Palestine Polytechnic University

College of Engineering

Electrical Engineering Department

Electrical Power Engineering

Title

Study of converting the electrical network in the city of Yatta from (33 kV) to (11 kV)

By

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الإهداء

إلى معلمنا الأول ومعلم الناس الخير.................... نبينا محمد صلى الله عليه وسلم

إلى من زرعوا فينا الطموح والمثابرة و الاجتهاد........................آباؤنا الأفاضل

إلى ينابيع المحبة و العطاء.........................أمهاتنا العزيزات

إلى إخوتنا وأخواتنا

إلى معلمينا و معلماتنا

إلى الأصدقاء و الزملاء

إلى من ناضلوا من أجلنا شهدائنا وأسرانا وجرحانا

إلى هذه الأرض التي نحب فلسطين

Abstract:

The electrical network in electrical systems is one of the most important elements of it, so he paid great attention and care as much as possible. From this point of view, we took the Yatta city electricity network as a project for us to develop a plan of action to transform the network within the city from 33 kilovolts to 11 kilovolts because of this system of great benefits that were deduced From the experience of the Hebron Electricity Company from this system, this system has helped the Hebron Electricity Company to overcome many obstacles and open up very great horizons for it. New tools and devices will be used, and the DigiSilent program will be used mainly in the design process.

الملخص:

ان الشبكة الكهربائية في الانظمة الكهربائية تعد من اهم عناصرها لذلك تولى اهتمام وعناية كبيرة قدر الامكان ومن هذا المنطلق اتخذنا شبكة كهرباء مدينة يطا مشروعا لنا لوضع خطة عمل لتحويل الشبكة داخل المدينة من 33 كيلو فولت إلى 11 كيلو فولت لما لهذا النظام من فوائد كبيرة تم استنتاجها من تجربة شركة كهرباء الخليل من هذا النظام وقد ساعد هذا النظام شركة كهرباء الخليل من تخطي الكثير من العقبات وفتحت امامها آفاق كبيرة جدا وسيتم استخدام ادوات واجهزة جديدة وسيتم استخدام برنامج ديجسايلنت بشكل اساسي في عملية التصميم.

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Figure1.1Yatta

1.1.Overview.

In our time the electricity become important as much as food and water, so people can't live without it, however the world now aims to offer the required quantity of power without interruption at the lowest cost.

The process of producing electricity is done in three stages, the first stage is generating the power, then transferring this power through the transmission system and the last stage is power distribution.

The main idea of this project is to make a plan to transform the electrical network in the city of Yatta from 33 kV to 11 kV affiliated to the South Electricity Company (SELCO).

1.2. Project Description.

The South Electricity Company is a private limited shareholding company bearing registration number (562439422), and its shareholders are from the municipalities and village councils located within its work area in the southern West Bank.

The South Electricity Company was established by a decision of the Palestinian National Authority as part of its plans to develop the electric current service in the Palestinian homeland and as one of the electricity companies in our homeland Palestine, so that its services include the distribution of electric power in its concession area. The South Electricity Company started its actual work in four municipalities: Dura, Yatta, Dhahiriya and Beit Ummar. During the first year of its life, other local and village councils joined the company, and a group of municipalities and village councils submitted applications to join the company.

In SELCO there is a different situation SELCO doesn't have distribution substations such as HEPCO substations, in SELCO they call it converting substations, they have a main distribution transformers distributed on a seventeen center points, these transformers connected with a main feeder of 33 KV that comes from the IEC & then they step down the voltage to 0.4 kV directly.

1.3. Methodology.

1) Obtaining data from SELCO companies about annual loads, existing substations and transformers ratings.
2) Using DigiSilent simulation program to draw the network and determine fault currents.

1.4. Objectives.

1 Designing comprehensive electrical plans for the entire city of Yatta with an 11 kV system on the digsilent program.
2 Clarify the differences between the 11 kV system and the 33 kV system,
3 Explanation of the economic benefits resulting from the 11 kV system.
4 Clarify the equipment needed by the system when converting from a 33 kV system to an 11 kV system.
5 Putting the results of an end to the electrical network in the city of Yatta after the conversion.

1.5. Background.

In this project, a transformer station will be designed from 33 kV to 11 kV with a capacity of 30 MVA, given that the project will take 5 years from the beginning of implementation to its end, knowing that the highest load of Yatta city is now 22 MVA.

1.6 Challenges and Obstacles.

1) One of the most important difficulties is the lack of good financial support for the implementation of the project.
2) The need to build a new electrical network with a length of 8 km.
3) Difficulty in digging streets to build the new electrical network due to the large population congestion in Yatta.
4) There is insufficient information about the electrical network in Yatta.

Table 1Time schedule

Week / Task	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Task 1																																
Task 2																																
Task 3																																
Task 4																																
Task 5																																
Task 6																																
Task 7																																
Task 8																																
Task 9																																
Task 10																																
Task 11																																

1.7. Time schedule.

Tasks

Task 1: select the project

Task 2: Data collection about the recently loads

Task 3: Study the load forecasting

Task 4: Decide substation capacity

Task 5: locate the station

Task 6: Design substation Busbars

Task 7: power transformers selection and installation plan

Task 8: substation auxiliary system

Task 9: Design fedders system

Task 10: Substation cables selection

Task 11: Safety and security of the substation

1.8 Project flow chart

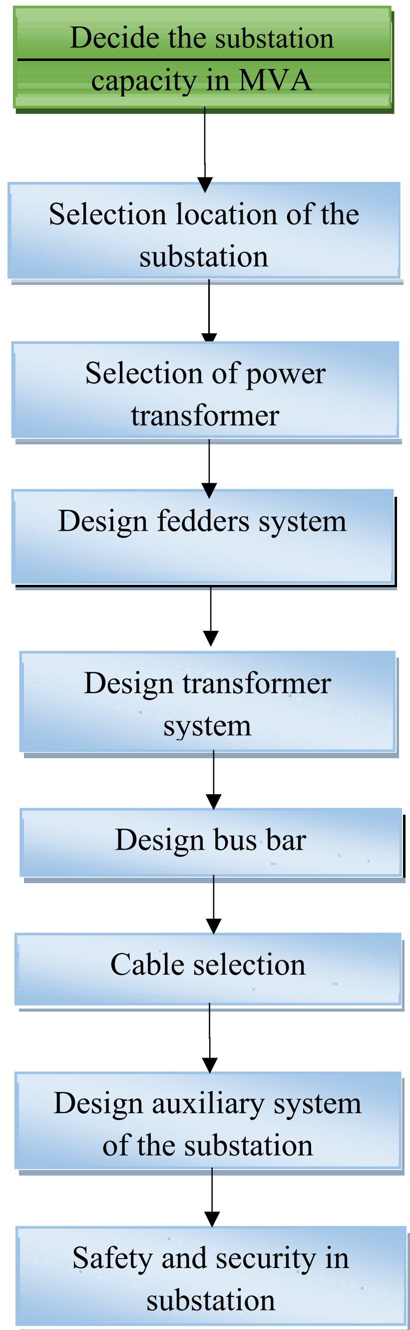

Diagram 1flow chart

CH.2. Electrical Substation

2.1 What is Substation?

2.2 Types of Substation

2.3 Functions of a Substation

2.4 Substation Equipment / Components

2.1 What is Substation?

A substation is an installation that interconnects elements of an electric utility's system. These elements can include generators, transmission lines, distribution lines, and even neighboring utility systems.

It is common to refer to the transmission and distribution elements as networks or again, as systems.

Depending on the size and complexity of a particular utility system, the transmission and/or distribution networks may include more than one voltage level.

For instance, a utility's transmission network may include 115 kV and 230 kV transmission lines, while another utility's distribution network may include both 13.8 kV and 34.5 kV distribution lines.

The substation provides the interconnection of transmission circuits and the transformation between the network of different voltages.

The substation is connected to the network through overhead lines. In some cases, it may not be possible to make a connection to the substation directly by the overhead line and underground cable entry must be considered.

Electrical Substations have the following mission to accomplish:

- Step-up and step-down voltage transformation
- Connection of separate transmission and distribution lines into a system to increase efficiency and reliability of power supply.
- Sectionalizing of the power system to increase its reliability and operational flexibility – substation called "switching substation"

The different substation configurations are characterized by their busbar arrangements and generally, any number of circuits may be provided by repeating the pattern.

2.2.Types of Substation.

There are many kinds of ac substations. They are classified into different types based on various criteria. Some of them are discussed below.

Based on the construction and installation of switchgear, electric substations are of two types.

1. Air Insulated Switchgear Substation (Open Terminal Substation)
2. Gas Insulated Switchgear Substation (Metal Clad Substation)

Based on transmission voltage and function, the electric substation is classified into three types.

1. Transmission Substation
2. Subtransmission Substation
3. Distribution Substation

In addition to this, based on the installation premises there are four major types of substations.

1. Generating Substation
2. Customer Substation
3. System Station
4. Distribution Station
5. Switching Substation

Diagram 2Type of substaiton

2.3.Functions of a Substation.

A substation performs a major role in our power system. The functions of a substation may include one or more of the following:

- To isolate a faulted element from the rest of the utility system.
- To allow an element to be disconnected from the rest of the utility system for maintenance or repair.
- To change or transform voltage levels from one part of the utility system to another.
- To control power flow in the utility system by switching elements into or out of the utility system.
- To provide sources of reactive power for power factor correction or voltage control.
- To provide data concerning system parameters (voltage, current flow, power flow) for use in operating the utility system.

2.4.Substation Equipment / Components.

An electrical substation contains many types of equipment. Substation generally comprises the following equipment:

1. Power Transformers
2. Tap Changing Equipment
3. Circuit Breakers
4. BusBar, Bays and Steel Structures
5. Lightning Arrester
6. Circuit Switchers
7. Disconnect Switch / Isolator
8. Earth Switches
9. Current Transformer
10. Potential Transformer
11. High-Voltage Fuses
12. Metal-Clad Switchgear
13. Shunt Reactors
14. Coupling Capacitor Voltage Transformer
15. Control House
16. Control Panel
17. Substation Protective Relays
18. Supervisory Control
19. Remote Terminal Unit
20. Digital Fault Recorder
21. Capacitor Bank
22. Voltage Regulator
23. Power-Line Carrier Equipment
24. Microwave Equipment
25. Batteries

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CH.3. Power Transformers

3.1 Substation location

3.2 Substation power transformers installation plan

3.3 Back up transformers

3.4 Substation auxiliary system

3.5 Tap changer

➢ Power Transformers.

Power transformers is a one kind of transformers that is used to transfer electrical energy between the generation and distribution primary circuits. In this substation two medium step down power transformers will be installed with total capacity of 30 MVA. These transformers stepping down the voltage that comes from the generating unit with a value of 33 kV to 11 kV.

Power transformers can be classified into three types based on their capacity. Small power transformers, medium power transformers and large power transformers.

1) The range of small power transformers can be from 500-7500kVA.
2) The range of medium power transformers can be from -100MVA.
3) The range of large power transformers can be from 100MVA & beyond.

For Yatta substation we select 33/11 KV step down Minera MP Schneider power transformers in order to be installed there as shown in figure 2.1, the substation needs five transformers of 15 MVA capacity, so the total capacity of the substation will reach 30 MVA by the year 2027.

Figure 2Minera MP Schneider power transformer

3.1.Substation Location.

Selection the location of the substation is very important and must include the following considerations, the current location of yatta substation achieves most of the following considerations.

Considerations of selection the location of the Substation [4]:

1. Locate the substation as much as feasible close to the load center of its service area, so that the addition of load time's distance from the substation is a minimum.
2. Locate the substation such that proper voltage regulation can be obtained without taking extensive measures.
3. Select the substation location such that it provides proper access for incoming sub-transmission lines and outgoing primary feeders.
4. The selected substation location should provide enough space for the future substation expansion.
5. The selected substation location should not be opposed by land use regulations, local ordinances, and neighbors.
6. The selected substation location should help minimize the number of customers affected by any service discontinuity.

Any distribution system is typically started with a distribution substation that is fed by one or more sub-transmission lines [5], in our case the distribution substation is fed directly from a high-voltage transmission line 33 kV. Each distribution substation will serve one or more primary feeders.

3.2. Transformers used in the station.

Figure 3Transformers used in the station.

In this station will be used transformer number two of the (best) company, the capacity of each adapter 15 MVA, a transformer from 33 kV to 11 kV.

The best company of the best Turkish companies in the transformer industry is characterized by low price.

3.3. Back up transformers.

We recommend the presence of an electrical transformer reserve capacity of 10 mega volt ampere even if any malfunction occurred in one electrical transformer is used for this electrical transformer instead.

3.4. Substation auxiliary system.

Usually the substation auxiliary system consists of two systems, Ac auxiliary system and DC auxiliary system. AC power is required for substation building small power, lighting, heating and ventilation, some communications equipment, switchgear operating mechanisms, ant condensation heaters and motors. DC power is used to feed essential services such as circuit breaker trip coils and associated relays, supervisory control and data acquisition (SCADA) and communications equipment [6].

3.4.1. Ac auxiliary system.

In general, the design criteria of the substation ac auxiliary system is determined by the existing and the future loads inside the substation, these loads are typically measured in kVA. Depending on the substation size, reliability and load requirements the substation should contain multiple sources. One ac source as normal or preferred source and another sources as backup sources.

System stability.

System stability considerations are important for the reliability requirements of the substation. If the loss of a substation results in a system disturbance to the electrical grid that could create a blackout condition in the area, the station service system should have an independent power source. The auxiliary power system requirements for redundant supply may also need to include the ability for the station to complete black start operations that’s mean that a local generation source is required to supply the station power system and battery chargers for the protection circuits in the event of a system collapse and subsequent repowering .

3.4.2. Substation DC Auxiliary System.

Typically the main purpose of the dc auxiliary system on the substation is to provide a reliable power source for power system protection. DC systems provide power to operate protective relays, monitoring equipment, and control circuits that operate power circuit breakers or other fault-isolating equipment. The dc systems are designed to provide power for these protection systems during outages and when the power systems are intact. The following figure is a simplified dc system block diagram.

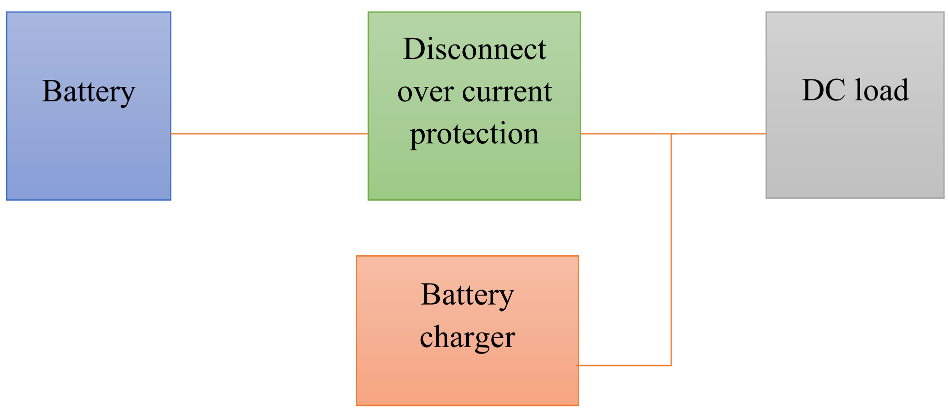

Diagram 3The DC system block diagram

Typical equipment served by the dc system

The dc system in a substation serves many critical and non-critical functions and equipment. Some typical equipment served may include:

1. Circuit breakers
2. Circuit switchers
3. Motor operators
4. Protective relay systems
5. SCADA

6. Fire protection/detection
7. Emergency lighting
8. Security systems

As we notice a various types of devices work with a DC voltage, as a result of this many DC to DC converters must be used in order to offer all the ranges of operating DC voltages .

Many backup batteries must be installed on the substation in order to provide a backup power source to operate those devices that should not be turned off in case of power outages.

3.5. Tap changer.

A tap changer is a mechanism in transformers which allows for variable turn ratios to be selected in distinct steps. This is done by connecting to a number of access points known as taps along either the primary or secondary winding.

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Figure 4Tap changer

CH.4. Distribution transformer in yatta

4.1 What is a Distribution Transformer?

4.2 Distribution Transformer Construction

4.3 Types of Distribution Transformer

4.4 Difference Between Power Transformer and Distribution Transformer

4.5 information about Distribution transformer in yatta

4.1. What is a Distribution Transformer?

Definition.

A distribution transformer is also introduced as a typical form of an isolation transformer. The basic function of this transformer is to modify the high voltage to the standard output like 240/120 V to apply in electric energy distribution. There are various forms of transformers available in the distribution system, such as single-phase, three-phase, pad-mounted, underground, and pole-mounted distribution transformers.

A distribution device has another term that is a service transformer. It is an instrument that supplies the final voltage transformation in the power network, stepping down the output employed in the distribution lines to the users' rating.

Normally, a distribution transformer level is less than 200MVA, while some national norms can allow for ratings up to 5000 MVA to be known as distribution transformers. If the level is more than 200MVA (or 5000MVA in some regions), it's introduced as a power transformer.

Since distribution transformers are powered for 24 hours a day (even when they don't use to carry any load), dropping the iron wastes has an initial role in the transformer's modeling. Commonly, they don't perform at full capacity. At lower potentials, they are constructed to have optimum efficiency. The voltage adjustment in these devices should be kept to a minimum in other to have higher efficiency. So, they are constructed to include the small leakage reactance.

Figure 5Distribution Transformer

4.2.Distribution Transformer Construction.

The modeling of a distribution transformer can be performed similarly to the small size types. The main components of this transformer mainly include conservator, oil tank, breather unit, buchholz relay, oil indicator, pressure relief device, temperature detector, radiator, thermal relay, and bushing.

- The oil tank is employed to soak the windings by placing them in.
- A conservator is installed above the oil tank at the outside of the transformer unit. It is attached to the basic tank by using a metallic tube. The oil through the tank can be simply contacted and enlarge all overloading so that the temperature of the oil can be decreased or increased.
- Buchholz relay is applied when a conservator tank is performed since it monitors errors like a waste of oil when it goes low, improper moving of oil between the transformer and tank.
- A Breather set consists of silica gel that absorbs the humidity of the oil. It modifies its color from blue to pink.
- The oil indicator determines the rate of the oil through the conservatory unit.
- The temperature detector identifies the oil temperature. If the oil temperature increases to a particular level, then the device will be disconnected from the system.
- The pressure relief part reduces the pressure through the transformer to prevent an explosion of the device.
- A thermal relay is employed as an indicator for the winding temperature.
- The radiator is applied to improve the transformer's cooling efficiency.
- The bushing is utilized to connect the internal sections of the transformer using an exterior electrical network.

4.3.Types of Distribution Transformer.

Distribution transformers are classified into various types like single phase, three phases, pad-mounted, pole-mounted, and underground transformers according to the application or requirement.

1 Single Phase

These transformers are particularly employed for applications wherever a three-phase source is not needed. Typically, these are utilized for repairing overhead distribution powers in residential cases. These are also applicable in light commercial loads, industrial lighting, and power applications.

Figure 6Single Phase Distribution Transformer

2 Three Phase

This type of distribution transformer is used to keep electrical energy from the basic distribution network to a minor distribution user. This form of transformer sends the current to a secondary distribution case and also decreases the voltage of the primary component. These types decrease the voltage source for the primary network according to the user requirement.

Figure 7Three Phase Distribution Transformer

This voltage often modifies and can be dissimilar for the consumers of residential, commercial, and light industries. These devices operate based on the different ratings of frequency and voltage according to the standards defined in various countries. While a single-phase type is employed in residential applications, a three-phase form with a pad is used in primary underground networks.

4.4.Difference Between Power Transformer and Distribution Transformer.

The main differences between a power transformer and a distribution transformer are summarized below:

- Power transformers are employed in the transmission line of greater voltages for step down and step up cases (400 kV, 200 kV, 110 kV, 66 kV, 33kV) and are typically rated above 200MVA.
- On the other hand, a distribution transformer is used for lower voltage applications as a means to end consumer connectivity (11kV, 6.6 kV, 3.3 kV, 440V, 230V) and is normally rated less than 200 MVA.

Transformer Size / Insulation Level:

The power transformer is used for the transmission application at great load, high voltage larger than 33 kV, and 100% efficiency. It also includes a big in size in comparison with a distribution transformer and is employed in producing station and transmission station high insulation rating.

The distribution transformer is applied for the distribution of energy at a low voltage less than 440v-220v in domestic cases and 33KV in industrial applications. It can operate at low efficiency at 50-70%, easy in installation, small size, having low magnetic wastes, and is not often fully loaded.

Iron Losses and Copper Losses:

As discussed before, power transformers are utilized in transmission circuits, so they do not directly receive to the users; thus, load variations are very less. These are loaded completely 24 hours a day, so Copper and Iron wastes take place all over the day.

The average powers are nearer to full load, and these are constructed in such a method that maximum efficiency at complete load state. These are independent of time so, in evaluating the efficiency, just the power basis is adequate.

Maximum Efficiency:

The basic difference between power and distribution transformer is that a distribution transformer is constructed for maximum efficiency at 60% to 70% power as it generally doesn't perform at full load all the time. Its load is based on the distribution demand. While a power transformer is created for maximum efficiency at 100% load as it often operates at 100% load is close to producing station.

A distribution transformer is employed at the distribution rating where the voltages should be lower. The secondary output is almost often the voltage delivered to the end-user. Due to the voltage drop limitations, it is commonly not feasible to deliver that secondary output over great distances.

Uses/Applications of Distribution Transformer:

Some applications of the distribution transformer are as the following:

- This transformer varies from high voltage input to low voltage output, employed in businesses and homes.
- The basic operation of this is to step down the input to supply isolation between two windings, including primary and secondary.
- This transformer distributes the energy to remote regions which are created from the power plants.
- Typically, a distribution transformer distributes the electrical power to industries with less usage under 33KV and also for domestic applications less than 440volts to 220volts.

4.5. information about Distribution transformer in yatta .

The Yatta network contains 135 electrical transformers for distribution without the Al-Haddad factory transformer.

القدرة	قدرة الحمل	مكان المحول	نوع المحول	اسم المحول
160KVA 1	0.05kva	خارجي "على البرج"	ELCO	واد الرخيم 2
160KVA 2	0.05kva	خارجي "على البرج"	ELCO	مشروع الجوايا
160KVA 3	0.05kva	خارجي "على البرج"	ABB	واد الرخيم 1
160KVA 4	0.05kva	خارجي "على البرج"		محطة البئر
160KVA 5	0.05kva	خارجي "على البرج"	ARDAN	الدير (عقبة ابراهيم)
160KVA 6	0.05kva	خارجي "على البرج"	ARDAN	تيسير عريد
160KVA 7	0.05kva	خارجي "على البرج"	ELCO	محمد موسى عريد
160KVA 8	0.05kva	خارجي "على البرج"	TRAFO	واد ابو الفول
160KVA 9	0.05kva	خارجي "على البرج"	ABB	المطينة
160KVA 10	0.05kva	خارجي "على البرج"		سالم الشواهين
160KVA 11	0.05kva	خارجي "على البرج"		ربحي الشواهين
160KVA 12	0.05kva	خارجي "على البرج"		الغويطة
160KVA 13	0.05kva	خارجي "على البرج"		هارون الرشيد
160KVA 14	0.05kva	خارجي "على البرج"	ABB	مجد الباع
160KVA 15	0.05kva	خارجي "على البرج"	ABB	المنطار
160KVA 16	0.05kva	خارجي "على البرج"	ABB	مراح جبر
160KVA 17	0.05kva	خارجي "على البرج"		علي رشيد
160KVA 18	0.05kva	خارجي "على البرج"	ABB	محمود رشيد
160KVA 19	0.05kva	خارجي "على البرج"		احمد رشيد (شركة الميزان)
160KVA 20	0.05kva	خارجي "على البرج"	MACE	عدي الشواهين
160KVA 21	0.05kva	خارجي "على البرج"	ELCO	موسى عريد (شركة التطور
160KVA 22	0.05kva	خارجي "على البرج"	ELCO	موسى نصار
160KVA 23	0.05kva	خارجي "على البرج"	MACE	خالد موسى نصار
160KVA 24	0.05kva	خارجي "على البرج"	ARDAN	نافز نصار (التعاون)
160KVA 25	0.05kva	خارجي "على البرج"	ELCO	نافز نصار
160KVA 26	0.05kva	خارجي "على البرج"	ARDAN	رسمي ابو قبيطة
160KVA 27	0.05kva	خارجي "على البرج"	ARDAN	معصرة احمد حسن نصار
160KVA 28	0.05kva	خارجي "على البرج"	ARDAN	نصار ستون
160KVA 29	0.05kva	خارجي "على البرج"	ARDAN	موسى رشيد (الكسارة)
160KVA 30	0.05kva	خارجي "على البرج"	ARDAN	ام العمد الغربية
160KVA 31	0.05kva	خارجي "على البرج"	MACE	بيت عمرة 1
160KVA 32	0.05kva	خارجي "على البرج"	ARDAN	بيت عمرة 2
160KVA 33	0.05kva	خارجي "على البرج"	ELCO	بيت عمرة 3
160KVA 34	0.05kva	خارجي "على البرج"	ELCO	خلة عربي
160KVA 35	0.05kva	خارجي "على البرج"	MACE	النخيلة (الشواهين)
160KVA 36	0.05kva	خارجي "على البرج"	MACE	الحدب 1

اسم المحول	نوع المحول	مكان المحول	قدرة الحمل	القدرة
السواكنة	ABB	خارجي "على البرج"	0.1kva	250KVA 1
معصرة رشيد	MACE	خارجي "على البرج"	0.1kva	250KVA 2
كازية ابو علي (الكاظم)	ELCO	خارجي "على البرج"	0.1kva	250KVA 3
دائرة السير	MACE	خارجي "على البرج"	0.1kva	250KVA 4
اعزيز الشرقي (البئر)	MACE	خارجي "على البرج"	0.1kva	250KVA 5
محطة مستشفى ابو الحسن القاسم	ELCO	خارجي "على البرج"	0.1kva	250KVA 6
خلة خضر	MACE	خارجي "على البرج"	0.1kva	250KVA 7
حجر السخاينة	MACE	خارجي "على البرج"	0.1kva	250KVA 8
واد البقيع	ARDAN	خارجي "على البرج"	0.1kva	250KVA 9
المصلى الغربي	MACE	خارجي "على البرج"	0.1kva	250KVA 10
ام السطر 1	MACE	خارجي "على البرج"	0.1kva	250KVA 11
محطة ام السطر 2 د.عثمان ابو صبحة	ELCO	خارجي "على البرج"	0.1kva	250KVA 12
تلة الصمود 1	ABB	خارجي "على البرج"	0.1kva	250KVA 13
الرهنية	ELCO	خارجي "على البرج"	0.1kva	250KVA 14
تلة الصمود (2)	ELCO	خارجي "على البرج"	0.1kva	250KVA 15
الحنو	MACE	خارجي "على البرج"	0.1kva	250KVA 16
خلة صالح 1	ARDAN	خارجي "على البرج"	0.1kva	250KVA 17
خلة صالح 2	MACE	خارجي "على البرج"	0.1kva	250KVA 18
ابو سمرة		خارجي "على البرج"	0.1kva	250KVA 19
ابو عزيزة (ابو اصبع)	ELCO	خارجي "على البرج"	0.1kva	250KVA 20
مثلث يوسف احمد (البوت)	MACE	خارجي "على البرج"	0.1kva	250KVA 21
محطة الشركة	ARDAN	خارجي "على البرج"	0.1kva	250KVA 22
محطة العمرية	ARDAN	خارجي "على البرج"	0.1kva	250KVA 23
السويدان	ABB	خارجي "على البرج"	0.1kva	250KVA 24
العرقوب (1) العدرة	ABB	خارجي "على البرج"	0.1kva	250KVA 25
العرقوب (2) خلة حيان	ABB	خارجي "على البرج"	0.1kva	250KVA 26
الكرمل (خلوي)	MACE	خارجي "على البرج"	0.1kva	250KVA 27
الكرمل (خلة رحيلة)	MACE	خارجي "على البرج"	0.1kva	250KVA 28
الكرمل (ماعين - النعامين)	ARDAN	خارجي "على البرج"	0.1kva	250KVA 29
الكرمل (المنتزة)	TRAFO	خارجي "على البرج"	0.1kva	250KVA 30
محطة التوانة	ARDAN	خارجي "على البرج"	0.1kva	250KVA 31
البلدية	ELCO	خارجي "على البرج"	0.1kva	250KVA 32
بصل وسط البلد	MACE	خارجي "على البرج"	0.1kva	250KVA 33
الكراج	MACE	خارجي "على البرج"	0.1kva	250KVA 34
دير الهوى	ARDAN	خارجي "على البرج"	0.1kva	250KVA 35

اسم المحول	نوع المحول	مكان المحول	قدرة الحمل	القدرة
القفير 1	TRAFO	خارجي "على البرج"	0.2kva	400KVA 1
القفير 2 - الفرحانية - صايل الجندي	MACE	خارجي "على البرج"	0.2kva	400KVA 2
ابو حميد القفير 3	TRAFO	خارجي "على البرج"	0.2kva	400KVA 3
المزرعة	MACE	خارجي "على البرج"	0.2kva	400KVA 4
الوقائي	MACE	خارجي "على البرج"	0.2kva	400KVA 5
المحكمة	ABB	خارجي "على البرج"	0.2kva	400KVA 6
سهل ابو هرش (1) الواحة	MACE	خارجي "على البرج"	0.2kva	400KVA 7
سهل ابو هرش 2	MACE	خارجي "على البرج"	0.2kva	400KVA 8
الحديدية	MACE	خارجي "على البرج"	0.2kva	400KVA 9
موسى الخطيب	ARDAN	خارجي "على البرج"	0.2kva	400KVA 10
خلة العدرة	ABB	خارجي "على البرج"	0.2kva	400KVA 11
بنك الاسكان	MACE	خارجي "على البرج"	0.2kva	400KVA 12
محمد موسى نصار	ARDAN	خارجي "على البرج"	0.2kva	400KVA 13
مركز الدعوة	ARDAN	خارجي "على البرج"	0.2kva	400KVA 14
المرملة	ARDAN	خارجي "على البرج"	0.2kva	400KVA 15
كازية بصل (رقعة)	ABB	خارجي "على البرج"	0.2kva	400KVA 16
رقعة المدارس	MACE	خارجي "على البرج"	0.2kva	400KVA 17
الصادق الامين	ARDAN	خارجي "على البرج"	0.2kva	400KVA 18
العرق الابيض	ABB	خارجي "على البرج"	0.2kva	400KVA 19
خريسة الشواهين	ELCO	خارجي "على البرج"	0.2kva	400KVA 20
نادر رشيد	BEST-EBG	خارجي "على البرج"	0.2kva	400KVA 21
واد الماء	MACE	خارجي "على البرج"	0.2kva	400KVA 22
بلل	ARDAN	خارجي "على البرج"	0.2kva	400KVA 23
الجنيدي	IMEFY	خارجي "على البرج"	0.2kva	400KVA 24
الدوير	ARDAN	خارجي "على البرج"	0.2kva	400KVA 25
البويب	TRAFO	خارجي "على البرج"	0.2kva	400KVA 26
الديار المقدسة	ARDAN	خارجي "على البرج"	0.2kva	400KVA 27
العروس 1	MACE	خارجي "على البرج"	0.2kva	400KVA 28
محول العروس 2	ABB	خارجي "على البرج"	0.2kva	400KVA 29
مزارع البقر / شعب العروس	ABB	خارجي "على البرج"	0.2kva	400KVA 30
مرج الدودة	ELCO	خارجي "على البرج"	0.2kva	400KVA 31
زيف	MACE	خارجي "على البرج"	0.2kva	400KVA 32

القدرة	قدرة الحمل	مكان المحول	نوع المحول	اسم المحول
630KVA 1	0.25kva	خارجي "على البرج"	MACE	الحيلة الشرقية
630KVA 2	0.25kva	خارجي "على البرج"	MACE	الحيلة الغربية
630KVA 3	0.25kva	خارجي "على البرج"	MACE	الوسيم
630KVA 4	0.25kva	خارجي "على البرج"	ABB	الشلودي
630KVA 5	0.25kva	خارجي "على البرج"	ARDAN	رشيد - قلقس
630KVA 6	0.25kva	خارجي "على البرج"	MACE	عبد الحليم غيث
630KVA 7	0.25kva	خارجي "على البرج"	MACE	النماء
630KVA 8	0.25kva	خارجي "على البرج"	MACE	مصطفى رجب
630KVA 9	0.25kva	خارجي "على البرج"	TRAFO	ابو سنينة
630KVA 10	0.25kva	خارجي "على البرج"	ELCO	شركة مصنع الباطون الجاهز / الخالدية
630KVA 11	0.25kva	خارجي "على البرج"		محطة السلام
630KVA 12	0.25kva	خارجي "على البرج"	ELCO	واد علي (وائل بدوي)
630KVA 13	0.25kva	خارجي "على البرج"	MACE	جب هوبر
630KVA 14	0.25kva	خارجي "على البرج"	ELCO	محطة اليتيم
630KVA 15	0.25kva	خارجي "على البرج"	ARDAN	محطة الحمامدة
630KVA 16	0.25kva	خارجي "على البرج"	MACE	شركة النخبة للحجارة والرخام
630KVA 17	0.25kva	خارجي "على البرج"	ARDAN	خلال الشنار
630KVA 18	0.25kva	خارجي "على البرج"	ARDAN	موسى محمد سليمان حريزات
630KVA 19	0.25kva	خارجي "على البرج"	ARDAN	ام مليس
630KVA 20	0.25kva	خارجي "على البرج"	ARDAN	منيزل
630KVA 21	0.25kva	خارجي "على البرج"	MACE	شارع الحديدية الكرمل
630KVA 22	0.25kva	خارجي "على البرج"		حسن علي نصار - رقعة
630KVA 23	0.25kva	خارجي "على البرج"		استاد يطا الدولي
630KVA 24	0.25kva	خارجي "على البرج"		خلال الشنار
630KVA 25	0.25kva	خارجي "على البرج"	Lankmited	محطة التنقية
630KVA 26	0.25kva	خارجي "على البرج"		الرمح الذهبي
630KVA 27	0.25kva	خارجي "على البرج"	MACE	سامي نصار الجندي
630KVA 28	0.25kva	خارجي "على البرج"	MACE	واد السادة
630KVA 29	0.25kva	خارجي "على البرج"	MACE	الدب للحجارة والرخام

Table 2information about Distribution transformer in yatta

The entire electrical transformers in the city of Yatta, it is possible to operate on a 11 kilo volt system without replacing, through an arm that is on the surface of the electrical transformer be moved by the electric map for the adapter.

As for the Al-Haddad factory, its load capacity is about 8 MVA.

CH.5. Switchgear

5.1 Introduction

5.2 Function of switchgear

5.3 Switchgear control panel

5.4 Components of Switchgear

5.5 33 KV Switchgear

5.6 11 KV Switchgear

5.7 Ring Main Unit

- **Switchgear**

5.1. Introduction

The apparatus used for switching, controlling and protecting the electrical circuits and equipment is known as switchgear. The term ‘switchgear’ is a generic term that includes a wide range of switching devices like circuit breakers, switches, switch fuse units, off-load isolators, High Rupturing Capacity fuses (HRC fuses), contactors, miniature circuit breakers, etc [13].

It also includes the combination of these switching devices with associated control, measuring, protecting and regulating equipment. The switchgear devices and their assemblies are used in connection with the generation, transmission, distribution, and conversion of electrical energy.

We all are familiar with low voltage switches and re-wirable fuses in our life. Switches are used for opening and closing an electric circuit while fuses are used for over-current and short-circuit protection. In such a way, every electrical device wants a switching and a protecting device.

Various forms of switching and protective devices have been developed. Thus switchgear can be taken as a general term covering a wide range of equipment concerned with the switching, protection, and control of various electrical equipment [13].

5.2. Function of switchgear

A switchgear has to perform the functions of carrying, making and breaking the normal load current like a switch. In addition, it has to perform the function of clearing the fault current for which sensing devices like current transformers, potential transformers and various types of relays, depending on the application, are employed [14]. There also has to be provision for metering, controlling and data, wherein innumerable devices are used for achieving the switchgear function.

5.3. Switchgear control panel.

Some types of equipment are designed to operate under both normal and abnormal conditions. Some equipment is meant for switching and not sensing the fault.

During normal operation, switchgear permits to switch on or off generators, transmission lines, distributors and other electrical equipment. On the other hand, when a failure (e.g. short circuit) occurs on any part of the power system, a heavy current flows through the equipment, threatening damage to the equipment and interruption of service to the customers. However, the switchgear detects the fault and disconnects the unhealthy section from the system .

Similarly, switching and current interrupting devices play a significant role in the modern electrical network, right from generating stations, transmission sub-stations at different voltages, distribution substations, and load centers. The switching device here is called a circuit breaker. The circuit breaker, along with associated devices for protection, metering and control regulation, is called a switchgear.

5.4. Components of Switchgear.

Switchgear essentially consists of switching and protecting devices such as switches, fuses, isolators, circuit breakers, protective relays, control panels, lightning arrestors, current transformers, potential transformers, auto re-closures, and various associated equipment [14].

5.4.1. Switches

A switch is a device which is used to open or close an electrical circuit in a convenient way. It can be used under full-load or no-load conditions but it cannot interrupt the fault currents.

5.4.2. Fuses

A fuse is a short piece of wire or thin strip which melts when excessive current flows through it for sufficient time. It is inserted in series with the circuit to be protected.

When a short circuit or overload occurs, the current through the fuse element increases beyond its rated capacity. This raises the temperature and the fuse element melts (or blows out), disconnecting the circuit protected by it.

5.4.3. Circuit breaker

A circuit breaker is an equipment which can open or close a circuit under all conditions: no load, full load and fault conditions. It is so designed that it can be operated manually (or by remote control) under normal conditions and automatically under fault conditions. For the latter operation, a relay circuit is used with a circuit breaker.

Circuit breakers are classified into different types based on the following criteria.

1. Based on the voltage level

    a. Low voltage circuit breaker
    b. Medium voltage circuit breaker
    c. High voltage circuit breaker

2. Based on where is installed

    a. Outdoor circuit breaker
    b. Indoor circuit breaker

3. Based on the actuating mechanism

    a. Spring Operated Circuit breaker
    b. Pneumatic circuit breaker
    c. Hydraulic circuit breaker

4. Based on the arc interrupting medium

    a. Vacuum circuit breaker
    b. SF6 circuit breaker
    c. Oil circuit breaker
    d. Air blast circuit breaker

5. Based on External characteristic design

    a. Live tank circuit breaker
    b. Dead tank circuit breaker.

5.5. 33 KV Switchgear.

Figure 833 KV Switchgear

In this project we will use four switches of 33 kV class F400:

Features:

- The F400 range offers a full choice of perfectly adaptable, pre-designed functional units
- The F400 offer is composed of:

- F400 Vacuum which covers all performances up to 36kV - 2500A - 31.5 kA/3s
- F400 SF6 which covers all performances up to 36/40.5 kV - 2500/1250A - 40 kA/3s // 31.5 kA/3s

- The F400 range, in association with Sepam digital control units, is designed to interface with new or existing supervision systems

Performances:

- Technology: Vacuum and SF6
- Standard: IEC
- Rated voltage: 36 kV (Vacuum) / up to 40.5kV (SF6)
- Busbar system: Single
- Rated current busbar: Up to 2500A
- Rated operational current: Up to 2500A
- Rated peak withstand current: 31.5kA (Vacuum) / 40kA (SF6)
- Loss of service continuity: LSC 2B
- Partition class: PM

4.6. 11 KV Switchgear.

Figure 911 KV Switchgear

In this project we will use SEVEN switches of 11 kV class NEX 17:

Features:

- NEX17 is a modular type tested cubicle, designed to meet local requirements and local standards, equipped with the EVOLIS vacuum circuit-breaker.
- NEX17 is manufactured, with Schneider Electric's support, by franchised panel builders.

Performances:

1) Technology: Vacuum
2) Standard: IEC
3) Rated voltage: 17.5kV
4) Busbar system: Single
5) Rated current busbar: 2500A
6) Rated operational current: 2500A
7) Rated peak withstand current: 31.5kA
8) Internal Arc Classification: AFLR 25kA/0.5s
9) Loss of service continuity: LSC 2B
10) Partition class: PM

4.7. Ring Main Unit.

Figure 10Ring Main Unit

In this project we will use EIGHT switches of Ring Main Unit class Ringmaster:

Features:

Extensible RMU combining all MV functional units: circuit breaker, switch, feeder metering units

1) Rated current up to 630 A
2) Short circuit current up to 21 kA
3) Indoor outdoor IP54 design
4) Internal arc proof
5) Gas pressure indicator
6) Self powered protection and monitoring control devices guaranteeing the security of your installation
7) Time Limit Fuses (TLF)
8) VIP protection relays
9) Easergy T300

Benefits:

Ensuring hi-reliability in the toughest conditions.
Modularity, simplicity, insensitivity to the environment, Ringmaster is the compact highly reliable solution for both your indoor and outdoor MV distribution network applications up to 12 Kv.

Applications.

- Offers multiple configurations and meets all the MV application requirements from simple transformer protection to sectionalising with remote control.
- Outdoor and indoor applications.

CH.6. Substation Cables and insulators and fuses

➢ Substation Cables.

6.1. Introduction

Electrical power can be transmitted and distributed either by overhead system or byunderground cables. The ground cables have several advantages such as ruggedconstruction, greater service reliability, increased safety, lesser chances of faults, low maintenance cost, better appearance and lesser interference from external disturbance like storms, lightening ice, trees, etc.,. As compared to overhead system.

However their major drawback is that they have greater installation cost end insulation problems at high voltages compared with the equivalent overhead systems. Hence, cables are mainly employed where it is impracticable to use overhead lines. Earlier day's underground cables were mainly uses in thickly populated areas and thatto these are limited for low and medium voltages only, but now a days due to requirement even extra high voltages for longer distances. The possibility of supply interruption due to lightning in cables is lesser but if a fault occurs due to any reason it is not easily located. Or long distance power transmission, cables can't be used to their large charging currents.

In this part we describe the cables which considered to be used at Tarqumia substation. These cables divided into two types:

1- Power cables.

2- Control cables.

6.2. Power Cable Selection conditions .

Select any cable to observe the following.

1 - International or Special Standard. (Alternatively, the precise usage of the cable).

2 - Rated voltage.

3 - Copper or Aluminum conductors.

4 - Size of each conductor.

5 - Insulation material: XLPE or others.

6 - Number and identification of conductors.

7- Other requirements.

6.3. Choice of voltage .

The rated voltage is specified as Vo / V; where: Vo is the rated voltage between conductor and screen or outer metallic protection. V the rated voltage between any two conductors.

In three phase systems Vo is V / 3 The voltage of the cable must be chosen according to the maximum voltage Um in normal working conditions, which must not exceed the rated voltage by more than 20%.

6.4. Determination of the cross sectional area.

The determination of the cross sectional area depends on the:

- Current carrying capacities in continuous loading,
- Permissible short-circuit current,
- Conditions of installation (temperature, spacing,...).

6.5. Current carrying capacities .

The heat produced by the cable under the set conditions must be able to dissipate to the ambient environment at any point of the cable installation; therefore the loading of the cable must be limited accordingly. The current carrying capacities shown in the electrical characteristics tables are calculated according to the internationally adopted method of the IEC publication 60287 for a maximum core temperature of 90˚C, at the following installation conditions.

6.6. cables in yatta network:

Most of Yatta's electric network is overhed by 97%.

There are in project 160 Cable clip was They were measured using Google Earth, to the lack of data in the South Electricity Company.

الكيبل	قطر الكيبل	طول الكيبل	نوع الكيبل	طبيعة الكيبل	الفولتية في المستقبل
LINE	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 2	150mm^2	0,35 KM	steel سلك + المنيوم	هوائي	11kv
LINE 3	150mm^2	037 KM	steel سلك + المنيوم	هوائي	11kv
LINE 4	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 5	150mm^2	0,7 KM	steel سلك + المنيوم	هوائي	11kv
LINE 6	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 7	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 8	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 9	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 10	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 11	150mm^2	0,4KM	steel سلك + المنيوم	هوائي	11kv
LINE 12	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 13	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 14	150mm^2	0,56 KM	steel سلك + المنيوم	هوائي	11kv
LINE 15	150mm^2	0,11 KM	steel سلك + المنيوم	هوائي	11kv
LINE 16	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 17	150mm^2	0,67 KM	steel سلك + المنيوم	هوائي	11kv
LINE 18	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 19	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 20	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 21	150mm^2	0,11 KM	steel سلك + المنيوم	هوائي	11kv
LINE 22	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 23	150mm^2	0,12 KM	steel سلك + المنيوم	هوائي	11kv
LINE 24	150mm^2	0,22 KM	steel سلك + المنيوم	هوائي	11kv
LINE 25	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 26	150mm^2	0,23 KM	steel سلك + المنيوم	هوائي	11kv
LINE 27	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 28	150mm^2	0,2 KM	steel سلك + المنيوم	هوائي	11kv
LINE 29	150mm^2	0,45 KM	steel سلك + المنيوم	هوائي	11kv
LINE 30	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 31	150mm^2	0,44 KM	steel سلك + المنيوم	هوائي	11kv
LINE 32	150mm^2	0,1 KM	steel سلك + المنيوم	هوائي	11kv
LINE 33	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 34	150mm^2	0,44 KM	steel سلك + المنيوم	هوائي	11kv
LINE 35	150mm^2	0,55 KM	steel سلك + المنيوم	هوائي	11kv

LINE 36	150mm^2	0,3 KM	steel سلك + المنيوم	هوائي	11kv
LINE 37	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 38	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 39	150mm^2	0,34 KM	steel سلك + المنيوم	هوائي	11kv
LINE 40	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 41	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 42	150mm^2	0,88 KM	steel سلك + المنيوم	هوائي	11kv
LINE 43	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 44	150mm^2	0,22 KM	steel سلك + المنيوم	هوائي	11kv
LINE 45	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 46	150mm^2	0,66 KM	steel سلك + المنيوم	هوائي	11kv
LINE 47	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 48	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 49	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 50	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 51	150mm^2	0,66 KM	steel سلك + المنيوم	هوائي	11kv
LINE 52	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 53	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 54	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 55	150mm^2	0,44 KM	steel سلك + المنيوم	هوائي	11kv
LINE 56	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 57	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 58	150mm^2	0,22 KM	steel سلك + المنيوم	هوائي	11kv
LINE 59	150mm^2	0,33 KM	steel سلك + المنيوم	هوائي	11kv
LINE 60	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 61	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 62	150mm^2	0,66 KM	steel سلك + المنيوم	هوائي	11kv
LINE 63	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 64	150mm^2	0,33 KM	steel سلك + المنيوم	هوائي	11kv
LINE 65	150mm^2	0,21 KM	steel سلك + المنيوم	هوائي	11kv
LINE 66	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 67	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 68	150mm^2	0,25 KM	steel سلك + المنيوم	هوائي	11kv
LINE 69	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 70	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 71	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 72	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 73	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 74	150mm^2	0,23 KM	steel سلك + المنيوم	هوائي	11kv
LINE 75	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 76	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 77	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 78	150mm^2	0,34 KM	steel سلك + المنيوم	هوائي	11kv

LINE 79	150mm^2	0,5 KM	المنيوم + سلك steel	هوائي	11kv
LINE 80	150mm^2	0,45 KM	المنيوم + سلك steel	هوائي	11kv
LINE 81	150mm^2	0,5 KM	المنيوم + سلك steel	هوائي	11kv
LINE 82	150mm^2	0,56 KM	المنيوم + سلك steel	هوائي	11kv
LINE 83	150mm^2	0,1 KM	المنيوم + سلك steel	هوائي	11kv
LINE 84	150mm^2	0,5 KM	المنيوم + سلك steel	هوائي	11kv
LINE 85	150mm^2	0,67 KM	المنيوم + سلك steel	هوائي	11kv
LINE 86	150mm^2	0,5 KM	المنيوم + سلك steel	هوائي	11kv
LINE 87	150mm^2	0,44 KM	المنيوم + سلك steel	هوائي	11kv
LINE 88	150mm^2	0,5 KM	المنيوم + سلك steel	هوائي	11kv
LINE 89	150mm^2	0,3 KM	المنيوم + سلك steel	هوائي	11kv
LINE 90	150mm^2	0,78 KM	المنيوم + سلك steel	هوائي	11kv
LINE 91	150mm^2	0,5 KM	المنيوم + سلك steel	هوائي	11kv
LINE 92	150mm^2	0,66 KM	المنيوم + سلك steel	هوائي	11kv
LINE 93	150mm^2	0,1 KM	المنيوم + سلك steel	هوائي	11kv
LINE 94	150mm^2	0,5 KM	المنيوم + سلك steel	هوائي	11kv
LINE 95	150mm^2	0,33 KM	المنيوم + سلك steel	هوائي	11kv
LINE 96	150mm^2	0,5 KM	المنيوم + سلك steel	هوائي	11kv
LINE 97	150mm^2	0,5 KM	المنيوم + سلك steel	هوائي	11kv
LINE 98	150mm^2	0,77 KM	المنيوم + سلك steel	هوائي	11kv
LINE 99	150mm^2	0,5 KM	المنيوم + سلك steel	هوائي	11kv
LINE 100	150mm^2	0,5 KM	المنيوم + سلك steel	هوائي	11kv
LINE 101	150mm^2	0,6KM	المنيوم + سلك steel	هوائي	11kv
LINE 102	150mm^2	0,5 KM	المنيوم + سلك steel	هوائي	11kv
LINE 103	150mm^2	0,5 KM	المنيوم + سلك steel	هوائي	11kv
LINE 104	150mm^2	0,5 KM	المنيوم + سلك steel	هوائي	11kv
LINE 105	150mm^2	0,5 KM	المنيوم + سلك steel	هوائي	11kv
LINE 106	150mm^2	0,44 KM	المنيوم + سلك steel	هوائي	11kv
LINE 107	150mm^2	0,5 KM	المنيوم + سلك steel	هوائي	11kv
LINE 108	150mm^2	0,5 KM	المنيوم + سلك steel	هوائي	11kv
LINE 109	150mm^2	0,5 KM	المنيوم + سلك steel	هوائي	11kv
LINE 110	150mm^2	0,5 KM	المنيوم + سلك steel	هوائي	11kv
LINE 111	150mm^2	0,33 KM	المنيوم + سلك steel	هوائي	11kv

LINE 112	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 113	150mm^2	0,2 KM	steel سلك + المنيوم	هوائي	11kv
LINE 114	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 115	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 116	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 117	150mm^2	0,22 KM	steel سلك + المنيوم	هوائي	11kv
LINE 118	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 119	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 120	150mm^2	0,11 KM	steel سلك + المنيوم	هوائي	11kv
LINE 121	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 122	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 123	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 124	150mm^2	0,11 KM	steel سلك + المنيوم	هوائي	11kv
LINE 125	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 126	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 127	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 128	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 129	150mm^2	0,11 KM	steel سلك + المنيوم	هوائي	11kv
LINE 130	150mm^2	0,44 KM	steel سلك + المنيوم	هوائي	11kv
LINE 131	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 132	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 133	150mm^2	0,67 KM	steel سلك + المنيوم	هوائي	11kv
LINE 134	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv

LINE 135	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 136	150mm^2	1 KM	steel سلك + المنيوم	هوائي	11kv
LINE 137	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 138	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 139	150mm^2	0,4 KM	steel سلك + المنيوم	هوائي	11kv
LINE 140	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 141	150mm^2	0,42KM	steel سلك + المنيوم	هوائي	11kv
LINE 142	150mm^2	0,7 KM	steel سلك + المنيوم	هوائي	11kv
LINE 143	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 144	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 145	150mm^2	0,2 KM	steel سلك + المنيوم	هوائي	11kv
LINE 146	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 147	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 148	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 149	150mm^2	0,45 KM	steel سلك + المنيوم	هوائي	11kv
LINE 150	150mm^2	0,11 KM	steel سلك + المنيوم	هوائي	11kv
LINE 151	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 152	150mm^2	0,1 KM	steel سلك + المنيوم	هوائي	11kv
LINE 153	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 154	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 155	150mm^2	0,5 KM	steel سلك + المنيوم	هوائي	11kv
LINE 156	150mm^2	1 KM	steel سلك + المنيوم	هوائي	11kv
LINE 157	150mm^2	2km	steel سلك + المنيوم	هوائي	11kv

LINE 158	150mm^2	2km	المنيوم + سلك steel	هوائي	11kv	
LINE	240mm^2	10 KM	المنيوم	ارضي	33kv	كيبل يطا الرئيسي
LINE 1	150mm^2	8 KM	المنيوم + سلك steel	هوائي	33kv	كيبل مصنع الحداد

Table 3cables in yatta network

All cables used in the electrical network are 150 mm aluminum.

Figure 11the electrical network are 150 mm aluminum

6.7. insulators.

Figure 12insulators

There is no need to change the insulators in the network because we will reduce the voltage from 33 kV to 11 Kv.

6.8. fusesin HV.

Figure 13fusesin HV

We need to change all the fuses that protect the electrical transformers, because if the voltage drops from 33 kV to 11 kV, the current will increase, and in this case the fuse will burn out, so we need to change all the fuses in the electrical network.

CH.7. Safety and security of the substation

7.1 Fences and walls

7.2 Entrance-equipment locks

7.3 Lighting

7.4 Electric and magnetic fields

7.5 Additional security measures

7.6 Substation Fire Protection

Access to electric supply substations by unauthorized personnel could make a problem. These intrusions may cause losses, damage or misoperation of equipment and facilities and may create potential safety and environmental liabilities. So here we presents a various methods and technics to mitigate or to prevent unauthorized persons from entering the substation.

7.1. Fences and walls.

According to the National Electrical Safety Code® (NESC®) (Accredited Standards Committee C2-1997), the substation requires fences and walls to be employed in order to keep unauthorized persons away from the substation.

Two types of fences can be used [24].

a) Chain linked fences.

This type of fence is the least vulnerable to graffiti and is generally the lowest-cost option. Chain-link fences can be galvanized or painted in dark colors to minimize their visibility, or they can be obtained with vinyl cladding. They can also be installed with wooden slats or colored plastic strips woven into the fence fabric, the following figure describes the chain linked fence:

Figure 14Chain linked fences

b) Wood fences.

Wood fences should be constructed using naturally rot-resistant or pressure-treated wood, in natural color or stained for durability and appearance. A wood fence can be visually overpowering in some settings. Wood fences should be applied with caution because wood is more susceptible to deterioration than masonry or metal, the following figure describes the wooden fence:

Figure 15wooden fences

c) Walls.

It's usually used in Palestine. Although metal panel and concrete block masonry walls cost considerably more than chain-link and wood fences, they deserve consideration where natural or landscaped screening does not provide a sufficient aesthetic treatment, the following figure describes the substation walls:

Figure 16Walls.

Each of these options is available in a range of types, shapes, and colors, and can be used in combination for an attractive architectural appearance. Brick and precast concrete can also be used in solid walls, but these materials can be far more expensive. These materials should be considered where necessary for architectural compatibility with neighboring facilities. Walls can be subject to graffiti, and this should be part of the consideration of their use [24].

7.2. Entrance-equipment locks.

All entrances to substations should be locked. All equipment's located outdoors and within the substation fence should have a provision for locking cabinets and operating handles where unauthorized access could cause a problem. Padlocks should be of a type that can utilize a nonreproducible key. Similar locking devices should be used on gates and doors to any buildings within the substation fence [25].

7.3. Lighting.

The entire interior of the substation may be provided with dusk-to-dawn lighting to provide a minimum light level of 21.52 Lux (2 foot-candles). Placement of lighting posts should be such as not to assist an intruder who may climb the posts to enter the substation. All wiring to the lighting posts should be in conduit or concealed to minimize tampering by an intruder. In addition, areas outside the substation, but within the facility property, should also be considered for lighting to deter loitering near the substation [25].

7.4. Electric and magnetic fields.

Electric substations produce electric and magnetic fields. These power frequency electric and magnetic fields are a natural consequence of electrical circuits and are found around appliances and machines in the home and workplace [24].

In a substation, the strongest fields around the perimeter fence come from the feeders entering and leaving the substation. The strength of fields from equipment inside the fence decreases rapidly with distance, reaching very low levels at relatively short distances beyond substation fences.

Electric and magnetic field sources in a substation.

Typical sources of electric and magnetic fields in substations include the following:

1. Transmission and distribution lines entering and exiting the substation
2. Bus work
3. Transformers
4. Air core reactors
5. Switchgear and cabling
6. Circuit breakers

7. Ground grid
8. Capacitors
9. Battery chargers
10. Computers

Many methods can be used to reduce the effect of electric and magnetic fields. The designer of an electric substation can typically reduce the effect of electric and magnetic fields on workplace by follows [24]:

1. Increase the height of the buses. If the height of buses doubles, the level of electric field directly underneath the bus decreases by more than 50%.
2. Decrease the phase spacing and bus diameter. Theoretically, a decrease of 50% of either phase spacing or bus diameter could cause a reduction in the electric field level by approximately 10%.
3. Optimize substation layout. The presence of nearby buses, either grounded or at lower voltages, acts as a shield and reduces the electric field in the immediate area.
4. Use natural shielding. Trees, and other vegetation along the property line may reduce the electric field level there.

7.5. Additional security measures.

The following additional security measures should be considered [25]:

1. Structures and poles should be kept a sufficient distance from the fence perimeter to minimize the potential use of the structure itself to scale the fence.
2. All sewer and storm drains that are located inside the substation perimeter, with access from the outside, should be spiked or fitted with vertical grillwork to prevent entry.
3. Manhole covers or openings should be located on the inside of the substation perimeter fence.
4. Driveway barriers (gates, guardrails, ditches, etc.) at the property line for long driveways can help limit vehicular access to the substation property.
5. Signs should be installed on the perimeter fence to warn the public that:

a. Alarm systems are providing security for the substation.
b. Entry is not permitted.
c. There is a danger of shock inside.

7.6. Substation Fire Protection.

Substation fire protection conditions are very necessary for substation safety. Proper electrical clearances are necessary for the design, construction, and operation of electric supply substations.

Minimum External Clearances between Transformer Live Parts of Different Phases

For high voltage terminals of the transformer at 161 kV nominal voltage, the minimum clearance between top shed of insulator of bushings of different phases is 1321 mm [26].

The minimum phase to phase and phase to earth clearance and terminal spacing's for transformers shall comply with **IEC 60076-3** except that the minimum phase to phase and phase to earth clearance and spacing's for 33 kV shall be 500 mm respectively. Spacing's shall include an additional allowance of 150 mm for the space taken up by the terminal connection.

Table 7.1 describes the minimum external clearances between transformer live parts of different phases

Table 7.1: Separation between large transformers

nominal terminal voltage	minimum clearance mm (inch)
33 kv	1321 (53)
11 kv	500 (20)

Table 4Separation between large transformers

Large oil-filled transformers should be separated by at least 30 ft (9.1 m) of clear space and/or a minimum 1 h fire rated barrier.

Separation of large transformers from buildings.

According to IEEE Guide for Substation Fire Protection, the typical oil quantities on three phase power transformers for typical MVA rating described in table 7.2:

Table 7.2: typical oil quantities on three phase power transformers for typical MVA

Gallons of oil	Typical MVA ratings
12 000 and above	100 MVA and above
10 000–11 999	50–99 MVA
8000–9999	30–49 MVA
2000–7999	5–29 MVA
1999 and below	5 MVA

Table 5 typical oil quantities on three phase power transformers for typical MVA

Transformers containing 2000 gal (7571 L) or more of insulating oil should be at least 20 ft (6.1 m) from any building. If these large oil-filled transformers are located between 20 and 50 ft (6.1–15.2 m) of a building, the exposed walls of the building should constitute, or be protected by, at least a 2 h fire-rated barrier. The barrier should extend in the vertical and horizontal directions such that any point of the transformer is a minimum of 50 ft (15.2 m) from any point on the wall not protected by the barrier. Should it be necessary to encroach on the above minimums, the installation of a transformer fire protection system should be considered.

CH.8. Financial cost

	NUMBERS	PRICE
SWITCH 33 KV	4	560000 ILS
SWITCH 11 KV	8	800000 ILS
RING MAIN UNIT	8	640000 ILS
POWER TRANSFORMER	2	3000000 ILS
FUSES	405	2000 ILS
LINES	8KM	300000 ILS
STATION ITEMS		400000ILS
TOTAL		5702000ILS

Table 6Financial cost

CH.9. digsilent powerfactory program and Substation Single Line Diagram

— Introduction
— PowerFactory Features

9.1. Introduction.

PowerFactory is a leading power system analysis software application for use in analysing generation, transmission, distribution and industrial systems.

It covers the full range of functionality from standard features to highly sophisticated and advanced applications including windpower, distributed generation, real-time simulation and performance monitoring for system testing and supervision. PowerFactory is easy to use, fully Windows compatible and combines reliable and flexible system modelling capabilities with state-of-the-art algorithms and a unique database concept. Also, with its flexibility for scripting and interfacing, PowerFactory is perfectly suited to highly automated and integrated solutions in your business applications.

Figure 17digsilent powerfactory program

9.2. PowerFactory Features.

Figure 18PowerFactory Features.

- AC, DC and AC linearised analysis methods, including regional assessment
- Outage levels: n-1, n-2, n-k
- Fast contingency screening with recalculation of critical cases using AC method
- Single and multiple time phase consideration
- Dynamic contingencies option for creating fault cases “on the fly”
- Remedial Action Schemes for flexible and dynamic analysis of post-fault actions
- Substation automation via switching schemes
- Automatic time sweep contingency analysis of a 24 hour time period incl. parallelisation
- Generator effectiveness and quad booster effectiveness
- Enhanced Fault Case management
- Comprehensive spreadsheet reporting features incl. graphical visualisation of critical cases
- Tracing of individual contingency cases
- Contingency comparison mode
- Support of parallelised Contingency Analysis for multiprocessor hardware
- Reloading of results

9.3.Substation Single Line Diagram.

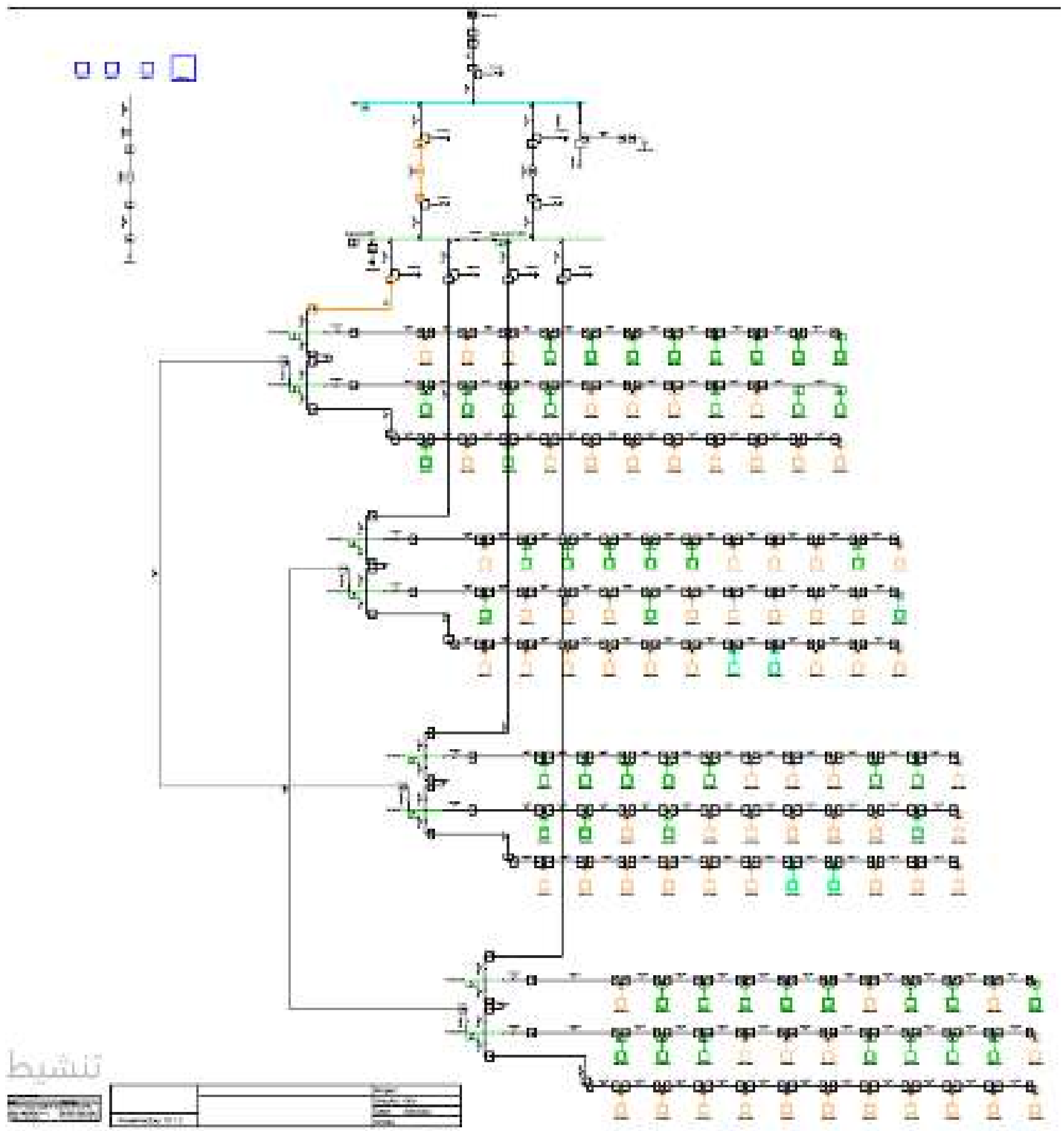

Diagram 4Substation Single Line Diagram

Conclusion:

In this project, many conclusions achieved which must be taken into account to improve yattia network , those conclusions represents as:

1. DIGSILENT software can design the power system precisely as it exists in the real world, and gives the measurement accurately matching the practical system.

Recommendations:

- Design a SCADA to a supervision on the network, and it's simplicity in collecting the data.
- Connect harmonics filters to limit the effect of harmonics in the grid.
- Apply GIS system to find out loads for each customer and on which phase was connected.

References:-

1- The annual report of the South Electricity Company for the year 2020

2- the annual report of the Hebron Electricity Company for the year 2021

3- a report from the South Electricity Network

4- a report from the Hebron Electricity Network

5- website about substations(https://vietnamtransformer.com/our-news/transformer-substation-types-of-transformer-substation)

6- websit abouta program (https://www.digsilent.de/en/features.html)

7- website of Schneider Company(https://www.se.com/ww/en/)