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# Key Lessons Learned on Engineer of Choice's Partnership with Nuclear Owners for New Build and Plant Operation Support Programs

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PUBLIC

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# ENGIE makes the zero carbon transition as a service\* possible for our customers



## Produce

Centralized and decentralized production and sale of low CO<sub>2</sub>-emitting electricity, including renewable energies.

- The world's leading independent power producer (IPP)
- 104.3 GW<sup>(1)</sup> installed
- 93% of low CO<sub>2</sub>-emitting activities
- The leader in wind and solar power in France



## Distribute

Distribution, transportation and storage of gas and electricity upstream of supply to customers.

- The European leader in gas transportation and distribution
- 4,500 km of gas pipelines in Brazil
- The first demonstrator of the injection of green hydrogen into the gas distribution network in France
- A 600 km electricity grid between northern and central Chile



## Customer solutions

Development of unique integrated solutions to support the transition to zero carbon of businesses and local authorities.

- 24 million contracts worldwide
- N°1 worldwide in cold networks
- N°2 worldwide in recharging systems for electric mobility
- N°1 worldwide in micro-grids

(1) On 31/12/2018, at 100 %, \*competitive, co-funded, made to measure



# ENGIE, **55 years** of expertise in nuclear energy

Stakeholder in Europe **first commercial PWRs**

BR 3 (1962-1987) - Chooz A (1967-1991)

Operator of **7 reactors** in Belgium  
(3 at Tihange and 4 at Doel)

The Group capacities in Belgium, France  
and Germany : **6 424 MW**

Generating about **8%** of the electricity produced by the Group

**Independent** from suppliers & vendors



# ENGIE, a major player in the nuclear sector

Considering Nuclear Energy as a contributor to the energy transition  
With more than 55 years of expertise in nuclear energy  
Mastering the whole nuclear value chain

**A Nuclear Operator**  
with ENGIE ELECTRABEL

committed to keep its reactors  
in safe operation  
as long as legally, technically  
and commercially sound

**Nuclear  
Safety**

**Nuclear Services Subsidiaries**  
delivering a broad range of Nuclear  
engineering & services to:

- **Operating NPPs**, including for LTO
- **Nuclear New Build** projects
- **Decommissioning and Radwaste Management**

Developing partnerships with large companies  
Fostering Research and Innovation  
Managing talents and competences

# Tractebel > Nuclear

Covering the full life cycle of nuclear facilities with 55 years experience



- **Architect-Engineer** and **Responsible Designer** for all 7 Belgian NPP units
- Permanent **Engineering Support** to the Belgian and French Utilities
- **Worldwide** experience and references on designing and implementing **customized** solutions for international owners
- Full range of **nuclear** and **non-nuclear engineering** expertise to deliver **multi-disciplinary** projects
- **Independence** from suppliers
- **Uncompromising approach to safety** in all projects and services
- **Credibility** towards stakeholders
- **Top 5<sup>th</sup>** Nuclear Engineering company in Engineering News Record's ranking
- **9 offices in Latin America** among which 5 in Brazil

Projects in  
21  
**COUNTRIES**

950  
employees

€ 180  
**MILLION**  
turnover

# Engineer of Choice across the full lifecycle of nuclear facilities



Advanced  
Technologies



New Build



Plant Operation  
Support



Radwaste  
Management



Decommissioning  
& Dismantling



# Nuclear New Build and Plant Operation Support Challenges

- Mastering project **schedule**
- Keeping **costs** affordable
- Ensuring constructive interactions with **safety authorities**
- Securing and developing the specific **skills** required
  - ✓ During design & construction
  - ✓ As future operator
- Mastering the **supply chain**
- Promoting **public acceptance**



# Pallas Multi-Purpose Research Reactor

Engineer of Choice for the design and construction of the PALLAS Reactor. PALLAS is a nuclear multi-purpose research reactor to produce medical isotopes and to supply a wide range of irradiation services

**CLIENT** Pallas  
**LOCATION** The Netherlands  
**PERIOD** 2015 - 2025

## CHALLENGES

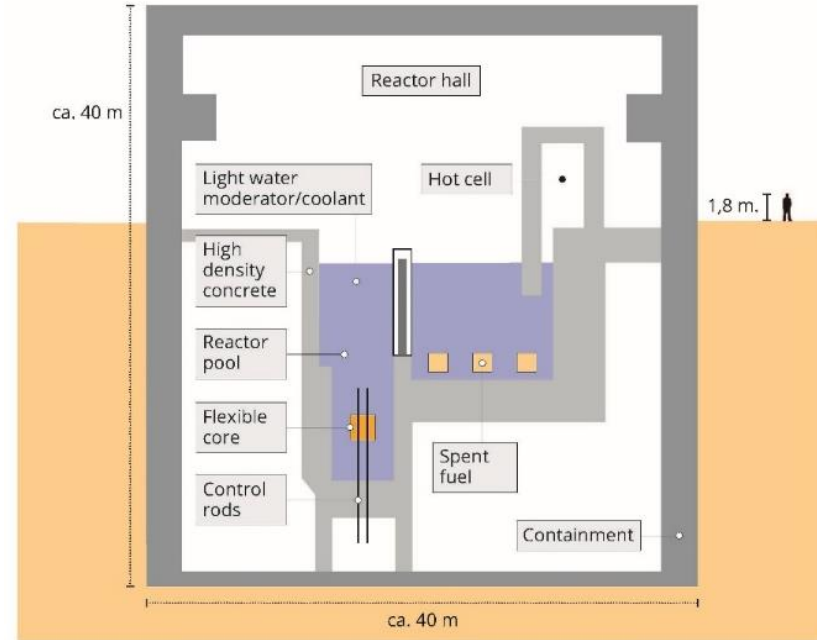
- Build new facility for isotope production and R&D
- Develop and execute a fully-privately funded project
- First Nuclear New Build in the Netherlands since 1975

## → SOLUTIONS

- Fully integrated team in Alkmaar (NL)
- Resident engineer in vendor's office in Bariloche (Arg) to liaise with Client
- Multi-disciplinary EoC support

## PALLAS-reactor

Schematic representation of the planned pool-type reactor





# Tihange and Doel Long-Term Operation

The program consists in the implementation of the required investments (ageing management and design upgrade) to extend the operation of Tihange 1 and Doel 1 – 2 units till 2025.

**CLIENT** ENGIE Electrabel

**LOCATION** Belgium

**PERIOD** 2012 - 2019

## CHALLENGES

- Realize fully IAEA-compliant LTO programs on 3 units with time and operation constraints
- Total value > 1.3 Bio €, hundreds of projects

## → SOLUTIONS

- Close partnership between Owner and EoC, 150 staff mobilized in peak
- EoC Multi-skills approach : shift to project mode with effective deployment of all concerned technical and project management competencies
- Defend the selected technical orientations in front of the Belgian safety authorities



# Tihange Flooding Protection

Tractebel mandated to study, develop and implement the construction of the technical solutions related to the successive and independent external flooding protections

<b>CLIENT</b>	ENGIE Electrabel
<b>LOCATION</b>	Belgium
<b>PERIOD</b>	2010 - 2015

## CHALLENGES

- Safety requirements reevaluated in a PSR : Flood return period > 10000 years
- Respond to Belgian Stress Tests
- Work on the heat sink while preserving operation

## → SOLUTIONS

- EoC team on site with Owner
- Detailed design and implementation of innovative site flooding protection including locks, valves, siphons, pumping stations, automation





# Borssele I&C Modernization

Tractebel is the Engineer of Choice to support and advise in execution of a large-scale I&C modernization program in the frame of the Borssele NPP extended operations project

<b>CLIENT</b>	Elektriciteits Produktiemaatschappij Zuid-Nederland (EPZ)
<b>LOCATION</b>	The Netherlands
<b>PERIOD</b>	2012 - 2017

## CHALLENGES

- Owner captive from OEM
- Complex I&C System

## → SOLUTIONS

- On-site integrated team Owner - EoC
- Competent I&C and qualification experts
- Senior licensing expert supported the interactions between Owner and Safety Authorities



# Koeberg Steam Generator Replacement

Tractebel is the Engineer of Choice to provide engineering support in the frame of the replacement of the steam generators on both Koeberg NPP units in accordance with international relevant operational and safety practice

CLIENT	ESKOM
LOCATION	South Africa, Koeberg
PERIOD	2010 - 2020

## CHALLENGES

- Owner of last early generation Steam Generators
- Koeberg units operated at reduced power
- Skilled NPP team requires support for such a complex modification

## → SOLUTIONS

- Use extended Belgian experience with SGRs to specify, relicense, procure and install replacement SGs
- Front-office team in South Africa + Expert team in back-office
- Training and localization plan





# Engineer of Choice Organization and Activities



- Core Team in front office + Multi-disciplinary expert team in back office
- Develop a concept and a mature basic design before going to the market for implementation in order to reduce risks and associated financial coverage
- Carry out very detailed studies and preparation prior to implementation
- Select Suppliers with proven experience
- Make close follow-up of the Suppliers including document review, inspection, surveillance and audits
- Coordinate studies by involving the Engineer of Choice, the Owner (O&M) and the Suppliers
- Establish close and transparent collaboration between all involved stakeholders

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# Contacts

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# Engineer of Choice Organizational Structure

- Core team in front-office
  - Local integrated staff located on-site including staff from both the Owner and the Engineer of Choice (EoC) in the spirit of acting jointly
  - Broad on-site technical expertise to cover daily/permanent needs
  - Planning, project control and project management
  - Fast response to emergency issues related to technical and project aspects
  - Suppliers oversight during implementation on site
  - Organizing the in-country training and localization plans
  - Interface with back-office team
- Back-office team
  - EoC's home-based workforce mobilised on purpose
  - Full range of technical services related to design, engineering and manufacturers oversight
  - Specialty knowledge

