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COMMUNITY PROMOTION OF ECGLC ENERGY SECTOR: KEY ROLE OF THE NEW REGIONAL DISPATCHING CENTRE OF KAMANYOLA

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SUMMARY

In 2012, the Delegation of the European Union awarded Studio Pietrangeli (SP) the contract for consultancy services relating to the feasibility, detailed design and bidding documents for the 220kV Kamanyola Station and 220kV transmission lines (TLs).

The Multinational Electric Grid Interconnection project of the Nile Equatorial Lakes Countries was issued by NELSAP, Nile Equatorial Lakes Subsidiary Action Program falling within the Nile Basin Initiative (NBI).
The Initiative includes the electrical interconnections between Burundi, Rwanda, DR Congo, Uganda, Kenya and Tanzania.

This project culminates the development efforts of the Economic Community of the Great Lakes Countries, ECGLC (CEPGL, in French, *Communauté Économique des Pays des Grands Lacs*) exerted in the energy sector, since his revival in 2007, supported by the Ministries of the three countries aimed at the exploitation of all available energy sources in the Great Lakes Region and faces the long-lasting energy shortage.

Therefore, the Kamanyola Regional Dispatching Centre project falls under a far wider development program for the promotion of a strong regional potential in hydropower development exploiting the cross-border community resources of the Ruzizi River, which flows from Lake Kivu to Lake Tanganyika in the heart of the ECGLC. The total Ruzizi valley hydroelectric potential is estimated at over 500MW, currently exploited only by Ruzizi I, belonging to SNEL and Ruzizi II, owned by SINELAC.

The planned 220kV TLs will have a common hub in the Kamanyola HV Substation, a strategic location close to the incoming Ruzizi III HPP and at the boundary of the three countries.

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By the forthcoming refurbishment of the existing Ruzizi I and Ruzizi II HPPs (built respectively in the 50s and 80s), two additional plants (Ruzizi III and IV) will step up the hydro cascade from the present 60MW to some 500MW. Accordingly, a new transmission grid shall be realized at 220kV voltage level, hence avoiding the unsuitable development of the existing 70/110kV lines.

SP project also includes two important facilities for the exploitation of the future 220kV electrical grid:

- the Regional Load Dispatching Centre in Kamanyola (RLDC), which will supervise the entire 220kV grid jointly with the national dispatching centres (existing and future)
- the Ruzizi Hydro Cascade Coordination Centre (CCC), also located in Kamanyola, to maximize the energy production of the four HPPs and to manage the water uses.

The authors will describe the main aspects of the project:

- technical features of the Regional Dispatching Centre role in the near future to improve grid reliability and availability and its implementation plan within ECGLC institutional framework,
- hierarchical relationships among the various parties acting on the grid operation, i.e. state infrastructures, national electricity companies, independent power producers, etc..
- an overlook of the Kamanyola 220kV Station and its related task in supervising the future 220kV transmission grid, interconnected to EAPP (Eastern Africa Power Pool) and SAPP (Southern Africa Power Pool) wider area network.

Finally, the authors point out the importance of the Social and Political features involved by the project as it can help improving cooperation between the three countries and create a solid foundation for a long-lasting agreement.

KEYWORDS

ECGLC, CEPGL, Ruzizi, 220kV Transmission System, Dispatching Centre, Institutional Framework, Burundi, DR Congo, DRC, Rwanda

Introduction

The Kamanyola RLDC project falls under a far wider development program for the promotion of strong regional potential in hydropower development exploiting the cross-border community resources of the Ruzizi River, which flows in the heart of the ECGLC. The total Ruzizi valley hydroelectric potential has been estimated in over 500 MW, with a total ascent of over 700m and a highly regulated flow by the natural reservoir that is Lake Kivu. The river is currently exploited only by Ruzizi I belonging to the DR Congo (SNEL) and Ruzizi II (SINELAC) owned by the three states, Burundi (BUR), Rwanda (RWA) and the DR Congo (DRC).

The ECGLC sub-region has long faced energy shortages.
The development of this project culminates the Community development efforts exerted in the energy sector since the revival of the ECGLC in 2007. The Energy Organization of the Economic Community of the Great Lakes Countries, GLE, (EGL in french, Organisation pour l'Énergie de la Communauté Économique des Pays des Grands Lacs) which operates to ensure cooperation between the member states in the energy sector, acts as the planning authority of studies and project implementation, and with the support of the Ministries of the three countries, has already started projects of paramount importance.

Figure 1 – Project location

The recovery program foresees the exploitation of all available energy sources in the Great Lakes Region. The energy sector is indeed a catalyst for the socio-economic development of the region. The overall objective of the sector recovery and development is to promote peace, stability and development in the region through political and economic rapprochement of the three countries involved and Community promotion within the ECGLC countries.
During the past two decades, the ECGLC member states have withstood the most serious political crises of their lives, marked among others by unprecedented ethnic conflicts, widespread insecurity and the enduring blockage of the republican institutions and administrations.
The revival of ECGLC seemed the ideal way for the member states to restore the framework of dialogue centred not only on the technical, economic, social and regional integration issues, but also on prevention, management and conflict resolution.

Background

The Multinational Electric Grid Interconnection project of the Nile Equatorial Lakes Countries was issued by the Nile Equatorial Lakes Subsidiary Action Program (NELSAP), which envisaged the following five interconnections:

i. the interconnection between Burundi, Rwanda and the DR Congo;
ii. the interconnection between Kenya and Uganda;
iii. the interconnection between Rwanda and Uganda;
iv. the interconnection between Rwanda and Burundi ;
v. the interconnection between Kenya and Tanzania.

The first grouping includes the interconnections within the ECGLC zone.

Between 2012 and 2014, SP provided his engineering consultancy services for the feasibility study, detailed design and bidding documents for the 220kV Kamanyola Station and 220kV TLs. According to the project, the new lines will have a common hub in the new Kamanyola Station, a strategic location close to the Ruzizi III HPP in the DR Congo, at the boundary of the three countries. The SP

project also includes two important facilities for the exploitation of the grid, embedded to the new Kamanyola station, such as:

- the Regional Dispatching Centre, which will supervise the entire 220kV grid jointly with the national dispatching centres (existing and future) of the Economic Community of the Great Lakes Countries (ECGLC) member countries, and
- the Ruzizi Hydro Cascade Coordination Centre, to maximize the energy production of the four HPPs and to manage the water uses and consumption within the authorities of the three countries regional policy.

The Ruzizi River exploitation is forthcoming through the refurbishment of the existing Ruzizi I and Ruzizi II HPPs (while two additional plants will be built to step up the hydro cascade from the present 60MW to some 500MW). Accordingly, it has been established that a new transmission grid shall be realized at 220kV voltage level, hence avoiding the unsuitable development of the existing 70/110kV lines.

The Kamanyola station, in this background, is devoted to be the liaison of the existing dispatching relationships of the three beneficiary countries already established among Mururu II and the national centres of RN1 (BUR), Gikondo (RWA) and Ruzizi I (DRC), and to implement the future regional operating and commercial targets, by close cooperation with the CCC, the EAPP and CAPP (Central Africa Power Pool) for trans-boundary power exchanges. Finally, the environmental impact assessment together with the institutional framework study, allowed project optimization and its integration within the international context.

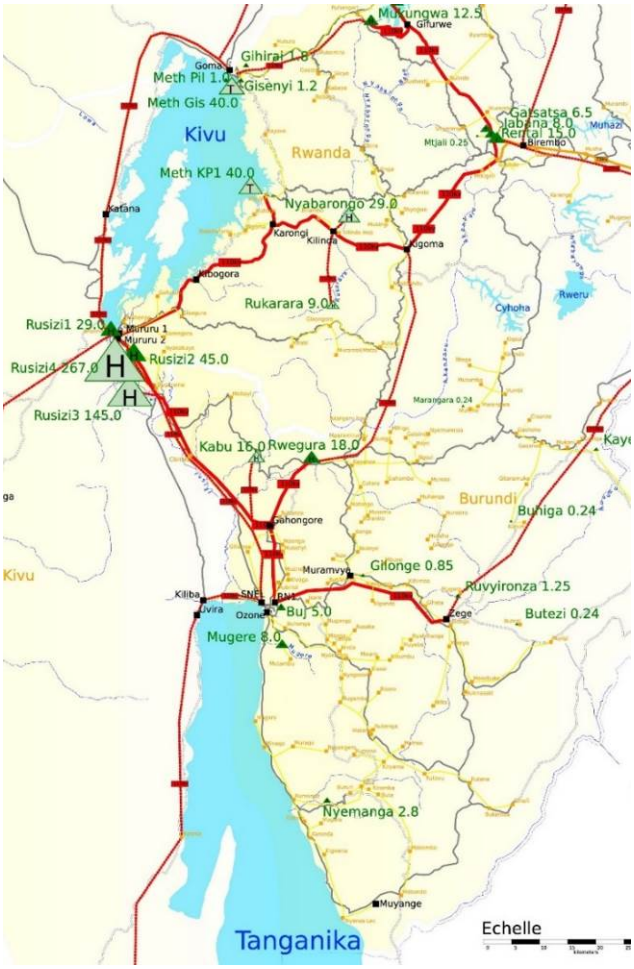

Figure 2 – Ruzizi river cascade geographic map

Outline of the Project

The main scope of the project is to allow the Organization for Energy of the Great Lakes Community, GLE, to warrant the security, quality of supply and economy of the power system operation, looking forward to the wide area management. To achieve this goal, GLE is in the process of implementing state-of-the art technological systems supported by an extensive communication network.

The occasion given by the ongoing exploitation of the Ruzizi river potential is gained by defining a wide-range role to the RLDC infrastructure. As a matter of fact, the RLDC concept finds true on the need of managing the Ruzizi Cascade power plants. The need of interconnecting these HPPs in the regional network – intended to be a multi-country network composed by the transmission system and loads of the Lake Kivu area – imposes the necessity of upgrading the existing control system, presently limited to few HPPs and not optimised for remote energy management. The service contract awarded to SP includes the design and tender documents for the 220kV Kamanyola Substation, which the RLDC and the CCC form part of, and the two 220kV overhead lines, namely the 93km long Kamanyola – Kibuye, and the 8km long Kamanyola – Ruzizi III.

Among the most challenging tasks faced by the consultant during the design stage, we recall:

- ✓ the complexity of the transmission networks, operated under the three national utilities
- ✓ the full integration of old existing installations with the forthcoming new ones
- ✓ the need to provide the RLDC with capabilities matching energy demand and consumer population growth in the next 30 years of operation, which will see a substantial development of the present network at 30-70-110kV, small and poorly integrated, towards a mashed, interconnected system at 110-220kV.

Table I – Actual consistence of the GLE's network (at year 2012)

Generating units	**Qty**	**Inst. Power [MW]**
Thermal units / thermal power plants	37 / 7	113,5
Hydroelectric units / hydro power plants	22 / 8	144
Gas turbine units / Gas-fired power plants	3 / 2	17,5
Total	**62 / 17**	**275**
Transmission Network		Line bays
220kV substations	-	-
110kV substations	21	38
70kV substations	6	10
Total	**27**	**48**
Interconnection lines (Uganda, Tanzania)	none	none
220kV lines	none	none
110kV lines	19	434km
70kV lines	5	257km
Total	**24**	**691km**

Table II – Future GLE network, with horizon at the year 2035 (indicatives values)

Generating units	**Q.ty**	**Inst. Power [MW]**
Thermal units / thermal power plants	62 / 25	1.410
Hydroelectric units / hydro power plants	33 / 11	880
Gas turbine units / Gas-fired power plants	20 / 12	463
Total	**115 / 48**	**2.753**
Transmission Network	**no.**	
220kV / 110kV / 70kV substations	27/30/7	~ 2.000/~ 800/~ 300 MW
Interconnection lines (Uganda, Tanzania) / 220kV/110kV/70kV	2/28/30/6	210/1800/710/260km

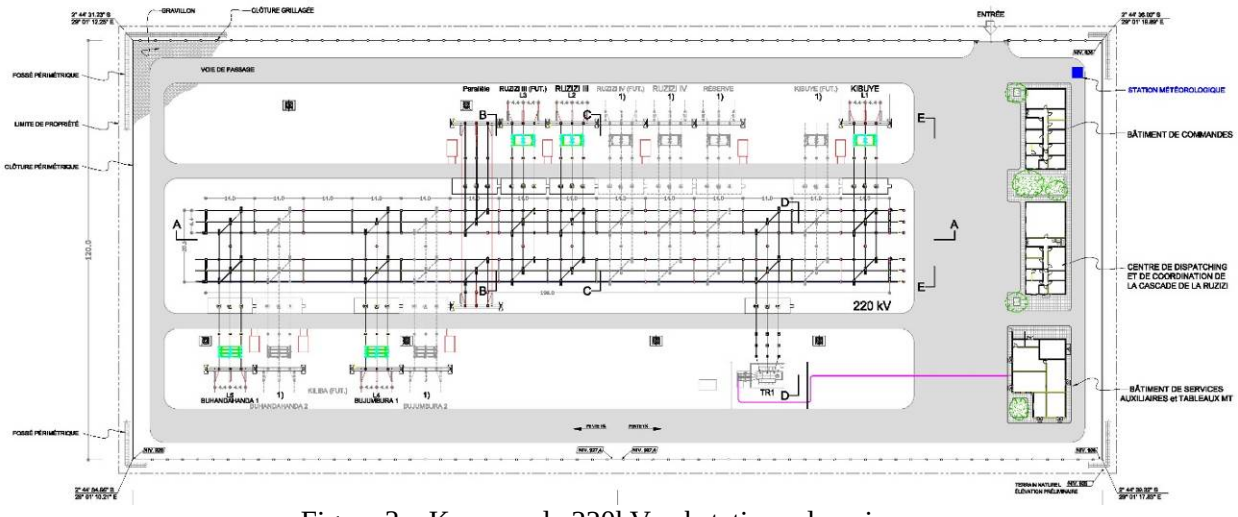

Figure 3 – Kamanyola 220kV substation, plan view

In order to assess network assets in different scenarios, SP conducted an extensive network analysis, with transient stability issues investigation, based on energy demand projection and new incoming projects as per national utilities plans. Evaluating RLDC operating range, its capabilities in managing data flows and performing remote telecontrol of the network, the consistency included the above figures: the interconnected network extension at year 2035 is approx. 90,000km^2 (300 x 300km), from

North Burundi up to South Uganda, covering the entire Rwanda, and from the Tanzanian border to the DR Congo (eastern Network). The single line diagram shown here below refers to target year 2020.

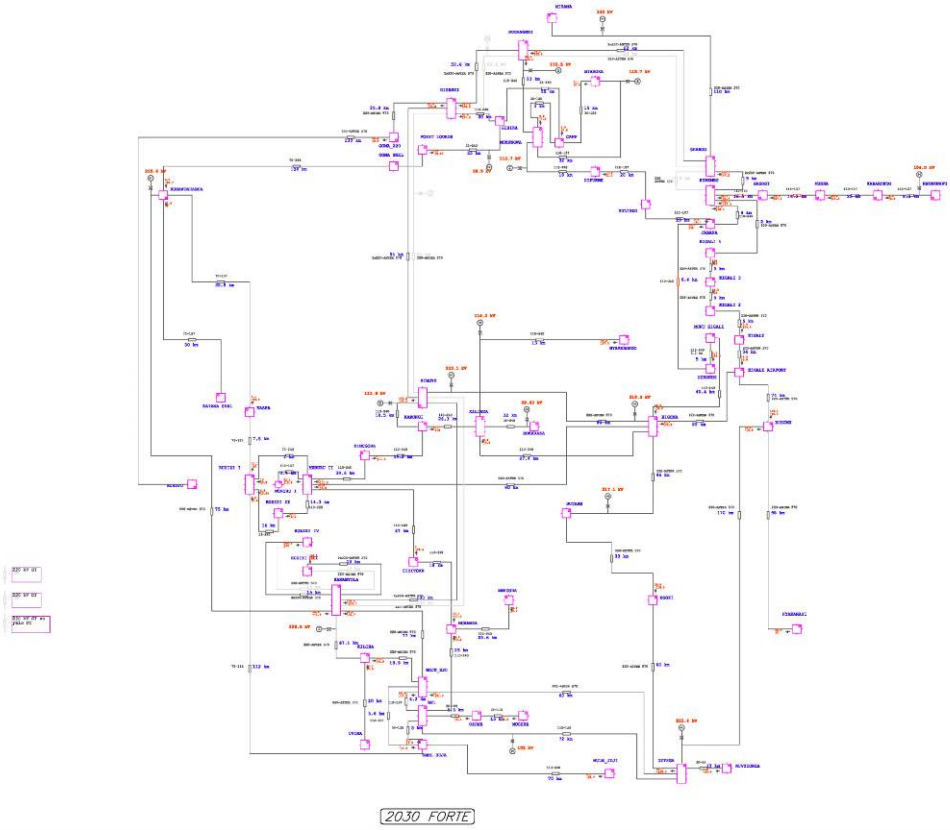

Figure 4 – HV grid topology view in the target year 2020

The Kamanyola outdoor type substation is rated 4000A – 50kA$_{eff\ sym}$, 1050kV$_p$ in a double bus bars configuration with no.12 line bays and no.1 220/30kV step-down transformer bay for local distribution reinforcement. The cost estimate of the infrastructure rounds 11M€.

Present Situation

DR Congo exports to the SAPP via Zambia from 220kV lines from South Katanga the power generated by Inga I and II, and from the three midsized HPPs in South Katanga. The Eastern provinces are interconnected north south, and with Rwanda - to the Ruzizi plants. Ruzizi I HPP (SNEL) is linked to Bujumbura (BUR) and Buhandahanda (DRC) via 70kV, to Mururu II (RWA) via 110kV. Ruzizi II HPP (managed by the « Société Internationale d'Électricité des Pays des Grands Lacs (SINELAC) », a joint venture with Rwanda, DR Congo and Burundi) is interconnected at 110kV to Rwandan grid via Mururu II (RWA). Energy volumes are agreed with the dispatching station in Goma, Ruzizi I, Mururu I and Mururu II on a daily basis forecast, taking into account the thermal and gas units availability of the Lac Kivu stations. Data transmission presently relies on different technologies (partly PLC, partly OF, mainly via VHF-HF radio instructions), but the 220kV future development will assure data exchanges among the new RLDC and load nodes and generating stations by SCADA, thanks to harmonization of the various projects of the GLE's area such as Buhandahanda, Goma, Kiliba-Uvira, and their lines. The most important eastern DR Congo new hydro options are Ruzizi III and Ruzizi IV projects. As an important part of this scenario, the forthcoming rehabilitation of Ruzizi I and II HPPs will allow the telecontrol of the entire Ruzizi Cascade under the RLDC's dispatching functions.

The transmission system of **Burundi** (member of the EAPP), is based on 70 and 110kV OHLs, while distribution system includes 10, 15, 30 and 35kV lines operated under the responsibility of the national power company REGIDESO. 110kV RN1 dispatching station in Bujumbura receives energy from the Mururu II (SINELAC) 110kV switching station (through Bubanza station) on pre-paid based criteria. Fibre optic is used on 30kV grid only, thus marginally contributing to radio communication. Burundi

is planning several HPPs and thermal projects, together with T&D systems reinforcement. For instance, REGIDESO has refurbished and upgraded RN1 in 2012 to facilitate future communication with the new 220/110kV Bujumbura and Kamanyola station via SCADA. Moreover, the Burundi-Rwanda (220kV Kigoma-Butare-Ngozi-Gitega OHL with UE/FED10 fund) together with Burundi-Tanzania interconnection will complete the grid meshing. The design of the 220kV, 75km long Bujumbura – Kamanyola (DRC) OHL, linking the country's energetic needs to major regional Ruzizi HPPs and opening to the progressive private sector exploitation, is under implementation. In such a way, Burundi will be capable very soon to establish a suitable import/export management between the regional countries, looking forward to wheeling a prospected long-term low cost hydraulic energy production, by sharing market tariffs harmonization and regulation.

Transmission network of **Rwanda** represents a remarkable portion of GLE's network. EWSA has planned numerous HPPs sites exploitation and thermal plant installation to meet the 1,000MW generation under Vision 2020 goals. Transmission system extends to 350km of 110-70-30kV, interconnecting DR Congo and Burundi and managing energy exchanges via Mururu II (SINELAC) on an operator-based pre-paid and daily load demand dispatching upon request. Rwandan transmission capability development is another crucial aspect in GLE's energy market asset. 220kV voltage level has been suitably selected to meet the energy demand forecast and rate growth, mainly taking place in Kigali capital city, to the north, in booming phase.

Grid Codes

One of the difficulties in managing a multi-countries management infrastructure project, such the subject on dealing with the RLDC, is to assess full compatibility of the code by means of which the relevant utilities and operators will act, sharing common rules.

The term Grid Code, as recalled in the EWSA Rwanda Grid Code, 2012, is widely used to refer to a set of documents that legally establishes technical and operational rules for the connection to and use of an interconnected power system, so to ensure its reliable, efficient, economic, and safe operation. Therefore, the shared Grid Code must be objective, transparent, non-discriminatory, and consistent with government policy, define the obligations and accountabilities of all the participants, and specify minimum technical requirements for the transmission system. The authors took in consideration the available national codes pertaining to the countries beneficiary of the project. In this regards, the EWSA (ex RURA) Rwanda Grid Code, already mentioned, and the South African Grid Code – System Operation Code (2010) were deemed the most suitable documents for ease of reference.

Kamanyola Regional Load Dispatching Centre Functions

Dispatching operation should rely on base criteria, i.e. economy, easiness, redundancy, feasibility.

The dispatching concept assumes that the energy quantity exchanges negotiation will gain ground in the three countries (an "energy market") by the means of suitable physical or telematic platform, which will let the buy/sell transactions easy and transparent among the different utilities and operators. In this regard, the RLDC will have a technical and institutional role, in assuring proper operation of the interconnected transmission network in the safest security conditions, to warrant continuity and quality of the service. Telemetering system will acquire in real time the status of the network at different levels (generation, transmission, distribution) and, in case of need, the RLDC will take relevant corrective action. "Ad hoc" software and managerial tools will allow the RLDC to perform his functions, developed at various stages, such as :

- at the planning stage, with the preparation of the generation programs on the basis of the energy and power demand forecast at national level and of the unit commitment and availability
- at the real-time control stage, optimizing the transmission operation, acting on the network asset and configuration, offering service of urgent intervention to avoid major faults and black start coordination in case of major disturbance or black out
- at the back-analysis stage, with operation data processing

These functions will be born jointly with the EAPP, SAPP and CAPP within the development and coordination plans of each country. In view of the above, the RLDC will closely work in collaboration with the Ruzizi CCC, placed in the same premises of the Kamanyola Substation.

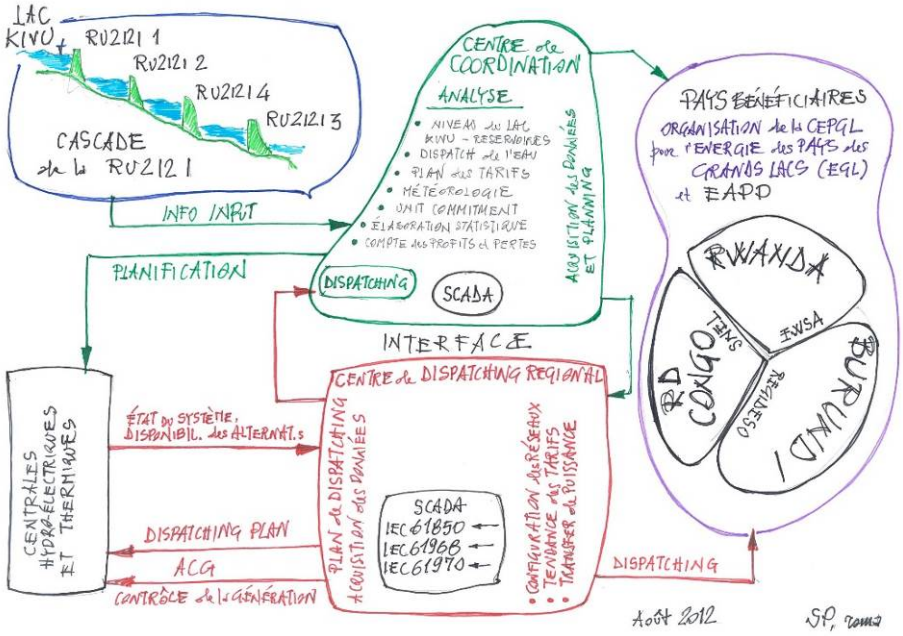

Figure 5 – RLDC, CCC, Ruzizi HPPs and GLE grid interfaces

Project Description

The 220kV Kamanyola Substation will house the RLDC in a dedicated building.

The RLDC will have a direct responsibility on the control of the Kamanyola Substation, of the incoming and outgoing TLs and also of the HPPs of the Ruzizi Cascade via the remote telecontrol console ("Poste de Téléconduite", PT). Moreover, the RLDC will supervise the interconnected network of the three countries (Burundi, Rwanda and DR Congo) and therefore the out-boundary power flows with Tanzania and Uganda, via :

- telecontrol console and the Mururu II station, with the purpose of plant operation
- national dispatching centres, for what the remaining network and the interconnection system are concerned

At the beginning of its operation, the RLDC will be linked to the existing dispatching centres of Mururu II and Gikondo (Kigali, Rwanda), and Bujumbura (Burundi). The design of the control system considered the necessary requirements for the interface with the existing third-parties equipment already in place. Successively, the RLDC will be connected to the future national dispatching centre in the 220kV stations at Kigali, Shango (RWA), Buhandahanda (DRC) and Bujumbura (BUR). From the hierarchical point of view, the Kamanyola RLDC is depending on the national dispatching organizations, but featured with technical capabilities for network supervision.

The following scheme shows :

- geographical connections between existing and future station and dispatching centres
- means of connection and features, such as teleprotection / vocal communication / SCADA services channels

The RLDC relies on SCADA and EMS (Energy Management System) capabilities in order to perform "on-line" and "off-line" functions, namely:

- ON LINE
  - remote operation, control and supervision of the 220kV Kamanyola and Mururu II stations, of the GLE lines and stations as an alternative to the local control
  - remote operation and control of the Ruzizi hydraulic cascade power plants, composed of the existing Ruzizi I and II and the future Ruzizi III and IV, as an alternative to the local control, and in close cooperation with the CCC, placed in Kamanyola
- OFF LINE
  - Supervision of the interconnected network (SNEL, REGIDESO, EWSA) and of the boundary interconnection to Uganda and Tanzania, via the national dispatching centres

placed in Rwanda (Mururu II, Kigali, Gikondo), DR Congo (Buhandahanda et Goma) and Burundi (RN1 à Bujumbura)

- evaluation of the interconnected network static and dynamic security, analysis and energy demand forecast, with associated load demand curves, acquisition and revision of the production plans and planned boundary power exchanges
- spinning and stand-by generating reserve forecast

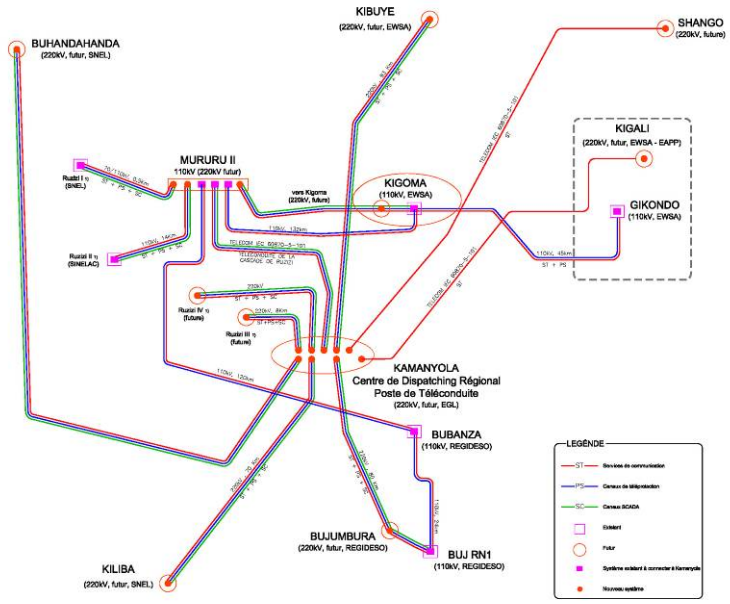

Figure 6 – Telecommunication and SCADA Diagram

The need of future connection to different utilities and companies required a wide coverage by standard protocols, such as IEC 60870-5-101, 103, 104 Master & Slave (Serial-TCP/IP), IEC 60870-6 TASE.2 (ICCP), IEC 61850 (TCP/IP), DNP 3.0, Modbus. In addition, full compliance with the existing licensed communication protocols for third-party RTU guarantees a complete interface.
The core role of SCADA is telecontrol for remote operation of GLE's power plants and substations:

- 220kV Kamanyola station and associated TLs
- 110kV/70kV Mururu II substation and associated lines which supply the three electric utilities (SNEL, REGIDESO et EWSA)
- existing Ruzizi I and Ruzizi II power plants, under rehabilitation
- future Ruzizi III and Ruzizi IV power plants

The communication and control system is based on the large use of optic fibre. Telecontrol console (either automatically or by operator) receives telemetering of the GLE's network and operates the 220kV Kamanyola and Mururu II stations at the beginning, and on a medium to long-term basis will supervise and operate the 220kV network.
As main players of the GLE's network, the scheme includes the Ruzizi Cascade HPPs, thanks to the forthcoming rehabilitation of the existing HPPs and the future Ruzizi III and IV, on-line and linked to both RLDC and CCC remote functions.
Data acquisition is made via the SCADA and automation equipment of the controlled electric installations for what the "on-line" functions are concerned, while the "off-line" functions are performed via the interface with the national dispatching centres and with the out-boundary dispatching centres in Uganda and Tanzania.

Scada Architecture And Boundary Interconnection
The design foresees that the RLDC in Kamanyola can operate for supervision and telecontrol of :

- the 220kV/30kV Kamanyola substation, the Mururu II station and its 220/110/70kV lines relevant to GLE's grid
- the Ruzizi Cascade HPPs

The RLDC is provided with a complete set of control, protection and metering signals management aimed at data acquisition for equipment status, grid perturbations and anomalies, equipment operation (VAR information and OLTC), meteorological and environmental indicators, chronological events data, etc. Hardware configuration is based on modern open industry standard SCADA/EMS systems, fully redundant LAN/server and optical fibre with communication applications, and provided of a dedicated multifunctional software suite, geographical referenced (Figure 7).

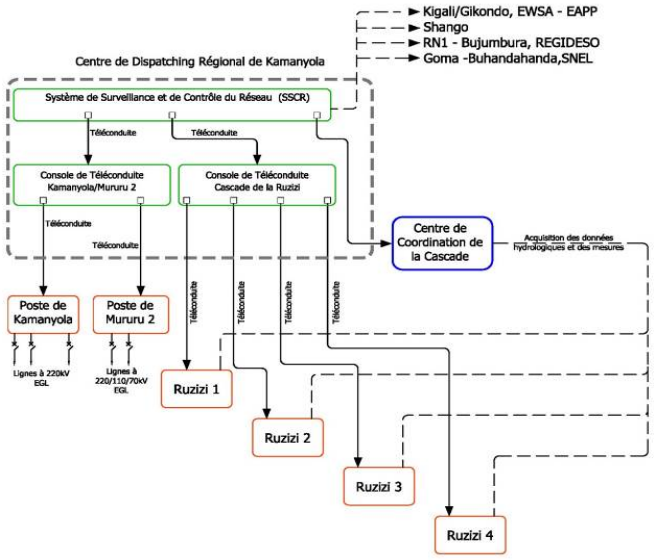

Figure 7 - conceptual scheme for telecontrol and data exchange among network, RLDC and CCC

Figure 9 shows the planned detailed configuration for the implementation of the control centres at the various levels: the remote telecontrol of one of the hydroelectric power plants of the Ruzizi Cascade (SCADA system, green block) as performed in Kamanyola (3rd level, remote console light blue block).

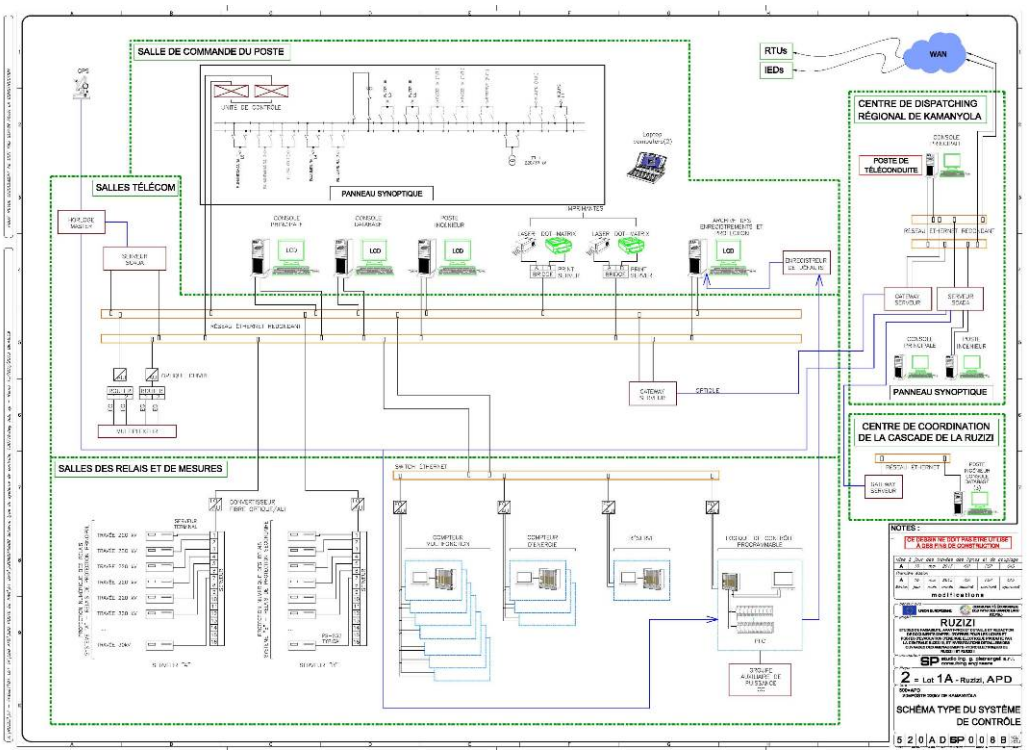

Figure 8 – Kamanyola station SCADA architecture diagram

Data concentrators will be implemented in all T&D stations requiring the RTU upgrade for data collection and integration via local Intelligent Electronic Devices (IEDs) thus supporting local automation scheme.

Interface With Ruzizi Cascade Coordination Centre (CCC)

Kamanyola premises will also host the Cascade Coordination Centre for Ruzizi HPPs.

The CCC's role consists in cascade energy production optimization and water uses with the aim to fulfill the national electric providers energy demands (SNEL, REGIDESO and EWSA), by taking into account the entire Lac Kivu hydrographic basin hydrology and the ABAKIR's directives.

The ABAKIR (Lake Kivu and Ruzizi River Basin Authority) is the high-level authority responsible for the water release from the Lake Kivu, whose protocols must be considered by the Ruzizi CCC during the production planning.

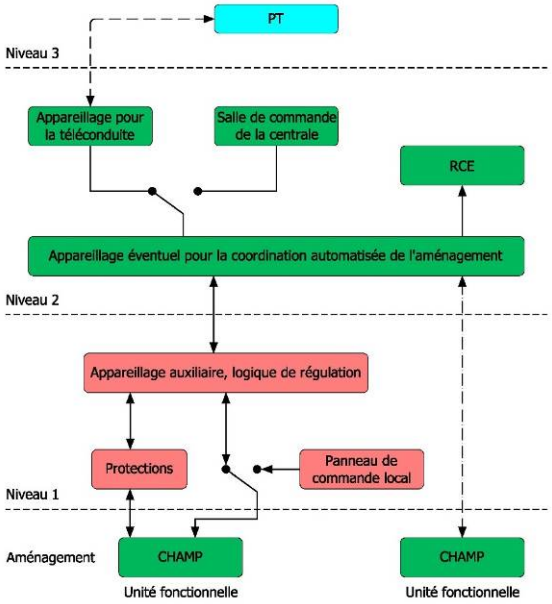

Figure 9 - configuration for the implementation of the control centres at the various levels

The CCC, on the basis of the RLDC's load demand forecast received from the national dispatching centres, computes the daily available energy capability of the different reservoirs and HPPs of the Ruzizi cascade (as subdivided in run-of-the-river, accumulation basins, etc.). Through a dedicated software, it elaborates water volumes and flows management in relation to their use.

Institutional Framework And Financial Scheme

In the regional context, the Great Lakes countries are ready to create a platform of attractive private investments in the energy sector by implementing the most suitable institutional framework for management of the Ruzizi cascade and the future 220kV transmission network. This platform will help also in mitigating the hydrological risks, which could have an undesirable impact on sustainable operations of the existing and future plants of the Ruzizi cascade, and the mobilization of financing of hydropower development under Private Public Partnerships (PPP).

Studio Pietrangeli' investigated viable institutional frameworks aimed at defining the most promising and convenient scheme to manage the new RLDC and CCC, in relation to the various stakeholders, such as the EGL itself, the national electric companies (REG, REGIDESO and SNEL) and the independent power producers.

Selection of the most appropriate management scheme took into consideration the need for equity, guaranteed remuneration for services rendered to support the infrastructures, independence and security for the Countries. After an in-depth analysis and fine-tuning of various options, a "*Délégation de service public à une société privée*" was identified as being the most viable. Consequently, the financial and technical management of the RLDC will be entrusted to a private or public (or mixed)

company that will also bear the commercial risk of the business. In this way, the Countries retain ownership of the infrastructure.

Commercial agreements will be arranged and entered into among the power producers, the national companies and the RLDC agent company. In the proposed framework, the power producers of the Ruzizi Cascade plants together with the national electric utilities will bear the costs for the services rendered by the RLDC and the CCC.

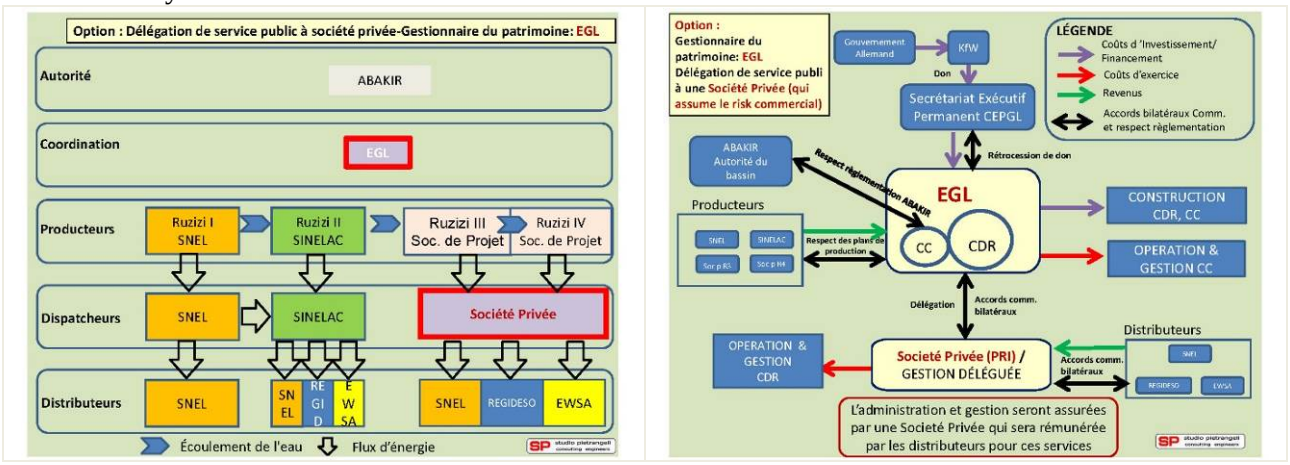

Figure 10 - selected option diagrams for different hierarchical levels (left side); costs/remuneration flows among the involved parties (right side)

Investment and O&M Costs estimate

The investment costs for procurement, supply, installation and commissioning were estimated in about 11.3M€ (2012), including environmental issues and EGL's staff capacity building and training. The RLDC/CCC will employ 9-people staff, including a director, administrative personnel (legal advisors), technical expertise and data processing team. The estimated annual budget for administrative, commercial and technical operation of the centre ranges in 500k€.

Therefore, a "transaction fee" has been identified to constitute the incoming revenue linked to the services rendered by the RLDC for transmission operation optimization. The financial analysis identified break-even value of the fee's profitable threshold, say about 1c€/kWh, to be charged to the electric companies in order to assure the balance of the Kamanyola RLDC and substation O&M costs.

Conclusion

Further to the efforts made at technical and financial levels, ECGLC and GLE finally set up the path towards the establishment of the most suitable institutional framework, aimed to the sustainable management of the Ruzizi water resource coordination and its energy production exploitation. In this scenario, the future 220kV Kamanyola Dispatching Centre will play the key role.

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