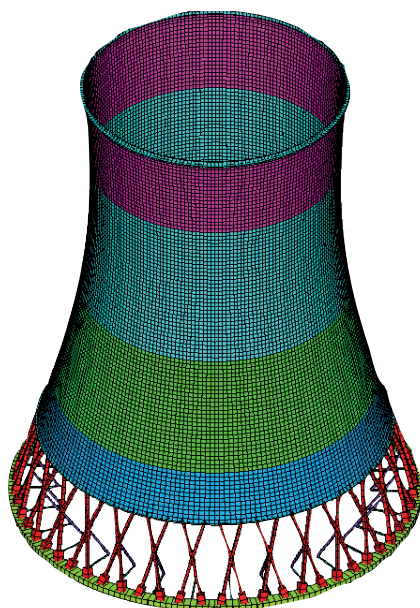
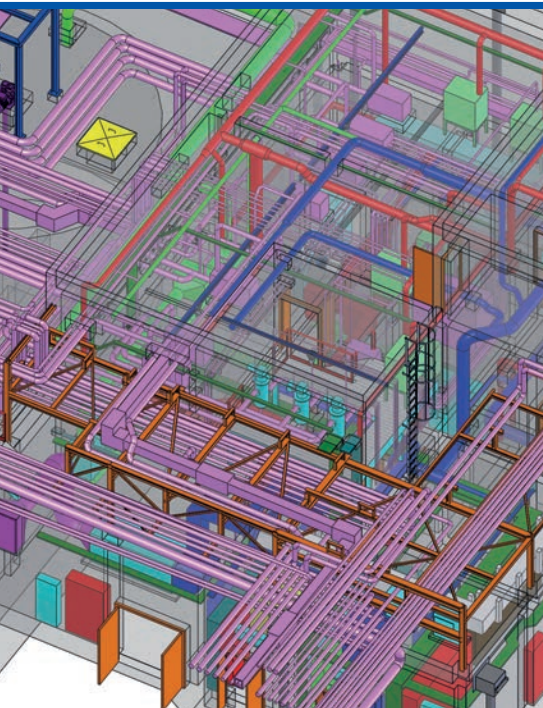




Energy & Industry



# NUCLEAR SECTOR





<b>The Ingerop Company</b>	<b>3</b>
<b>Energy and Industry branch in a nutshell</b>	<b>4</b>
<b>From Industry to the nuclear sector</b>	<b>5</b>
<b>IT tools</b>	<b>6</b>
<b>Our Qualifications and certifications</b>	<b>7</b>
<b>Our main References</b>	<b>8</b>
<b>Contact</b>	<b>18</b>

# THE INGEROP COMPANY

49 SUBSIDIARIES WORLDWIDE

ACTIVITIES IN MORE THAN 80 COUNTRIES

1700 STAFF MEMBERS

24 IN FRANCE



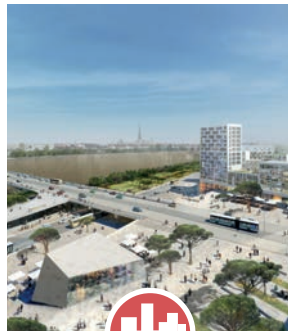
## 4 ACTIVITIES AND SERVICES AT ALL STAGES OF A PROJECT

TECHNICAL AND ORGANIZATIONAL ASSISTANCE TO OWNERS | FEASIBILITY STUDIES (TECHNICAL, FINANCIAL, OPTIMIZATION) | PRELIMINARY DESIGN | DETAILED DESIGN | CONSTRUCTION DESIGN | BUILDING PERMIT DOCUMENTATION | PROJECT MANAGEMENT | PROCUREMENT | DESIGN AND CONSTRUCTION MANAGEMENT | CONSULTING TO GOVERNMENTS AND INSTITUTIONAL ORGANISATIONS | ASSISTANCE TO MAINTENANCE



### BUILDING

- | Teaching and research
- | Hospitals & healthcare establishments
- | Sporting, cultural and leisure facilities
- | Commercial property
- | Commercial urban planning
- | Housing & accommodation
- | Stations and terminals



### URBAN DEVELOPMENT & TRANSPORTATION

- | Road and highways
- | Infrastructure networks
- | Bridges and tunnels
- | Urban development
- | Land use management & planning
- | Railways
- | Urban transportation
- | Transportation systems & equipment



### ENERGY & INDUSTRY

- | Industrial buildings
- | Civilian and military nuclear
- | Aeronautics, aerospace
- | Food, wine production processes
- | High technologies & micro-electronics
- | Data centers
- | Power plants
- | Pharmaceuticals, biotechnologies, cosmetics
- | Iron & steel production
- | Heat networks
- | Geothermal & renewable energy



### WATER & ENVIRONMENT

- | River hydraulics
- | Water & infrastructure
- | Urban water
- | Ports & coastal engineering
- | River structures
- | Environment
- | Ecology and biodiversity
- | Waterways and canals
- | Dams

# ➤ ENERGY AND INDUSTRY BRANCH IN A NUTSHELL

Due to its historical presence in the center of France, the headquarters of the Energy & Industry branch are located in this area, nevertheless its teams work on projects all over the country and world-wide, in collaboration with the international offices of Ingerop.

Over time, Ingerop's teams widened their skills and operates today in many different engineering fields such as nuclear, fossil and renewable energies, automotive (including equipment manufacturing), steelwork and metal works, defence, ceramics, high-tech, petrochemicals, fine chemicals, pharmaceuticals, biotechnologies, airport facilities, logistics and food processing.

The share of Energy & Industry business, which employs more than 350 team members, is around 18 % of the Company's global turnover and shows a smooth upward trend over the past few years.

## Our offer of services:

**Project owner's assistance (strategic advice, feasibility studies, master plans)**

**Project management**

**Consulting**

**Feasibility studies**

**Audits, Checking, Expert advice**

**Comprehensive project supervision and coordination (all trades, design - construction)**

**Specific project supervision and coordination within EPC contractor consortia**

**Supervision of construction works, control and coordination, assistance for technical acceptance of works and commissioning**

**Complex calculations**

**Lay-out optimization**

## ➤ FROM INDUSTRY TO THE NUCLEAR SECTOR

As regards the nuclear sector, Ingerop has acquired along the decades extensive experience in designing and calculating complex structures for nuclear facilities. Since 2002, Ingerop focused on more system- and process-oriented projects in this field. Nowadays, Ingerop offers integrated services based on its sound know-how, top-notch expertise and insight into the management of nuclear projects, for both revamping and new build activities.

Ingerop has made the development of the energy sector one of its top priorities in particular for the nuclear sector along with NucAdvisor, the first French engineering practice specialising in civil nuclear power. NucAdvisor's main mission is to assist governments or their representatives in developing their nuclear programs offering expertise and consulting services on specific topics like siting, licensing and operation of nuclear power plants, as well as decommissioning and dismantling and radioactive waste management.



In January 2016, a new subsidiary has been created - INGEROP Contracting - which provides a global EPC/turnkey offer covering all fields of energy and industry. Its goal is to deliver projects from the design up to the commissioning, while taking a clear commitment on the overall cost and schedule.



### Our main fields of intervention:

**Industrial architecture / flow optimization, simulation of manufacturing processes**

**Upgrading, revamping, requalification, maintenance, standard and special handling**

**Scientific calculations (mechanics, hydraulics, fluid dynamics and structures)**

**Fluid Processing (gas, liquids, bulks) - conventional, special and nuclear HVAC**

**Mechanical, electro-mechanical and electro-hydraulic equipment**

**Power, lighting and communication networks, I&C, industrial IT and electronic surveillance**

**Geotechnics - Foundations - Roads, utilities and networks**

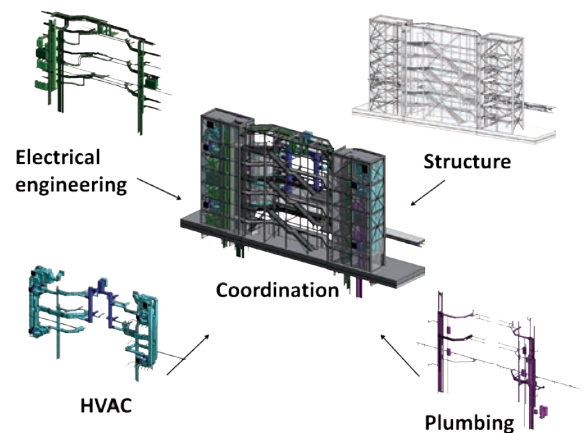
**Civil Works - Steelwork - Structures**

**Finishing, architecture and landscaping**

## ➤ IT TOOLS

### BIM, 3D MODELLING

BIM, Building Information Model, is systematically used by Ingerop for all our buildings. The use of 3D models allows from an early stage a complete overlap of the architectural views and engineering drawings. At further stages of detailed design, mechanical and electrical engineering as well as all technical parameters are integrated in the structure in such a way that coordination is automatically ensured. This process is a crucial technical, interface management and cost control tool throughout the complete engineering process.



### SCIENTIFIC AND DESIGN SOFTWARE

All workstations and software (spreadsheets, databases, project management, simulation, post-processing) along with CAD/CAM (AUTOCAD, SOLIDWORKS, CATIA, PDMS,...) are state-of-the-art, original and updated.

All data are stored and transferred within a secure internal network. For each project we make use of our internal document management system, developed exclusively for Ingerop : the AGORA system.

All our design engineers have access to a set of tools specific to their own discipline, as follows :

Géotechnics / Structure-Soil-Structure interaction	MISS-3D/ Z-SOIL
Seismics / Spectral and Modal analysis / Airplane crash	ANSYS/ASTER
Explosion	BLAST by LS-DYNA
Rapid Dynamics (Load Drop)	LS-DYNA
Ventilation - Fluid Dynamics / Thermal analysis	FLUENT / FLO VENT / FLO EFD
3D Modeling / 3D Layout studies	SOLIDWORKS / CATIA / PDMS/REVIT
3D Animation	MOTION WORKS
Calculation of Mechanical Assemblies	SIMULATION
Fluid flow Simulation	FLOW SIMULATION
Simplified seismic calculations	ROBOT
Configuration and Interface management	Proprietary tools
Radiation Protection and Criticality	MCNP/MERCURE

# ➤ OUR QUALIFICATIONS AND CERTIFICATIONS

## Quality, Health, Safety and Environment



ISO 9001 version 2008  
OHSAS 18001 version 2007  
ISO 14001 version 2004



Comité français de certification des Entreprises  
pour la formation et le suivi du personnel travaillant  
sous Rayonnements Ionisants

CEFRI no. 965E - 26/02/2014  
(French authorisation for working  
in radioactive environments)



UIC MASE no. RA 2013-305  
(French certification for improving safety and  
reducing risks at work)

## Technical Capabilities



O.P.Q.B.I. no. 85 04 0697 - 01-08-2015 (French acknowledgement of  
engineering capabilities)

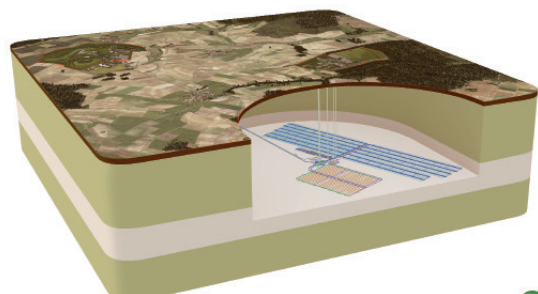
## EdF/UTO Qualification



Ingerop obtained the EDF UTO qualification to carry out activities for  
EDF's Nuclear Power Plants in the following fields :

- Chemistry
- Waste/Environment
- Decommissioning/Dismantling
- Electricity and electric networks
- Civil Works, steelwork, roads and networks
- Mechanics, maintenance, special equipment, nuclear HVAC
- Thermohydraulics
- Scientific Information
- Work Supervision (excluding outages)
- Scheduling and control
- Expertise (excluding works, including in particular geotechnics and civil works)

# ➤ OUR MAIN REFERENCES



Extrait de C.I.M./EKS.15.0005.C



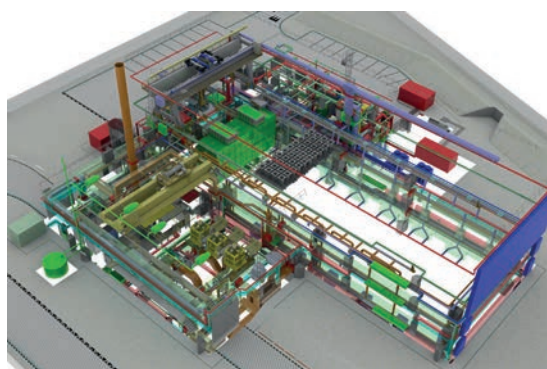
## ANDRA - CIGEO Project

**Project owner** : ANDRA (French National Radioactive Waste Management Agency)

**Project description** : Cigéo (Centre Industriel de stockage GEOlogique, Industrial Centre for Geological storage/disposal) is the French national reversible deep repository dedicated to storing nuclear waste according to strict safety and reliability requirements. On the Bure site are currently located the underground laboratories of ANDRA (see photo on the left). The majority of materials comes from French spent nuclear fuel, consisting of long-lived high-level and medium-level waste, including vitrified waste.

**Scope of work** : Ingerop and Technip work together in a 50/50 consortium named "Gaiya" to provide the overall project management for preliminary basic and detail design phases.

**Project value** : Several tens of billions of Euros



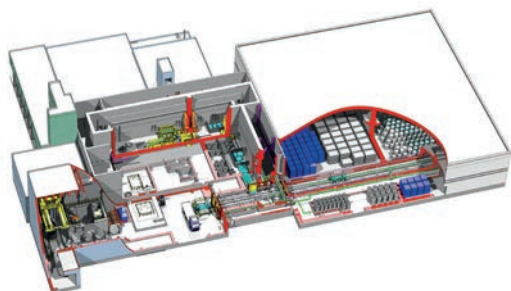
## CEA - DIADEM Project

**Project owner** : CEA (Commissariat à l'énergie atomique et aux énergies alternatives - French Alternative Energies and Atomic Energy Commission) / VALHRO

**Project description** : DIADEM (Déchets Irradiants ou Alpha de DEMantèlement, radioactive waste or alpha emitters from dismantling) is a future interim storage facility at CEA Marcoule site that will collect, manage and store for 50 years a bundle of radioactive waste that is not acceptable by the current disposal solutions. In particular it will host the waste produced by the dismantling of the Phénix experimental fast breeder sodium reactor, and materials from other fuel cycle facilities being decommissioned. It features integrated systems for logistics and remote handling of packages and containers, radiological controls and supervision.

**Scope of work** : EPCM and design

**Project value** : 50 M€



## EDF CIDEN - ICEDA Project

**Project owner** : EDF CIDEN (EDF's Decommissioning and Dismantling department)

**Project description** : ICEDA (Installation de Conditionnement et d'Entreposage de Déchets Activés, conditioning and storage facility for activated waste) is a centralized facility under construction on the Bugey site for conditioning and interim storage of intermediate, long lived waste coming from the dismantling of six French nuclear power plants (Graphite-Gas type), transported to the site by road or rail. It features three large hot cells, a waste cementation plant, an effluent treatment plant, automatic package handling, manipulation, measurement and characterization systems, allowing practically full remote operation of the facility, from the unloading bay up to the storage area.

**Scope of work** : Project management of specific packages within an EPC consortium, global project management during the design phase, concept design, optimization of flows and sizing studies, industrial architecture, coordination of studies for all trades, construction drawings for civil works, 3D lay-out, assistance to works supervision for the construction phase, design of the cement preparation units.

**Project value** : >150 M€



#### JAEC - JRTR Project (Jordan)

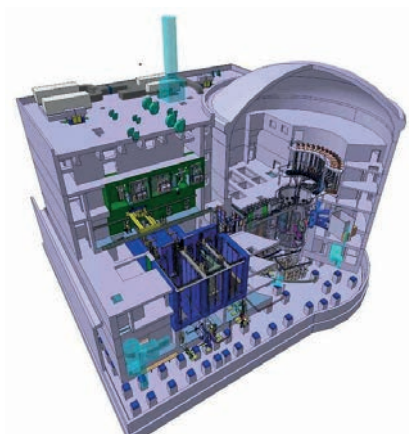
**Project owner :** Jordan Atomic Energy Commission

**Project description :** Construction of the first nuclear research and training reactor of the Hashemite Kingdom of Jordan, located on the campus of the Technology University of Irbid.

**Scope of work :** Ingerop is working with NucAdvisor to deliver the Project owner's assistance for the construction phase. Work includes project oversight of procurement, construction, installation and testing.

**Project value :** > 200 M\$

**Area :** Around 6000 m<sup>2</sup> of nuclear buildings, and auxiliary structures extending for more than 3 hectares.



#### CEA - Jules HOROWITZ Reactor Project

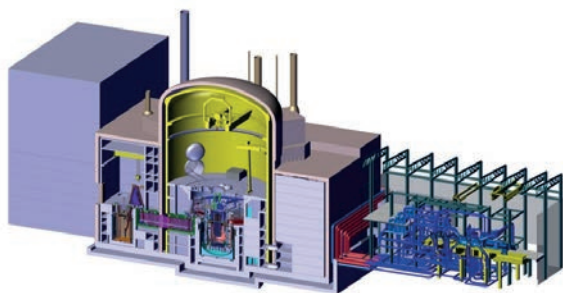
**Project owner :** CEA

**Project description :** Under construction on CEA Cadarache site, the RJH research and isotopes production reactor, result of an international cooperation, will cover the experimental needs for testing nuclear fuels and materials for the next 50 years. It will also be employed for producing specific radio-isotopes for medical use, meeting 25-50% of the European demand.

**Scope of work :** Construction studies for civil works, including complex interfaces with mechanical components (e.g. hot cells)

**Project value :** > 700 M€

**Volume of concrete structures :** 40 000 m<sup>3</sup>

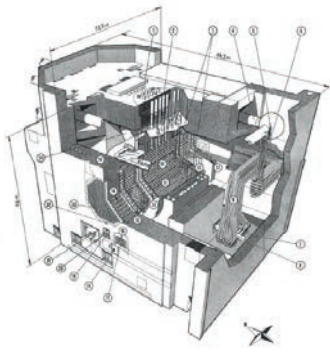


#### CEA - ASTRID Project

**Project owner :** CEA

**Project description :** Pre-project design studies of a 600 MWe GEN-IV experimental sodium-cooled fast breeder demonstration reactor. It will be designed, constructed and put into operation to validate the safety features, performances, scalability and industrial feasibility of the concept, as well as to assess the transmutation efficiency for minor actinides. Like the French Phénix and Superphénix reactors, the reactor will eventually burn its own fuel bred from natural or depleted uranium blankets.

**Scope of work :** Project owner's assistance. Working alongside a project team made up of experts from several sectors and laboratories, INGEROP's mission is to deliver a technical 3D lay-out and industrial architecture optimization of the whole reactor design, providing interface, change and configuration management. The work includes the management of multiple designs, as the choice of the definitive one will be made in a further phase.



### EDF - BRENNILIS Decommissioning and Dismantling Project

**Project owner :** EDF CIDEN

**Project description :** Preliminary scenario for the decommissioning and dismantling of the reactor building of EDF's Brennilis HWGCR nuclear power plant

**Scope of work :** Preliminary study of the D&D scenario and definition of a detailed scenario including the cinematics of waste during the operations



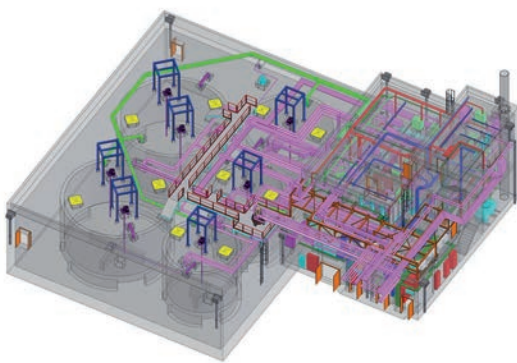
### GANIL - SPIRAL 2 Project

**Project owner :** GANIL (CEA/CNRS – French National Centre for Scientific Research)

**Project description :** GANIL (Grand Accélérateur National d'Ions Lourds, big national heavy ion accelerator) is a particle accelerator for the study of fundamental nuclear physics and multidisciplinary research on the Caen site in Normandy. The main purpose of the facility is the production of exotic nuclei at extremely high intensity by collision of high energy heavy ion beams on a target. Ingerop worked on the SPIRAL2 (second generation system for on-line production of radioactive ions) upgrading project of the accelerator and several related experiment and laboratory rooms.

**Scope of work :** Project management of the buildings and logistic infrastructures of the facility, of the process utilities and overall installation, excluding the accelerator's beam and target systems.

**Project value :** 72 M€ (excluding accelerator equipment)



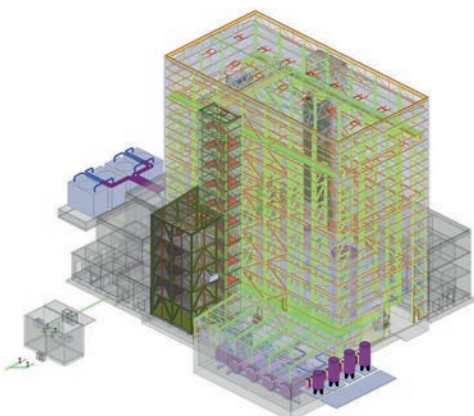
### CEA - Maintien STEL Project

**Project owner :** CEA

**Project description :** The conversion project of the STEL (Station de Traitement des Effluents Liquides, Liquid Effluent Treatment Facility) at CEA Marcoule site has two main objectives: to upgrade the facility in order to allow for a 30 year life extension, and to replace the current asphaltting process with a new enveloping process. The work has been split into different packages: building new basins, circuits and auxiliary functions; seismic reinforcement of the pumping station and creating a new discharge duct to the river; essential work for commissioning the new sludge cementing station; maintaining in optimal conditions perennial equipment and infrastructures and decommissioning the obsolete ones. The critical and fundamental condition of the project is to keep the facility operating during the revamping works.

**Scope of work :** Project management

**Project value :** 25 M€



### CEA - CHEOPS Project

**Project owner :** CEA

**Project description :** The CHEOPS (Circuit et Hall d'Essais des grOs comPosants Sodium) will be a facility located at CEA Cadarache site, containing test rigs for components and circuits operating with liquid sodium, including a pump-out and a carbonation system, used to qualify the future main equipment of the Astrid reactor (sodium-cooled, featuring a sodium-gas secondary exchanger).

**Scope of work :** Project management of specific packages within an EPC consortium, global project management during the design phase, process design, industrial architecture, coordination of studies for all trades, 3D lay-out, assistance to works supervision for the construction phase.

**Project value :** 90 M€

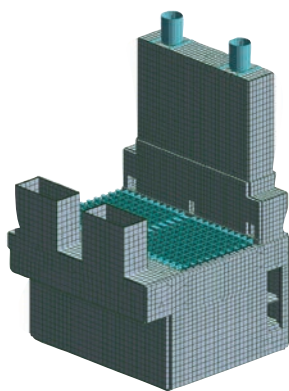
### CEA - PLINIUS 2 Project

**Project owner :** CEA Cadarache

**Project description :** The PLINIUS 2 facility (Platform for Improvements in Nuclear Industry and Utility Safety) is dedicated to the study of corium interactions with different materials (structural, moderator-coolant) in case of severe accidents, covering generation II, III, III+ LWR as well as gen-IV liquid sodium-cooled reactors (ASTRID in particular). It will allow the qualification of advanced strategic means for accident mitigation and will help validate the results from present-day and future simulators. A wide range of analytic and large-scale integral experiments will be possible, using 'fuel' prototype materials based on depleted uranium - with quantities ranging from 5g up to 500 kg

**Scope of work :** Design, safety analyses, project management and construction/erection supervision

**Project value :** 17 M€ (excluding process)



### AREVA- EEVLH BUILDING Project- LA HAGUE

**Project owner :** AREVA

**Project description :** Half-buried structure for the storage of vitrified high activity waste at La Hague reprocessing facility. Dimensions of the structure : 30 m x 35 m x 50 m (height)

**Scope of work :** Finite Element analysis of the structure, integrating seismic loads and thermal loads induced by radioactive decay. Construction studies for civil works (concrete and steelwork).

**Project value :** 13 M€

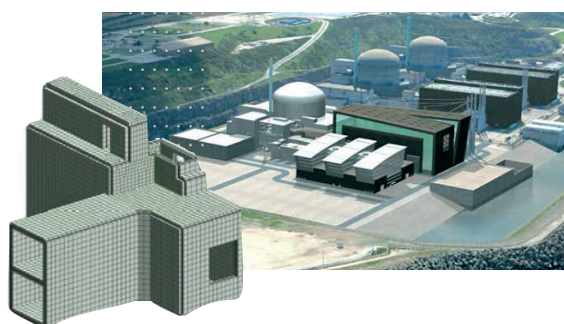


### CEA - INCCA Project

**Project owner :** CEA

**Project description :** The main purpose of INCCA (INstallation de Caractérisation de Colis Anciens, characterisation facility for legacy packages) facility at CEA Cadarache site is to assess the quantity of fissile material and alpha activity of legacy radioactive waste packages by means of non-destructive tests prior to their shipping to other processing sites.

**Scope of work :** Concept and preliminary design – including flow optimization and industrial architecture, civil engineering, HVAC, electricity and networks, safety studies and radiation protection.



### EDF – EPR FLAMANVILLE 3 NPP Project

**Project owner :** EDF

**Project description :** For the first nuclear power plant built in France for decades, Ingerop designed the service galleries and tunnels housing the interconnecting fluid, electric and signal networks and allowing the circulation of maintenance personnel between the different buildings of the plant. These galleries extend for more than 2 km and feature huge concrete structures at their intersections. In addition, Ingerop calculated the sustaining walls around the Turbine Hall and the structures protecting the plant cooling ducts (pipes with diameter of 3.50 m).

**Scope of work :** Design and construction studies



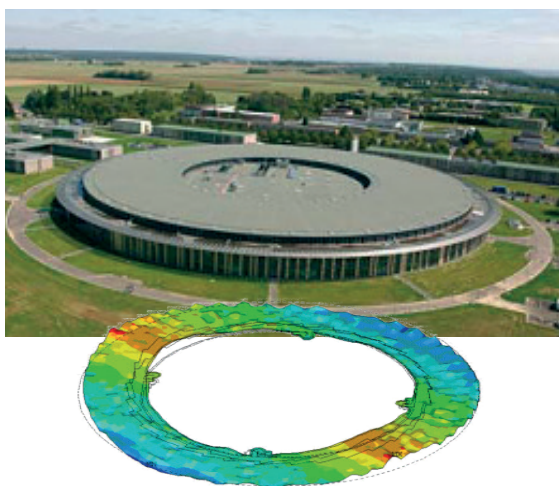
#### CEA - ESCALE ED 223 Project

**Project owner :** CEA/DAM

**Project description :** Interim storage facility for very low and low activity waste produced at Valduc centre.

**Scope of work :** Global project management for building and process.

**Project value :** 17 M€



#### CEA/CNRS - SOLEIL Project

**Project owner :** SOLEIL Consortium (CEA-CNRS)

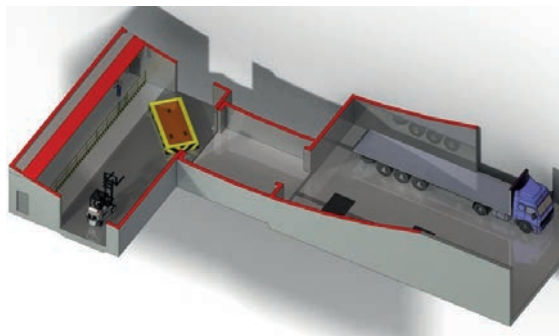
**Project description :** Surrounded by a research centre extending for more than 17 hectares on the outskirts of Paris, the main building hosts a sophisticated electron synchrotron for the production of highly coherent and ultra-bright bremsstrahlung X-radiation. The design of the building and structures presented remarkable constraints on structure stability, with relative displacement allowance in the micron range.

**Scope of work :** Project management of building and infrastructure, economic studies

Deliverables included :

- Validation of micron-scale vibrational tolerances by modelling via ANSYS code, by transient dynamic and PSD (power spectral density) analysis.
- Study of the background noise and of the structure-soil-structure interaction using SASSI software

**Project value :** 65 M€ (excluding accelerator equipment)



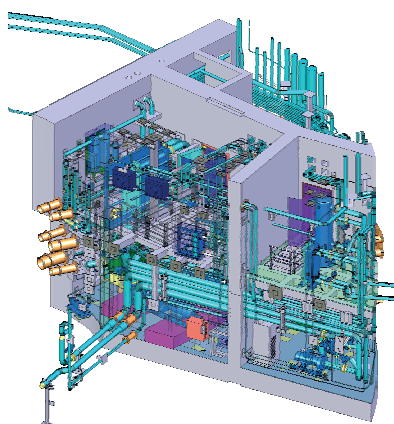
#### CEA - LASER MEGAJOULE Project

**Project owner :** CEA Military

**Project description :** Component hatch at Laser Mégajoule compound, allowing for the transfer of massive components to the experimental hall.

**Scope of work :** Project management

**Project value :** 2 M€

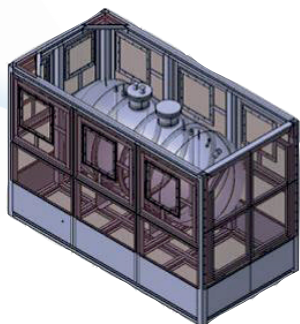


#### CEA - MOLFI Project

**Project owner :** CEA

**Project description :** Design of a production facility at the Jules Horowitz Reactor for molybdenum-99 (MOLybdène de Fission) employed in technetium-99m biomedical imaging.

**Scope of work :** Project owner's assistance



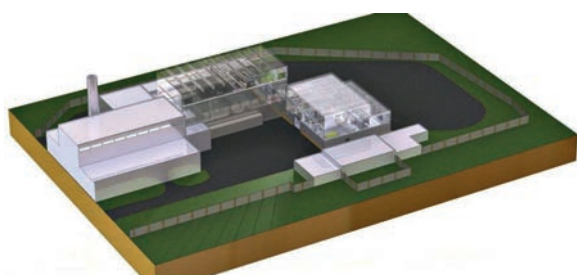
#### CEA - IVAN-ICARE Project

**Project owner :** CEA

**Project description :** Pump-out and carbonation systems of the contaminated sodium for the Phénix experimental reactor at Marcoule site.

**Scope of work :** Project management

**Project value :** 5 M€



#### CEA - STEP Project

**Project owner :** CEA

**Project description :** Construction of an external hall providing temporary storage for radioactive waste packages, in order to limit risks of load drop in the existing STAR facility at Cadarache site. The activities included: construction of a new airlock, an unloading bay, reinforcement of floors and beams inside the existing building, installation of new handling equipment (for loads of up to 33 tons).

**Scope of work :** Global project management

**Project value :** 12 M€

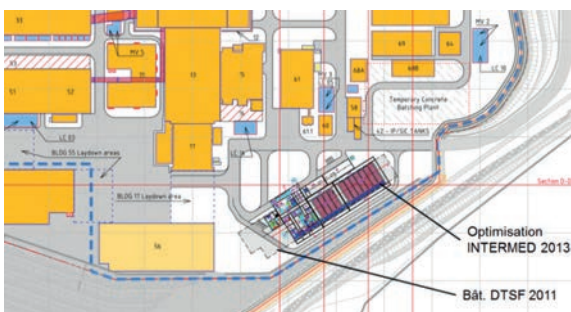


#### EDF - VERCORS Project

**Project owner :** EDF CIPN (EDF's engineering department for the operating nuclear fleet)

**Project description :** Construction of a 1:3 scale mock-up of a reactor building of the EDF's nuclear fleet P4-type, to carry out tests at harsh thermal and pressure conditions, simulating accidental situations and aging effects on a double wall containment.

**Scope of work :** Preliminary design



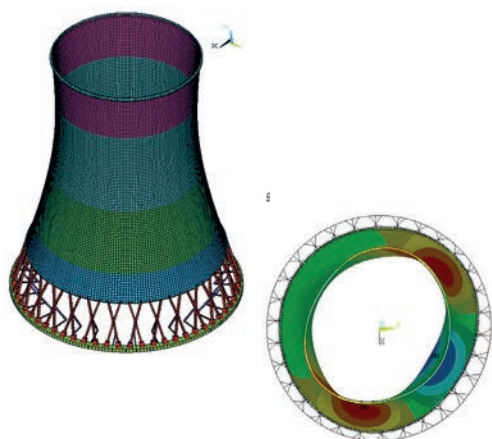
#### CEA - INTERMED Project (within ITER compound)

**Project owner :** CEA

**Project description :** Interim storage facility for waste material highly contaminated by tritium during operation of the ITER fusion reactor in Cadarache. The interim storage period before transfer to ANDRA's disposal sites has been set at 50 years.

**Scope of work :** Preliminary studies (feasibility)

**Project value :** > 100 M€



### EDF - Transposition of EUROCODE 1 NV65 norms for windload to cooling towers

**Project owner :** EDF SEPTEN

**Project description :** Study driven by an evolution in the regulatory framework, based on the modelling and calculation of the resistance margin for the Cattenom NPP's Cooling tower. Assistance to EDF on the drafting of the new standard.

**Scope of work :** Main deliverables and activities :

- Non-linear modelling of reinforced concrete structures using ANSYS code
- Robustness assessment of the structure
- Participation in the elaboration of new standards for wind calculations for cooling towers.

### EDF - Seismic resistance of BUGEY NPP's nuclear island

**Project owner :** EDF CIPN

**Project description :** Seismic resistance assessment for Bugey NPP's nuclear island, in the framework of post-Fukushima safety upgrades. Design of a solution for connecting structures via dampers, limiting seismic displacements and avoiding clashes within structure blocks housing "hardened safety core" functions.

**Scope of work :** Deliverables included :

- Seismic assessment by non-linear transient calculation with Aster Code of the full nuclear island, on a single model comprising ten buildings
- Evaluation of optimal position for the dampers, so as to avoid clashes within the buildings
- Detailed verification and assessment of safety margins for the whole existing reinforced concrete structures and steelwork
- Calculation of spectra at structures level (transient method)
- Structural reinforcement studies.

### EDF - Post-Fukushima stress-tests implementation

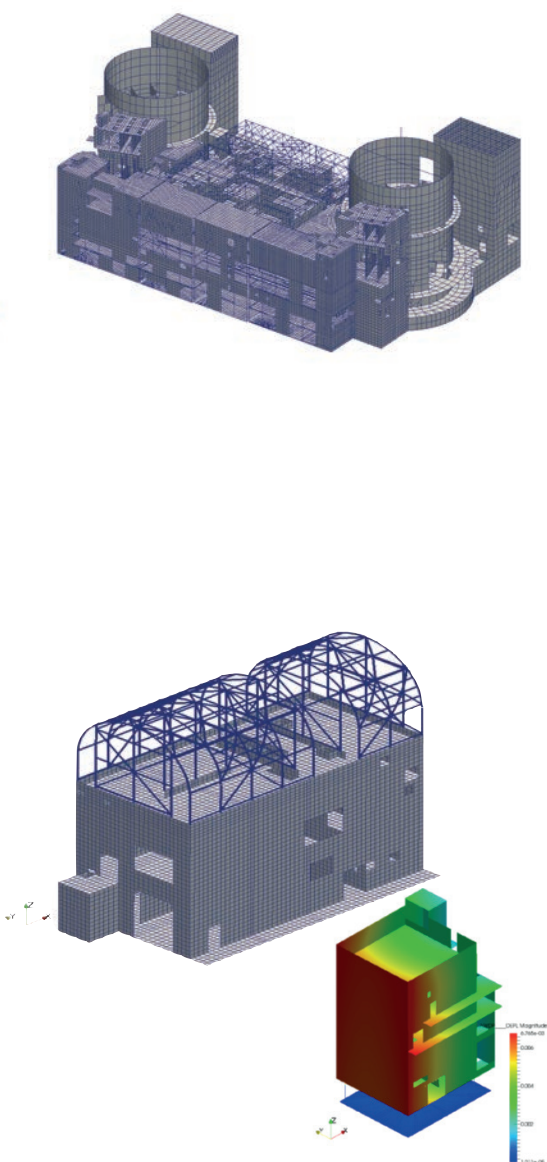
- DUS - Emergency Station Black-Out Diesel Project
- REF-U - Ultimate Heat Sink Project

**Project owner :** EDF CIPN

**Project description :** In the framework of post-Fukushima safety upgrades, and its "Hardened safety core" approach, EDF is installing emergency station-black out diesels and ultimate heat sink systems for emergency cooling on its whole existing NPP fleet (58 units), housed in separate, reinforced buildings. Building configurations are site-dependent, but all feature massive base-mats and seismic isolation.

**Scope of work :** Seismic/structural analyses, execution studies for civil works and steel structures for the DUS in several EDF sites, and for REF-U's pilot project to be implemented later on all EDF's fleet :

- Modelling and calculation of the structures using Aster code (civil works and steelwork)
- Execution drawings (form-works, reinforcement and steelwork)





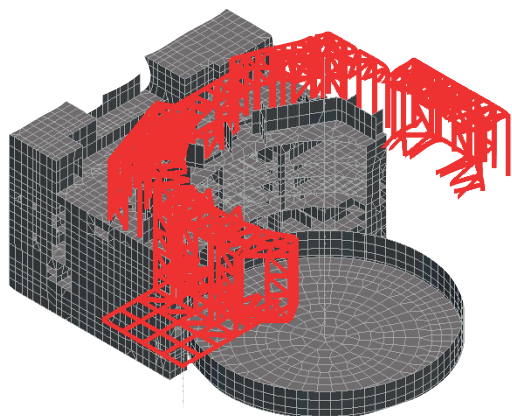
#### CEA - ROTONDE Project

**Project owner :** CEA

**Project description :** Centralized logistic platform dedicated to the management and control of radioactive waste packages produced at CEA Cadarache centre.

**Scope of work :** Project management in partnership with Comex Nucléaire.

**Project value :** 8 M€



PV

#### EDF - SEISMIC AND HAZARD RESISTANCE FOR EXTERNAL STEAM LINES' PROTECTION IN N4 REACTORS

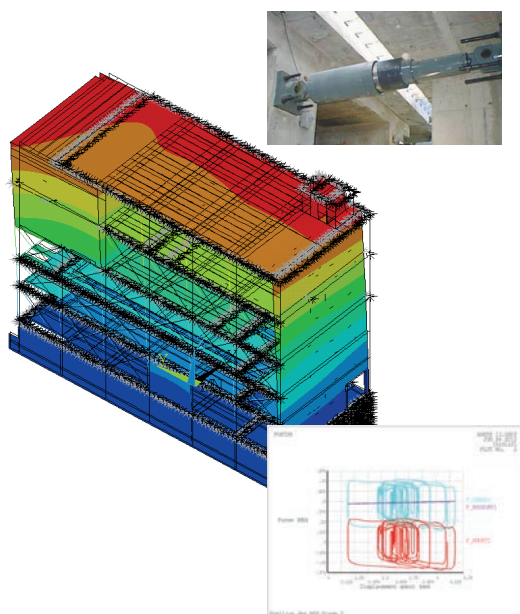
**Project Owner :** EDF CIPN

**Project Description :** The current specific structure design is expected to ensure protection against external hazards for the reactor's steam lines, near the containment's penetrations of the N4-type reactors (1450MW, 4 units installed in France).

It is based on steel frame gantries radially distributed along the reactor's building, anchored as well to the roof of the Safety Auxiliary building.

**Scope of Work:**

- Assessment of the existing structure's resistance to earthquakes, tornados and other external hazards
- Proposal of a set of modifications to enhance the overall structural resistance.



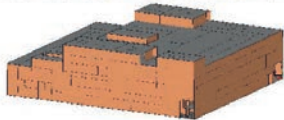
#### EDF - Feasibility study for seismic response improvement of EDF NPP by means of preloaded spring dampers

**Project owner :** EDF – Customer : EIFFAGE TP

**Project description :** Pilot study to assess the feasibility of the reinforcement of the structures of EDF NPPs by means of preloaded spring dampers, in the framework of the assessment of safety margins on the seismic resistance of the operating NPP (part of the “hardened safety core”, Post-Fukushima studies).

**Scope of work :** Deliverables included :

- Feasibility study for the research for positioning dampers the building
- Non-linear transient calculation for the building using ANSYS code.
- Post-processing using the “polyhedral concomitances’ domains” proprietary method (developed by Ingerop's R&D) for structural verification



### AREVA - Studies for the CID building at AREVA'S MELOX facilities

**Project owner :** AREVA

**Project description :** Retrofit of CID building at MELOX facility, requiring modifications of the existing structures. Feasibility study for a change in the building's function.

**Scope of work :** Deliverables included :

- Seismic calculation by 3D modelling via ANSYS code, taking into account the soil-structure interaction effects computed via MISS3D
- Structural resistance assessment after the retrofiting works
- Floor spectra calculation (via FSG software)

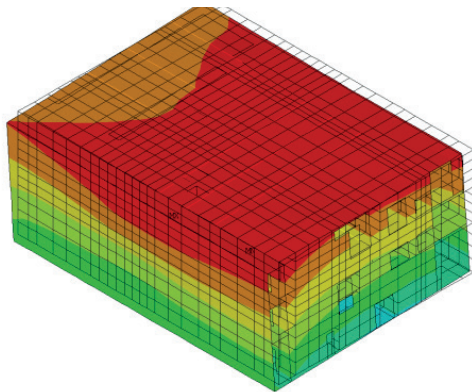
### CEA - Retrofit of LEGS building at ATALANTE Lab

**Project owner :** CEA/VALRH0

**Project description :** The upgrade of LEGS building (ATALANTE Laboratory, CEA Marcoule) required modification and reinforcement of the existing structures, as well as seismic assessments for the whole building an for a shielded hot cell system.

**Scope of work :** Seismic assessment and execution drawings for the modifications of the building, including :

- 3D Modelling and seismic calculation via ANSYS code
- Floor Spectra calculation (via FSG software)
- Comprehensive structural resistance assessment
- Transient non-linear calculation of a shielded hot cell system consisting of reinforced concrete modules, with focus on modelling the contacts between the blocks
- Execution studies for the reinforcing steelwork needed for modifying the layout, and for improving the seismic resistance of the shielded hot cell system



### CEA – FRAMEWORK CONTRACTS

Ingerop, in partnership with, provides engineering services to CEA sites via framework contracts covering several fields and disciplines :

- buildings and facilities;
- seismic/load drop calculations and assessments;
- HVAC and fluid systems for nuclear facilities;
- process studies;
- civil works, roads, utilities and networks

### EDF - FRAMEWORK CONTRACTS

Ingerop has been providing engineering services for several EDF departments for years :

- CNEPE – engineering of conventional islands;
- SEPTEN – nuclear expertise;
- CIPN – engineering for the operating nuclear fleet;
- CIH – engineering for conventional fossil-fired power plants



energy

Department:  
Energy  
REPUBLIC OF SOUTH AFRICA



SOUTH AFRICA

NucAdvisor

 PALLAS

#### **SOUTH AFRICA - Advisory services on economic impact of localisation for the nuclear expansion programme**

**Project owner :** RSA Department of Energy

**Project description :** Ingerop SA and NucAdvisor were appointed to develop a financial model to calculate the effect of the planned localisation program for the Nuclear Build program on the RSA economy by modelling effect on GDP, Direct, Indirect and induced Jobs created, Tax revenues, capital and operational costs of a nuclear plant. This project included developing reports to benchmark international experience in developing a localisation program and developing information on the current circumstances in RSA. A recommendations report was produced.

#### **SOUTH AFRICA - Advisory studies on owner/operator and financing structures for new build nuclear fleet programme and study on the cost of nuclear project**

**Project owner :** RSA Department of Energy

**Project description :** DOE wanted to identify and establish the optimum owner-operator structure to source the capital at a project and organizational level. The aim was finding the appropriate financing structure that will support capital generation and borrowing as well as the appropriate corporate structure to enable the objectives of the New Build Program while considering legal, regulatory and other constraints. Ingerop SA and NucAdvisor facilitated the above by assessing international experience, developing various owner-operator structures and assessing their pros and cons in the international and local context and proposing an optimal structure and key success factors.

#### **SOUTH AFRICA - Study on the cost of nuclear project**

**Project owner :** RSA Department of Energy

**Project description :** The purpose of the study by Ingerop SA and NucAdvisor was to provide an update on cost of nuclear power based on available public information and internal, well sourced information. Available information was statistically analyzed to arrive at a range of costs. Finally, the levelised cost of electricity was developed and compared with other types of electricity generation (i.e. Wind, Solar PV, Solar CSP, Gas and Coal)

#### **NETHERLANDS - Contribution to the owner's engineering for Pallas Reactor-Petten (NL)**

**Project owner :** Foundation Preparation PALLAS-reactor (PALLAS) - Netherlands

**Project description :** This state-of-the art multi-purpose reactor will replace the existing High Flux Reactor (HFR), which has been in operation for over fifty years and is now approaching the end of its economic life. PALLAS is a pool-type reactor, which is able to deploy its neutron flux more efficiently and effectively than the HFR. The most important feature of PALLAS-reactor is its operational flexibility. Its core can be set up very flexibly and hence respond to changing markets (medical radioisotopes, irradiation services...)

**Scope of work :** In the framework of the Owner's Engineering contract by Tractebel Engineering – NucAdvisor, INGEROP provides its expertise for system engineering management, design reviews, requirements management and analysis, support to tender activities, interface management, configuration management and functional analysis, using value engineering to optimize the design

# CONTACT

## EUROPE

### RENDEL LIMITED

61 Southwark Street  
London  
SE1 1SA  
United Kingdom  
Phone: +44 20 7654 0500  
london@rendel-ltd.com

### INGEROP SPAIN (T3)

C/Mallorca, 214, 2º, 3º  
08008 Barcelona, Spain  
Phone: +34 93 323 86 05  
ingerop.bcn@ingerop.es

C/Princesa, 24, 6ºDcha  
28008 Madrid, Spain  
Phone: +34 91 758 48 99  
ingerop.mad@ingerop.es

C/Gran vía de Colón nº21 4ºC  
Edificio Olimpia  
18001 Grenade, Spain  
Phone: +34 958 28 62 26  
ingerop.gra@ingerop.es

### GEOS CONSULTING ENGINEERS

1, route de l'Aéroport - CP 331  
CH-1215 Genève 15, Switzerland  
Phone: +41 22 309 30 60  
geos@geos.ch

54, avenue Dapples  
CH-1006 Lausanne, Switzerland  
Phone: +41 21 613 44 88  
geos@geos.ch

### INGEROP BULGARIA

INGEROP High-Point Rendel PO  
Box 106  
3700 Vidin, Bulgaria  
Phone: +33 6 19 58 10 96

### INGEROP MONTENEGRO

Njegoseva BR.6  
81000 Podgorica, Montenegro  
Phone: +33 6 19 58 10 96

### INGEROP POLSKA

Biuro Rachunkowe ABG  
ul. Skierniewicka 14/2  
01-230 Warszawa, Poland  
Phone: +33 1 49 04 55 61  
biuro@abg.waw.pl

## AFRICA

### INGEROP SOUTH AFRICA

Block E, Edenburg  
Terraces First Floor  
348, Rivonia,  
Ground Floor Boulevard,  
Rivonia 2128 - P.O Box 3867  
Johannesburg, South Africa  
Phone: +27 11 808 30 00  
jhb@inegrop.co.za

### INGEROP SENEGAL

SICAP Sacré Coeur Cité Keur Gorgui  
Immeuble Hermès 4 - Lot n°95  
BP 4153 Dakar, Senegal  
Phone: +221 33 824 92 58  
ingerop.senegal@orange.sn

### INGEROP ALGERIA

Nouvelle Zone Urbaine Lotissement  
C1 N°12 àin nâadja  
Alger, Algeria  
Phone, fax: +213 21 60 77 63  
ingerop.algerie@ingerop.com

### INTEC TUNISIA

N°5, impasse n°1,  
avenue Abdelaziz Thaalbi  
1013 Menzah 9  
Tunis, Tunisia  
Phone: +216 71 875 249  
intec@intec.com.tn

### INGEROP MOZAMBIQUE

Avenida Julius Nyerere n°258  
C.P. 3241 - Maputo, Mozambique  
Phone: +258 21 49 66 50  
mpm@ingerop.co.mz

### INGEROP INTERNATIONAL CONSULTANTS

St. Louis Business Centre  
Cnr Desroches &  
St. Louis Streets  
Port-Louis, Mauritius  
Phone: +230 208 75 75 / 203 11 00  
ingerop.mau@ingerop.co.za

## SOUTH AMERICA

### INGEROP COLOMBIA

Carrera 15A No 124 - 60, of 102 Bogota D.C.,  
Colombia  
Phone: +57 4 703 31 49  
colombia@ingerop.es

### INGEROP GHISOLFO

Edificio del Comercio,  
Monjitas 392 of 1103  
Santiago, Chile  
Phone: +56 2 664 17 78  
ingenieria@ghisolfo.cl

### INGEROP PERU

C/ Dos de Mayo 534, oficina 306  
Miraflores  
Lima, Peru  
Phone: +56 2 266 41 778  
alvaro.fernandez@ingerop.com

## MIDDLE EAST

### INGEROP SAUDI ARABIA

PO Box 31801  
Riyadh 11418, Saudi Arabia  
Phone: +966 11 461 52 47  
saudi.arabia@ingerop.com

## ASIA

### INGEROSEC

Shinjuku i-LAND Tower 43F  
6-5-1, Nishi-Shinjuku,  
Shinjuku-Ku  
Tokyo, Japan 163-1343  
Phone: +81 3 53 24 02 11  
ingerosec@ingerosec.com

### VJEC

University of Civil Engineering  
20th floor, Icon 4 Building  
243A De La Thang, Dang Da Dist  
Hanoi, Vietnam  
Phone: +81 3 5324 0211  
trungdn@vjec.vn

**STÉPHANE POTIN**  
Managing Director,  
Energy & Industry Branch

+33 4 73 16 34 34

**ROBERTO MUSCETTI**  
International Development Manager,  
Energy & Industry Branch

+33 6 13 03 35 97

**[energyandindustry@ingerop.com](mailto:energyandindustry@ingerop.com)**

**[www.ingerop.com](http://www.ingerop.com)**



Energy and Industry Branch

ZI de Ladoux - 11, rue verte - BP 30200

63118 Cébazat - FRANCE

Tel. +33 4 73 16 34 34

ingerop.energyandindustry@ingerop.com

[ingerop.com](http://ingerop.com)

