Howard University Department of Electrical and Computer Engineering

VOLTAGE FAULT PROTECTION SYSTEM FOR GRID-TIED RENEWABLE ENERGY SYSTEM

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Background

- Total use of Renewable Energy will increase to 53% by 2020.
- Renewable Energy poses a problem of Voltage fluctuations.
- Customers need a device that will protect them and their appliances from damages due to sag and surge in voltage.
- Consumer's need the voltage supply to be **constant**.

Problem Formulation

Homes with grid-connected RE have a greater risk of voltage fault

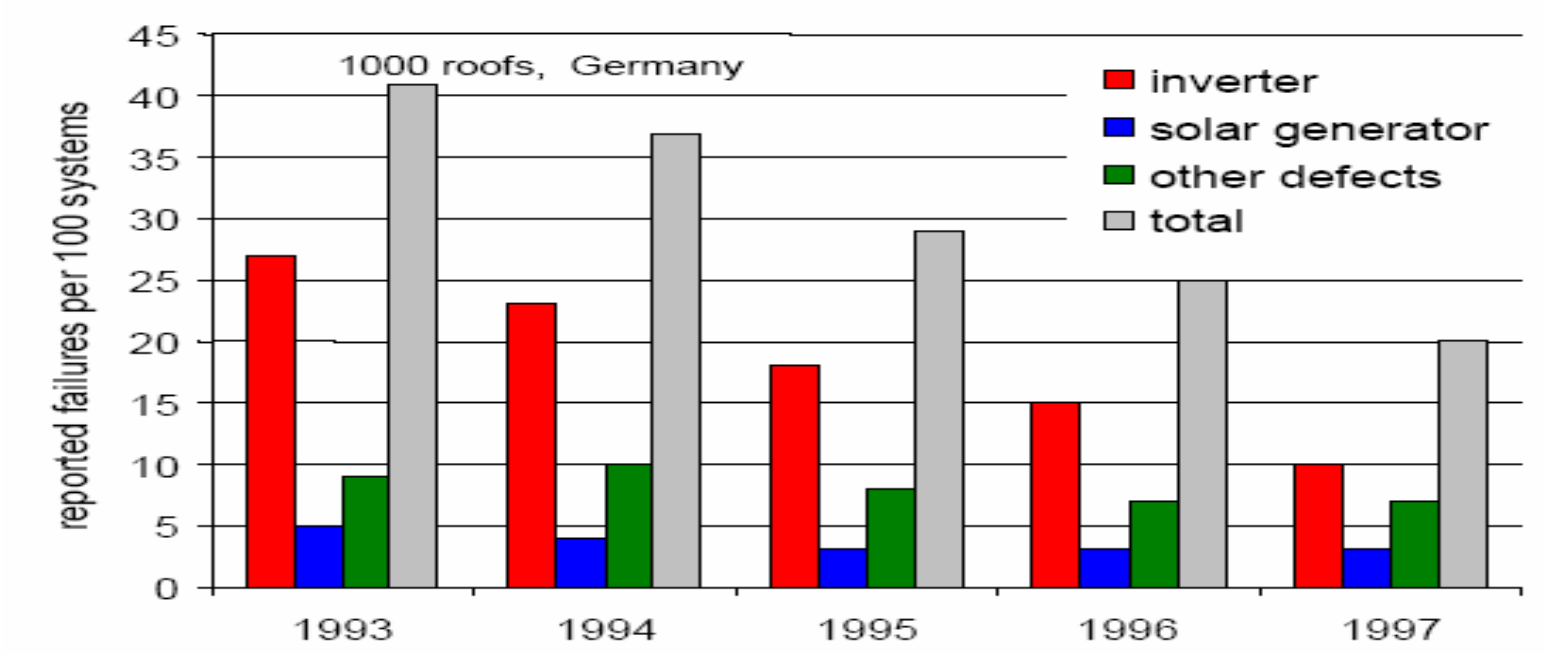

Fig: 1: Failures by main component as reported by the system owners under the »1000-Roofs-Programme« (Erge et al. 1998).

Source – International Energy Agency

Design Requirements

Alternative Solutions

- **Use three-level converters**
- **Install a voltage regulator (Voltage stabilizer)**

Constraints

- **Safety measures must be followed**
- **Must be automated**
- **The range rated voltage on appliance**

Knowledge Contents

- **Electronics**
- **Power Analysis**
- **Power communications**
- **Network Analysis**

Solution Methodology

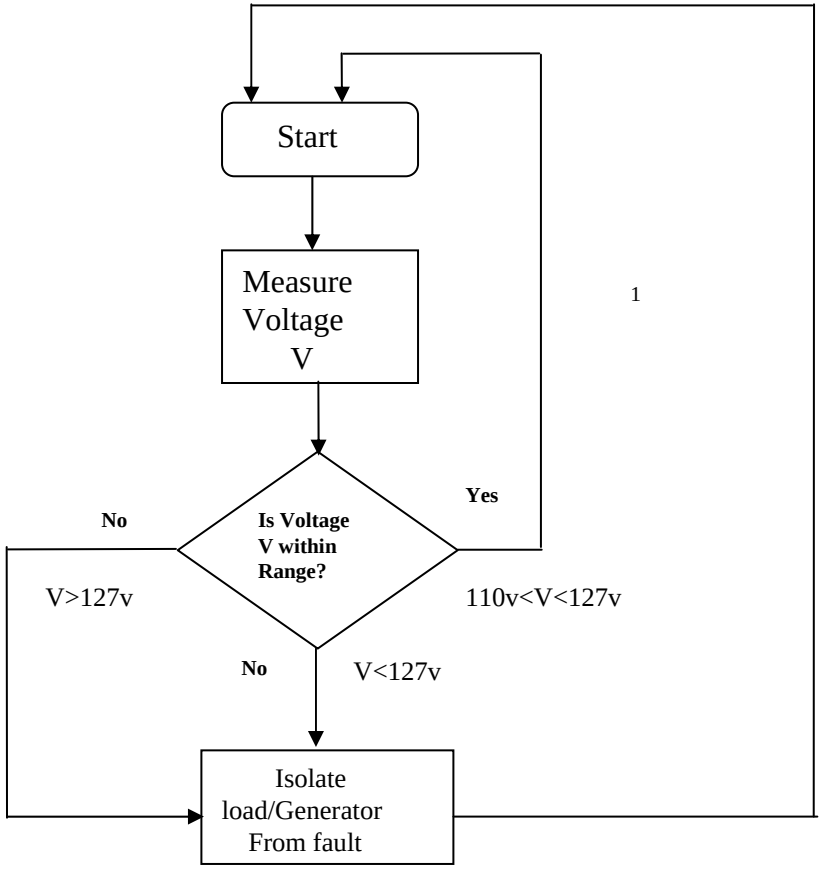

Fig: Methodology Flow chart

- system functionality will be:
- Detect fault in the system by:
  - Measurement of voltages
  - Evaluate the fault
- Protect system:
  - Isolate the Fault

Solution Approach – Main

Protection Control unit

- Voltage Data Logger
- CPU
- Switch

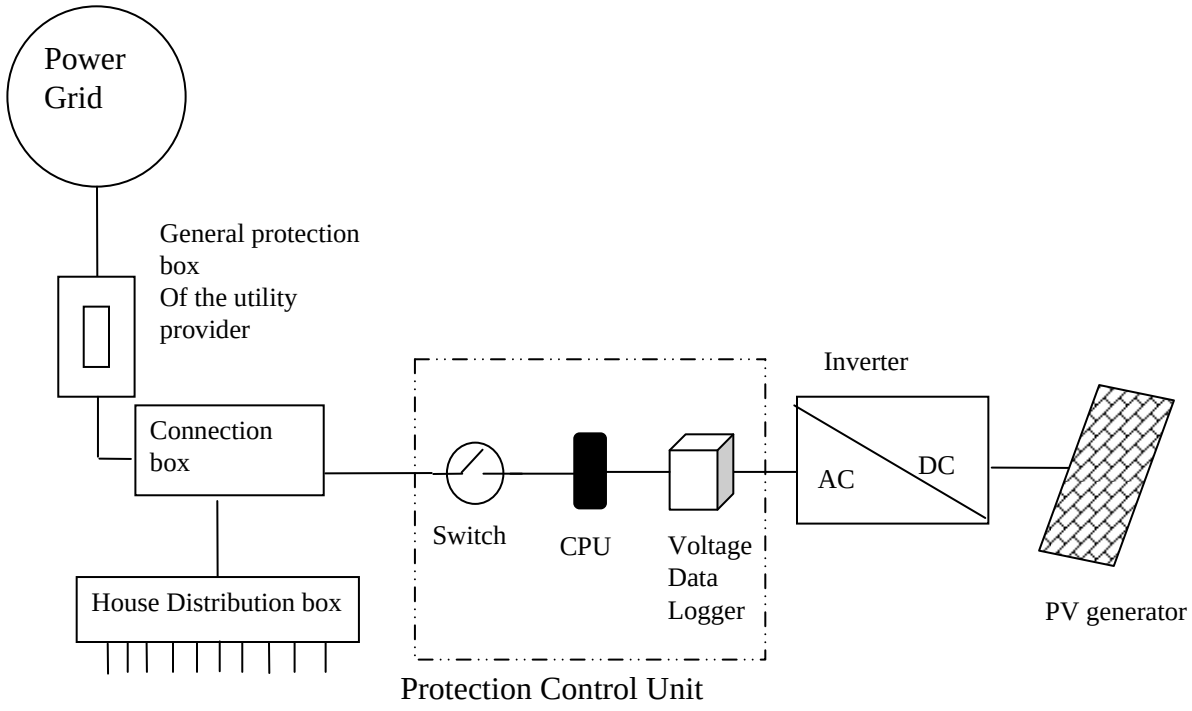

Fig: Overall system of a grid-connected RE system with Voltage Fault Protection System.

Alternative Solutions

- **Use of a voltage regulator (Voltage stabilizer)**

  Drawback:
  - Will not be able to isolate the fault caused on the distribution side.

- **Three-level converters**
  - reduces high voltage ratings for the switches and good dynamic switching

  Drawback:
  - Does not address the situation whereby we have low voltage ratings

Tasks and Project Management

Milestones	Timeline
Problem Definition	November, 2007
Technology and Implementation Selection	December, 2007
End-product Design	January, 2008
End-product Prototype	February, 2008
End-product	March, 2008
Demonstration and Final Report	March, 2008

Verification Plan and Deliverables

Verificatioon Plan:

- Investigate several **devices that could be used to mitigate unforeseen voltage fault problem**
- **Get the range/zone based on the information provided by the devices.**
- **Design a device that will eliminate the use of voltage not within the safety range.**
- Check that the system operates within the specified range.

- Troubleshoot system

Deliverables:

- A control unit mounted on board :
- Voltage data logger
- CPU
- Switch

Cost and Resources

Component	Order cost
Voltage Data Logger	$70
PIC16F877A-I/P	$10.00
RS232 Converter	$15.00
Switch	**$5.00**
Miscellaneous	$20.00
Total	**$120.00**

Conclusion

- **Protect loads against voltage faults arising from the grid-tied**
  - **Vulnerable to voltage faults**

- **Need - for further advancements in the technology that provides protection**
  - **Security and Financial benefits**