilities:
- on drilled cores - pieces of furniture - tank blocks - rubble - dust - different types of wastes.

Identification of radionuclides by autoradiography technique remains difficult, but a screen stacking method has been developed recently to improve the selectivity of this non destructive technique.

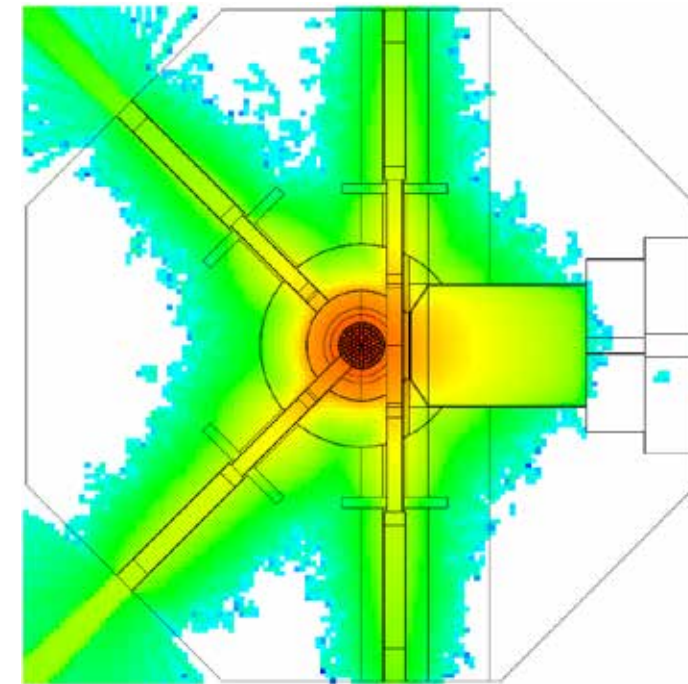
The research is funded by CEA and Andra (PIA).



FiR 1 TRIGA Research Reactor Decommissioning Project

FiR1 is a 250 kW TRIGA Mark II type open pool reactor from General Atomics. It has been in operation for education, research, BNCT treatments and isotope production in Finland for the years 1962-2015 and is planned to be decommissioned in following few years. Overall the reactor has been in use for around 11 500 MWh. Radioactive waste will consist mainly of concrete, steel, aluminium, graphite and BNC Fluental neutron moderator materials.

At first, the presentation introduces FiR1 reactor history and scientific use of it. This is followed by an indicative schedule of the VTT decommissioning project and on-going work. This includes licensing, agreements and procurement processes on dismantling planning, dismantling waste management and return of SNF. We present the calculation system for the activity inventories in the reactor structures and preliminary activity measurements in different materials. Some planned dismantling methods are illustrated and an outlook to future steps is presented.



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SPEAKER

MONDAY 17:00

EN

Dr. Dominik Winter

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52428 Jülich - Germany

Website www.jen-juelich.de



SPEAKER

MONDAY 17:30

EN

Dr. Anton Philipp Anthofer

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Website www.vpc-group.biz

Planning and Performing Decision Measurements with the Objective of the Clearance of a Nuclear Facility Building for Later Demolition

The clearance of a nuclear facility building involves detailed and sophisticated planning in order to meet the given requirements arising from e. g. ordinances, standards, guidelines, and recommendations. In addition and from a licensee's point of view, the optimization of the planned clearance procedure in terms of cost and duration is of major interest.

In this presentation, an appropriate and optimized procedure for performing decision measurements as a part of the clearance of a nuclear facility building for later demolition on the site of the Research Center Jülich drew up by the Jülicher Entsorgungsgesellschaft für Nuklearanlagen is presented.

For the mentioned purpose, the obtained results of the decision measurements shall be capable to proof that the clearance levels for surface contamination are not exceeded. Bulk activity, as a result of neutron activation reactions during operation, must be excluded (or adequately considered) when striving the clearance for later demolition.

The requirements for the measurement methods applied to measure surface contamination are specified in the relevant standards and guidelines. Basically, the measurement methods need to be capable to measure particles emitted by at least one radionuclide in the facility-specific nuclide vector (key nuclide) with a sufficient accuracy taking into account the distribution of the surface contamination on or in the building structure.

Another key aspect is the general number of the decision measurements. Generally, comprehensive area-covering measurements need to be performed on the standing structure. In the case of the clearance of a nuclear facility building, the application of appropriate random sample procedures is possible in order to decrease the number of decision measurements.

In summary, the planning process for performing decision measurements as a part of the clearance of a nuclear facility building for later demolition including possible optimizations is presented.



Integrated Planning From Residual Material to Released Final Storage Containers

The German federal final disposal for low-level and intermediate level radioactive waste Konrad is approved for 303.000 m³. This volume is divided into 36 % for public sector (research reactors, nuclear power plants of former German Democratic Republic (GDR)), ca. 60 % from operation, decommissioning and dismantling of nuclear power plants. The rest originates from nuclear industry and from federal state collecting facilities.

It is planned to transfer 7.575 m³ per year into the final disposal, regarding 40 years of disposal operation. At the moment there are 2.936 m³ volume for final storage, which are suitable for storage in the German federal final repository Konrad. This corresponds with ca. 530 final storage containers, most of nuclear industry.

The previous practice of dismantling and disposal of low-level and intermediate level radioactive waste is often separated into several steps of planning and practice. These are decommissioning, conditioning,

packaging and documentation for final disposal, while there is no integrated plan from beginning to the end. The completion of all relevant documents to the final disposal documentation is necessary to confirm the acceptability for reposition. This step of the disposal process is critical, especially if data collection is lacking or insufficient.

An integrated planning from residual material, or the dismantling planning, to released final storage containers includes the planning and implementation of all product control measures. Therefore, a detailed description and planning of all control measures, process steps, options for optimization (e. g. volume or time-optimized packaging of containers) flow into a finely tuned process qualification.

This approach guarantees a fast procedure of the final disposal documentation by a well-conceived organisation.



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SPEAKER

TUESDAY 13:15

D

Dr. Ruth Welsing

Company Kümmerlein Rechtsanwälte & Notare
Messeallee 2
45131 Essen - Germany

Website www.kuemmerlein.de



SPEAKER

TUESDAY 13:45

EN

Gerard Laurent

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26 D rue Arago
69100 Villeurbanne - France

Website www.insolutions.fr

Decommissioning & Waste Management under a new Regulatory Framework – What has changed?

The transfer of radioactive waste liabilities from nuclear power plant operators to the German state is subject of the Act on the re-regulation of radioactive waste liabilities. Radioactive waste liabilities are transferred to a foundation with legal capacity under German public law registered in Berlin. Thereby the German state will be fully liable for the interim storage and disposal of radioactive waste.

Nuclear power plant operators paid € 24.1 billion cash to the fund in return for being released from their radioactive waste liabilities. The amount equals a basic amount equivalent to the provisions already set aside by the operators for the purpose of financing radioactive waste management and a risk premium of 35.7 % to cover the risk of cost increases in the future. The amount was transferred to the fund on July 1st 2017. The nuclear power plant operators stay liable for the provision and financing of decommissioning and dismantling of the nuclear power plants as well as for the correct packaging of the radioactive waste.

The regulation of a follow-up liability minimises the financial risks of possible changes in corporate structures to ensure that the group assets are liable for the costs of decommissioning, dismantling and waste managements of the operating companies.

The Act on the re-regulation of radioactive waste liabilities is the last step in phasing out nuclear electricity production in Germany. The decision to phase out nuclear electricity production in Germany made it for the first time possible to quantify the amount of radioactive waste as well as the nuclear power plant operators' period of time left for making profits by producing nuclear electricity. The regulation of the distribution of liabilities provides a win-win-solution for the nuclear power plant operators and the general public: the nuclear power plant operators' liability is limited and the risk of a deficit at the expense of the general public is minimised.



D&D Waste Management „Rip and Ship or not?“

Even if the Rip & Ship strategy seems to have a lot of credits for recent decommissioning plants, this presentation will give some lights about the choice possible for the location to do the waste cutting and conditioning/packaging between:

- on the dismantling area itself,
- on a facility in the building concerned by dismantling (like for most of the old D&D works)
- on a waste management facility on site (belgian choice at Doel),
- on an external facility out of the site (,Rip & Ship' situation like at Zion).

For each situation the advantages and disadvantages will be described.

An application case will be developed for a PWR reactor depending of the country concerned.



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SPEAKER

TUESDAY 14:15

D

Wolfgang Honetschläger

Company EnBW Kernkraft GmbH
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76661 Philippsburg - Germany

Website www.enbw.com/enkk



SPEAKER

TUESDAY 14:45

EN

Yun-Chung Chi

Company Atomic Energy Council
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Dismantling Strategy of Nuclear Power Plants

Germany has decided to phase out of nuclear power by the year 2022. Operation and post-operation as well as decommissioning and dismantling of the EnBW nuclear power plants are in the hands of EnBW Kernkraft GmbH (EnKK). Power is produced in the units Neckarwestheim II and Philippsburg 2. The respective units Neckarwestheim I and Philippsburg 1 have not produced any electricity since 2011, decommissioning/dismantling started in 2017. In 2012, EnKK established a strategy for the dismantling of all blocks, communicated and thus created clarity for politics, society, business partners and employees. In order to ensure the safe, efficient and rapid dismantling, various preparations are currently in progress. EnKK has a clear strategy which is implemented consistently since 2012. Therefore, EnKK takes the lead in dismantling in Germany. The lecture will show how EnKK is strategically positioned for the upcoming decommissioning, the relevant approvals and technical preparations for the implementation of the decommissioning and the related waste. It also gives information about the project management. The change management process of the company and the implemented stakeholder communication are also presented. These measures are designed to ensure safe,

efficient and near-term decommissioning and to lead the company into the future.

EnBW Kernkraft GmbH:

- Three sites: Philippsburg, Neckarwestheim, Obrigheim
- Stands for safety
 - in operation
 - in the transition phase
 - during decommission and dismantling
- Employees: around 1,600

EnBW AG Company Profile:

- One of the largest energy supply companies in Germany
- Business segments: Sales, Grids, Renewable Energies, Generation and Trading
- Annual revenue in 2016: more than 19 billion euros
- Customers: around 5.5 million
- Employees: around 20,000



The Challenges of Nuclear Decommissioning in Taiwan

Taiwan's new government has decided to abolish all its owned nuclear power plants (NPPs) by 2025, to meet the public calls for an entirely "nuclear-free homeland" following the Three Mile Island near-meltdown in 1979, Chernobyl's severe meltdown in 1986 and the recent Fukushima nuclear disaster in 2011.

Currently, Taiwan has three operational NPPs and six reactors, which all run by the Taiwan Power Company (Taipower), provide 36.5 TWh of total generated power (258 TWh gross) of island in 2015. Taipower has also had problems on how to dispose its generated nuclear wastes, either high level or low, which was for many years causing the anger of local inhabitants. The first NPP (Chinshan 1) faces the end of its licensure in December 2018. NPP1's second reactor is scheduled to be decommissioned in mid-July 2019. The second NPPs are retired in late December 2021 and early March 2023 respectively. And subsequently, the Maanshan twin reactors are obligated to end in July 2024 and May 2025.

In November 2015 Taipower has delivered an official DECON (Immediate Dismantling) decommissioning plan of Chinshan 1 and 2 to the Atomic Energy Council (AEC) for approval. According to this formal documentation, decommissioning is to be over 25 years, i.e., in four stages: shutdown and defuelling to the end of 2026, dismantling to 2038, testing to 2041, and site remediation to 2043. The predicted costs by Taipower are of the order of NT\$18.5 billion (US\$600+ million) to decommission. At the legislative hearing, however, Taipower has received some extent of skepticism from both environmental groups and legislators. The issue involves the questions of whether Taipower has been underestimating the costs or not. And later on Taipower agrees to give details and further calculations on the decommission costs, adding extra costs of building

dry and consolidated storage facilities, and when it intends to initiate the decommissioning mission without delay. Thus, cost escalation may push the actual expense to a higher grade than expected.

Furthermore, we are aware that public opinion of nuclear power has changed dramatically following the Fukushima accident. Opposition to nuclear power has now become a mainstream position. In Taiwan, we have never been able to put a proper medium-term storage facility into effect, and long-term storage remains a dream. Taipower has tried, and repeatedly failed, to find somewhere to dispose of the radwaste permanently. Actually, Taiwan is facing serious challenge to manage nuclear waste that has no place to allocate them. This thorny issue still remains.



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SPEAKER

TUESDAY 16:30

D

Dr. Oliver Wilhelm

Company EnBW Kernkraft GmbH
Rheinschanzinsel
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Website www.enbw.com/enkk



SPEAKER

WEDNESDAY 09:00

D

Markus König

Company Munich Re
Königinstraße 107
80802 München - Germany

Website www.munichre.com

Lessons-learned from EnBW's Decommissioning Strategy

Germany has decided to phase out of nuclear power by the year 2022. Operation and post-operation as well as decommissioning and dismantling of the EnBW nuclear power plants are in the hands of EnBW Kernkraft GmbH (EnKK). Power is produced in the units Neckarwestheim II and Philippsburg 2. The respective units Neckarwestheim I and Philippsburg 1 have not produced any electricity since 2011, decommissioning/dismantling started in 2017. In 2012, EnKK established a strategy for the dismantling of all units, communicated and thus created clarity for politics, society, business partners and employees. In order to ensure the safe, efficient and rapid dismantling, various preparations are currently in progress. EnKK has a clear strategy which is implemented consistently since 2012. Therefore, EnKK takes the lead in dismantling in Germany.

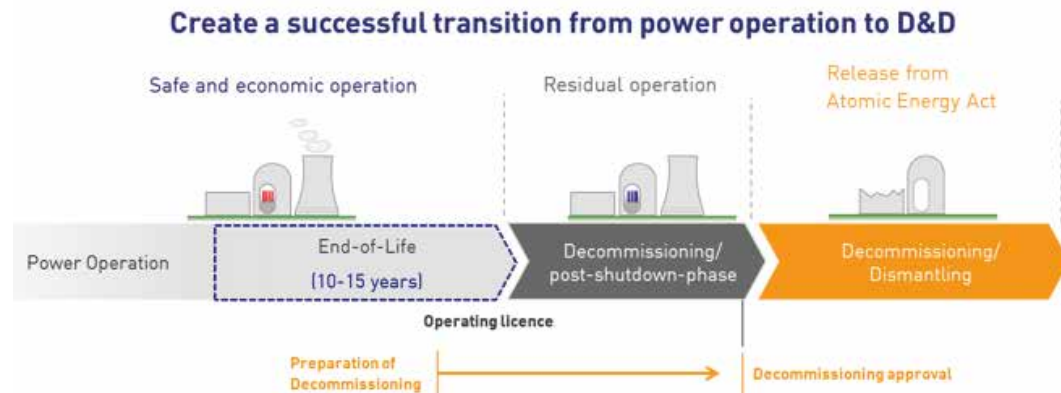
The presentation at hand discusses the relevant brickstones for a successful D&D planning of NPPs. The difficulty of handling project complexity in D&D is addressed and the EnBW solutions are presented.

EnBW Kernkraft GmbH:

- Three sites: Philippsburg, Neckarwestheim, Obrigheim
- Stands for safety
 - in operation
 - in the transition phase
 - during decommission and dismantling
- Employees: around 1600

EnBW AG Company Profile:

- One of the largest energy supply companies in Germany
- Business segments: Sales, Grids, Renewable Energies, Generation and Trading
- Annual revenue in 2016: more than 19 billion euros
- Customers: around 5.5 million
- Employees: around 20,000



Decommissioning Cost Overrun Coverage for Nuclear Facilities

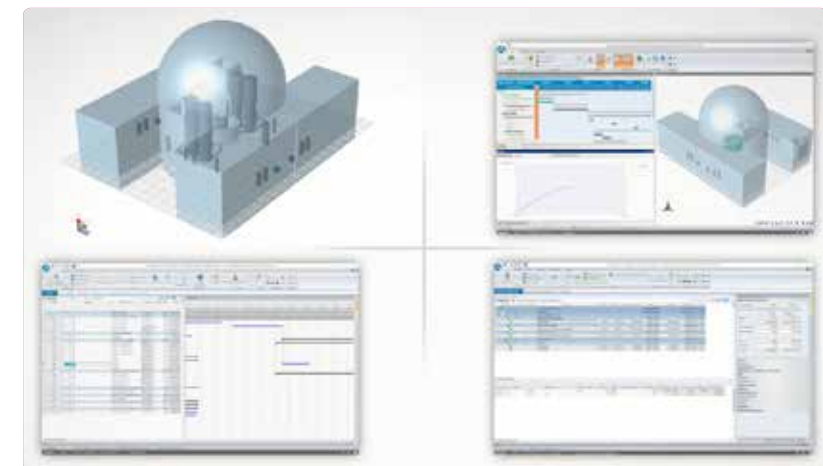
Decommissioning of nuclear facilities is a complex process. Some projects finish years later than planned, resulting in significant cost overruns. Until now, available insurance products could not fully meet the demands of the project owners.

The majority of large infrastructure projects are completed with a time overrun and usually exceed the originally estimated project costs by 50 to 100%, sometimes even as much as 1000 or 2000%. Nuclear decommissioning projects are even more complex and time consuming undertakings than large infrastructure projects. Extra costs can arise from the non-availability of contractors or tools, conflicts between contractors, misdiagnosed estimates of work hours and errors in project management, to mention a few.

Successful decommissioning ventures require maximum transparency to ensure full control of cost and time. BIM (Building Information Modelling) – IT solutions in connection with an improved cooperation and planning phase could provide this transparency.

To protect nuclear decommissioning projects against cost overruns with an insurance solution, Munich Re sets up an advanced predictive analytics system for project monitoring. The simulation of the decommissioning process is based on a Building Information Modelling Application and enables Munich Re to create a custom-made insurance coverage against cost overruns. Based on the level of detail which is entered into the simulation, it is possible to keep close track of the project development and identify deviations early so as to perform risk mitigation measures. The experience with other comparable projects allows Munich Re to provide benchmarking regarding cost and time and recommendations for improvements of the project risk mitigation strategy.

Besides the higher cost certainty, such a non-physical damage triggered insurance solution gives the project owners the benefit that fewer financial reserves are required due to the protection against cost overrun provided by an insurance product.



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SPEAKER

WEDNESDAY 09:30 D

Felix Hübner

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SPEAKER

WEDNESDAY 10:00 D

René Scholl

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Website www.bkw.ch

Development of an Optimizing Project Planning System for Nuclear Decommissioning Projects

In its World Energy Outlook 2014, the International Energy Agency (IEA) forecasts that in 2040 about 200 nuclear reactors will be shut down worldwide. Consequently, many nuclear reactors and nuclear facilities will be dismantled. In addition to the technical challenges of dismantling, project management and, in particular, the planning of dismantling is a major challenge. Planning in this context is very complex, especially due to two central requirements: On the one hand, the planning of nuclear dismantling has to be sufficiently detailed for a large number of project activities to obtain a decommissioning permit. On the other hand, only very few experience values and many uncertainties in nuclear dismantling exist, which make planning even more difficult. So far, no planning approach exists that can deal with these challenges and that is optimizing the planning considering different interacting and interfering influences on project outcome of nuclear dismantling projects, such as time, cost and quality.

Instead, the planning is usually carried out manually and is visualized by software. A computer-assisted optimization of the planning is not yet carried out.

In order to address these challenges and to support deconstruction planning with the aid of optimization algorithms, a project planning system with an integrated optimizing approach was developed and tested. The developed project planning system enables an integrated and optimizing cost and resource planning. It was tested and validated with data provided by industry partners. It is worth highlighting that the developed optimization method only needs very little calculation time, so that it can be used to calculate different optimized schedules for different scenarios. Consequently, the optimization method can especially be used for scenario or sensitivity analyses.



Financing of Nuclear Decommissioning and Final Disposal of Radioactive Waste in Switzerland

The financing of nuclear decommissioning and disposal of radioactive waste in Switzerland is highly regulated. Operators of nuclear power plants are obliged to pay contributions into funds to safeguard the financing of backend costs. The funds are under direct supervision of the government. The federal council appoints the members of the administrative board of the funds.

The estimation of the costs has to be updated periodically every five years.

Updating the cost estimation is a lengthy and complex project. Currently, the cost estimation 2016 is under review after a two-year evaluation process.

Once the new cost estimation is approved by the authorities, fund contributions will be re-assessed. The performance of the funds is an important element of financing the costs.

The funds invest in well-diversified global portfolios and have shown an average yearly performance in real terms above 3 % since inception. Despite this historical performance, the target yield of 2% p.a. used in calculating the contributions has been a political issue.



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SPEAKER

WEDNESDAY 11:00 D

Jürgen Lang

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Dismantling Planning, Implementation and Evaluation using Material Tracking Software – Practical Experiences

The lecture deals with the initial conditions of the dismantling planning in the material tracking system (RVS) and the information provided in the planning tool as well as the resulting coordinated specifications for on-site execution.

The easy to use and advantageous application of the RVS by the on-site staff constantly feeds the execution and evaluation tool and leads to a constant improvement and optimization in the planning process.

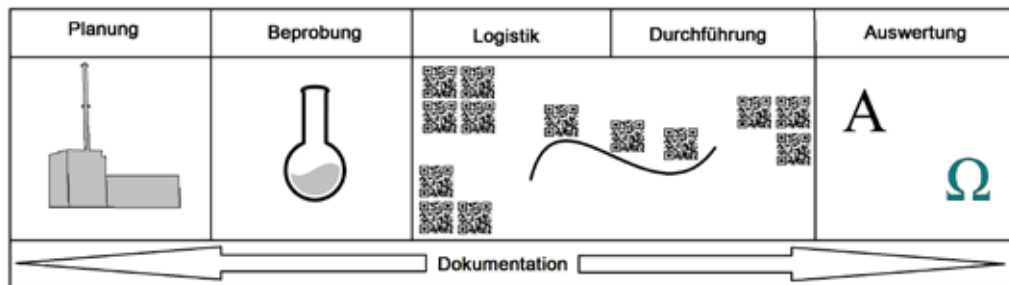
In addition, all documents required for the user are provided in the document manager in a easy touse functionality. The performance of the areas of dismantling, pre-decomposition and decay, decontamination, orientation measurement and clearance measurement is to be seen by means of

examples in the evaluation tool. Performance monitoring of the individual treatment steps is thus possible. It would even be possible to submit specific packages (SWR / DWR) to interested parties in planning and implementation. Thus, both planning and implementation costs could be minimized.

The logistics are presented in two main groups, which differ in empty packaging (empty trough) and package (filled trough).

The RVS tablet is used to cover these completely. The location is thus documented.

We now have a modern and user friendly IT tool for operational deconstruction with the new material tracking system.



SPEAKER

WEDNESDAY 11:30 EN

Masanori Hirota

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1400 Vienna - Austria

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Knowledge Management for Decommissioning – The International Decommissioning Network of IAEA (IDN)

Building, collecting, transferring, sharing, maintaining, preserving and utilizing knowledge is essential to developing and maintaining the necessary technical expertise and competences needed to implement the decommissioning of nuclear installations. Effective approaches to knowledge management help to achieve this objective.

Nuclear knowledge management has become an increasingly important element of the nuclear sector in recent years. Countries with existing nuclear programmes need to secure the capacities and human resources necessary to sustain the safe operation of existing installations, including their decommissioning and related programmes for spent fuel and waste. Replacing retiring staff and attracting the

young generation to a career in the nuclear field are key challenges. Countries with expanding nuclear power programmes require skilled and trained human resources to design and operate future nuclear installations. Capacity building through training and education and transferring knowledge from centers of knowledge to centers of growth are essential.

The IAEA supports knowledge management activities in decommissioning of Member States through various tools and services, including: technical publications; workshops and conferences; E-learning materials; and peer review services. A key aspect of its approach to knowledge sharing has involved the establishment of networks of relevant professionals involved in project design, implementation and oversight .

IAEA Support: Networks

Web Based Tools to support Information Sharing

Networks

- URF** Geological Disposal Underground Research Facilities for Geological Disposal
[Learn More / Join URF](#)
- DISP** International Low Level Waste Disposal Network Near Surface Disposal of Low Level Subsurface Waste
[Learn More / Join DISPNET](#)
- SFM** Spent Fuel Management International Network on Spent Fuel Management
[Learn More / Join SFM](#)
- IDN** International Decommissioning Network Decommissioning of Nuclear Facilities
[Learn More / Join IDN](#)
- GGUES** Coordination Group for Uranium Legacy Sites Coordination Group for Uranium Legacy Sites
[Learn More / Join GGUES](#)
- ICT** IAC Technologies Instrumentation and Control Technologies Network
[Learn More / Join ICT](#)
- MSN** Management System Network of Excellence Management System Network
[Learn More / Join MSN](#)
- LAB** International Network of Laboratories for Nuclear Waste Characterization LABNET - International Network of Laboratories for Nuclear Waste Characterization
[Learn More / Join LABNET](#)
- NKM** Nuclear Knowledge Management Network
[Learn More / Join NKM](#)
- ENV** Network on Environmental Management and Remediation ENVIRONET - Environmental Remediation and SOCM Management Network
[Learn More / Join ENVIRONET](#)
- bDN** Beta-Delayed Neutron Emission Beta-Delayed Neutron Emission
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SPEAKER

WEDNESDAY 13:00 EN

Ulrich Scholl / Peter Berben

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Tecnubel GmbH • Borsigstraße 7
76185 Karlsruhe - Germany
Website www.kte-karlsruhe.de • www.tecnubel.be



SPEAKER

WEDNESDAY 13:30 D

Lukas Tatzig

Company Institute of Production Engineering and Machine Tools,
Leibniz University Hannover
An der Universität 2
30823 Garbsen - Germany
Website www.ifw.uni-hannover.de

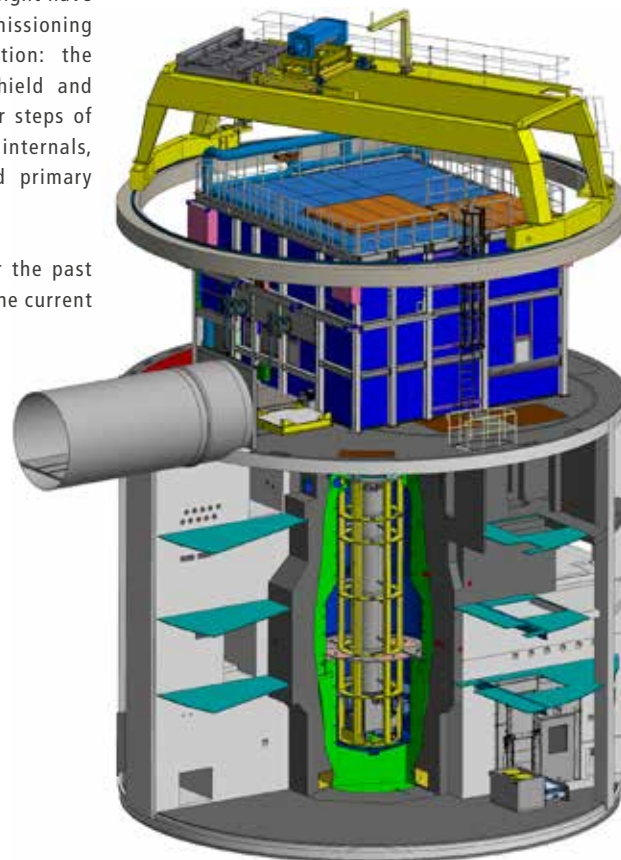
Remote Dismantling of the Biological Shield of the „Compact Sodium-Cooled Nuclear Reactor (KNK)“

The Compact Sodium-Cooled Nuclear Reactor Facility (KNK) located at the Karlsruhe research center, was operated as the prototype for the fast breeder at Kalkar (Germany). It was shut down in 1991 due to the decision to phase out of reprocessing in Germany. It was decided to dismantle the plant and its site to a "green field". A stepped decommissioning plan was agreed, consisting of ten decommissioning steps for which separate licenses are requested.

Of these ten decommissioning steps, the first eight have been completed. In the ongoing 9th decommissioning stage, the last step is now in preparation: the dismantling of the activated biological shield and metal liner of the reactor pit. In the former steps of the current stage, the reactor vessel, its internals, the reactor vessel thermal insulation and primary shielding were removed.

This presentation will give a summary over the past decommissioning steps, will give a view on the current status and an outlook.

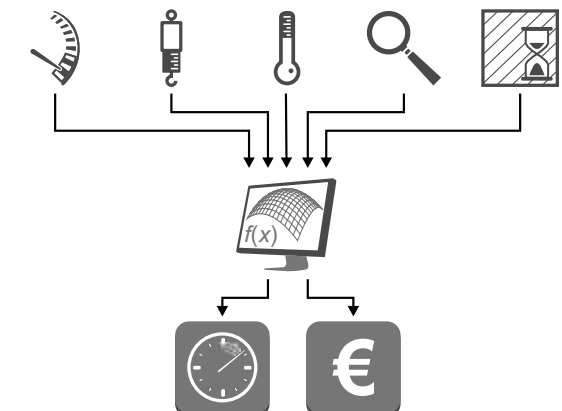
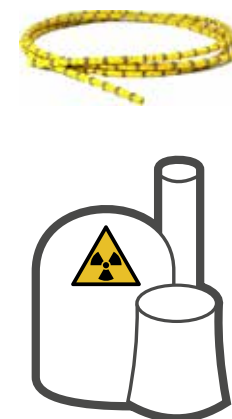
ENGIE Tecnubel is involved in the current stage of the KNK project. Remote handling experts and operators assist in testing and modifying the remote handling tools and equipment in a full size mock-up. This is part of the feasibility proof which is requested by the safety authorities. Further on, Tecnubel is building and training a pool of operators to assist in the implementation of the equipment in the KNK and to execute the future remote handled dismantling works. Their role will be enlightened too in this presentation.



Dry Diamond Wire Sawing of reactor core installations – cost optimization by adapted process control

Diamond wire sawing is frequently used in the dismantling of nuclear power plants to cut concrete, reinforced concrete and steel. Compared with the processing of mineral materials diamond wire sawing of steel is associated with higher tool wear due to higher mechanical and thermal loads. In addition, thermal loads are increasing if conventional water cooling is avoided to reduce cross-contamination and secondary waste. Therefore, the dry wire sawing process has to be adapted to the specific conditions to ensure an economic cut of reactor core installations.

At the Institute of Production Engineering and Machine Tools IFW at Leibniz Universität Hannover the dry diamond wire sawing of steel is investigated. A process model is developed based on analytical and experimental results to link tool wear mechanisms with input parameters by means of mechanical and thermal tool loads. Based on this knowledge, a model-based method is derived to design the dry diamond wire sawing of steel systematically. With this method, costs can be optimized in the light of the target conflict of productivity and tool life.



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SPEAKER

WEDNESDAY 14:00 D

Dr. Peter Hausch

Company Krantz - Caverion Deutschland GmbH
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Website www.krantz.de



SPEAKER

WEDNESDAY 15:00 D

Dr. Luc Schlömer

Company WTI Wissenschaftlich-Technische Ingenieurberatung GmbH
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52428 Jülich - Germany

Website www.wti-juelich.de

Several Ventilation Concepts for Decommissioning of Nuclear Facilities

Negative pressure cascades and filtering of exhaust air by means of HEPA filters are mandatory also during decommissioning of nuclear facilities. The installed operating ventilation system is not designed and suitable for this task.

In supplement of the operating ventilation system, additional ventilation systems have to be installed and put into operation. Due to the high proportion of chips and plasma dust in the air during disassembly and shredding of the contaminated equipment, special precautions such as separation of chips, use of re-cleanable filter systems and discharge systems for swarf, dust and aerosols must be taken.

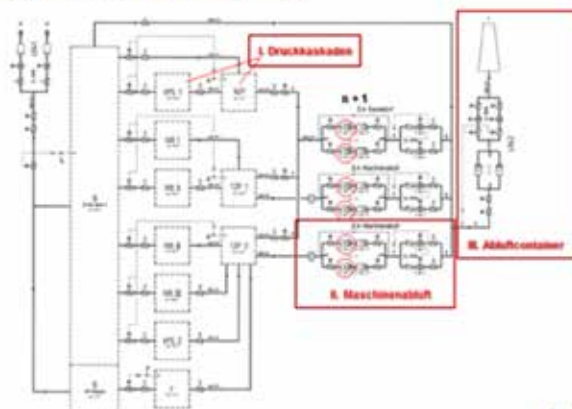
Also the dismantling of the building structures made of concrete and steel results in high concentrations of dust. Temporary extraction devices in addition and supplementary to the installed ventilation system will be used. A temporary protective tent will be installed at each workplace, and by means of a re-cleanable HEPA filter system a negative pressure inside the tent and a directed airflow into the tent will be maintained.

For decommissioning of the operating ventilation system an external ventilation system, consisting of control console, pre- and HEPA - filtration including lock and decontamination shower, high performance centrifugal fan, activity monitoring and vent stack, will be installed and put into operation. This ensures further both a directed air flow into the building and filtering of exhaust air. This substitute ventilation system is preferably installed outside the building as a stand-alone solution.

When using external ventilation systems, supply air flows untreated into the building. Due to the natural moisture content of the air and the temperature of the building structures, this results in significant condensation causing contamination spreading and growth of mould. Hence the use of desiccant dehumidifiers is technically and economically sensible.

The presentation will give a brief insight about special developed and already successful implemented additional ventilation systems for decommissioning of NPPs: "Lubmin", "Rheinsberg", "Neckarwestheim".

Rückbau KKW Greifswald ZLA



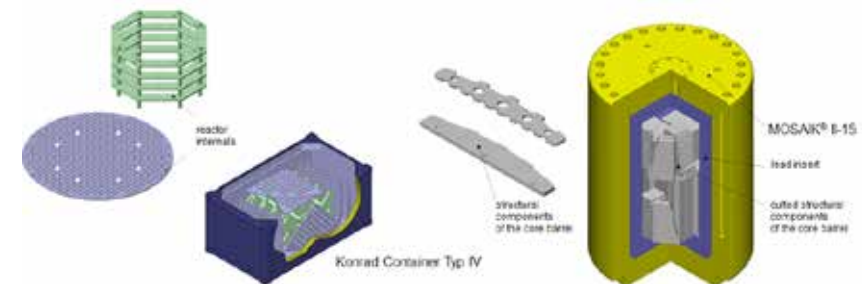
Optimized Planning for the Decommissioning of Reactor Internals

According to the Atomic Energy Act, § 9, waste producers in Germany are responsible for the disposal of low and intermediate level radioactive waste in a controlled manner. With regard to this, radioactive waste has to be professionally conditioned in compliance with the transport requirements according to the ADR and the waste acceptance requirements for the German final repository Konrad. Since the enactment of the KFK law in December 2016, this type of professional conditioning is also a prerequisite for an early transfer of ownership of the conditioned radioactive waste to the federal government within the scope of interim storage in federal facilities.

WTI Wissenschaftlich-Technische Ingenieurberatung GmbH (WTI) has gained great experience by performing validated activation calculations and activity declarations for activated core components in the scope of conditioning campaigns by order of GNS Gesellschaft für Nuklear-Service mbH (GNS). WTI developed a method for activation calculations of core components for different conditioning campaigns, e. g. for the characterization of control rods from light water reactors or fuel assembly (FA) and core structures like FA centering pins, screws of the core barrel, instrumentation lances and fittings. Furthermore, the applied method was successfully evaluated by the German competent authority along with different conditioning campaigns so that the method

has been qualified. This leads to a significant speed-up during the evaluation phase of the competent authority in this kind of decommissioning projects.

Based on the obtained accurate specific nuclide activities, optimized packaging concepts can be created for each waste stream according to the aforementioned regulatory boundary conditions. The different boundary conditions for six campaigns with control rods, the performed activation calculations and the results from validation show that an adequate determination of activation can be achieved. By this an efficient and validated activity declaration can be performed. For this purpose, WTI has access to extensive expertise regarding activation calculations that enables flexibility concerning the future specific needs and capabilities of customers. The currently used calculation tools for activation calculation in components from the reactor core region show a very good agreement of dose rates predicted by calculation with measured dose rates. Same results are observed by comparison of measured and calculated nuclide activities. The enhancements of calculation tools allow the same first-class quality activation determination for components outside the fuel element zone, e. g. parts of the control rod drive, the core shroud or the core support grids. These assessments enable WTI as well as its customers to create cost-efficient packaging concepts.



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SPEAKER

WEDNESDAY 15:30 D

Dr. Philipp Kruse

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

Website www.gns.de



WEDNESDAY 16:15 D

Conditioning and Packaging the Pressure Vessel and Reactor Internals at GKN I

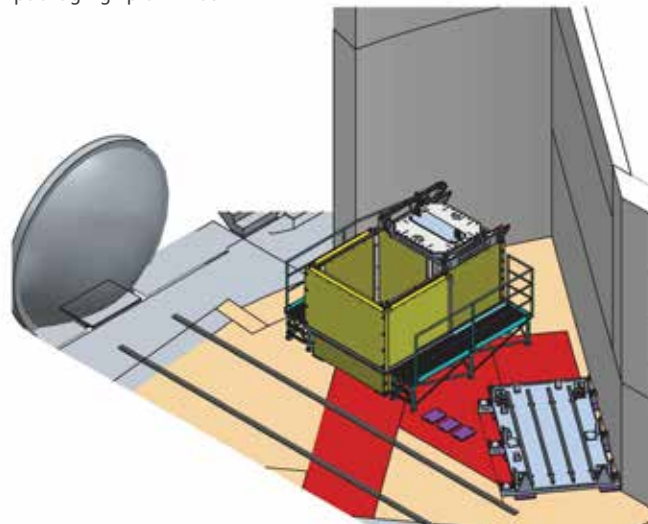
GNS Gesellschaft für Nuklear-Service mbH cooperates with Westinghouse Electric Germany GmbH (WEG) and Uniper Anlagenservice GmbH (UAS) in a project for the disposal of activated components at EnBW's NPP Neckarwestheim. The project comprises dismantling and segmenting of reactor internals and the reactor pressure vessel (RPV) of reactor unit I as well as the packaging in qualified containers for interim storage and final disposal. While WEG is responsible for dismantling and cutting of reactor internals and UAS for the conditioning of the RPV, GNS assumes the packaging of all the accruing materials.

adjusted in cooperation with the customer. In addition to some inevitable MOSAIK®-casks for the highly-activated reactor internals, several steel containers (SC) Type II and Type IV were scheduled. The inventories of the SCs were optimized taking into account the further decay until delivery to final disposal.

For packaging the SCs outside of the pool, GNS in close cooperation with the Eisenwerk Bassum mbH (EWB) constructed a loading station. The loading station enables a minimization of the dose for the employees despite of the optimized loading of the SCs.

GNS planned the packaging based on the cutting plan provided by WEG and UAS depending on the corresponding activities, the weight and the packaging density of the segmented parts. The activity of the core components and the RPV of GKN I was calculated by GNS affiliated company Wissenschaftlich-Technische Ingenieurberatung GmbH (WTI). To minimize the amount of high-performance shielding casks of type MOSAIK®, the packaging plan was

The first nine loadings of SC Type IV with parts of the Upper Internals prove a good performance of the loading station: a loading including the transfer of the cask out of the containment is possible within only eight to ten hours. SC Type II will be packed next which will be a benchmark for the loading station due to the higher activity of the packaged components.



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SPEAKER

THURSDAY 09:00 D

Dr. Matthias Fritzsche

Company Mirion Technologies (Canberra) GmbH
Walter-Flex Strasse 66
65428 Rüsselsheim

Website www.mirion.com



SPEAKER

THURSDAY 09:30 D

Martin Rathgeber

Company NucTecSolutions GmbH
Salzstr. 8
82194 Groebenzell - Germany

Website www.nuctecsolutions.com

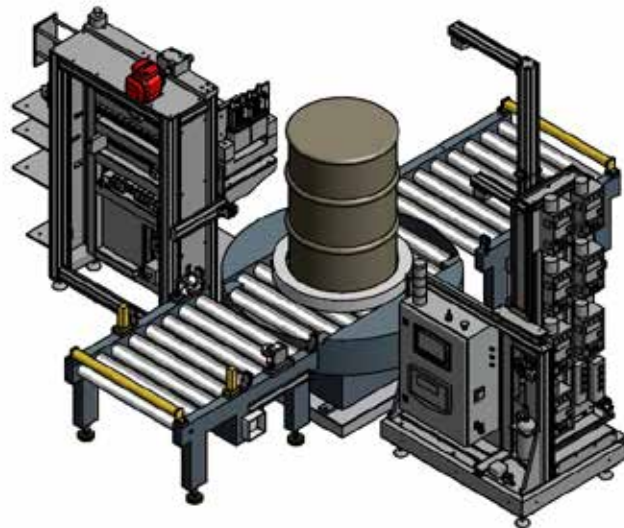
Advanced Segmented Gamma-Scanner

One of the necessarily required steps during operation and decommissioning of nuclear sites is the characterization of waste. Besides radionuclide-specific analyses for the determination of nuclide vectors, the waste packages' emitted radiation is usually measured using a High-purity Germanium Detector (HPGe) system and several dose rate probes to upscale the activity inventory. If the type of waste permits homogenization, the waste is usually homogenized by shredding and blending to ensure that the density and activity is evenly distributed inside the whole drum. An integral measurement of the drum, which means the acquisition of a single spectrum of the whole rotating drum, may give correct results if the waste is homogeneous inside the drum.

In reality, this is usually not the case since not all waste types allow a homogeneous comminution with reasonable effort. Therefore, and in order to meet the requirements according to the DIN ISO 11929,

uncertainties for the waste's inhomogeneity need to be taken into account by uncertainty analysis. These uncertainties are usually chosen too conservative, which leads to high additional costs for interim and final storage as well as for transportation. One approach to lower the uncertainties is scanning the drums in several segments. By this approach, the results are more accurate; however, a detailed localization of activity inhomogeneities is still not possible.

This presentation will show a new approach of determining the activity distribution inside a waste drum by segmentally scanning the drum. This approach, coupled with an innovative method for data analyses, allows that local inhomogeneities can be identified and be considered in the efficiency calibration. Consequently, this will help to declare the waste with less conservative assumptions and therefore help to lower the cost for waste transport and storage.



Accident with Significant Activity Release - Experiences with Immediate Measures and Decontamination

In December 2016 a release of Se-75 occurred at a service company.

A source used in the non-destructive material testing was opened by a fault assessment.

Buildings and exterior areas of the site were contaminated.

In the lecture we will discuss the immediate and further decontamination measures as well as the measurements for the clearance.

NucTecSolutions GmbH is a radiation protection and dismantling service company for emergency measures in all areas. In the last 10 years, seven emergencies have been successfully managed by our team, along with numerous dismantling and disposal projects.



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SPEAKER

THURSDAY 10:00 EN

Jean-Marie Thierry

Company VEOLIA Nuclear Solutions
556 Chemin de l'Islo
38670 Chasse / Rhône - France
Website www.nuclearsolutions.veolia.com



SPEAKER

THURSDAY 11:00 EN

Dr. Clere André Bérangère

Company ALTRAN
1330 rue Guilbert de la Lauzière Bât. C10
13856 Aix-en-Provence - France
Website www.altran.com

Innovative Vitrification Technologies for the Treatment of Low- and Intermediate-Level Waste

The first key issue for Low & Intermediate waste produced by the nuclear sector (generated from production & from final dismantling) is stabilisation of waste to avoid dissemination & contamination. The second key topic is reduction of waste volumes as final repositories capacities are scarce (or not available yet, which requires temporary storage solutions) and expensive.

„Geomelt“ technologies were developed in the USA, patented worldwide and first contracts were awarded in 1993, with both in-situ and in-container references: more than 13,000 metric tons of nuclear waste were processed up to now (in addition to 13,000 t of hazardous waste, particularly in Japan).

This company was later acquired by Kurion, then Veolia - the „industrial specialist of environment“ which has now a visible presence in the nuclear sector waste management in addition to global water, waste & energy services.

A test facility was recently developed at National Nuclear Laboratory (NNL) to demonstrate the technical & economical feasibility of vitrification for low activity & intermediate activity, in comparison with traditional (and not sustainable) solutions such as concrete - one should keep in mind that sand is a scarce resource.

Projects are now being developed in Europe and Japan (for Fukushima) and Germany could benefit from this technology as different types of waste can be vitrified (including metallic objects of even concrete blocks).

Combined with our characterisation know-how (in situ measurement backed by laboratory tests), access technologies (remotely operated arms) and water decontamination (Fukushima), together with our operation & maintenance contracts of nuclear waste facilities (CEA, ANDRA), Veolia Nuclear Solutions can provide a packaged innovative solutions to the low & intermediate activity nuclear waste issue.



Mechanical Conception of a Concrete Core Sampling Tool for Nuclear Decommissioning Coupled with Robotic ANDRO Solution

With the increase of the number of nuclear power plants being shut down, nuclear decommissioning activities are in worldwide expansion. At this time, more than one hundred nuclear plants are being stopped or dismantled. Nuclear sites remediation and decommissioning presents a real challenge in terms of cost, delivery time and technologies.

In the present work, our interest is focused on nuclear concrete structures decommissioning, which can be subject to radioactive contamination. Their remediation is realized by peeling off the civil structure up to a certain depth determined by measurements, sample analysis and calculations.

In order to minimize the radioactive concrete waste volume, while eliminating all radioelements from the civil structure, the concrete depth to take off must be determined exactly. Its depth can be evaluated using geostatistical studies, but destructive methods must be carried out to complete the characterization. These operations require the operator's presence and the traditional methods do not guarantee intact

samples. In order to minimize the operator radiation exposure during these operations, and to collect intact samples, we propose an innovative solution to automate the extraction.

We present a detailed study of the conception of a new core concrete extractor, specifically designed to quickly collect intact and standardized samples. Coupled with a dedicated remotely controlled robot, containing a sample storage box, operations will be performed without contamination risks for the machine operator, in compliance with the ALARA policy.

The solution allows a better evaluation of concrete contamination due to the sample standardization. Several solutions have been proposed and compared using mechanical calculations on Hypermech software. Their elasticities, reliabilities, dimensions and geometries have been investigated. As function of results, the tool shape was updated and optimized. A physical prototype is currently in test phase.



ANDRO
Advanced Nuclear
Decommissioning RObotics

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SPEAKER

THURSDAY 11:30 EN

Neil Owen

Company Createc
4 Derwent Mills Commercial Park
CA13 0HT Cockermouth - United Kingdom

Website www.createc.co.uk



SPEAKER

THURSDAY 12:00 EN

Dr. Hendrik Wiesel

Company Advanced Nuclear Fuels GmbH
Am Seitenkanal 1
49811 Lingen - Germany

Website www.areva.com

Mapping Radiation with a Mobile Gamma Imaging Instrument

In decommissioning, radiation monitoring and remediation it is often necessary to map and quantify radioactive contamination in areas quickly and efficiently with minimal human exposure.

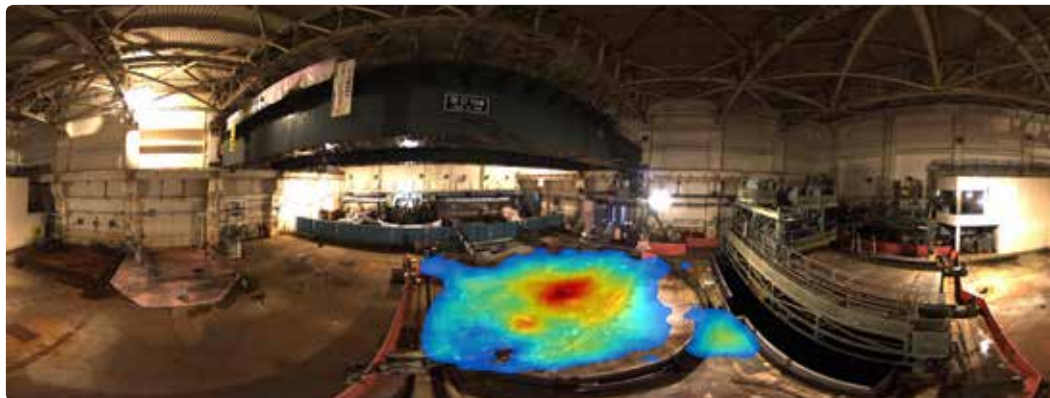
Our solution is a simple and intuitive handheld instrument that can be deployed by non-experts. The user initiates a survey by pressing a single button and walking around the area. The instrument displays the video from the camera mounted on the front of the instrument with a realtime overlay showing the source location of any detected gamma radiation. The user then builds up the gamma image by manually sweeping the sensor over the area of interest.

It's possible to cover wide areas rapidly at a low resolution by stepping back from them and fill in detailed areas more rapidly by stepping closer. The system provides the user with a visual indication of which parts of the image have adequate exposure so they can keep sweeping the system over the survey area until the desired resolution is reached.

The system is based on two existing technology platforms, developed by Createc: the N-Visage 3D radiation mapping engine and Createc's real-time Laser Rangefinder (LiDAR) positioning system, used on RISER, our Unmanned Aerial Vehicle (UAV). For the Handheld N-Visage we developed a simplified version of the 3D mapping engine that is capable of fusing the radiation data and 3D data together in real-time.

The picture shown is a panoramic 2D Radiation Gamma Image obtained using the N-Visage system at Fukushima, Japan.

The instrument's camera pose is calculated by the LiDAR positioning system and this information can be used to render the 3D activity model as it would be seen from the current camera view. This image is then displayed as a transparent overlay on the real-time video image. This means that as the user moves the sensors, both the video image and the rendered gamma image align perfectly – in effect, this is an augmented reality display of the contamination source.



QUANTOM – Quantitative Analysis of (non-)toxic Material

The management and safe disposal of low and intermediate level radioactive waste requires knowledge of its inventory with regards to chemically toxic and non-toxic substances. To avoid pollution of underground water reserves, the amount of chemotoxic inventory in a repository is restricted.

Derived from this restriction the waste acceptance requirements of each repository define acceptable limits regarding the mass amount of chemically hazardous substances. In addition to the standard radiological characterization, every waste package has to be characterized with respect to its chemical composition to comply with these requirements. This characterization can be performed either on the basis of existing waste documentation or, if the documentation is insufficient, on further analytical assays.

In principle, hazardous substances shall be quantified by traceability and quality controls performed during the waste production and conditioning processes. However, there are a lot of historical waste packages worldwide for which only poor or even no information or documentation is available. Based on this issue, there is an increasing need for a retrospective characterization in order to fulfill the acceptance criteria for final disposal or a safe long time interim storage.

The speaker will give an introduction to an innovative non-destructive method for multi-element detection based on prompt and delayed neutron activation analysis - called QUANTOM. This advanced technology offers a new methodology for scanning unopened waste packages and allows a retrospective identification and quantification of the waste matrix elements or hazardous substances.



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Proficiency in Nuclear Engineering

Professional activities in the complex discipline of nuclear engineering demands constant advanced training that takes up after formal studies end. For this reason, we decided to develop a training programme that not only provides instruction in elements of basic knowledge but also facilitates intensive analysis of special subject areas. Our reflections resulted in six training modules that satisfy this requirement.

The training programme by AiNT offers not only a general view of individual topic areas, but also imparts a greater depth of knowledge, e.g. on the issues of radioactive waste disposal or interrelationships in energy policy. The programme is constantly being expanded and refined in response to changes in the field, so that it is possible to address a broad range of technical subjects with internationally recognised speakers.

We are guided strongly by psychological learning principles during the design of our course modules. For example, receptiveness to and retention of the contents of the instruction modules are supported by the structures of the information and a relaxed learning atmosphere. The individual subject areas are introduced by professional, qualified and experienced presenters who have distinguished themselves through exceptional technical skills and teaching qualifications.

Additionally, we offer engineering and consultancy services on the highest scientific level. Especially the development of measurement technologies for the characterization of radioactive waste, the simulation of nuclear process as well as waste management belong to our services. We support our clients in the process of conditioning, characterization and packaging to qualify their waste for the German repository Konrad.



heavy transport - next level

August Alborn GmbH & Co. KG is an experienced and competent family-run company since 1891.

We are specialized in heavy lifting, fluids, relocation and transportation of large components, heavy and wide loads in the conventional as well as in the nuclear area.

Individual and economic solutions by the project processing in all areas, permanent call availability, careful planning and coordination accompanied with very short-term actions characterize our provision of service.

We also provide feasibility studies, detailed route and time planning, route reconnaissance and obtain the necessary permits. This is achieved by qualified and committed team of employees, using advanced equipment and innovative technology.

We provide a wide range of transportation devices and special vehicles like saddle trucks, low loaders, flatbed trailers with high payloads, mobile cranes and special equipment like our 1,440 to. hydraulic gantry.

Our new JMG mobile crane with max. capacity of 35 t. introduces the highest quality standards:

- the most powerful in compact size, the most precise and user friendly with the radio control,
- the most agile and safest among electric cranes.

The responsible use of the environment and resources is reflected in our quality management and certified according to ISO 9001:2008 and SCCP: 2011 Standards.

"If you intend to rebuild yourself, do it every day" is our motto for 125 years.



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ALE is a Complete Solution Provider for Lifting, Transporting, Installing, Ballasting, Jacking and Weighing Large, Heavy Loads

With a global network of operating centres and a fleet of heavy cranes, specialist transport and installation equipment, ALE combines exceptional project management with engineering intelligence to offer worldwide transportation and lifting services to all industry sectors.

ALE's reputation for safety, precision and responsibility carries a great deal of weight in the nuclear power sector, and we are well equipped to support the increase in nuclear power generation.

Over the last 20 years, we have developed strong working relationships with key providers, supporting projects ranging from the replacement of steam generators and reactor heads to the design of systems for dismantling turbines and electrical generators. We provide engineering resource early in the planning process to produce necessary HSQE and nuclear safety documentation ahead of critical plant outages, minimising operational impact.

Although we prioritise risk and safety, we also champion innovative engineering. Manoeuvres can combine lifting, tilting, skidding and hydraulic turning, and this demands careful planning and faultless execution, with activity scheduled to coincide with planned stoppages to reduce disruption and downtime.

We can design bespoke lifting systems to fit within existing station designs – a skill which has won us recognition for our flexibility and multiple project awards. In addition, one AL.SK crane can be positioned in the centre of the site to install multiple pieces up to 5,000t, replacing individual cranes lifting smaller pieces at each reactor building. With a small footprint and extended radius, AL.SK cranes cause minimal impact and can be located inside the plant with no amends to infrastructure, or outside where they can operate offsite. With a capacity as high as this, clients can produce larger modules to minimise onsite construction.



AREVA GmbH - Our customers' performance is our everyday commitment!

AREVA NP 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 for nuclear power plants and offers a full range of reactor services.

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

AREVA NP in Germany (AREVA GmbH) - Being one of the largest engineering centers worldwide, the German platform is an important country for AREVA NP. AREVA NP Germany specializes in maintenance

services, modernizing and enhancing the safety of nuclear power plants all over the world. The country has also developed a unique expertise in instrumentation and control (I&C) and fuel assemblies.

AREVA GmbH 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.



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ASUP GmbH - Ihr Partner für Industrie, Handwerk, Kommunen und Entsorgungswirtschaft

Die ASUP GmbH ist seit fast 20 Jahren spezialisiert auf den Vertrieb von Produkten und Lösungen im Bereich Arbeitsschutz für den sicheren Umgang mit Gefahrstoffen. Als Partner für Industrie, Handwerk, Kommunen und die Entsorgungswirtschaft garantiert ASUP mit mehr als 90 Mitarbeitern an vier Standorten in Deutschland und der Schweiz Top-Service und zuverlässige Sicherheit. Mit einem eigenen Außendienst ist ASUP in der Lage auf individuelle Kundenwünsche einzugehen und gleichzeitig eine hohe Produktverfügbarkeit und zuverlässige Belieferung sicherzustellen. ASUP hat dabei ein Portfolio von attraktiven Eigenmarken entwickelt und kann als Direktimporteur besonders günstige Einkaufskonditionen für eine Vielzahl von Produkten an seine Kunden weitergeben.

Automess GmbH

Wir sind eine Firma mit circa 30 Mitarbeitern und seit 1970 auf den Gebieten Entwicklung, Herstellung und Vertrieb von Kernstrahlungsmessgeräten tätig.

Schwerpunkt unserer Aktivität ist die Entwicklung und Fertigung von tragbaren Geräten wie Dosisleistungsmessgeräten und Personendosimetern. Der federführende Mitbegründer von Automess, Herr Dr. rer. nat. Wilhelm Buttler sen., war seit den späten 1950er Jahren in Ladenburg bei einer Firma für Feuerwehrbedarf mit der Entwicklung von Strahlungsmessgeräten beschäftigt. Unter seiner Regie wurden Produkte wie der Teletector geschaffen, die inzwischen weltweit bekannt sind. Dr. Wilhelm Buttler sen. machte sich 1968 selbstständig und gründete 1970 die Firma Automess.

Nach fast vier Jahrzehnten hingebungsvoller Arbeit auf dem Gebiet der Strahlenschutzmesstechnik verstarb er leider im Jahre 1995. Seither führt sein Sohn Herr Dr. rer. nat. Wilhelm Buttler jun. mit gleicher Hingabe die Entwicklung und das Unternehmen weiter.

Die langjährige Erfahrung von Automess auf dem Gebiet der Kernstrahlungsmesstechnik gewährleistet einen hohen Stand der Entwicklung und eine auf modernster Technologie basierende Fertigung. So haben wir schon im Jahre 1978 mit dem Szintomat 6134A das erste tragbare batteriebetriebene Strahlungsmessgerät hergestellt, das mit einem Mikroprozessor ausgestattet war. Im Jahre 1984 haben wir mit dem Dosimeter 219.1 das erste elektronische Personendosimeter hergestellt, das mit einem Mikroprozessor ausgestattet war. Unsere Forschungs- und Entwicklungsabteilung arbeitet immer daran neue, innovative Ideen umzusetzen, die unsere Geräte noch anwenderfreundlicher machen.

Automess-Geräte dienen dem Strahlenschutz in Industrie, Forschung, Arbeitsschutz, Zivil- und Katastrophenschutz sowie bei Feuerwehren.

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)

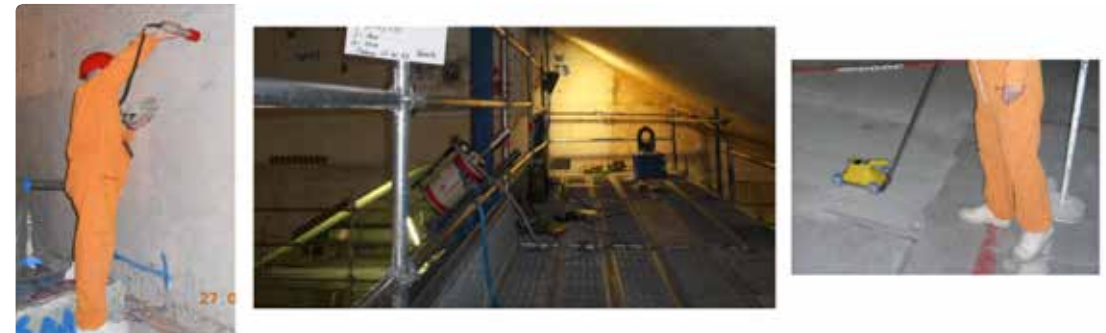
BS has been active in the consultancy business for more than 35 years now. The services cover the areas of radiation protection, nuclear technology, software development, plant and process engineering as well as mining and environment. Founded in Aachen, BS has nowadays additional branches in Hamburg, Bruchsal and Andernach with a total of about 50 employees.

Our work in the nuclear field is executed under contracts with the nuclear industry as well as with administrative bodies of the European Union, international organizations like OECD and IAEA, 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 etc., and a large variety of services in the area of decommissioning and dismantling, like planning, execution of licensing procedures (both in the nuclear and the conventional sector), radwaste management, decon-

tamination, clearance of materials, buildings etc. We have at our disposal a complete set of measurement instruments for radiological characterisation and clearance, including 9 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 transport license as well as our license for handling radioactive substances allows us to offer complete waste management solutions from a single source.

Several of our employees have been appointed members of advisory bodies like SSK (Commission on Radiation Protection) and ESK (Nuclear Waste Management Commission) as well as international working groups of IAEA, EU and OECD/NEA. Our work with DIN (German Institute for Standardisation) fosters standards on clearance measurements.



Baltic Scientific Instruments, Ltd.

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Website www.bsi.lv



Krantz - Business Unit from Caverion

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Email dirk.thybussek@krantz.de
Website www.krantz.de



Bringing Solutions for your Radio Nuclide Analysis Applications

Baltic Scientific Instruments was established in 1994 on the basis of Riga Research and Development Institute for Radio-Isotope Apparatus (RNIIRP, est.1966), which belonged to Ministry for Atomic Energy. In 2003 the company entered the group of BRUKER companies and in 2007 changed its name to Bruker Baltic. In June, 2010 the company bought out its shares from Bruker AXS and returned its name Baltic Scientific Instruments (BSI).

Baltic Scientific Instruments specializes in the development and serial production of the spectrometric devices based on silicon, high-pure germanium and cadmium-zinc-tellurium spectrometers. Our products are applied in nuclear

energetic and ecology, geology and mineral resource industry, medicine and research activities, customs control and other spheres.

We know that off-the-shelf-solutions are in many cases not sufficient to meet the costumers needs. To provide the best possible solution for your application, we offer additional to our off-the-shelf-solutions also highly customized solutions. If necessary, our well-trained specialists will find new and unique solutions to fulfill your requirements.

Just contact us and our Sales Team will help you to find the best solution for your application.



Krantz Designs, Manufactures and Sells Filter Systems and Dampers for HVAC Systems

Krantz develops, designs and manufactures air distribution systems, cooling and heating systems for ceiling and façade 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.

As a Caverion trademark, Krantz shares the same core values. These values serve as motivation and guidance at the same time (for more information please take a look to our webpage).

Department Filter Systems and Dampers

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.

Filter Systems

Krantz offers a wide range of filter systems for applications with high tightness requirements, like:

- HEPA filter systems
- Re-cleanable HEPA filter systems
- HEPA filter air outlets
- Duct filters
- Filter walls
- Mobile filter systems
- In-cell filters
- Sorption filter systems
- Sorption filter elements
- Sorption cartridge filters

Dampers

Krantz offers a wide range of dampers for applications with high tightness requirements, like:

- Gastight dampers acc. DIN 25496
- Air flow controllers
- Pressure relief dampers
- Louver dampers
- Non-return dampers
- Pressure surge dampers



ENGIE Deutschland is your partner for building services systems when dismantling nuclear and radiation-protected plants.

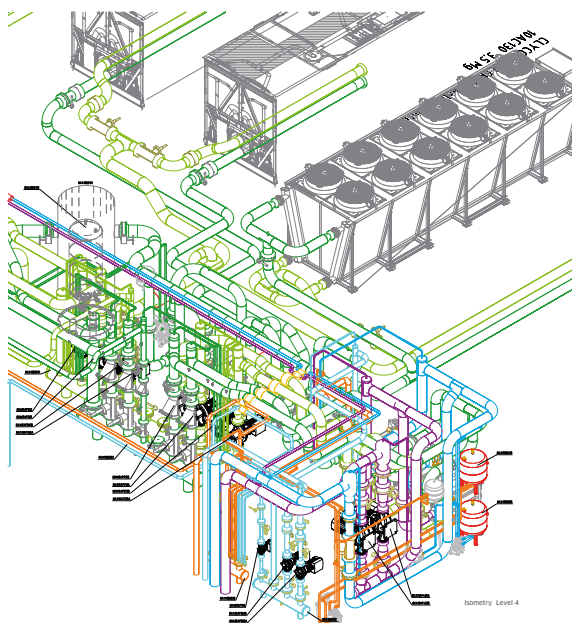
ENGIE Deutschland is one of Germany's leading specialists in technology, energy and services. Its range includes building services systems, plant and process engineering, facility management, energy management, energy procurement, renewable energy and industrial refrigeration technology.

We are also experts in complex supply and disposal systems in nuclear plants. We concentrate our know how particularly on the dismantling and decommissioning of nuclear power 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. ENGIE provides specialist expertise on external ventilation plants and dismantling, rebuild, new build and services for ventilation systems in controlled areas.

Across Germany ENGIE Deutschland is represented at 30 sites and, in 2016, recorded sales of around 1.8 billion euros with 3,000 employees. The publicly quoted ENGIE Group is a world leader in electricity, natural gas and liquefied natural gas (LNG) as well as for energy services and, in 2016, achieved sales of around 66.6 billion euros with 153,090 employees.



GNS Gesellschaft für Nuklear-Service mbH - Competence for Nuclear Services

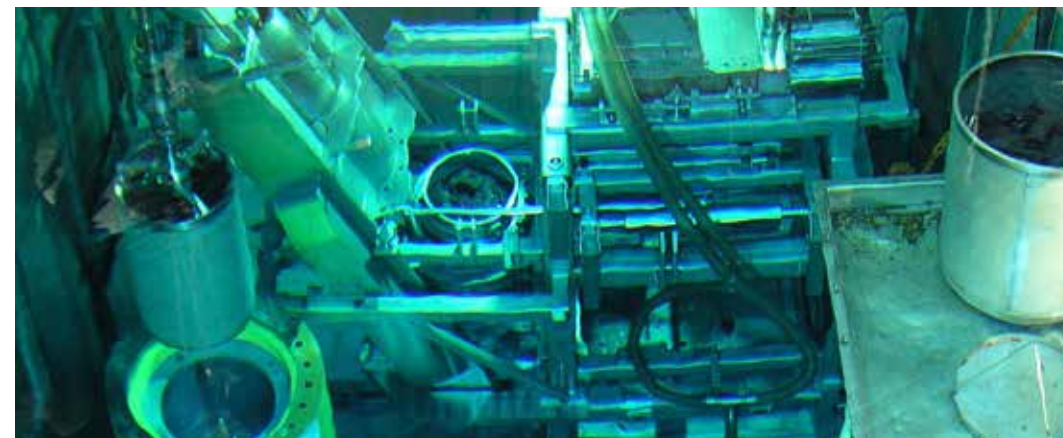
GNS Gesellschaft für Nuklear-Service mbH offers comprehensive solutions for the management and disposal of spent nuclear fuel and all types of radioactive waste from the operation of nuclear power plants based on its nuclear expertise of more than 40 years. For more than 25 years, GNS has been responsible for the management of all the radioactive waste and the SNF 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 and interim storage facilities and preparations for final disposal.

The complete life cycle of the spent fuel casks is covered by GNS, since it is not only the designer and manufacturer of the casks, but is also responsible for the dispatching prior to transport and storage of the casks within the NPPs.

Almost 1500 spent fuel/HLW casks of the CASTOR® and CONSTOR® type and more than 7500 MOSAIK® casks and GNS Konrad Containers® 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.

In addition to 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, e.g. in the UK at Bradwell and Sizewell, and is responsible for the retrieval of HLW from reprocessing in France and the UK back to Germany.





HEBETEC ENGINEERING LTD - 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 places particular importance to provide its equipment in as new condition to construction sites. The quality of the equipment is under permanent improvement. New components are being developed by our in house engineering- and design department.

Assignments often require specialised and tailor-made solutions. Thanks to a large machinery variety Hebetec is in the position to present adequate solutions and is able to react on short terms with high individuality and flexibility.

The lifting engineering market is subject to special outline conditions and is characterised by high mutual trust between client and service provider. Based on a vast experience gained during company history and on a sound corporate base, Hebetec is in the position to offer world-wide competitive services on a top quality level.



Nuclear Technology / Decommissioning

The company IEM FörderTechnik GmbH has been located in Kastl (Bavaria) for more than 45 years.

IEM manufactures, among other conveyance, electric-mechanical driven roll- and chain conveyer systems for the transport of bulk- and piece goods.

Handling of Bulk Material by Dust Capsuled Through Chain or Corrugated Edge Belt Conveyors Nuclear Technology / Decommissioning

- Barrel Transportation of LLW (low level radioactive waste)
- Barrel Filling and Waste Compression
- Barrel Sealing and Closing
- Weighing and Dimensional Check
- Handover to Rail Transportation System



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LIESE

Sondermaschinen ■ Anlagentechnik

Developing Custom Nuclear Measurement Solutions

KEP Nuclear is the subsidiary of the KEP Technologies group in charge of developing custom nuclear measurement solutions.

With more than 40 years experience in the development of large volume calorimeters, KEP Nuclear has recently extended its expertise (gamma-ray spectrometry and neutron counting specialists) and engineering (project management and process integration) capabilities.

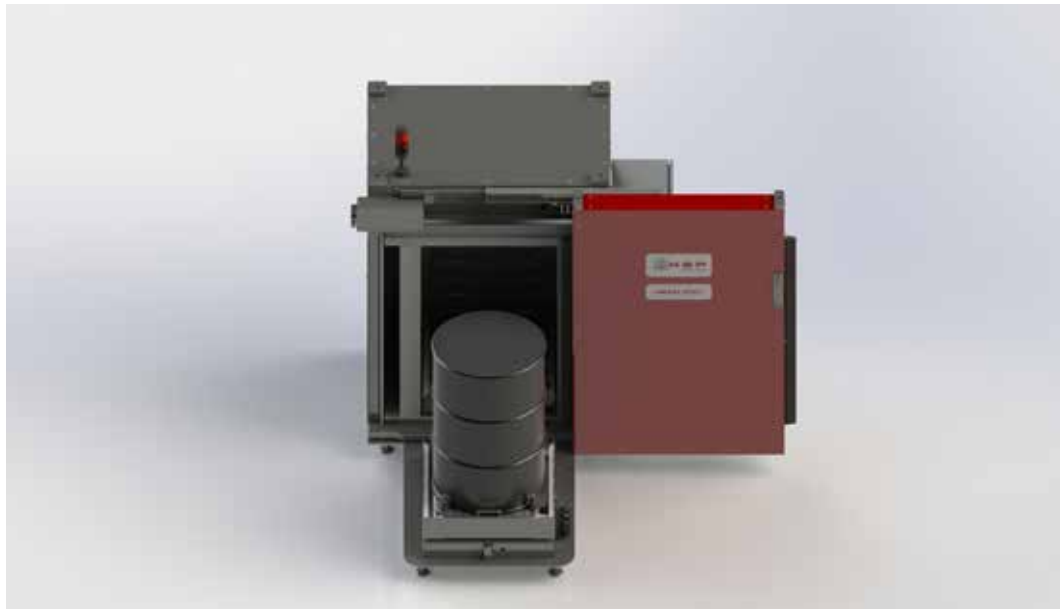
Our team operates in every project management phases (from the project conception, definition and execution to the conclusion of the project).

The main solutions KEP Nuclear has already implemented to help customers are :

- Manual and automated gamma-ray spectrometry.
- Neutron counting.
- Large volume calorimeters.

The key markets we address are :

- Nuclear decommissioning.
- Waste retrieval.
- SNM accountancy.
- Waste transportation and storage.



LIESE GmbH - A strong Partner for Nuclear Technology / Waste Management

Liese is a specialist for Materials Handling Technology and Special System Construction.

We provide in-depth, comprehensively planned and documented solutions for the safely treatment of radwaste. These include:

- Conveying and Handling Systems for drums, pellets and containers
- Cementation Systems
- Filling Stations
- Gantry Crane Systems
- Gamma Measurement Stations / Drum Scanner in cooperation with Marschelke Messtechnik (software engineering) and ORTEC AMETEK GmbH (nuclear instrumentation)
- Lidding Stations
- System Control Solutions, including visualisation
- System Monitoring

Our customers are suppliers to the nuclear industry and nuclear facility operators.

As our customers you benefit from the experience and the expertise gained from the large number of successfully completed projects - plus a quality management system that has been certified in accordance with DIN EN ISO 9001:2015.

For more information, visit www.liese-gmbh.de



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

Mirion Technologies is a leading provider of innovative products, systems and services related to the measurement, detection and monitoring of radiation. As a global leader in radiation measurement, Mirion's mission is driven to protect people, property and the environment from the harmful effects of ionizing radiation.

The company delivers high quality, state of the art solutions that constantly evolve to meet the changing needs of its customers.

Mirion has a whole range of sophisticated tools and world-class expertise to solve your most demanding nuclear measurement challenges in Decommissioning & Dismantling (D&D) applications.

Mirion designs, builds, commissions and operates products and provides services to support your D&D projects. This includes a wide range of instrumentation for all stages of D&D project lifecycles.

As well as supplying fixed installed Non Destructive Assay systems, our Measurements & Expertise team provides full consultancy services as well as field measurements teams to perform on-site measurements. We develop advanced and innovative tools that meet or exceed your needs, focusing directly on the success criteria for the D&D projects such as acceleration of site clean-up, minimization of waste volumes or reduction in waste sentencing costs.

With the merger of Canberra in 2016, Mirion expanded its portfolio and the breadth of its expertise to bring a new standard of solutions to their customers:

- Fixed and mobile systems for protecting individuals from radiation exposure
- Spectroscopy solutions
- Cameras for extreme environments ; measurement & expertise for decommissioning & waste management
- Safety-related fixed & mobile Radiation Monitoring Systems
- Nuclear sensing instrumentation & sealing systems
- Dosimetry services



NRG Consultancy and Services (C&S)

NRG Consultancy and Services (C&S), based in the Netherlands, unites more than 60 years of nuclear engineering, research, and 24/7 operational reactor experience into one unique purpose: the safe, reliable and efficient utilization of nuclear technology. Mid-sized, with 125 highly qualified engineers and consultants, we deliver services and solutions in the areas of nuclear safety and licensing, asset integrity, fuel management, inspection services, decommissioning and waste management, and radiation protection.

We give customers and partners access to extensive experience and in-depth expertise. We have recognized world class experts in various fields. We are independent from other service providers, utilities, or regulatory bodies. Being part of the larger NRG organization (circa 450 engineers, scientists, and operational staff), NRG's unique facilities in Petten (high flux reactor, hot cells, radiochemical laborato-

ries, decontamination and waste treatment facility) and in Arnhem (mock up hall for inspections) are at our disposal.

We strive to be at the forefront, a visionary and innovator in the advancement of nuclear technology. We invest a significant amount of time and resources in research and development to continuously improve nuclear safety, to optimize the use of nuclear assets, and to reduce the nuclear footprint for next generations.

We are expanding our business on an international scale to become a driving force in an international network of innovative nuclear service providers, who jointly offer a broad scope of services in their markets and together establish a preferred supplier status.





NucTecSolutions GmbH - Radiation Protection, Decommissioning and Emergency Management

NucTecSolutions GmbH was founded in 2006 as a radiation protection services and demolition company.

As a multidisciplinary company, NucTecSolutions GmbH has the possibility to provide services of all kinds with radioactive substances in all areas. Due to the unique company structure, we connect planning and project planning with the targeted implementation on site with a precise working team of young, technically competent employees.

This combination of theory and practice provides a service in radiation protection, deconstruction and renovation at the highest level of cost effectiveness. Our developments in measurement technology, handling techniques and decontamination processes, together with our own infrastructure, as such analysis and mobile units as a first-class trained team, allow projects to be interlinked and thus save money. A direct connection between planning, radiological actualization, the actual deconstruction, decontamination and measurement for the release is quite useful for small- and medium-sized projects.

This has been consistently implemented by NucTecSolutions GmbH since the company was founded.

For this purpose, NucTecSolutions GmbH has special measuring technology, its own equipment and self-developed decontamination processes, which are also available to the customers as well as to the project success in the efficient operation of the team.

After several incidents, NucTecSolutions GmbH decided in 2014, including nuclear emergency services. The combination of continuous activities in radiation protection, decommissioning activities and nuclear emergency protection is optimal for both parties, since in case of emergency there is sufficient material available, the team with measuring equipment.

For the dismantling, a team with emergency protection experience in case of unpredictable events is quite reasonable.

NucTecSolutions GmbH stands for high-level radiation protection combined with efficient dismantling.



NUKEM Technologies - Your Partner for Nuclear Engineering Solutions

The NUKEM Technologies Group is world-wide active in the areas of management of radioactive waste and spent fuel, decommissioning of nuclear facilities, engineering and consulting. It belongs to the ROSATOM Group.

The company's engineers develop solutions that are both modern and proven effective. Furthermore, the solutions build upon NUKEM's extensive experience within the nuclear sector, which began over five decades ago. The company's activities comprise a broad spectrum of services ranging from concept studies to the delivery of turn-key projects, from partial solutions to complete project and contract management. The company's Engineering and Consulting services play an important role in contributing to innovative design and build.

NUKEM is based in Alzenau, Germany where also the majority of the more than 110 staff is working.

Consistent customer orientation and quality management are essential cornerstones of NUKEM's corporate philosophy. We place a high premium on individualized service, timely project completion, complete and understandable documentation and providing our customers with superior-quality products. A visible sign of our emphasis on quality is NUKEM's quality assurance system based on DIN EN 9001. In addition, we are proud of being certified regarding KTA 1401, DIN EN ISO 14001:2009 and OHSAS 18001.



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Alpha-tight housings and protective systems from PEDI ensure the personal and environmental safety during dismantling procedures.

For 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 life 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.



Stäubli Tec-Systems GmbH – Connectors Complete tailor-made solutions

Founded in 1892 in Horgen on the shores of Lake Zurich, Stäubli is an international group headquartered in Pfäffikon, Switzerland. Over 4,500 employees work in the three business areas; textile, robotics and connectors. With a global presence of 12 manufacturing facilities, sales and service in 25 countries and further representation in 50 countries, Stäubli today offers worldwide service and sales of its products for all divisions.

Stäubli Tec-Systems GmbH is the branch office for Germany and Austria. Its Connectors business unit is one of the world's leading manufacturers of quick couplings, robot tool changers, multi-coupling and changing systems for injection and casting tools. Operational and functional safety, as well as the economic viability during the purchase and life-time of the products are the fundamental aspects of Stäubli's research and development.

Based in Bayreuth, the company developed a concept for its customers which is unique in

the market. In line with the requirements of the respective project, Stäubli offers tailor-made and individual complete system solutions from simple mono-coupling, multi-couplings and quick-release systems, to fully automatic tool changing systems. Stäubli Connectors develops and produces modular mono- and multi-coupling systems for a wide range of media and working environments. Typical applications are compressed air, breathing air, hydraulics, alternative energies, vacuum, liquids and gas.

Short tool changing times combined with high process reliability are the features of Stäubli's tool changing systems. The group company Multi-Contact develops and produces electrical connectors of all kinds for energy and data as well as optical fibre connections and photovoltaics. Quick Coupling Systems from Stäubli meet the highest safety standards. The tried and tested Stäubli sealing technology ensures that both working conditions and the environment are clean.



Nuclear service provider, experienced in D&D

Tecnubel has over 30 years of experience in providing advanced solutions for the nuclear industry. Together with its subsidiaries Transnubel and ECS, its expertise covers a wide range of activities in nuclear decommissioning, going from resource operations to engineered tailor made solutions.

It has provided services to various nuclear sites in Belgium and abroad, from nuclear power plants to nuclear fuel cycle facilities and from nuclear research centers to waste treatment facilities. This strong presence in the nuclear industry enables it to provide practical and technical services with high added value delivered with the greatest care and respect for quality, safety and environment.

Tecnubel is well positioned, within the ENGIE Group, to offer the preparatory studies and hands-on practical solutions to help minimize risks and resolve problems of accidental or accumulated contamination, the removal or replacement of ageing or contaminated components, radioactive or toxic waste treatment and more. In its further geographical expansion, Tecnubel GmbH was founded in 2016 with first projects at KTE and more recent at JRC Karlsruhe. This German affiliate concentrates on remote handling and is growing

rapidly. Tecnubel GmbH became also a trustworthy partner for KHG.

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. It gained a lot of experience in D&D due to its active participation in planning and execution of large Belgian dismantling projects, such as the nuclear fuel factories Belgonucleaire and FBFci, and from its international projects such as the Serbian Vinca decommissioning and the remote handling training courses at Chernobyl. It disposes of 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.). Tecnubel also stands for a thorough preparation of its project execution and methodical training of its operators. This results in efficient performances and very good safety track records. Having an own training school, teaching facilities and even a full scale 'Controlled Area Simulator', is proof of its commitment to comprehensive preparation and training.



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:
 - Selection of decommissioning techniques;
 - Drafting of decontamination and decommissioning procedures;
 - 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;
- Cost-benefit analysis & Schedule Optimization;
- Evaluation of quantities of waste generated;
- Decommissioning Plans, Safety Analysis Reports, Environmental Impact Reports;
- Development of Decommissioning Radiation Protection/ALARA Program.



Support in all Phases of Decommissioning and Dismantling

Since its founding in 1872, TÜV Rheinland has been synonymous with safety worldwide. Thanks to new ideas, internal developments, profound expertise and a global network, we can make products, services, systems and people safer and thus more competitive from the outset as well as promote people and train them to become experts.

Since the civilian use of nuclear energy began in Germany, TÜV Rheinland has been gathering comprehensive expertise in all areas of nuclear technology – be it for research reactors, pressurized water reactors, boiling water reactors, fast breeder reactors, high-temperature reactors or uranium enrichment facilities.

TÜV Rheinland helps companies to observe and comply with safety and quality standards while taking national and international regulations into

consideration. Our customers benefit from expertise resulting from a wide range of national and international projects.

TÜV Rheinland has been continuously involved in decommissioning and dismantling nuclear systems for more than 20 years. Based on the experience we have acquired, we can perform a wide range of activities for you that include services such as consulting in approval and supervisory procedures, support in the development of decommissioning and dismantling concepts and the underlying technical reports to practical on-site activities in the area of radiation protection. As a result of company acquisitions and the appointment of experienced employees from the industry in particular, we can provide comprehensive services in the area of dismantling and disposal for the industry.

Services of TÜV Rheinland Industrie Service GmbH and ISTec GmbH for the industry in the area of decommissioning

Consulting Services	Products	On-Site-Services & Laboratory
<ul style="list-style-type: none"> Services regarding Waste Management Services regarding Licensing and Supervising Procedures Services for final and interim storages Decommissioning Concepts Technical Services (e.g. Radiation & Fire Protection) Training Project Management Quality Management 	<ul style="list-style-type: none"> ReVK (Program system for tracking and controlling radioactive waste) ADAS (System for the acquisition and evaluation of activity data for collecting radiological measured values and process data) VerBA (Improved fire alarm system due to consistent documentation of all events relevant to fire protection and permanent monitoring) 	<ul style="list-style-type: none"> Providing radiation protection engineers and technicians for On-Site-Services Radiological Characterization Clearance Supervising of On-Site staff (rad. Prot.) In-House Laboratory <ul style="list-style-type: none"> - Gamma-Spectroscopy - Various measurement equipment (e.g. ISOCS, Inspector 1000)

Integrated Planning From Residual Material to Released Final Storage Containers

The German federal final disposal for low-level and intermediate level radioactive waste Konrad is approved for 303.000 m³. This volume is divided into 36 % for public sector (research reactors, nuclear power plants of former German Democratic Republic (GDR)), ca. 60 % from operation, decommissioning and dismantling of nuclear power plants. The rest originates from nuclear industry and from federal state collecting facilities.

It is planned to transfer 7.575 m³ per year into the final disposal, regarding 40 years of disposal operation. At the moment there are 2.936 m³ volume for final storage, which are suitable for storage in the German federal final repository Konrad. This corresponds with ca. 530 final storage containers, most of nuclear industry.

The previous practice of dismantling and disposal of low-level and intermediate level radioactive waste is often separated into several steps of planning and practice. These are decommissio-

ning, conditioning, packaging and documentation for final disposal, while there is no integrated plan from beginning to the end. The completion of all relevant documents to the final disposal documentation is necessary to confirm the acceptability for reposition. This step of the disposal process is critically, especially if data collection is lacking or insufficient.

An integrated planning from residual material, or the dismantling planning, to released final storage containers includes the planning and implementation of all product control measures. Therefore, a detailed description and planning of all control measures, process steps, options for optimization (e. g. volume- or time-optimized packaging of containers) flow into a finely tuned process qualification.

This approach guarantees a fast procedure of the final disposal documentation by a well-conceived organisation.





VTT Technical Research Centre of Finland Ltd.

VTT is one of the leading research and technology organizations in Europe and a broad-scope contributor in international nuclear research. VTT is independent and has a solid reputation as the leading Technical Support Organisation of the Finnish nuclear safety authority (STUK) for more than 30 years.

Our field of expertise and research activities cover the NPP technology and safety, and nuclear waste management and disposal. VTT provides contract research services, as well as technology solutions and software modeling and simulation codes to nuclear regulators, nuclear operators, designers and manufacturers.

Key offerings:

- NPP safety analysis, design review, design licensing support
- I&C design and modernization solutions and services

- Research reactor operation and decommissioning expertise
- Radwaste radiological inventory analysis, decommissioning waste planning
- Radwaste and Spent fuel underground repository (disposal) - R&D services, analyses, design solutions and safety case for engineered barriers, containers and canisters
- International safety reviews and support to Regulatory Authorities
- NPP life-time management and performance improvement solutions
- VTT ProperTune® - multiscale modeling solution, for integrated computational materials engineering (ICME)
- VTT ProperScan® - holistic solution for improved performance of materials, systems and plants

