

**ASSIGNMENT-01**

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| **SL No.** | **Question and Answer** | **Marks** |
| **01** | Explain equipment sensitivity on voltage sags with 3 case studies.  **ANS**: Determining equipment sensitivity can be the most difficult task when analyzing voltage sag concerns. The sensitivity of equipment presented here was determined as part of EPRI Power Quality Case Studies that dealt specifically with voltage sag problems.  **A. Chiller Controls:**  Process controllers can be very sensitive to voltage sags. An electronic component manufacturer was experiencing problems with large chiller motors tripping off-line during voltage sag conditions. The chillers supply water to an entire chip manufacturing and testing facility. During extreme voltage sags, enough chillers may trip to affect manufacturing, causing large monetary losses. A 120-V, 15-VA process controller which regulates water temperature was thought to be causing individual chillers to trip. This controller was tested using a voltage sag simulator for voltage sags from 0.5-1000 cycles in duration. The controller was found to be very sensitive to voltage sags, tripping at around 80% voltage, regardless of the duration.  **B. Programmable Logic Controllers:**  This is an important category of equipment for industrial processes because the entire process is often under the control of these devices. The sensitivity to voltage sags varies greatly but portions of an overall PLC system have been found to be very sensitive. The remote 1/0 units, for instance, have been found to trip for voltages as high as 90% for a few cycles. Fig. 10 shows the results of voltage sag ride-through testing on two different programmable logic controllers. The figure shows the difference between an old and a new version of the same PLC. The newer, type 1 controller is sensitive at 50-60% of nominal voltage, while the older, type 2 PLC could ride through zero voltage for 15 cycles. This illustrates how electronic equipment is becoming more sensitive to voltage variations.    Fig 1. Programmable logic controller ride-through capability  **C. Machine Tools:**  Machine tools can be very sensitive to voltage variations. Often, robots or complicated machines are used in the cutting, drilling, and metal processing that is required when specialized parts are produced. Any variation in voltage can affect the quality of the part that is being machined. Another reason machine tools are sensitive to voltage variations is for safety reasons. Robots generally need very constant voltage to operate properly and safely. Any voltage fluctuations, 'especially sags, may cause unsafe operation of the robot or machine. Therefore, these types of machines are often set to trip at voltage levels of only 90%. | **05** |
| **02** | Explain the concept of utility and customer solutions in voltage sag problems.  ANS: **A.** **Utility Solutions:**  Utilities derive important benefits from activities that prevent faults. These activities not only result in improved customer satisfaction, but prevent costly damage to power system equipment. Utilities have two basic options to continue to reduce the number and severity of faults on their system:  1) prevent faults  2) modify fault clearing practices.  Fault prevention activities include tree trimming, adding line arresters, insulator washing, and adding animal guards. Insulation on any transmission system cannot withstand the most severe lightning strokes, but any line that shows a trend toward lightning-induced faults is usually investigated.    Fig 1. General approach for the application of power conditioning equipment  **B. Customer Solutions:** Customer solutions usually involve power conditioning for sensitive loads. Proper application of power conditioning equipment requires an understanding of the capabilities of the device. Also important is a definition of the requirements of sensitive or critical loads. Fig. 1 is a schematic of the general approach used. Power conditioning equipment is used to isolate equipment from high frequency noise and transient power disturbances, or to provide voltage sag ride-through capability, or both.  There are several solutions currently available that will provide ride-through capability to critical loads:   * motor-generator sets (M-G sets); * uninterruptible power supplies (UPS’S); * ferro resonant, constant voltage transformers (CVT’s); * magnetic synthesizers; superconducting storage devices (SSD’s).     Fig 2. Motor-Generator set    Fig 3. UPS Configuration | **05** |