

# Emergency Equipment in Power System

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**Abstract**—Power outage is one of the problems any industrial or commercial facility could face. It happens due to several reasons. This outage surely affects the operation of any running business. However, some systems are extremely critical and power must not be cut-off for any small duration. This is an educational article, this paper will cover the emergency equipment of power system that prevents minor interruption into more critical loads of a facility until normal power system outage is fixed or reliable for longer period of time. The methodology of this paper relays on previous researches, journals, books, and conferences, that covered different aspects of the subject merged together to present simplified information for any beginner or professional engineer to review.

**Keywords**—Outage, UPS, Battery, Critical, Back Up, Circuit Breaker, Short Circuit, IT System, Industrial.

## I. INTRODUCTION

Emergency power systems are very important for any facility, especially industrial facilities that carries on the responsibility of financial income of a county or company, imagine the losses that results of a power outage in a factory, it is really affecting and calculation of the losses is shocking. A good example of power system failure is the blackout happened in India in 2012 that affected more than 900 Million people who suffered a hard time and Millions of dollars estimated as a loss [1]. In this journal, we will discuss possible solutions facilities rely on to decrease the risks of interruption in power system and allow the end users to handle get more prepared for the loss of power.

## II. THE HAZARDS OF SUDDEN OUTAGE OF POWER SYSTEM

Spotting the hazard of sudden power outage of the medical hospitals or clinics, this impact is clearly notable and giving the medical team very hard time since many equipment they use to support patients and make critical surgeries works only with electricity. In power failures, doctors must prioritize the people they serve with the more critical cases that require more attention, and they may have to delay any other appointment or surgery that is not urgent until power operation is back. This situation is always critical for ethical and moral scenarios doctors pushed into; it is always difficult to weigh the alternatives and the cases and requires high professional ethics of the doctors and good morals of the patients to be cooperative [2].

## III. MOST CRITICAL SYSTEMS TO PROTECT OF POWER OUTAGE

There are many electrical loads that are very critical for a facility; these loads must not face any power failure, even for few minutes, because power failure could cause huge losses of data in IT systems, money loss for industrial facilities and

safety and security for commercial buildings [3]. It is very important to protect data centers from power failure, and all necessary BMS and computers of a building to protect the loss of data. Additionally it is important to protect CCTV, firefighting and fire alarm systems from power outage to allow the people inside the facility to manage protecting the people inside and insure the level of security from stealing incidents of assets and information. In hospitals, many systems are connected to power back up systems such as MRI, ventilators, and cardiac resuscitation devices ... etc.

## IV. DIESEL SET GENERATORS

One of the most popular solutions to recover power outage is diesel set generators which works on transforming mechanical energy of diesel into electrical power that supplies the facility and minimize the effect of power failure [4]. The working principle of diesel generator is to contain an engine that transforms chemical energy of diesel into mechanical energy that rotates the dynamic part of the alternator, this rotator movement with excited windings of the rotor by an external DC source is resulting induced current in the stator winding that is to be used as a power source for any facility [5]. The use of diesel generator is very effective with very wild amount of load up to 2000 KW which means it could operate very large facility and the backup time it gives could reach 3 days depending on the diesel tank that is used with generator with the ability to refill the diesel tank to insure longer operation.

## V. AUTOMATIC TRANSFER SWITCH (ATS)

Automatic transfer switch (ATS) is an electrical device that is used to switch the electric load of a facility from one resource to another, it is commonly connected between loads and primary power source (grid) and secondary power source (generator) [6]. In case of primary source power failure ATS is sensing these interruptions and switching the power that supplies the load into the secondary resource in millisecond [7]. The existence of ATS is very necessary and minor mistakes in connection could lead of complete power outage so periodic maintenance and check-ups must apply into ATS.

### VI. UNINTERRUPTABLE POWER SUPPLY (UPS)

In every facility, uninterruptable power supply system (UPS) is used; it is connected to IT loads, safety and security systems, and other critical electrical devices. The use of UPS is very essential in cooperation with diesel generator since it provides instant backup power to critical load without even smaller interruption [8]. UPS uses DC batteries as backup of the AC system; it charges the battery using the rectifier inside it and provides regulated power to the critical loads during normal operation. In case of power failure, the batteries are discharged and DC voltage is converted to AC using the inverter of the UPS so the critical load could still be running during the power outage. UPS is efficiently supplying loads up to 500 KW and the backup time is depending on the initial design of the system so the more backup time is required the more batteries to be connected to the UPS and the more cost is paid in order to install and operate the UPS. Uninterruptable power supply system also contains maintenance bypass switch that allows us to neglect the UPS to feed the critical loads and allows us to make any necessary maintenance work of the UPS [9]. The schematic diagram of UPS is in figure 1 below:

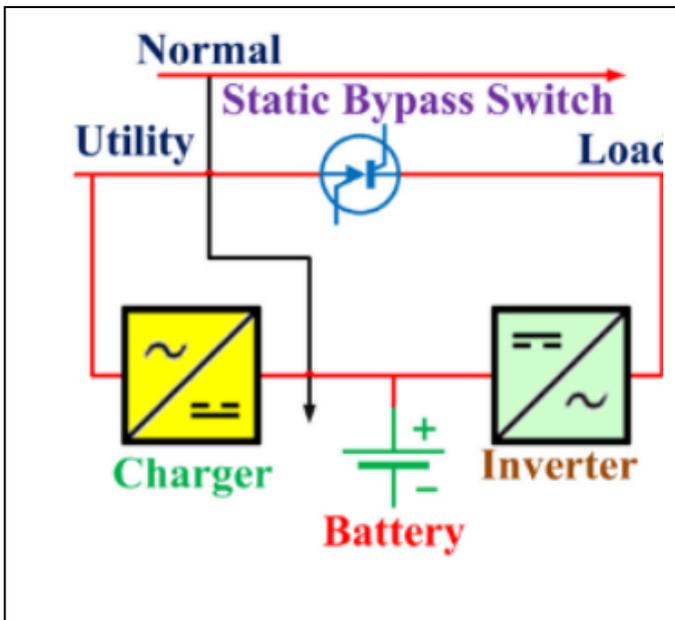


Figure 1: Schematic Diagram of Uninterruptible Power Supply System

### VII. EMERGENCY LIGHTING & CENTRAL BATTERY SYSTEM (CBS)

Emergency lights are lights of a facility that are attached with self-contained batteries that supplies power to the emergency lights in case of electrical failure in order to insure enough light to exit the building to the people in the workplace, and it contains emergency lights that are 10-20% of the normal light according to the referred specifications and exit lights that clarifies the rout to exit for persons wherever the person is [10]. One of the recent solutions that is used in case of power outages is the central battery system, which is centralized system that contains battery and integrated controller that supplies emergency lights in case of power outage instead of the separated battery for each unit, so it is easier to monitor the battery health of and easier to maintain the batteries in case of damage [11]. The schematic diagram for central battery system is shown in figure 2:

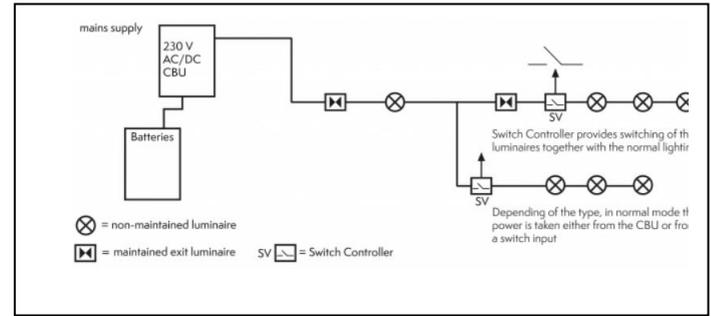


Figure 2: Schematic Diagram of Central Battery System

### VIII. USE OF RENEWAL ENERGY FOR EMERGENCY EQUIPMENT IN POWER SYSTEM

The word trend in nowadays is to protect the environment and depend more on the renewable energy sources such as solar and wind, but the argument is on the efficiency and cost-effectiveness of these systems [12]. Using renewable energy as a backup resource is very possible solution that can replace diesel set generators especially for smaller facilities, the use of renewable power in this case is efficient special in shorter power outages and it could be connected to the most critical loads until power grid is online [13]. Additionally, renewable resourced could be always connected to UPS and CBS so the power produced is saved in the battery of these systems and use in case of emergency [14].

### IX. CONCLUSION

This paper presented the contribution of different power system in case of power outage which protects losses in information, humans, and money. The outcome of this paper for professional or beginner engineer is to have a quick over view of these system and the working principle of it could be a good reference for none-specialized people in the field of electrical engineering. At the end it is always necessary to protect our critical loads with backup power system.

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