**Under Voltage Relay**

### Causes for Under Voltage
1. Closing and opening of CBs
2. Due to fault
3. Due to motor starting
4. Transformer energization
5. Equipment failure
6. Bad weather
7. Pollution
8. Construction activity

**Table showing IEEE Under Voltage Scheme**

<table>
<thead>
<tr>
<th>Types of Under Voltage</th>
<th>Duration</th>
<th>Magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instantaneous</td>
<td>0.5 - 30 cycles</td>
<td>0.1 - 0.9 pu</td>
</tr>
<tr>
<td>Momentary</td>
<td>3 cycles - 3 sec</td>
<td>0.1 - 0.9 pu</td>
</tr>
<tr>
<td>Temporary</td>
<td>3 sec - 1 min</td>
<td>0.1 - 0.9 pu</td>
</tr>
</tbody>
</table>

\[
\text{Ratio} = \frac{10}{50} = 0.2 \text{ sec} \\
\text{Time} = \frac{30}{50} = 0.6 \text{ sec}
\]

**Under and Over Voltage Microcontroller Based Scheme**

**Block Diagram**

- AC Input
- Power Supply
- Regulator
- PIC16F877A Microcontroller
- Liquid Crystal Display Unit
- Voltage Sensor
- Comparator Unit
- Reference Voltage
- Measured Voltage
- Error Signal
- Information Display
- Relay Driver
- Relay
- Load

**Objective**
- To keep voltage constant at load terminal

**Measurement Unit**
- Logical unit
- Relay (Decisive evaluation)
Over/Under Voltage Relay for Protection

1. First comparator is connected to buzzer. It gives alarm for any error value which is higher than threshold.
2. The relay will trip some load in case of under voltage condition.

Basic Circuit for Under/Over Voltage Relay

1. Ac input first stepped down and converted into DC
2. Two comparators N1 and N2
   N1 → alarm circuit
   N2 → operate the relay
3. These Zener diode and load having different settings.
4. There will be a time delay in these comparators.
Under Frequency Relay

- It operates when system frequency drops below the operating frequency.
- Back up protection for overfrequency \((V/f)\)
- Under frequency phenomenon occurs:
  - Due to turbine low speed
  - Automatic voltage regulator failure
  - Air gap failure / control machinery failure
  - High frequency fluctuation

a. The generator can withstand moderate frequency drop provided the voltage lies in acceptable limit.

b. The impact of underfrequency is as follows:
   1. Overfrequency of generators and motors
   2. Speed drops in motors
   3. Output voltage also drops

c. Under frequency relays are used to shed certain portion of load, whenever the system frequency fails to operate such a low level.
Over frequency relay

a. Over frequency or over speed protection, used to reduce eddy current losses as the frequency increases.

b. Many losses are directly function of frequency hence controlling the frequency is must

c. Over frequency relay will operate when system's frequency is higher than threshold.