

# Design & Development of Optimum Load Shedding with Voltage Stability Indicators in Power System

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**Abstract:-** Optimal load shedding strategy for power systems with optimum location and quantity of load to be shed is presented. The problem of load shedding for avoiding the existence of voltage instability in power systems is taken as a remedial action during emergency state in transmission and distribution sector. Optimum location of loads to be shed is found together with their optimum required quantity. The optimum load shedding in power strategies with voltage stability indicators is a simple new method is developed to determine the optimum location and the optimum quantity of load to be shed in order to prevent the system voltage from going to the unstable. This method is based on indicators of risk of voltage instability. It can be implemented for large power system to estimate voltage instability. Successive load flow runs are required to accomplish this method. The proposed method can be used for real time applications in power systems. The computation speed of these indicators is fast compared to other methods.

**Keywords—** Load shedding; voltage stability; labview; voltage indicators;

## I. INTRODUCTION

Electrical load shedding is a method of reducing the demand on the electricity generation and achieved by switching off some loads or energy supply to some geographical areas. This is usually a last measure by the utilities, and often implemented to prevent overloading the generating systems and eventual collapse of the entire power system.

Load shedding is one of the last things that a utility company should look at. It leads to frustrated customers and loss of revenue for the consumers as production drops. In addition, it may cause equipment damage.

Electricity companies should ensure that they have enough capacity to meet normal and peak demands. This can be achieved by planning for future electricity demand and progressively upgrading the generating equipment, maintain existing systems, reducing transmission losses and increasing efficiency in the entire system.

Power companies are required to supply sufficient energy to meet installed capacity. However, the demand may become inconsistent during peak periods. Whenever the power generated is insufficient to support the load, the electrical supply and distribution system becomes unbalanced and unstable.

If not controlled, the system can collapse and cause a total blackout. In such a situation, it may take hours or days to restore back the power. The utility monitors their systems and compare the load against the supply. If the difference between

the two gets very narrow, some of the sections are disconnected so as to prevent the system from becoming unstable.

## II. VOLTAGE STABILITY

Voltage stability is the ability of a power system to maintain steady acceptable voltages at all buses in the system under normal operating conditions and after being subjected to a disturbance.

Severe and increasing strain has been observed in the power system in recent years due to incongruence between the generation and transmission infrastructure. Environmental issues, change in energy portfolio and deregulated energy markets are some of the prime factors. The kind of stress developed in the system has caused concerns for voltage instability. Voltage stability refers to the ability of a power system to maintain steady voltages at all buses in the system after being subjected to a disturbance from a given initial operating condition.

## III. FLOW DIAGRAM

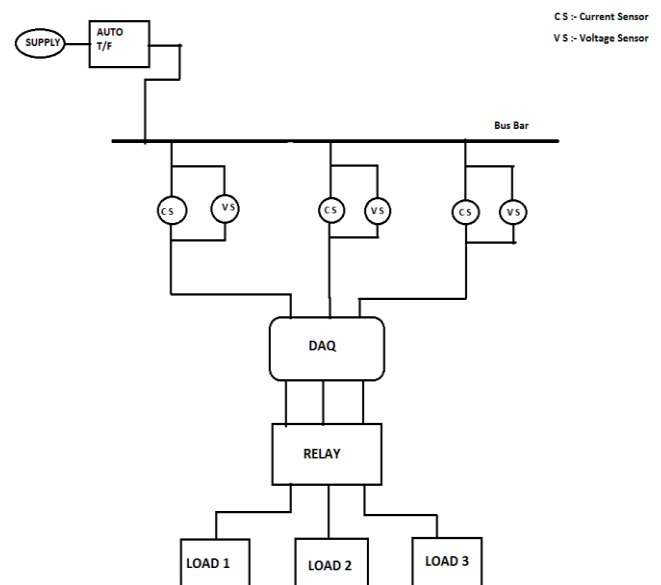


Fig. 1. Flow diagram.

CS-current sensor

VS-voltage sensor

In this project voltage sensors used ZMPT101B, current sensors used ACS712 and relay used is JQC-3FF-S-Z.

Voltage sensor can able to sense up to 250v, current sensors are 5A sensors and Relay used is 5Vdc

In this project the loads have divided into commercial loads and industrial loads. 150w exhaust fan is used as commercial load and 100W incandescent bulb in series with 18w fluorescent tube light has used

#### IV. COMPONENTS USED

##### A. voltage sensor

The AC voltage sensor can detect an electric field. Most of the detection can be done by a simple capacitor. A capacitor has two conductors or “plates” that are separated by a non-conductor called a dielectric. If we connect an ac voltage across the two conductors, an AC current will flow as the electrons are alternately attracted or repelled by the voltage on the opposite plate. There’s a complete ac circuit even though there’s is no wires actually in use. The electrical field inside the capacitor, between the two plates, is what completes the ac circuit. It shows this by giving off an audible noise or an LED. light to signify on how strong the electric field is. The stronger the electric field on a wire or object then the stronger the stronger the audible noise on the detector to help guide where the electricity is running at one time. It also gives the electrician a sense of security for when it comes to coming into contact with that part of the circuit. This AC Voltage sensor measures line voltage on mains up to 250 V.

##### 1. FEATURES

- Within 250V AC Voltage can be measured.
- Onboard micro-precision voltage transformer
- Ratio: 1000:1000
- Phase<=20
- Linear range: 0-1000V 0-10mA(Sampling resistor is 100ohm)
- Installation: PCB mounting (Pin Length> 3mm)
- Operating temperature: 40°C ~ + 70°C

##### 2. ADVANTAGES

- Analog output corresponding quantity can be adjusted.
- PCB board size: 49.5 (mm) x19.4 (mm)
- Good consistency, for voltage and power measurement
- Very efficient and accuracy



Fig. 2. Voltage sensor.

##### B. current sensor

The Dc Current Measurement Sensor is using IC ACS712 is provided in a small, surface mount SOIC8 package. It consists of a precise, low-offset, linear Hall sensor circuit with a copper conduction path located near the surface of the die. When current is applied through the copper conductor, a magnetic field is generated which is sensed by the built-in Hall element. The strength of the magnetic field is proportional to the magnitude of the current through the conduction path, providing a linear relationship between the output Hall voltage and input conduction current. The on-chip signal conditioner and filter circuit stabilizes and enhances the induced Hall voltage to an appropriate level so that it could be measured through an ADC channel of a microcontroller. The pin diagram of ACS712 device and its typical application circuit is shown below. Pins 1, 2 and 3, 4 form the copper conduction path which is used for current sensing. The internal resistance of this path is around 1.2 mΩ, thus providing low power loss. As the terminals of this conduction path are electrically isolated from the sensor leads (pins 5 through 8), the ACS712 device eliminates the risk of damaging the current monitoring circuit due to the high voltage on the conduction side. The electrical isolation between the conduction current and the sensor circuit also minimizes the safety concerns while dealing with high voltage systems

##### 1. FEATURES

- Low-noise analog signal path
- Device bandwidth is set via the new FILTER pin
- 3.µs output rise time in response to step input current
- The module can measure up to 20 amps.
- PCB board size: 31 (mm) x13 (mm).
- Analog Output.

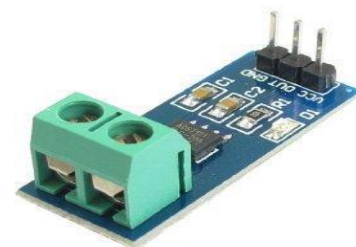


Fig. 3. Current sensor.

##### C. DAQ NI USB-6009

##### 1) Definitions

Warranted specifications describe the performance of a model under stated operating conditions and are covered by the model warranty. The following characteristic specifications describe values that are relevant to the use of the model under stated operating conditions but are not covered by the model warranty.

- Typical specifications describe the performance met by a majority of models.

• Nominal specifications describe an attribute that is based on design, conformance testing, or supplemental testing.

### 2) *Hardware description*

The National Instrument USB-6009 multifunction data acquisition (DAQ) modules provide reliable data acquisition at a low price. With plug-and-play USB connectivity, these modules are simple enough for quick measurements but versatile enough for more complex measurement applications.

### 3) *Software description*

The NI USB-6008 and USB-6009 use NI-DAQmx high-performance, multithreaded driver software for interactive configuration and data acquisition on Windows OSs. All NI data acquisition devices shipped with NI-DAQmx also include VI Logger Lite, a configuration-based data-logging software package. Mac OS X and Linux users can download NI-DAQmx Base, a multiplatform driver with a limited NI-DAQmx programming interface. You can use NI-DAQmx Base to develop customized data acquisition applications with National Instruments LabVIEW or C-based development environments. NI-DAQmx Base includes a ready-to-run data logger application that acquires and logs up to eight channels of analog data. PDA users can download NI-DAQmx Base for Pocket PC and Win CE to develop customized handheld data acquisition applications

### 4) *Recommended accessories*

The USB-6009 have removable screw terminals for easy signal connectivity. For extra flexibility when handling multiple wiring configurations, NI offers the USB-6009 Accessory Kit, which includes two extra sets of screw terminals, extra labels, and a screwdriver. In addition, the USB-6009 Prototyping Accessory provides space for adding more circuitry to the inputs of the USB-6009.

#### Common Applications

The USB-6009 are ideal for a number of applications where economy, small size, and simplicity are essential, such as:

- Data logging – Log environmental or voltage data quickly and easily.
- Academic lab use – The low price facilitates student ownership of DAQ hardware for completely interactive lab-based courses. (Academic pricing available. Visit [ni.com/academic](http://ni.com/academic) for details.)

## V. LABVIEW SOFTWARE

Laboratory Virtual Instrument Engineering Workbench (LabVIEW) is a system-design platform and development environment for a visual programming language from National Instruments.

The graphical language is named "G"; not to be confused with G-code. Originally released for the Apple Macintosh in 1986, LabVIEW is commonly used for data acquisition, instrument control, and industrial automation on a variety of operating systems (OSs), including Microsoft Windows, various versions of Unix, Linux, and macOS.

### A. *Dataflow diagram*

The programming paradigm used in LabVIEW, sometimes called G, is based on data availability. If there is enough data available to a subVI or function, that subVI or function will execute. Execution flow is determined by the structure of a graphical block diagram (the LabVIEW-source code) on which the programmer connects different function-nodes by drawing wires. These wires propagate variables and any node can execute as soon as all its input data become available. Since this might be the case for multiple nodes simultaneously, LabVIEW can execute inherently in parallel. Multi-processing and multi-threading hardware is exploited automatically by the built-in scheduler, which multiplexes multiple OS threads over the nodes ready for execution.

### B. *Graphical programming*

LabVIEW integrates the creation of user interfaces (termed front panels) into the development cycle. LabVIEW programs-subroutines are termed virtual instruments (VIs). Each VI has three components: a block diagram, a front panel, and a connector pane. The last is used to represent the VI in the block diagrams of other, calling VIs. The front panel is built using controls and indicators. Controls are inputs: they allow a user to supply information to the VI. Indicators are outputs: they indicate, or display, the results based on the inputs given to the VI. The back panel, which is a block diagram, contains the graphical source code. All of the objects placed on the front panel will appear on the back panel as terminals. The back panel also contains structures and functions which perform operations on controls and supply data to indicators. The structures and functions are found on the Functions palette and can be placed on the back panel. Collectively controls, indicators, structures, and functions are referred to as nodes. Nodes are connected to one another using wires, e.g., two controls and an indicator can be wired to the addition function so that the indicator displays the sum of the two controls. Thus a virtual instrument can be run as either a program, with the front panel serving as a user interface, or, when dropped as a node onto the block diagram, the front panel defines the inputs and outputs for the node through the connector pane. This implies each VI can be easily tested before being embedded as a subroutine into a larger program.

The graphical approach also allows nonprogrammers to build programs by dragging and dropping virtual representations of lab equipment with which they are already familiar. The LabVIEW programming environment, with the included examples and documentation, makes it simple to create small applications. This is a benefit on one side, but there is also a certain danger of underestimating the expertise needed for high-quality G programming. For complex algorithms or large-scale code, it is important that a programmer possess an extensive knowledge of the special LabVIEW syntax and the topology of its memory management. The most advanced LabVIEW development systems offer the ability to build stand-alone applications. Furthermore, it is possible to create distributed applications, which communicate by a client-server model, and are thus easier to implement due to the inherently parallel nature of G

### C. Interfacing to devices

LabVIEW includes extensive support for interfacing to devices, instruments, camera, and other devices. Users interface to hardware by either writing direct bus commands (USB, GPIB, and Serial) or using high-level, device-specific, drivers that provide native LabVIEW function nodes for controlling the device.

LabVIEW includes built-in support for NI hardware platforms such as CompactDAQ and CompactRIO, with a large number of device-specific blocks for such hardware, the Measurement

and Automation explorer (MAX) and Virtual Instrument Software Architecture (VISA) toolsets.

National Instruments makes thousands of device drivers available for ownload on the NI Instrument Driver Network (IDNet).

## VI. LABVIEW SIMULATION

### 1. FRONT PANEL

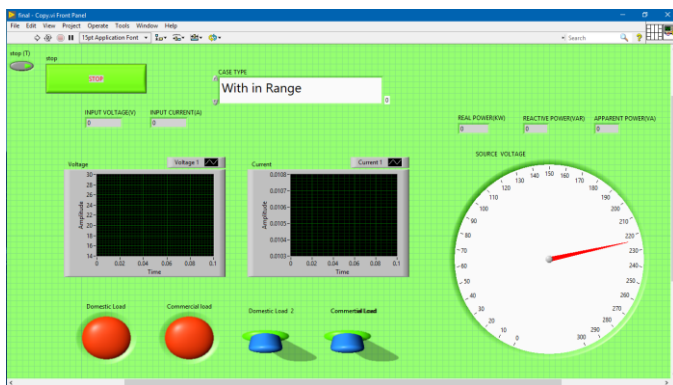


Fig. 4. Front panel in labview software.

Front panel is where the human interface is done with the programming

Here is the where controlling is done and readings is monitored continuously. As is in the figure of front panel shown the input supply is monitored in the meter on panel. Indicators are present to indicate whether the load has been shedded or not if the load is shedded then indicators shows red color and if load is not shedded then it shows green color

### 2. BACK PANEL

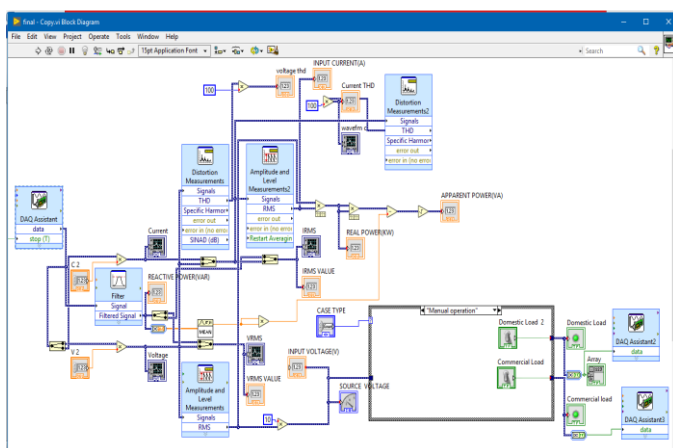


Fig. 5. Back panel in labview software.

Above figure showing the back panel of the software where the simulating program has written

The analog input is taken from DAQ and reduced distortions using some of the labview functions and given to the input of the case structure. A **Case Structure** is a branching control mechanism that allows different executions depending on the value of the label. In case structure we have given three case types of load shedding “within range”, “priority” and “manual operation”.

In within range we will be given certain range in this case we have given as 200 to 400V if the supply is within that range then no shed is done if due to fluctuation or by some other faults voltage exceeds or decrease the range then loads get shedded.

In the priority case when the generation of power is less than the power consuming then to maintain balance we have to shed some sides of load when we consider loads as domestic and commercial then we not prefer to shed the load on commercial side so by default we have to shed load on domestic side.

In manual operation there will commercial load switch and domestic load switch on the front panel we can shed manually whenever there is no requirement of power.

## VII. ADVANTAGES AND APPLICATIONS OF LOAD SHEDDING

- Load shedding impacts negatively on consumers and in particular the manufacturers and industries that rely on electricity.
- Prevents overloading and damage of the power generators
- Prevents instability and system collapse of the electrical generation and distribution systems
- Ensures that consumers or parts of the network have power as opposed to a total blackout.
- The planned schedules ensure that available capacity is shared fairly and each consumer gets power at one time or another.
- It serves as a warning to the utility hence forcing them to increase capacity, and efficiency so as to meet the demand.
- The main application of load shedding is balancing the demand and supply of electricity

## VIII. CONCLUSION

The load shedding based on the voltage stability using voltage sensors is proposed in this project. In this proposed project the load shedding is done in LabVIEW environment with the help of DAQ assistance by giving three priority case types in simulation which is more faster and effective way to shed the load

## REFERENCES

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