

# Modelling of Building Automation Project with Smart Network and Cogeneration Systems Integration

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**Abstract** - As we know, at present, when residential buildings are built, a traditional transformer substation is used in the process of providing them with electricity. Such distribution systems take electricity from the grid and transmit it to consumers. In this case, the residents of residential buildings are completely dependent on the current state of the electricity network. In this case, the description cases are also unambiguously determined by the distribution company and sold to consumers. However, with the integration of Smart networks and cogeneration systems, it is possible to create independent distribution systems in residential buildings designed, as well as increase the efficiency of electricity and other fuels through combined-production. In this way, in addition to improving the quality of electricity, it is possible to design active and dynamic tariff strategies for energy consumers. This paper highlights the process of integrating a smart building system into a smart network technology that is actually applied. The systems that bring smart building design systems to an intellectual form are explained and the substation infrastructure designed through the smart network system is analyzed.

**Keywords:** Dynamic Tariff Strategy, Smart Network, Combined-Production, Cogeneration, Quality of Electricity, Automation Panel, Insulated Network, Local Area Network, Building Area Network, Smart Building.

## I. INTRODUCTION

Today, thanks to evolving technology, many buildings are designed in the mind of smart buildings and provide both energy efficiency and consumer-friendliness. Smart buildings use automation of lighting, ventilation, and air conditioning systems, fire system, network infrastructure, first aid for hospitals, control, and management of medical devices. Although smart building technology works in many areas, in order to be fully smart, we need to use smart systems not only on the building side but also on the energy side. The last point where technology comes in this area is smart network systems. In this study, the proposed system work at the energy center of a smart building is proposed to ensure the integration of smart buildings with the smart grid. The proposed research is to

provide the most efficient and cheapest energy from the various sources to be included in the system from the central substation and to receive regular feedback through the feedback system.

## II. SMART BUILDING APPLICATION

In automated lighting systems, one of the smartest building applications, a 2x1.5 inches automation cable is laid between the fixtures and connected to the router module in the associated sub-system. These routers can be assembled in series with a Cat-6 communication cable and controlled from a central automation computer. The automated lighting system, which receives information through sunlight sensors located on 4 different facades of the building, adjusts the light bulbs according to the light level. 1-10V electronic ballasts are used in public utilities; DALI (Digital Addressable Lighting Interface) ballasts are used for individual use. Dali ballasted \* fittings can also be operated mechanically by means of light buttons [1].

Necessary adjustments in the automation of ventilation systems are carried out through DDC distribution panels, which are controlled by them. The following operating system is provided for the fire alarm-scenario system. Elevators are ordered. For example, in the event of a fire, the elevators are called to the first floor. In case of an earthquake, it opens to the nearest floor. In the building; special command signals are sent to the fire emergency doors and sensor doors, and all fire doors (emergency exit doors) and sensor doors open automatically immediately after the fire occurs. The emergency information system is activated directly. An automatic call command is given to the fire brigade. The valves in the fire extinguishing system are checked for water leakage. Despite the lack of electricity, an emergency lighting system is activated to illuminate the building [2].

Other integrated automation in network infrastructure automation can be combined with this infrastructure. In other words, stand-alone systems can be tracked by data slots in the same rack cabinet. Only central monitoring should be independent. Hospital nurse call system and medical device control and management also include smart building technology. While the patient is sleeping in a room, he sends

information to the nurse by pressing the call button. The information is reflected in the nurses' information table and the nurse is informed. The nurse then goes to the patient's room and reads the card to the call panel prepared for the nurses. Thus, it is determined which nurse reaches the patient at what time interval and for how long. One of the systems used in hospitals is the control and monitoring of medical devices. This system uses an IT system (INSULATED NETWORKS), operating room control panels, and UPS [3].

When we think about saving economically in smart buildings, we need to consider the cogeneration system. Cogeneration, heat, and power generation systems CHP (Combined Heat and Power) is a modular structure in which electricity and steam are produced from the same energy source at the same time. By using the heat released during the production of electricity and increasing energy efficiency, it provides more benefits than traditional energy systems. Because the energy is produced where it is consumed, losses in transmission and distribution lines are eliminated and the enterprise is offered an uninterrupted and high-quality power supply, regardless of the network. Accident and repair costs are reduced. As a result of the same joint use of electricity, hot water, and steam, the investment cost is recouped in a short time [4].

### III. INTEGRATION OF INTELLIGENT BUILDING SYSTEM INTO A SMART NETWORK

To use smart network technology in smart building applications, it is possible to use the most efficient and cheapest energy by automatically controlling the high-voltage control devices (distribution shells and/or transformers) belonging to more power sections of the facility that can supply more than one power. Two designs have been identified for this study. Different voltage levels are taken into account in both designs.

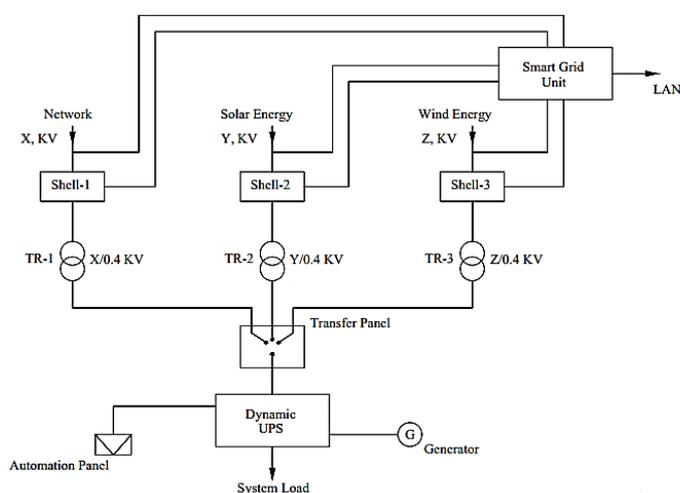


Figure 1: Smart network system powered by different voltage levels from different power sources

In this design, an independent high-voltage distribution structure for each power section and a system that supplies power to the building with transformers provided by these structures is considered to provide different power from different companies. The transformation coefficient of transformers should be selected according to the voltage level of the system from which the energy is obtained. The distribution structure where these transformers are connected is connected to the power automation panel. Dynamic Uninterruptible Power Supply must be installed at the output of the transmission panel, depending on the load potential of the building. The smart grid will select the most efficient and inexpensive form of power from the power supply points and will activate the appropriate shell and ensure the supply of the system. A Dynamic UPS \* must be used to prevent short-term interruptions during the transition from these supply points to the system. In this way, system interruptions can be avoided [5].

The intelligent network system continuously receives and analyzes information from all power supply points and distribution shells. Makes choices depending on the results of this analysis. Thanks to this system, monitoring of accidents that may occur in the project are provided. The smart network module allows remote access to the system via a LAN-Local Area Network, as well as intrusion into the system, depending on the permissions on the interface. In the current situation, a LAN connection may be sufficient, but the introduction of a BAN (building area network) in complex buildings such as hospitals and universities will allow the smart network to operate more efficiently. As a result, the system will be monitored from a centralized system and appropriate operations will be provided as a result of the necessary analysis.

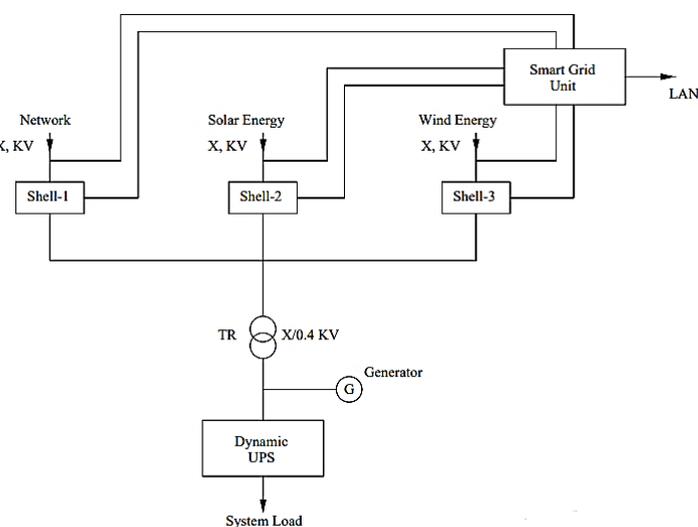


Figure 2: Smart network system fed from different power sources at the same voltage level

In the design shown in Figure 2, it is assumed that the voltage levels are equal when power is supplied from different sources. In this case, the system works with a single transformer. However, the only problem is that the smart network manages the Breakers to the shells separately. For the normal operation of the system, the distribution shells of the company through which the power supply will be provided must be used. The rest of the work plan is as in Figure 1. In both designs, the calculation can be done through the download and updating of tariff information, energy status report, and control / smart network [6].

Tariff; the system will be able to automatically submit an invoice and inform the company about the amount of consumption in smart meters located in independent shells. Thus, the remote control will be possible.

Download and update tariff information; Energy supply companies will be able to create tariff information on energy consumption and timing of network meters via the smart grid or independent internet connections, and download discount tariffs that may be available to smart meters to date.

Energy Statement Report; The smart grid will continuously monitor the power supply points and will be able to monitor the efficiency of the power center used in accordance with the timing and identify potential risks such as high voltage, voltage drop, and fluctuations [7].

Connection/opening control; Today, the opening and cutting operations at the outlet of the meters are carried out manually, which leads to a great loss of time and labor. With the help of a simple module that will be created in the measuring shells thanks to the smart network, companies will be able to automatically cut off power through remote intervention in case of non-payment of electricity consumption and re-energize if necessary.

When it comes to cogeneration in a smart building system, according to the energy cost analysis of the companies to be supplied with energy, a smart grid system can be included in the building system. The cogeneration system is able to work in a fully integrated with smart network technology. Since we need to save energy, it is up to us to make it more useful with a smart system. The cogeneration system has the option to work with natural gas, fuel oil, biogas and biofuels. Given the cogeneration system running on natural gas in our smart building in Figure 3 design, the smart grid can analyze natural gas price data and activate cogeneration when it is more appropriate than other energy options. It can even transfer the energy it already produces to the grid and switch to a more cost-effective system. In case of inability to meet the demand for electricity, the system can be operated at full load and maximum efficiency by taking

electricity from the network and selling it to the network in case of overproduction. In this case, the highest profit is provided. Although natural gas was initially considered as a fuel during cogeneration, waste treatment plants use Sewage gas, which consists of landfill gas and similarly, biogas, coke oven gas, and so on. Can be used in fuels such as. Like natural gas, these gases can be used directly to generate electricity and heat [8].

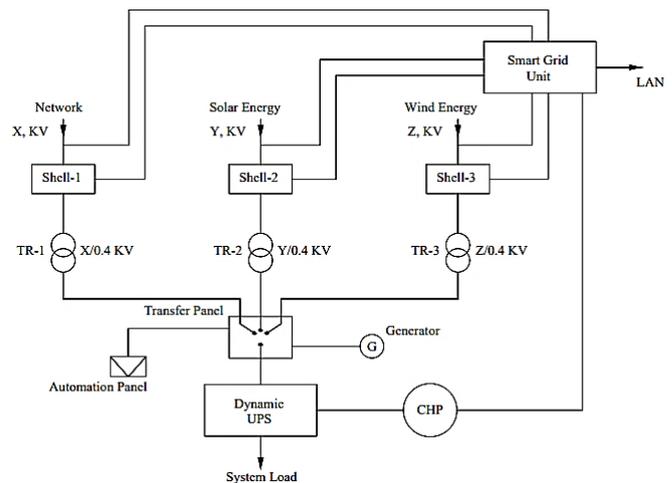


Figure 3: Integration of a smart grid and cogeneration system into a smart building system

#### IV. CONCLUSION

In the networks of the future, active (dynamic) consumers will be preferred over fixed (static) consumers, and therefore the transition of energy exchange between dynamic consumers in the networks and local renewable energy sources must be ensured. [9]. This paper highlights how smart grids can be integrated with smart building technology and alternatives to this integration. If smart buildings can provide different energy (wind, solar, etc.), it is possible to choose the most suitable energy for a smart building and monitor it under appropriate conditions. As the number of transformers in the structure shown in Figure 1 increases, the heat and copper losses in the transformer will increase, thus creating a negative situation in terms of energy savings. The study highlights different renewable energy sources, such as wind and solar energy.

The share of renewable energy sources in total energy production is growing day by day. This is because the production of electricity based on renewable energy sources such as wind and solar has less negative impact on the global climate and environmental pollution, and has important advantages such as not requiring fuel for energy production [10]. The use of renewable energy in large buildings, such as hospitals, reduces the energy load from the grid, increases the diversity of energy sources available in the enterprise, and

allows for material benefits through a smart grid. When cogeneration is added to the system, the enterprise will receive high energy and financial benefits. Since cogeneration systems achieve 30% electrical efficiency and 60% thermal efficiency, it is possible to achieve an overall efficiency of up to 90%. Dynamic UPS \*: These are UPS systems that provide the load with moving parts in the event of an accident. In the event of a network failure, it charges the battery without wasting time.

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