Nuvia Experience in Decommissioning
Technical Meeting ‘Experience of Reactor Dismantling’ Ingnalina NPP, Lithuania, 18 October 2018
Vinci and Nuvia

**Revenue: €38.5 bn**
- Workforce: 184,450

**CONCESSIONS**
- Revenue: €5.8 bn
- Workforce: 12,850

**CONTRACTING**
- Revenue: €32.5 bn
- Workforce: 171,650

**NUCLEAR**
- **SOILS**
  - €1609 m - W: 10700
  - €257 m - W: 900

- **NUCLEAR**
  - NUVIA €358 M W 2700

- **STRUCTURES**
  - TERRE ARMEE €183 m - W: 800
  - FREYSSINET €765 m - W: 7500

- **DATA**
  - SIXENSE

**EUROVIA**
- €7.9 bn
- 40,178 Workforce
VINCI is the largest construction & concessions company in the world.

Vertical integration allows us to provide turnkey solutions and supporting operations.

Nuvia is the Nuclear arm of VINCI Construction, providing international capability.

In nuclear civil engineering, VINCI offers substantial expertise around the world, from design and construction of containments to dismantling of these structures.
Scope
- Design and construct the New Safe Confinement and position over the Chernobyl reactor
- Delivered by Novarka – the French construction consortium formed by VINCI Construction and Bouygues Construction
- 1.5Bn EUR Project

Outcome
- Shelter has now been successfully moved into place
- Airtight seals and equipment tests to be completed in 2017 ready for final handover.

Challenges
- Construction performed away from the reactor
- Construct the largest moveable land-based structure ever built
- An unprecedented scale: weighs 3.5 times as much as the Eiffel Tower, is big enough to house the Stade de France and the Statue of Liberty.
Business Sectors

NUCLEAR

OIL & GAS

CONSTRUCTION

MARINE

DEFENCE

TRANSPORT

SERVICES

MEDICINE
Nuvia is an international organisation with offices located across the globe.

We have a diverse, international client base, which all have unique challenges.

Our global outlook enables us to invest our resources to best support our clients.
Nuvia Group Corporate Structure

Chief Executive Officer
Bruno LANCIA

Chief Executive Officer
NUVIA France
Hervé RIDOUX

Deputy CEO NUVIA
Chief Executive Officer NUVIA UK
Keith COLLETT

Chief Executive Officer
Nuvia Czech
Martin PAZUR

Finance & Administration
Hervé CONTAMIN

Human Resources
Simone MARKERING

Safety & Security
Mike LEWIS

Legal
Emilie CHAMLA
Nuvia Group Key Figures

2017 Revenue ≈ 335M €

- Nuvia France: 183M €
- Nuvia UK: 99M €
- Nuvia CZ: 29.7M €
- Nuvia India: 0.5M €
- Nuvia Canada + Pico Envirotec: 10.2M €
- SEA MED: 5.8M €
- NUVIA Nordic: 6.1M €

Nuclear Technology and Innovation
Nuvia Group Workforce

Breakdown by category

NUVIA GROUP
Workforce ≈ 2 700

NUVIA India
NUVIA China
NUVIA Canada
NUVIA Italia
NUVIA Nordic
NUVIA Czech
NUVIA France
NUVIA UK

Title
Nuvia Group Core Business
Supporting the full project lifecycle

Key Areas of Activity:

- Consultancy
- Design and Build
- Plant Life Extension
- Operations and Maintenance
- Decommissioning
- Radiation Protection
- Waste Management
- Products
Decommissioning Projects
Nuvia Understanding of RBMK Reactors

RBMK Reactor
The RBMK is an unusual reactor design, one of two to emerge in the Soviet Union in the 1970s.

The Soviet-designed RBMK is a pressurised water-cooled reactor with individual fuel channels and using graphite as its moderator.

It is also known as the light water graphite reactor (LWGR). The combination of graphite moderator and water coolant is found in no other power reactors in the world.

Decommissioning of these reactors therefore represents a significant challenge, one which Nuvia is well equipped to under take. Nuvia’s wide experience of graphite and other reactor types, a long history in decommissioning projects and extensive capability in waste management is represented in the following projects.
Ignalina NPP: Fuel Handling Systems

Full EPC supply of Fuel Handling Systems
Ignalina NPP: Fuel Handling Systems

**Scope**
- Design build test, install and commission the fuel handling systems along with operator training
- Two Fuel Bundle Handling machines (FBH) for under water handling of fuel bundles in both active reactor units
- Cask transfer bogie, seal and shield hatches, in-cell handler with interchangeable grabs, integrated control system, CCTV system and cell HVAC system

**Challenges**
- High levels of inspection, NDT, and management of the assembly and test of specialised equipment required
- Multinational supply chain and stakeholders

**Outcome**
- Nuvia successfully completed the design, manufacture, integrated testing, supply, installation, commissioning and operator training of the FBH machines

**NDA Supply Chain Export Award Winner**

**Fuel handling systems for the loading and repackaging of spent fuel storage casks for interim storage**
France has a fleet of graphite core reactors undergoing decommissioning. The table below lists some of these reactors:

<table>
<thead>
<tr>
<th>Site</th>
<th>Type</th>
<th>MWe</th>
<th>Operational</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marcoule G1</td>
<td>UNGG/GCR</td>
<td>2</td>
<td>1956-68</td>
</tr>
<tr>
<td>Marcoule G2</td>
<td>UNGG/GCR</td>
<td>40</td>
<td>1959-80</td>
</tr>
<tr>
<td>Marcoule G3</td>
<td>UNGG/GCR</td>
<td>40</td>
<td>1960-84</td>
</tr>
<tr>
<td>Chinon A1</td>
<td>UNGG/GCR</td>
<td>70</td>
<td>1963-73</td>
</tr>
<tr>
<td>Chinon A2</td>
<td>UNGG/GCR</td>
<td>200</td>
<td>1965-85</td>
</tr>
<tr>
<td>Chinon A3</td>
<td>UNGG/GCR</td>
<td>480</td>
<td>1966-90</td>
</tr>
<tr>
<td>Saint-Laurent A1</td>
<td>UNGG/GCR</td>
<td>480</td>
<td>1969-90</td>
</tr>
<tr>
<td>Saint-Laurent A2</td>
<td>UNGG/GCR</td>
<td>515</td>
<td>1971-92</td>
</tr>
<tr>
<td>Bugey 1</td>
<td>UNGG/GCR</td>
<td>540</td>
<td>1972-94</td>
</tr>
</tbody>
</table>

Decommissioning activities in UK including Magnox Reactors with Graphite Cores. UK also has a fleet of 14 AGRs with decommissioning expected to start in 2022.
Managing Graphite Reactor Cores

During the Heysham 1 (HYA) Reactor 1 2013 statutory outage, an unexpected result was found from the ‘Teletest’ inspection (which checks the boiler spines’ structural integrity) of the 1D1 Boiler Spine. This anomaly indicated a discontinuity to the boiler spine; the main structure supporting one of the boiler pod.

Nuvia supported Rolls Royce with their scope of the EDF Fleet Critical programmes Project by providing personnel to carry out (within Reactor Pressure Vessel (RPV)) cleaning and subsequent inspection of the Boiler Spine of Boiler 1D1 with the objective to provide justification for continued operation of the reactor.

Project conclusion

A team of qualified and trained Nuvia personnel were deployed to site. The cleaning and inspection activities were delivered by our site team.
Project Management Consultant to SERAW, Bulgaria

**Scope**
- Programme of work includes projects to facilitate the decommissioning of the four reactor units
- Provision of expert roles including: decommissioning, engineering, licensing, quality and commercial

**Challenges**
- Developing facilities for processing of ion exchange material, solid and liquid radioactive wastes, evaporator concentrate and waste disposal
- Delivery of the Radiania LLW repository

**Outcome**
- Nuvia continues to provide support on the management of existing and procurement of new projects to enable decommissioning successfully completed the design, manufacture, integrated testing, supply, installation, commissioning and operator training of the FBH machines

Plasma Melting Facility

Size Reduction and Decontamination Facility
Dealing with the legacy of the Soviet nuclear fleet in North West Russia
PM Consultant for the EBRD NDEP Support Fund

Scope
- Risk identification, regular update and management of the project risk register
- Development of a procurement plan, modes of procurement and realistic time schedules
- Preparation of tender documentation
- Reporting on the risks during the Project implementation
- Training of Client’s PMU personnel

Challenges
- Working on difficult sites
- Security considerations
- Introducing western project management processes

Outcome
- Nuvia continues to provide in-country and external support on the management of the projects to enable progress on the safe management of legacy spent nuclear fuel

Management of Spent Nuclear Fuel at Andreeva Bay

Submarine Dismantling
Decommissioning SuperPhenix
Decommissioning Superphenix at Creys-Malville

Scope
- Secondary circuit decommissioning
- Construction of decommissioning workshop & structural modifications
- Removal of BCC & PBT

Challenges
- 1500 tons material with Sodium contamination
- Robotic cutting of heavy components
- Reconfiguration of internal structures

Outcomes
- Successful cutting of secondary circuit
- Trials on BCC & PBT removal
- Planning for implementation in 2018
First Generation Magnox Storage Ponds (FGMSP) Export Facility, Sellafield

High profile NDA and ONR project, with a requirement for first class performance and quality
FGMSP Export Facility, Sellafield

<table>
<thead>
<tr>
<th>Scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Design, procurement and installation of all export equipment</td>
</tr>
<tr>
<td>• Design, build and manage testing of all critical machines (lid lift, flask fill/empty, skip hoist, skip bogie, flask bogie) at an off site integrated test facility</td>
</tr>
<tr>
<td>• Integrated trials</td>
</tr>
<tr>
<td>• Removal of redundant equipment in high hazard environment to enable installation on site</td>
</tr>
<tr>
<td>• Installation, test and inactive commission of new export plant and equipment on site</td>
</tr>
<tr>
<td>• Training for operational personnel</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Constrained timescales to meet Client deadline</td>
</tr>
<tr>
<td>• Significant background dose rates</td>
</tr>
<tr>
<td>• Limited building access</td>
</tr>
<tr>
<td>• Significant background dose rates</td>
</tr>
<tr>
<td>• Multiple stakeholders</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Over 250k Hrs worked without Report of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) or Lost Time Accident (LTA)</td>
</tr>
<tr>
<td>• Innovative self-shielding bogie design</td>
</tr>
<tr>
<td>• Successfully transformed the building</td>
</tr>
<tr>
<td>• Client exported first skip in April 2016 during Active Commissioning.</td>
</tr>
<tr>
<td>• Plant handed over to client for operations to reduce long term nuclear hazard at Sellafield</td>
</tr>
</tbody>
</table>

Refurbish the existing inlet building to enable safe and reliable export of the pond waste inventory
Design of a Flask Loading Facility
Concept and Scheme Design of a Flask Loading Facility

Scope
- To complete a concept and scheme design of a Facility to transfer fuel in Irradiated Fuel Containers from site flasks to road/rail transport flasks for onward transfer.

Challenges
- Separated by a distance of 550+ miles the integrated team needed to work closely and efficiently.
- Fixed project timescales despite changing requirements.
- Changing Client requirements brought many new stakeholders into the project requiring good stakeholder management.

Outcome
- Excellent Client feedback received.
- Economic materials such as aluminium cladding were selected to maximise the opportunities offered by a short plant life.
- Plant infrastructure reduced to a minimum, full advantage being taken of aspects such as natural ventilation where possible.
- Space envelopes give the design flexibility to incorporate additional capabilities should the need arise as the unknowns in the baseline data reach maturity.

Design of a Flask Loading Facility
Reactor Decommissioning: Chooz A
Decommissioning and dismantling of a Reactor Pressure Vessel (RPV)
Reactor Decommissioning: Chooz A, France

First Pressurized Water Reactor, Reactor Pressure Vessel to be decommissioned in France

Decommissioning and dismantling of a Reactor Pressure Vessel (RPV)

Scope
- Preparatory Work including design of decommissioning approach.
- Design of the hot cell & full-scale testing
- Civil Works – building reconfiguration
- Underwater vessel cutting
- Remote handling & dismantling
- Waste management
- HVAC & electricity reconfiguration

Challenges
- Waste volume reduction & optimisation
- Integration of many different specialities – civils, engineering, radiation protection etc
- Access constraints as the Reactor Pressure Vessel is in a small underground cavern

Outcome
- Successful completion of preliminary studies in 2012
- Certification and proving trials complete in 2014
- Civil engineering progressing well, due for completion in 2016
Updates of Preliminary Decommissioning Plans for OPG Waste Facilities
Updates of Preliminary Decommissioning Plans for OPG Waste Facilities

Scope
Update of Preliminary Decommissioning Plans (PDPs) for waste management facilities.

Challenges
- Checking existing documents against recognised international standards as well as Canadian domestic standards
- Identifying gaps and agreeing modifications with client

Outcome
- Upon acceptance of the recommendations from Nuvia’s Gap analysis, the PDPs were revised and submitted to the client for acceptance
Decommissioning: Dragon High Temperature Gas Reactor
Nuvia is undertaking the detailed design and build of plant and equipment to carry out reactor core segmentation, waste packaging and disposal operations.

**Scope**
- Detailed, Design and Build (DD&B) of Mechanical and EC&I systems, plant and equipment to deploy, carry out and/or support core segmentation and waste processing operations.
- Shield doors.
- Cranes, hoists, plant and tooling.
- Radiological assay systems.
- Waste packing and export plant.
- Ventilation plant.
- EC&I systems.
- Technical support during commissioning and operations.

**Challenges**
- Remote removal of reactor core from the inside out, and top down, operating through the neck of the Reactor Pressure Vessel (RPV).
- Assay of the waste as it is removed to provide assurance that the waste is within the defined limits for transport and disposal.
- Remotely packing of ILW components unsuitable for packaging in 6 m³ boxes (e.g. the fuel spikes) into cans and export in the Modular Flask.
- Remote packaging and grouting ILW into 6 m³ boxes.

**Objective**
- Successful design of systems and key interfaces to enable reactor decommissioning. (Ongoing Project)
Decommissioning Planning for UK Nuclear New Build Funded Decommissioning Programme

**Scope**

Technical authorship of the decommissioning activities and associated costs for Moorsides AP1000s. Acted as the independent verifier of the decommissioning activities and costs for the Wylfa ABWRs.

**Challenges**

- Avoiding preferential engineering and excessive detail
- Stakeholder management of several interested parties
- Understanding how to cost for waste disposal decades into the future, including waste repositories that are not yet built

**Outcome**

- Wylfa Project – Successfully delivered an independent verification report to support the FDP. The report has been passed to UK Government as part of the FDP
- Moorside Project – Successful chapter authorship, cost estimations and risk reviews delivered.

Applying experience and knowledge of Decommissioning to support the UK New Build Programme
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