



Developing high-performing power systems to meet the challenges of the energy transition

RTE international is a consultancy and engineering company whose activities cover all areas of electricity transmission. RTE international provides services for its clients worldwide, helping them to develop reliable and competitive power systems which rise to the challenges of energy transition.

As a subsidiary of RTE, Europe's largest Transmission System Operator, RTE international offers tailored solutions to stakeholders in the electricity sector, relating to the development, operation and maintenance of their networks.

Since its creation in 2006, RTE international's experts have carried out more than 300 projects in over 50 countries across all continents, drawing on the know-how and skills developed throughout RTE's 70 years of sucessful operation. RTE international employs nearly 80 members of staff and around 100 experts each year.

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FOREWORD

Throughout 2021, RTE international continued its exciting development, winning major projects in Africa, Europe and the Pacific. Our teams are working hard to support the power sector in its ambitious goal to achieve the energy transition. We are carrying out feasibility studies for offshore wind farms in the North Sea. We are developing coordination tools to facilitate interconnections in the ENTSO-E grid. We are digitalising infrastructure in the Balkans to better manage the network.

Becoming less dependent on fossil fuels - the energy sources that have shaped our industrial society - is a social, political, economic and, above all, technical challenge. Electrification is one of the levers which will make it possible to decarbonize our energy needs and address the current climate emergency. According to the IEA, the global demand for electricity will have doubled by 2050.

This will require us to transform our electricity systems and make them more efficient to meet the challenges of the energy transition. RTE international will assist networks operators in network studies and maintenance. We will share our knowledge and skills to create interconnected networks that will facilitate the integration of larger sources of renewable energy.

In order to tackle these challenges, we will draw on the expertise, technical skills and profound experience acquired by RTE, the largest electricity network in Europe which boasts 106,000 km of high-voltage lines, 2,800 substations, and 51 interconnections. Moreover, RTE international is a young and dynamic startup company with more than twenty nationalities and its own pool of determined and independent experts who come from renowned companies all over the world. Rest assured that we will put all our enthusiasm and knowledge into making the energy transition a success!

Our teams are working hard

to support the power sector in its ambitious goal to achieve the energy transition"

KEY FIGURES FOR 2021

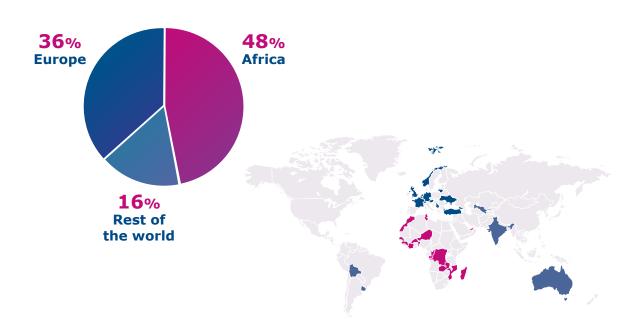


RTE international and its subsidiaries

76 Employees 138
Projects
carried out

5 000 staff-days

Country of projects and geographical distribution of turnover

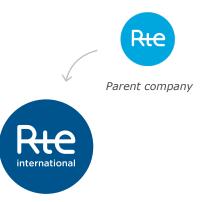


COMPANY ORGANISATION

The international arm of RTE, the french Transmission System Operator

RTE international is the wholly-owned subsidiary of RTE in charge of international projects.

As a subsidiary, RTE international benefits from a high degree of autonomy while relying on the strength and expertise of RTE.





High Voltage maintenance

Subsidiary established in 2020 in the Netherlands



Innovative solutions for power systems Subsidiary established in 2021 in Serbia

Bluestork Solutions

Engineering services Subsidiary established in 2021 in France

Offices in France



A RENOWNED PLAYER IN EUROPE AND THE WORLD

Through its expertise in the field of electricity transmission

1. What technical We provide areas does consultancy, RTE international engineering, operate in and in and technical which regions of the assistance services

world? to stakeholders in the energy sector,

particularly to Transmission System Operators. We rely on the expertise and methods we have developed as the French Transmission System Operator.

A significant proportion of our projects are funded by calls for tender from international donors, such as the World Bank or the AFD, with whom we have built a reputation for unparalleled technical competence and reliability over the course of our projects. Historically focused on West Africa - a region in which we have strengthened our foothold this year with the completion of ambitious projects in Senegal, Côte d'Ivoire, Burkina Faso and Benin - we have since broadened our geographical scope. For instance, we have established long-term relationships with Ukrenergo, the Ukrainian network operator, and EMS in Serbia.

We have built a reputation for unparalleled technical competence and reliability."



Francois Guillermet Business Development Director

2. RTE international There are two positioning itself to first is that we work on projects in offer Transmission **Europe. What is the** System reason behind the Operators our **new developments** knowledge and

is increasingly main reasons. The in this market? understanding of European rules.

For instance, this is the added value that we bring to clients such as LitGrid, for whom we are going to carry out a project - jointly with our partner EKC. Our project with LitGrid is aimed at drawing up their adequacy forecast in accordance with the new ENTSO-E rules in this area.

The second factor is that we have developed very specific expertise in two areas in particular: modeling HVDC systems and conducting simulation studies, and developing network operation tools for regional coordination centers.

DYNAMIC TEAMS

The Human Resources department continues to support staff and builds team spirit beyond remote working



Maxime Leleu **Human Resources** Officer

crisis affected employees a your working high degree conditions? of autonomy,

1. How has At RTE international. the health we offer our particularly in

terms of how they organise themselves and their work. For several years, RTE international's teams have been based in three different sites - Paris, Lyon and Marseille - and we work with many experts throughout the world. Thus, we had already integrated many of the practices that became popular throughout the pandemic, such as working from home and remote team meetings. In short, the health crisis allowed us to make our organizational structure official. I myself arrived at RTE international in the middle of the pandemic and, although I was confined to my flat and working from home, I was very well welcomed and supported during my first few months.



2. How do you Internal manage to develop communication a shared corporate obviously plays culture with three an important different sites? role, and we take

the time to meet

during business trips held at the different sites. We also organise an annual seminar - when health conditions allow it - which lasts several days and offers our employees the chance to meet up, be social, and have fun together.



3. What are your We also want hopes for 2022? to strengthen

our teams, by

hiring more engineers, project managers, and developers. I know that RTE international will be able to attract the best candidates. We have implemented a reward system that values both individual and collective performance. We offer exciting international assignments, an open working environment and a warm atmosphere!

STRONG GROWTH IN COMMERCIAL ACTIVITY

How would you 2021 confirmed **sum up 2021 for** the financial RTE international? strength of

the company.

Revenues increased throughout the year and RTE international continued to grow, a testament to the confidence and trust that our clients continue to place in us. Our clients are mainly public infrastructure companies. While a proportion of our projects are carried out in developing countries, financing from international sponsors allows us to benefit from financial security in terms of payment deadlines, exchange rate risks, etc. We are continuing to branch out and diversify our portfolio of clients and activities, allowing us to spread both our operational and commercial risks over various projects.



Pascale Bruyat **Finance Director**



We are continuing to branch out and diversify our portfolio of clients and activities





How did you deal Our teams with the Covid-19 managed these

crisis? unprecedented times with great

determination and initiative. In order to continue to make progress on certain projects, our experts used innovative technology, such as virtual visits using 360° videos. We are proud to have been able to maintain our level of commercial activity to meet our deadlines.



- Real-time simulations with HVDC/FACTS control replicas
- Dynamic performance analysis of HVDC/FACTS
- Power system studies
- HVDC/FACTS project management



Markus Vor dem Berge **Director of Power Electronics** and Studies

Technical excellence is indeed our distinguishing characteristic."

1. What is the role The energy of the new business transition aims to **line dedicated to** decarbonize our **power electronics** electricity mix and electromagnetic by integrating studies?

more renewable energy sources.

We offer our expertise to this structural change in the energy supply system by facilitating the integration of these powerelectronics interfaced devices, such as offshore wind farms, into the grid via High Voltage Direct Current (HVDC) transmission systems. The studies carried out by the Power Electronics and Studies team ensure better stability and de-risk these HVDC and FACTS projects.

2. How do your Our studies allow studies explicitly us to simulate ensure this?

and test the power systems

of highly technical and complex projects and to therefore identify any potential risks and interactions. We work to make systems more reliable. We are here to ensure the quality of our clients' projects. Technical excellence is indeed our distinguishing characteristic.

3. What are your Our expertise ambitions for 2022? continues to be

recognized globally

and, as a result, we are pursuing new projects, notably in the North Sea and Europe. We have also been approached by some very promising HVDC developers in the US and Asia.

HVDC is one of the key technologies that will make the energy transition a success. At RTE's CampusTransfo near Lyon, in our HVDC laboratory, we bring together the best European HVDC specialists for training sessions and webinars in order to share our different areas of expertise.

HIGHLIGHTS 2021

Assessing HVDC links interoperabilty

Client: **Equinor** Location: **Norway**

RTE international is carrying out studies for Equinor's HVDC links that supply the Johan Sverdrup oil field.

In order to reduce greenhouse gas emissions at sea, the field will use electrical power generated onshore, which will be transmitted through two HVDC links using Voltage Source Converter (VSC) technology.

The HVDC links are provided by two different manufacturers, which will be used in parallel operation and will supply an offshore grid. This is the world's first multivendor HVDC system in a grid forming operation. Physical control replicas hosted in our laboratory in Jonage are connected to a real-time simulator. They are used to simulate real scenarios in order to reduce the risk associated with the parallel operation of the two HVDC links.



"The parallel operation of the two HVDC-VSC links is expected to be commissioned in 2022 and we are glad to be part of this project, which represents a world-first in the field of HVDC."

Ming Cai HVDC Expert



Supporting HVDC systems of offshore windfarms

Client: **Sofia (RWE)**Location: **United Kingdom**

RTE international acts as technical consultant to assure the design and execution of the HVDC part of the Sofia Offshore Wind Farm project in the North Sea.

Our experts are examining the manufacturer's system and check the compliance of its design with the Grid Code, standards and the specifications defined by the Sofia project team.

"Sofia is one of the biggest offshore wind farm projects in the world and HVDC technology is a vital component. It makes it possible to envisage wind farms far from the coastline where the wind is stronger and steadier.

Sofia chose our team because of its recognised expertise in HVDC design and studies, with RTE international now being a dynamic player in the development of offshore wind power."

Hani Saad Senior HVDC Expert

FOCUS ON POWER ELECTRONICS AND STUDIES

The increasing use of power electronics-based devices is challenging the performance and reliability of power systems. Networks are becoming more complex and have to cope with higher constraints and risks. New projects involve many stakeholders and interfaces, often requiring multidisciplinary skills.

To meet these challenges, RTE international created the Power Electronics and Studies department in 2021, which is based in Lyon, France. Composed of experienced and passionate experts, our team is specialised in FACTS and HVDC projects and EMT studies.

The team's core competence lies in interaction studies of systems involving power electronics-interfaced devices. We study the impact and repercussions of these systems on, and between, each other. These studies are particularly important as they allow potential risks to be identified at an early stage, thus improving the availability of the power system during normal operation.



Electromagnetic transient studies play a key role. These are simulations that can be carried out both on a desktop PC (e.g. using tools such as EMTP or PSCAD) in an offline environment, and in the laboratory in real time with the hardware-in-the-loop (HIL) configuration using HVDC control and protection replicas.



The largest laboratory for HVDC and FACTS in Europe

RTE's CampusTransfo in Jonage houses the largest European real-time simulation laboratory dedicated to the integration of HVDC & FACTS devices. It includes replicas of all HVDC lines operated by RTE, from the three main HVDC system suppliers, but also replicas of projects developers, such as Equinor. The RTE international laboratory is also specialized in HVDC connection projects for offshore wind farms.

The engineers first of all model the whole HVDC system and perform simulations to analyse interactions and operability issues. However, the models are still limited in their ability to correctly represent all control and protection functions. Therefore, to complement these data simulations, RTE international's HVDC experts install replicas and connect them to real time power system simulators to analyse their behaviour.

2000m²

dedicated to technical rooms

16

real-time simulators

with about 300 CPUs as well as I/O cabinets for RTDS and Hypersim systems 200

physical cubicles



- Development of dedicated tools
- Coordination tools
- The Antares-Simulator
- IT consulting and projects



César Clause **Director of Digital Solutions**

RTE international's systems allows us software Business to develop useryou start this that anticipate commercial activity, their needs. and what do you Most of these **bring to your clients** tools have been that stands out?

1. You are Our global responsible for expertise in power **Line. Why did** oriented solutions designed by users based on their

> own operational experience. In particular, we offer tools that facilitate the day-to-day operation of networks and the coordination between Regional Coordination Centers and Transmission System Operators.

Open-source provides flexible, secure, and upgradeable solutions."

2. What is your Our digital approach? solutions are based on open-source software, mainly affiliated with the Linux Energy Foundation. This ensures neutrality and transparency. In addition, we foster interoperability between the components in order to meet specific customer requirements by developing new functionalities and by keeping the possibility of upgrading the solutions. Our solutions are completely open and can be taken over by a community of developers, to the

great benefit of our customers.

3. What is your Our ambition **ambition for the** is to develop coming years? user community

dynamics around

the open-source software we use, following the example of the Antares-Simulator. We believe that the open-source software model will transform our sector because it offers many advantages for achieving the energy transition. It accelerates development by sharing efforts, it fosters cross-industry collaboration by involving suppliers as well as end-users and it provides flexible, secure, and upgradeable solutions.

HIGHLIGHTS 2021

Facilitating outage planning and adequacy coordination

Client: ENTSO-E

Location: Western Europe

RTE international and Unicorn have deployed the Outage Planning Coordination Tool (OPC), the Short Term Adequacy Tool (STA) and the Let's Coordinate tools to facilitate coordination between the ENTSO-E members.

OPC harmonizes the European process for planning shutdowns for the maintenance of electrical infrastructures and STA ensures security of supply at the European level. The Let's Coordinate application provides a high-level notification and coordination layer for these two processes.





"These tools will enable all ENTSO-E member TSOs to execute OPC and STA processes in accordance with the requirements of the System Operation Guidelines."

Sascha Eschmann Business Analyst & Project Leader



Facilitating interconnections

Client: **European Commission**Location: **South-Eastern Europe**

RTE international is developing a dynamic coordination tool for South-Eastern Europe Transmission System Operators and Regional Security Coordinators as part of the Trinity Project.

By facilitating the interconnection of their networks and the coordination of operations, operators share their resources, creating a more flexible network. This flexibility enables an easier integration of renewable energy sources and a more secure grid, allowing the security of supply to be increased throughout the pan-European interconnected network.



"It will be possible for all operators to share information and for the TSOs to make coordinated decisions directly via the platform."

Olivier Voron Digital Project Manager

Focus on our open-source solutions









CE LET'S COORDINATE

The Antares-Simulator is a probabilistic supply-demand balance simulator. It is currently being used for the Ten Year Network Development Plan (TYNPD) of the European Association of Transmission System Operators (ENTSO-E).

PowSyBI (Power System Blocks) is a framework dedicated to electrical grid modelling and simulation.

FARAO is providing a solution for electrical power systems' Coordinated Capacity Calculation, Local Security Analysis and Coordinated Security Analysis.

OperatorFabric is a modular platform used in electricity, water, and utility operations which provides a notification GUI for coordination processes.

Let's Coordinate is a modular and field-tested platform used to improve operational communication and coordination between TSOs and their RSCs.



- Regulation and grid codes
- Economic and adequacy studies
- Interconnections and regional coordination
- Network studies, Master plans an RES integration
- Skills development
- Supporting the network operating function
- Unbundling



Philippe Michal **Director of Power System Expertise**

1. What is the Our expertise **Business Line's** scope of the

scope of your covers the entire **expertise?** electricity system, from carrying out

Master Plans and long-term adequacy studies, to technical regulation and training in network operation.

For example, we help our clients to imagine how their network could integrate more renewable energy sources in the next 10 or 20 years by proposing different prospective scenarios. We also support them in developing their regulatory framework. We work with operators as well as ministries and regulatory authorities, which requires specialist expertise and a great deal of experience. We also support our clients in improving the management of their network through audits and training courses.

We help our clients to im clients to imagine how their network could integrate more renewable energy sources."



2. What do you It is imperative think is the main to strengthen lever which will cooperation at make the energy transition a success?

all levels. First of all, increasing communication between

transmission system operators via regional coordination centres, such as the WAPP ICC in West Africa, which is currently being set up. This strengthens the security of supply of all interconnected networks while reducing the costs dedicated to reserve requirements. We can also strengthen cooperation by implementing transparent and enforceable rules for all stakeholders. I am pleased to see that this is moving in the right direction: we have been working on network codes on all continents for several years now, thanks to our knowledge and expertise.

HIGHLIGHTS 2021



Assisting integration into the European grid

Client: **Ukrenergo** Location: **Ukraine**

RTE international experts are providing technical assistance to the Ukrainian TSO to meet the conditions essential for its integration into the European electricity network. The project includes both regulatory and operational measures. In particular, Ukrenergo has to meet the requirements described in the various codes developed by ENTSO-E.

Harmonization of regulations will help promote competition in the electricity sector and create a more favourable environment for investment. During this project, RTE international's experts will also identify priority infrastructure projects that will promote Ukraine's integration into the ENTSO-E network.

"By helping Ukrenergo to modernize its practices to join the European interconnected space, we are improving the energy efficiency of the Ukrainian network, ensuring better reliability and facilitating the integration of renewable

energies at the same time."

Eric Morelle Project Manager

Supporting the creation of Information and Coordination Centres

Client: WAPP

Location: West Africa

RTE international is supporting the settingup of a common market to improve accessibility, competitiveness and the reliability of electricity in fourteen of the ECOWAS member states.

By sharing their power resources within a unified grid, ECOWAS countries will benefit from a reduction in the cost of electricity and increased security of supply. Since 2019, the teams from RTE international have been supporting the operationalisation of the body that will coordinate this common market, the Information and Coordination Centre (ICC) of the West African Power Pool (WAPP), located in Cotonou, Benin.



"This coordination centre will be the heart of an unprecedented collaboration in the region. It's a good demonstration of the role that electricity plays in development."

Jérôme Restoueix Project Manager



- Feasibility studies
- Design studies
- Specifications
- Assistance in awarding contracts
- Supervision
- Commissioning



Pierre Guillaume **Director of Engineering**

1. How do you We provide support support your to our clients in **clients?** the design and implementation

> of high voltage lines and substations. To do this, clients are supported by our technical experts, who have in-depth knowledge in all areas of transmission: overhead lines, underground lines, AIS substations, GIS substations, battery storage systems and even HVDC lines.

> Our project managers bring RTE's experience within network development; our parent company makes €1.5 billion of investments in France every year. Our experts are experienced in all aspects of project management: study phases, interaction with third parties, environmental studies, permits and administrative authorizations, management of calls for tenders, monitoring of implementation, and commissioning. We provide a truly integrated service from A to Z.

2. What does the We help our energy transition involve in terms of their engineering engineering work?

clients to update standards and procedures to

meet international standards. Networks are modernising and must evolve in their practices. Battery energy stoage systems are the best illustration of this. They address both the risks of network congestion and the intermittency of renewable energies. In order to integrate storage devices into networks, the structure of the network and the characteristics of the battery must be studied in order to develop an optimal adjustment.

At the forefront of innovation, RTE international has mastered the use of this technology and is making it available to its clients who wish to increase their renewable energy capacities.

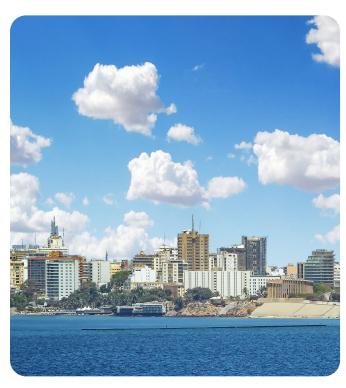


3. You became **Business Line this** in West Africa. **year, what are** We are proud your ambitions for

Our engineering **head of the** activities are engineering concentrated to contribute to the company? the deployment of access to

electricity in this part of the world. We are directly involved in the economic development that results from this access to electricity. But the energy transition is a challenge for the whole world, and so we also have major projects in the pipeline in European countries, such as Ireland and Switzerland.

Building substations and laying subsea cables



Client: **Senelec** Location: **Senegal**

RTE international, together with its partners, is managing the modernisation and reinforcement project for the High Voltage network in Dakar.

RTE international is in charge of the design and specification phases, as well as selecting the EPC companies who will be responsible for laying two 225 kV underground cables, creating two new 225/90 kV GIS substations and building a 225 kV subsea cable across the Bay of Gorée.

"This is a large-scale project, for which we will manage the design phase with our partners, including a major subsea component. We are delighted to be involved in this project, which will provide the Senegalese people with a more reliable

electricity network."

Johan Pitelet Project Manager



Supporting the implementation of digital substations

Client: **EMS**Location: **Serbia**

RTE international in supporting EMS in the modernisation of its network and the implementation of 100% digital substations.

This consists of digitalising the 110 kV Pancevo substation near Belgrade with technologies similar to those tested at the RTE site in Blocaux in Picardy. Digitalisation of this substation will enable the network to be more flexible and responsive to the constraints and multidirectionality required by the growing integration of variable renewable energy sources.

"Serbia is an electricity hub in Southeast Europe. Modernising its electricity transmission network means facilitating interconnections between Hungary, Romania, Bulgaria, Bosnia-Herzegovina, Montenegro, Albania and Macedonia."

Issam Kifouly Project Manager



- Optimisation of the Maintenance function
- Live Working
- Airborne services
- Turnkey services
- Procurement and delivery of equipment

1. What is the role of your Business Line? My team is responsible for supplying

the equipment used for Live Working and maintenance. RTE international delivers equipment with the highest international standards all over the world. For example, we work with Transmission System Operators in Burkina Faso, Turkey and Uruguay. We select the best tools and equipment for our customers and carry out our own test campaigns to ensure the reliability of approved equipment. For instance, we delivered conductive fabric to a customer in Europe so that they can make their conductive suits for Live Working. This is a guarantee of trust and quality for our customers, with whom we have long-term relationships.



'Amel Arotçaréna
Director of Procurement

2. What are your plans for 2022?

This year we will be rolling out an online platform

that will provide simple and user-friendly access to all our equipment recommendations. You will soon be able to access the tools required to carry out your maintenance work in the same way as you do your shopping on the Internet.

HIGHLIGHTS 2021

Delivery of a truck to carry out Live Working

Client: Sonabel Location: Burkina Faso

RTE international delivered a truck dedicated to the transportation of Live Working tools.

Thanks to this comprehensive equipment, Sonabel is now fully autonomous in the maintenance of its infrastructures. The tools and equipment used for Live Working require suitable transport conditions that protect them from shocks and climatic constraints such as humidity or rain.



"Ensuring the correct packaging of Live Working tools means guaranteeing the safety of those involved during the work phases."

Erica Caldeirinha-Ruas
Export and Material Logistics Assistant



We carry out our own test campaigns to ensure the reliability of approved equipment."





Paul Lagartinho **Director of Maintenance Optimisation and Live Working**

your maintenance power lines is an

1. What is the The maintenance particularity of of substations and activity? essential activity for the successful

> operation and management of an electrical transmission network. First of all, we offer our customers our expertise in order to optimize their maintenance policies. We also carry out numerous training courses. We offer conventional and helicopter-based turnkey maintenance operations, as well as Live Working operations.

It is perfectly possible to work safely on the network while it is still live."

2. What is the Live Live Working Work Method? enables maintenance

operations to be carried out without de-energising a line. It is an extraordinary method that offers network operators the possibility of minimising the impact of maintenance by avoiding release from service of installations and, ultimately, ensuring the electricity supply of their customers.

Despite a common misconception, it is perfectly possible to work safely on the network while it is still live. Our method offers operators a defined organization, training and effective tools to ensure their safety, no matter the work that they are carrying out. It contributes to the dissemination of a safety culture. We have observed that the deployment of live working at an operator's premises not only does not generate any additional accidents, but is also safer for an operator's team when carrying out work using conventional techniques.

3. What are your We are seeing a

plans for the growing interest coming years? in Live Working in Europe and

> have some big projects on the horizon. For example, we have been asked by the Dutch Ministry of Labour to demonstrate the high level of safety of our method. We are also going to carry out optical fiber unwinding operations in Switzerland this year, as well as the renovation of an electrical substation in New Caledonia.

HIGHLIGHTS 2021



Carrying out heliborne maintenance

Client: **Tennet**

Location: Netherlands

RTE international, via its subsidiary RTEi Netherlands, successfully carried out a heliborne project to change 1 826 bird beacons on high-voltage lines in the Netherlands.

As it is difficult to access from a land-based mobile work platform, the replacement of the beacons via helicopter considerably reduced the duration of the work.



"This success will support
TenneT and the government
to evaluate the possibility of
further developing this type
of maintenance operation,
helicopter and Live Working."

Dennis Geerts RTEi Netherlands Operations Director

Carrying out Live Working on substations

Client: **Enercal**

Location: New Caledonia

RTE international is carrying out Live Working to rehabilitate the Ducos 150kV HV substation in Noumea.

The DUCOS substation is a strategic electrical node for New Caledonia. It is connected to two major industrial sites including the main nickel mine and Noumea, which represents 80% of the total power demand of the island network. Thanks to Live Working, Enercal is ensuring power supply without inconveniencing the population and the businesses of New Caledonia.





"This ambitious project demonstrates the great flexibility of our methodology in order to respect the client's constraints to the maximum."

Raphaël Galisson Project Manager



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