PRESS KIT
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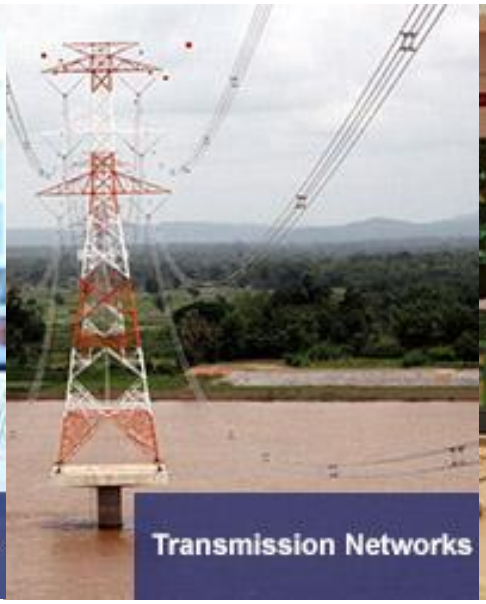
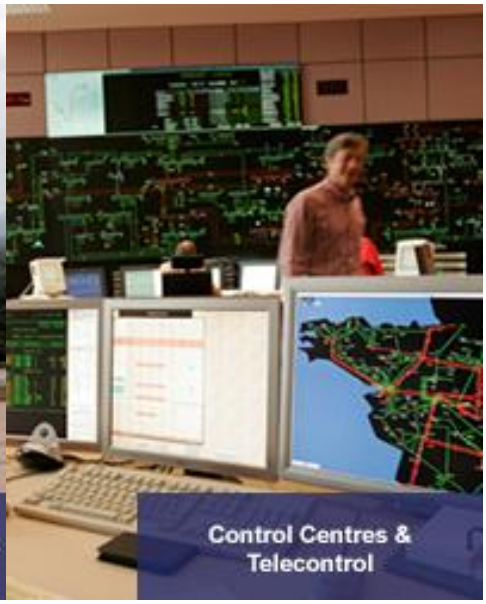
Engineering Transmission System

EDF's Transmission expertise in France and around the world





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THE POWER SYSTEM & ENGINEERING TRANSMISSION CENTRE IN BRIEF

As a consultant, technical assistant or project management assistant, CIST, Power System & Engineering Transmission Centre, supports its clients in the design, construction and improvement of transmission systems, from a detailed review of the power system right through to the commissioning of the Transmission installation (high voltage power line, high voltage electrical substation, dispatching centre...)

The **150 experts** intervene on all System and Transmission issues throughout the world. Drawing on its ground approach and inner understanding of operator issues, these women and men provide concrete and tailored solutions for each project. They work throughout the year **with the R&D teams**: laboratory tests, real-life experiences notably on island systems… the R&D and CIST work together on today's constraints while already combining this with the power system of the future.

Other advantages of CIST: its flexible organisation and its position within the EDF Group which allow easy transmission of information. Depending on the entrusted missions, only experts will intervene or a project group will be put together around the Project Leader, like a sort of music conductor, asking for the necessary expertise in each case. In a business sector where the projects are varied (from the design stage right through to implementation, from local connection to a country's master plan), the **responsiveness** of CIST is a guarantee of its effectiveness with its clients. With a strong team force, CIST can benefit from **relying on a group, EDF**, whose strength is an advantage on the projects that may sometimes last a decade.

Did you know?

Created in 2003, CIST has been ISO 9001 and ISO 14001 certified since its creation:

- first ISO 9001 certification in 2004 (renewed in July 2013 for 3 years)
- first ISO 14001 certification in 2005 (renewed in 2011 for 3 years)

Case study: A charter for shared safety

On 24th October 2013, CIST signed a safety charter with 23 service providers. More than simply the objective of "0 accidents", it is the process of supporting and exchanging good practices with external suppliers which makes this charter a strong managerial innovation.

SUMMARY

1. The expertise of CIST 4
2.1 Intervene upstream of projects 4
2.2 Designer of power systems and their control centres 5
2.3 Connecting generation plants to the transmission system 6
2. Thorough inspection of transmission projects 8
2.1 CIST expertise exported throughout the world 8
2.2 Expertise on the entire line 9
3. Innovation in CIST 10
3.1 New energies and smarts grids 10
3.2 Direct Current connections and super grids 11

1. The expertise of CIST

2.1 Intervene upstream of projects

From the network design to the support for establishing tenders, CIST advises developers and constructors of the high voltage electricity transmission system.

- **Pre-feasibility studies**

The projects may begin well before their actual implementation with pre-feasibility studies. At this stage, CIST studies the technical and regulatory constraints of the area in which it intervenes. It is the study of **network codes**, which are the country-specific regulations on its electricity system. The advantage of CIST lies in its experience and capability to collect relevant information by asking the right questions.

Did you know?

With data, projections and advanced tools at its disposal, CIST is capable of working on network behaviour simulations for a period of up to 30 years!

- **Feasibility studies**

These are more detailed and geographically concentrated, on an intervention site, and are used to assess the technical and economical viability of a transmission installation, whether it is a power line (overhead, underground or undersea); a high voltage electrical substation or even a dispatching centre.

- **Assistance in the preparation of documents and support in the tendering procedures**

CIST performs simulations from the power system master plans of the countries concerned. Static tools enable them to observe the energy flow injected into the network and their balance. Virtual testing of the network helps further improve the accuracy of the price-quality ration and are major decision support for EDF interlocutors.

Case study: In Lebanon, support in the preparation of tender documents

EDL (Electricity of Lebanon) has called upon CIST to support them with their tender regarding the construction of three urban substations at 220 KV – medium voltage in Tripoli and Beirut. A team of experts has been deployed for several weeks to design the technical specifications of the substations and of the Lebanese electricity transmission system. In partnership with a firm of architects, CIST has thus been able to prepare detailed documentation including, among others, geotechnical studies, topographical surveys and layout plans. During this service, CIST intended to identify the technical requirements to best integrate the substations in the urban buildings and environment while establishing a maximum and reliable connection to the transmission system.

2.2 Designer of power systems and their control centres

CIST teams provide advice to clients from the design to the implementation of their tele-control systems or their dispatching centres. The dispatching centre, the control tower of the power system, encounters two challenges:


Control-Centre
(United Arab Emirates - Abu Dhabi)

- **Integrating information and communication technologies** to effectively manage the power system
- **Optimizing the organisation of human resources in the centres that operate 24/7** (defining the process, the minimum size of teams, training advice for dispatchers and maintenance teams…)

Did you know?

Electricity generated by power plants cannot be stored. Also, to monitor and manage the electricity flows, the network relies on dispatching centres.

In France, to manage the whole transmission system, there is 1 national dispatching centre and 7 regional centres. In Spain or in the UK, there is one single transmission centre.

Case study: Support from A to Z in Vietnam

It all begun in 2009. CIST teams were chosen to advise the electricity company of Southern Vietnam (today called SPC, South Power Company) in the development of a new facility. The teams therefore left to study the situation before suggesting various ways, then a more detailed project of the chosen method.

At this stage, it was up to CIST to explain the technical solution, to assess its constraints and the costs so as to prepare the tender documents. With this step completed, the tender can therefore be issued. This was done in Autumn 2013. CIST continues to provide its expertise during the selection of the project implementation offer that most complies with the defined special features.

At each stage, CIST teams are there to advise and supervise in a transparent and constructive dialogue with their client.

The implementation of the new dispatching centre is scheduled for 2016.

2.3 Connecting generation plants to the transmission system

From Martigues (South of France) to Togo passing through the Mekong River, CIST experts intervene throughout the world.

- **A Repowering project in France**

In Martigues, where a large Repowering project was completed in 2012, the Repowering was to reconvert a thermal power plant which runs on fuel, to one that runs on gas while raising its power. The challenge was to reuse as much existing material as possible. The CIST team was in charge of electricity evacuation from the power plant and connection to the network, from support ahead of the project to project management support.


Martigues power plant (France)

- **Double ventilation in UAE**

From 2009 to 2013, CIST acted as a consultant – for the first studies in analysing tenders of different constructors – for the Dubai Electricity Company. The project: link the new areas in Dubai to support economic development, using two underground cables in tunnels of length 11 and 4 km. The solutions were adapted to the climatic conditions and to the irregular consumption of Dubai. In order to cool the cables during periods of strong heat and high consumption, the solution suggested was twofold:

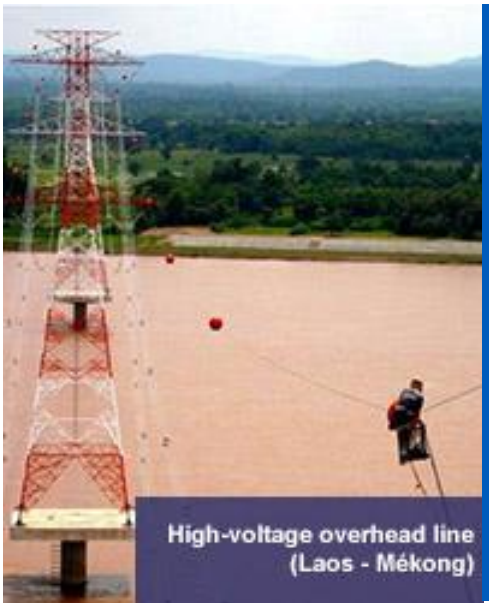

Underground line - ventilated tunnel (United Arab Emirates - Abu Dhabi)

- Installing **conventional chimneys** with natural air circulation,
- Installing a **forced ventilation system** to evacuate the heat stored in the tunnel more effectively.

Today, CIST supervises the construction stage of the project.

- **Togo-Benin Interconnection**

Upon request of the Electricity Community of Benin (CEB), intergovernmental organisation of the two countries, CIST has been working since 2008 on the design, then the implementation of two overhead lines and two transformer substations. The idea is to create a network loop and thus better share the resources of this geographical area. In the implementation phase, CIST manages the project on behalf of CEB like a real music conductor. It is the preferred contact of constructors, funding bodies and the project owner and ensures the implementation of chosen technical specific features.

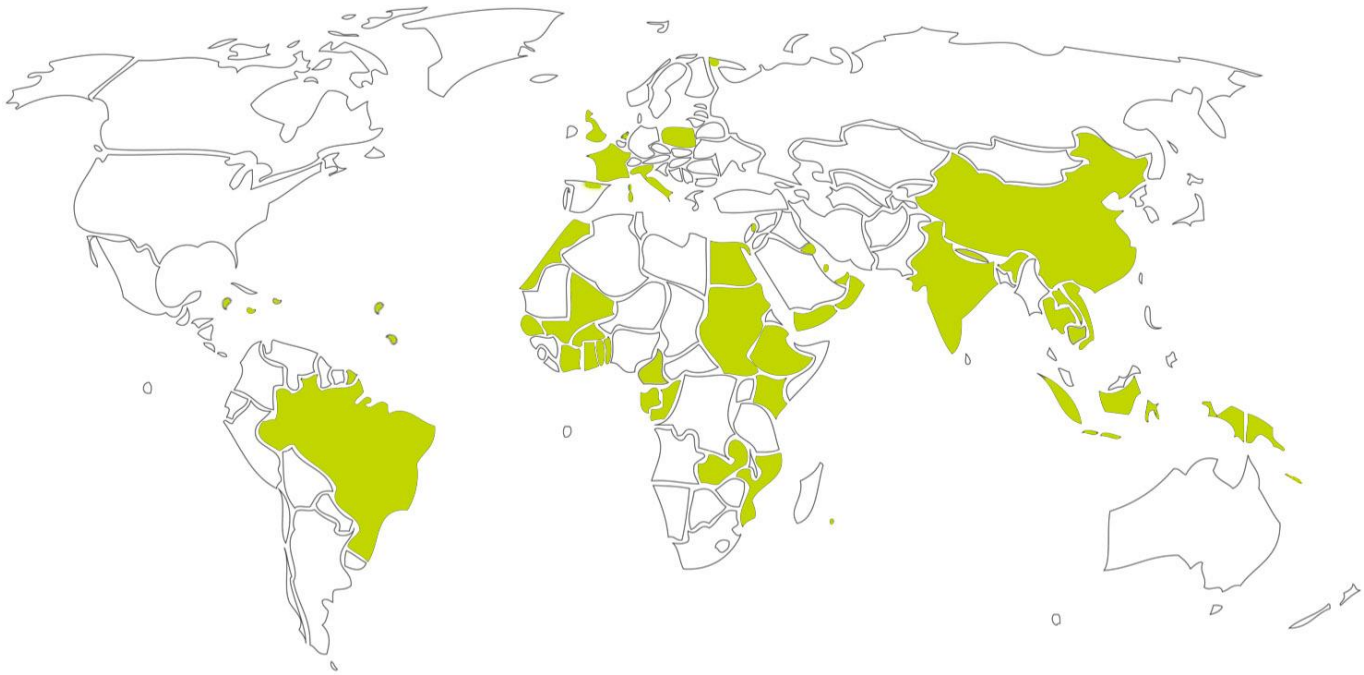


Case study: Stepping across the Mekong River, a challenge worthy of CIST's expertise

In the middle of the Laos forest, CIST supported the hydroelectric project "Nam Theun 2" (1.070 megawatts dam on the Nam Theun, a tributary of the Mekong flowing to the centre of Laos, in the province of Khammouane). As regards the transmission part, it consisted of marking the route of the 140 km line connecting the hydroelectric power plant to the national Laotian and Thai networks. To reconcile the requirements of the two countries, two links have been built, one at 115 kV for Laos and the other at 500 kV for Thailand. Specifically, it was not only crossing the forest, but also spanning the Mekong over 1.2 km. The teams had resorted to a technique rarely used; lifting the mast which allows mounting the pylon of 70m high by leaning, as construction progresses, on the actual structure of the pylon. Two gigantic pylons are well out of the riverbed, therefore enabling the supply of electricity to Thailand.

2. Thorough inspection of transmission projects

2.1 CIST expertise exported throughout the world



With the worldwide presence on 5 continents - Africa, America, Asia, Europe, Oceania – CIST supports its leading clients in more than 30 countries. Benefiting from extensive expertise and adaptability, CIST teams respect the constraints and local specific features. Moreover, CIST exercises its flexibility and carries out its power transmission projects.

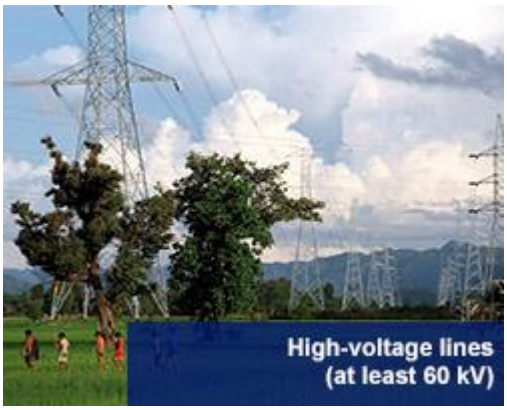
Did you know?

CIST supports its clients in more than 30 countries:

- Public enterprises;
- Transmission and distribution network operators;
- Generators;
- Administrations and ministries;
- Donor agencies;
- Industrial clients.

2.2 Expertise on the entire line

Whatever the electricity generation method, CIST supports its clients on all their problems with regard to System and Transmission.



3. Innovation in CIST

3.1 New energies and smarts grids

Renewable energies have changed the situation and the challenges with generation but also with transmission. To manage these new and often uncertain energy sources, CIST contributes to the development of smarts grids.

Did you know?

Smart grids: networks which use information and communication technologies to manage the different inflows and outflows of electricity.

CIST offers 4 study phases to support its clients with the optimal integration of new energies into their transmission systems:

- **Deposit study** (identifying the potential of renewable energy deposits in a given area and developing wind and solar farms),
- **Impact assessment** (analysing the impact of renewable energies on operation, transmission, already existing generation means and electricity tariffs),
- **Leverage study** (identifying possible levers to integrate renewable energy sources),
- **Action plan study** (developing roadmaps, master plans to encourage integration).


Integration of renewable energies

These four offers rely on specific methods for load and consumption simulation. CIST has elsewhere developed a probabilistic method, which is a specialised calculation method which helps characterise the variability of electricity generation. Thanks to it, it is possible to optimise, very accurately, the transmission system capabilities.

Cast study: Smarts grids and island systems

Innovative solutions are established in the island systems to maximise their energy efficiency. CIST has thus contributed in the establishment of 1.000 smart meters by EDF, in Martinique. In French overseas territories, the dispatching centres are reassessed and renovated to incorporate renewable energies.

In Jamaica, where the objective is to achieve 30% renewable energies in electricity generation by 2030, CIST has worked on a first study phase to identify the new generation areas of the island and to limit the additional cost of developing a smart grid to 5%.

3.2 Direct Current connections and super grids

Did you know?

Around the world, 200 installations run on direct current. Direct Current is more effective, as it generates fewer losses than alternative current from:

- **40 km** undersea;
- **50 km** underground;
- **600 km** overhead.

This technology addresses:

- The expansion of **high power electricity generation plants, often isolated** from the conventional transmission system,
- **The increasing demand** for electricity in urban areas,
- The need to interconnect power systems which have **different characteristics**.

Nicknamed "*electrical motorways*", the high voltage direct current networks raise technological challenges. CIST works with the R&D of EDF on three areas for improvement:

- **Controlling the conversion** direct current/ alternating current,
- **Optimisation of conductive materials**,
- **Development of highly effective circuit breakers**.

Inside the Lucciana conversion station (France - Corsica)

Case study: Direct Current undersea

At the end of the 1980s, a high voltage direct current line was established between Sardinia, Corsica and Italy (SACOI project). EDF undertook the design, then monitored the implementation of this unconventional project which included one third of cables undersea, which is 121 km. To install this network, high-tech boats have been called upon. Since then, CIST has been in charge of maintenance and ensure regular optimisation of cables and conversion systems.