LEBANESE INTERNATIONAL UNIVERSITY

School of Engineering
Department of Electrical and Electronics Engineering

OPTIMIZING SOLAR SYSTEMS USING SCADA

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Outline

- Introduction
- Maintenance and optimization
- Problem Statement
- Challenges
- Available Techniques
- Proposed Solution
- Comparison
- Cost Analysis
- Conclusion and future work

Introduction

- Photovoltaic is becoming essential.

- Photovoltaic is the direct conversion of sunlight into electricity.

Maintenance and Optimization

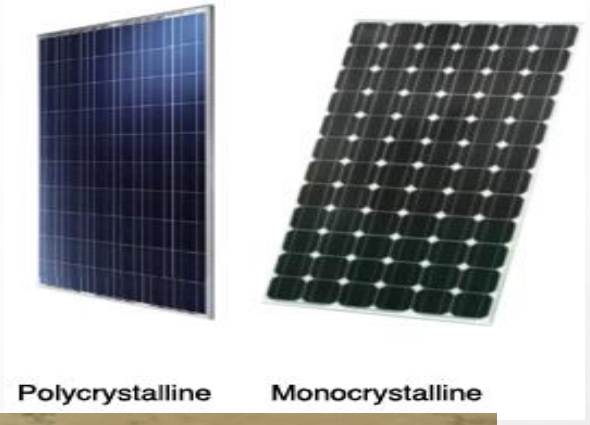
- Improving performance of PV systems.
- Analyzing and optimizing the functionality and performance of PV systems.
- Enhancing the control and the monitoring of the solar system inputs (Feedback) and outputs (alarms).
- Extending the life time and the efficiency of the system due to proper precise monitoring.

Problem Statement

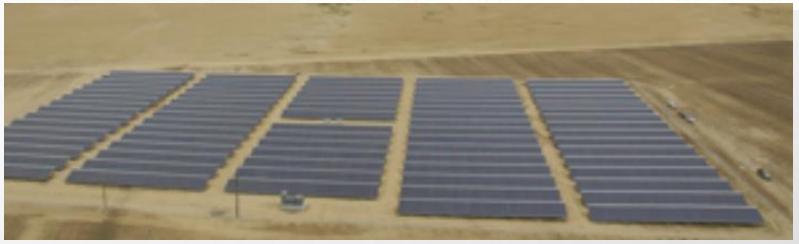
- Monitoring, sorting, and detecting PV faults
- Detecting degradation in real time
- Locating the faults
- Archiving and analyzing the faults for statistics purposes

Challenges

- Type of solar panels



- Area of the solar system



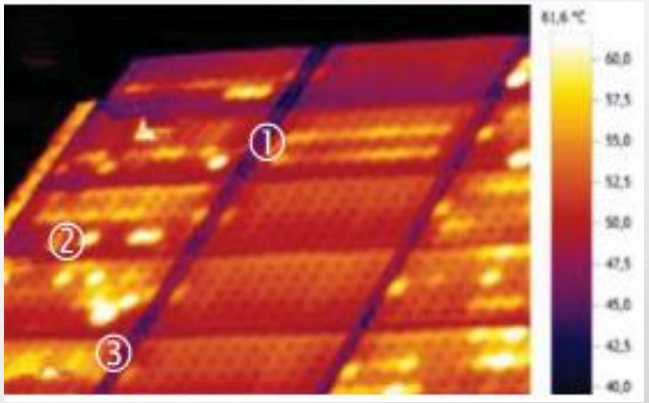
- Feedback status (diagnostics, error, etc.) of every solar panel

- Network length

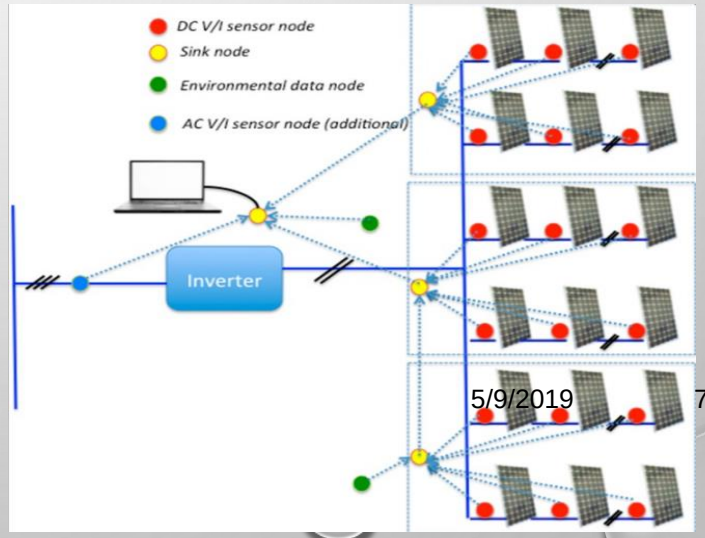
Available Techniques

- Visual inspection

- Thermography



- Wireless sensor based network

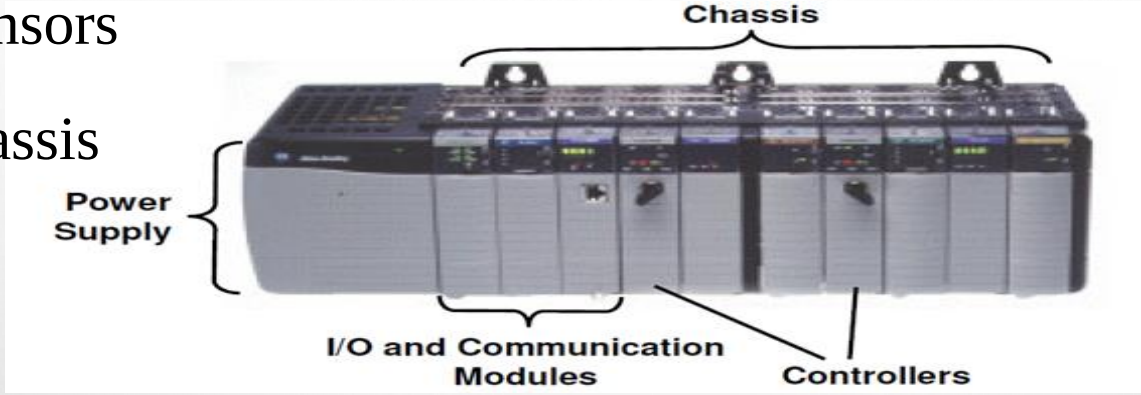


Proposed Solution

- Motivation
  - Limitations of current methods
- SCADA System based on PLC and industrial network
  - Supervisory Control and Data Acquisition
  - A system of hardware and software elements that allows to monitor, gather, record information and control outputs.

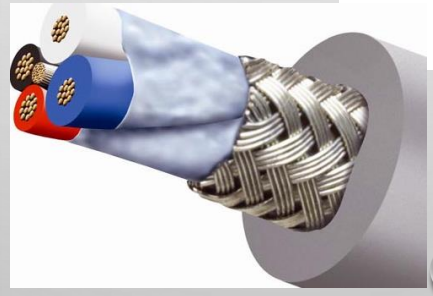
Equipment Used

- AKT-180-M Solar Panel
- Sensors
- Chassis

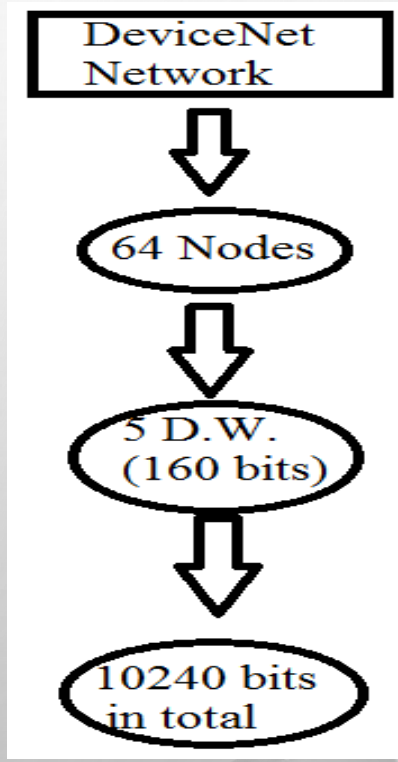


- DeviceNet Scanner

- DeviceNet Cable



•24 Vdc
•500 m thick cable length
•6 m drop line length



Equipment Used Cont'd

- I/O communication devices :
  - Armorblock
  - ArmorPOint

  } 10m signal cabling length

  - Flex
    - 30 meter signal cabling length
- PLC

- HMI

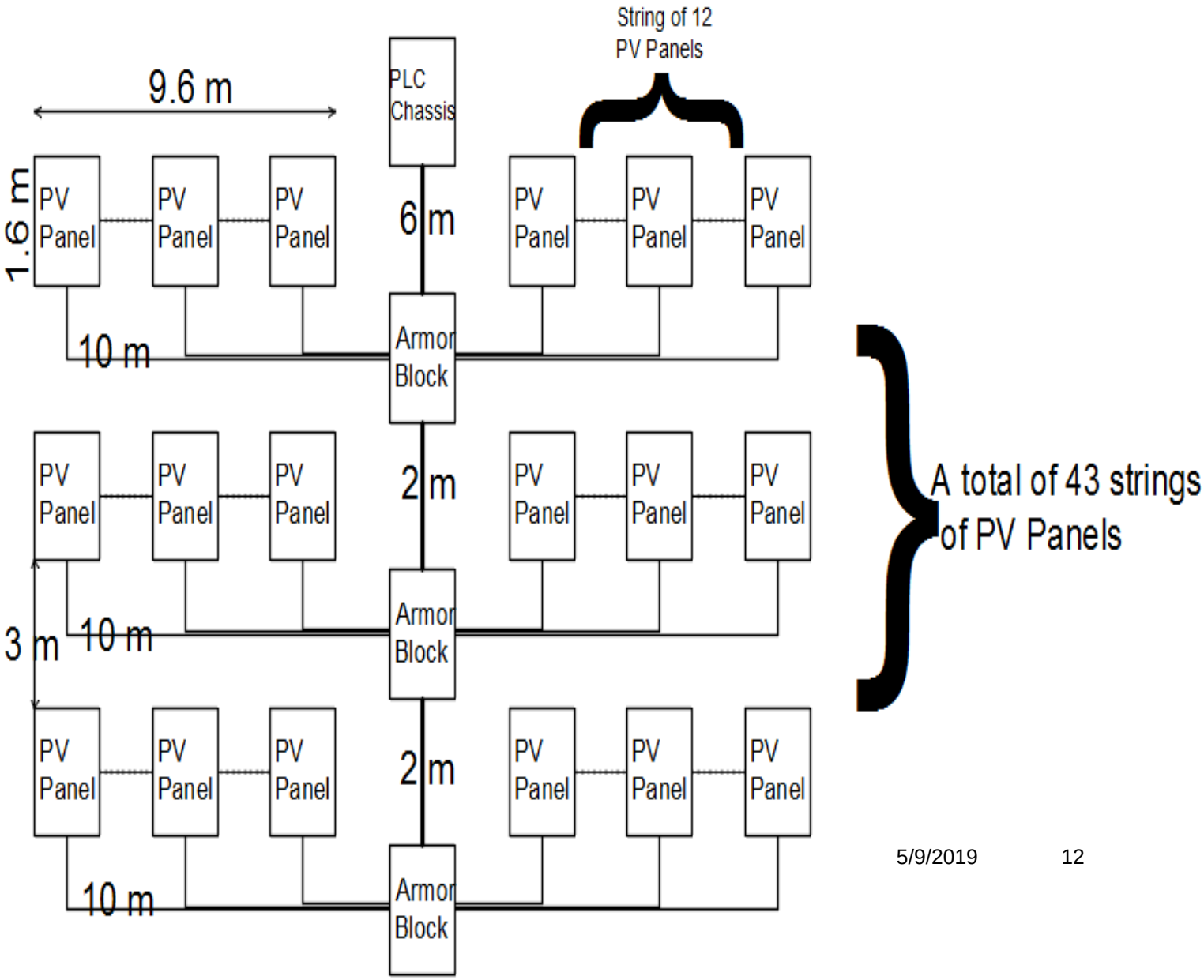
Design

- DeviceNet based system

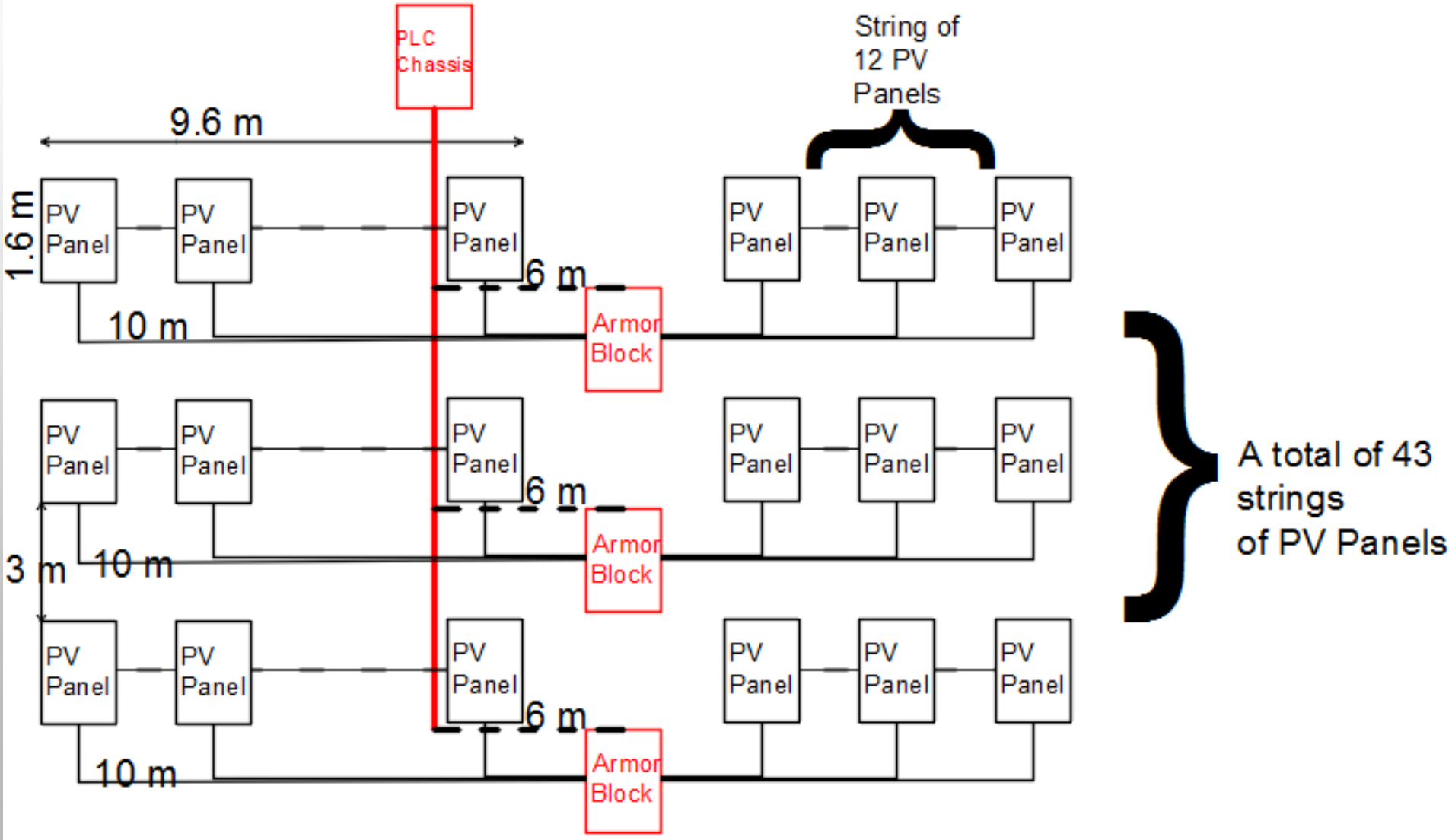
- PV farm with 93 KWp
- Three different scenarios
    1. ArmorBlock
    2. Flex
    3. ArmorPoint

Scenario I: Using ArmorBlock

- Area= 3162 m^2
- 516 PV panel
- 43 Strings
- 12 PV panels per string
- 16 points per ArmorBLOCK
- 1 complete row per ArmorBlock for T
- 2 complete rows for I and V readings
- 22 ArmorBlocks

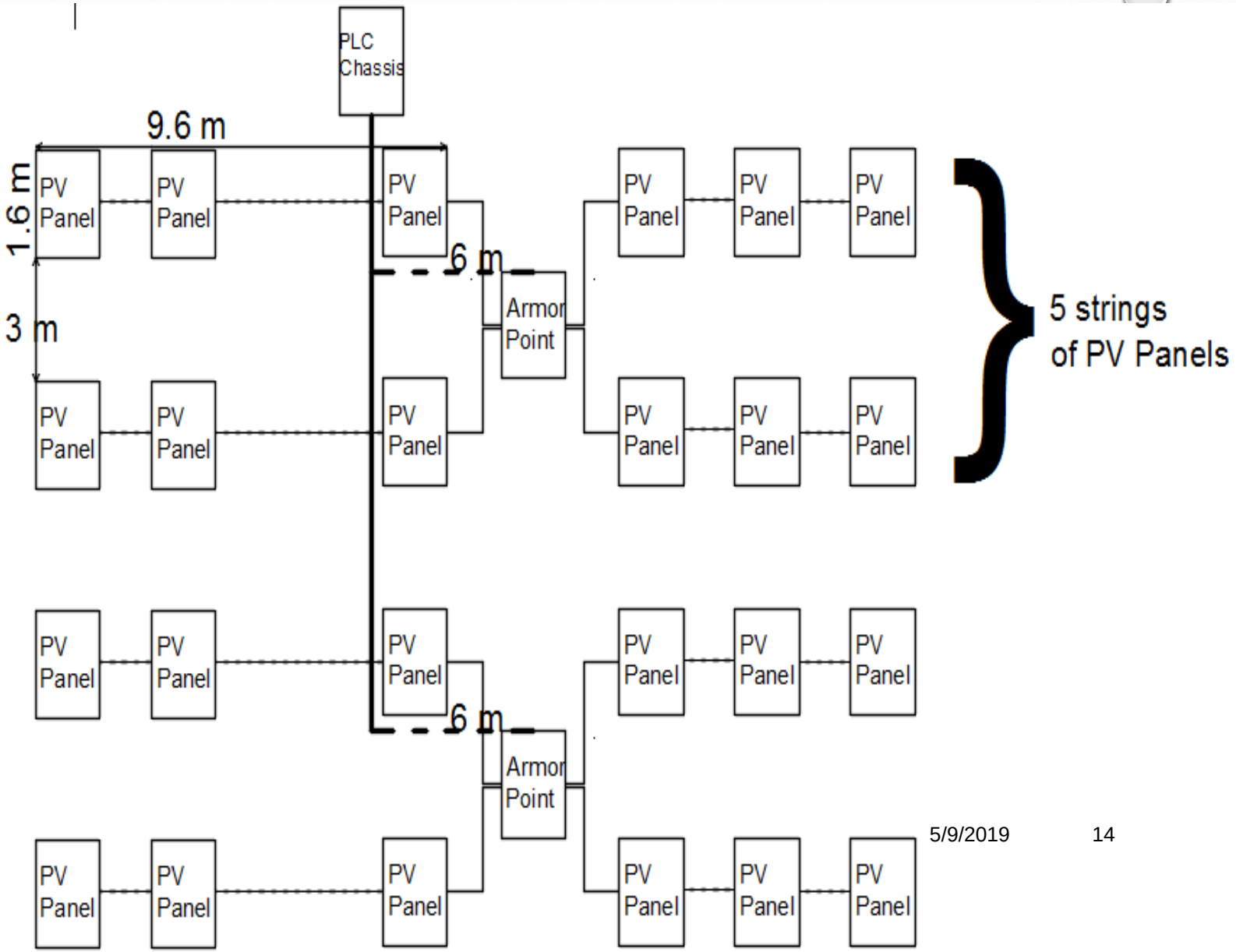


Scenario I Redistributed



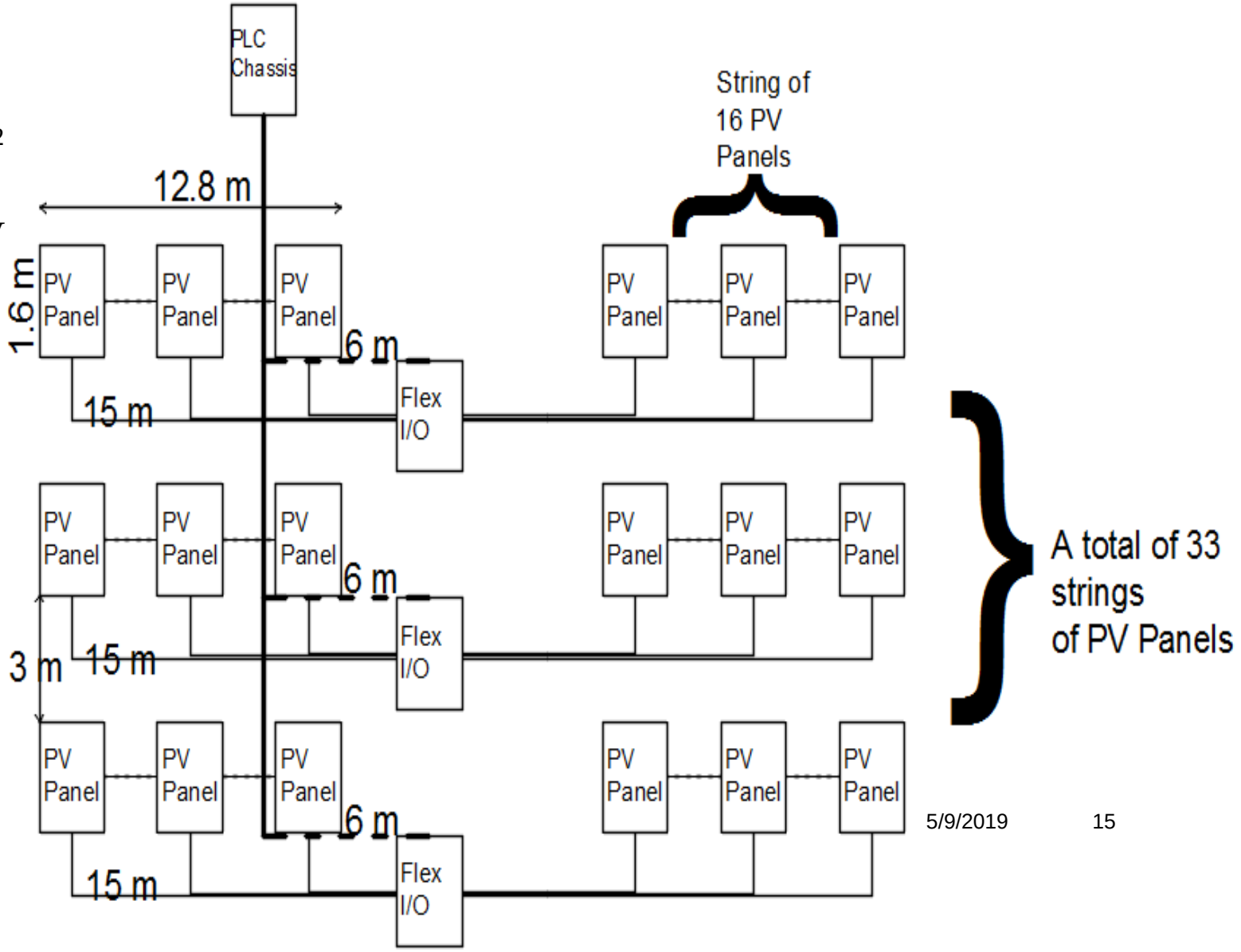
Scenario II: ArmorPoint

- Area= 3162 m^2
- 516 PV panels
- 43 string of PV panles
- 12 PV panels per string
- 63 I/O modules per ArmorPoint
- 5 complete rows per ArmorPoint
- Five ArmorPoints



Scenario III: Flex I/O

- Area= 2090 m^2
- 516 PV panels
- 33 string of PV panles
- 16PV panels per string
- 17 Flex I/O
- 1 complete row per Flex I/O
- 96 analog inputs



SCADA V.S. Thermography V.S. W.S.N.

Thermography	WSN	SCADA
Strongly affected by weather	Affected by weather	Independent of weather
	Limited number of controlled sensors	Expandable
No readings	Non-precise feedbacks	Higher precision of feedbacks
	Master-slave protocol only	Several protocols are available
Wireless communication only	Wireless communication only	In addition to cabling, wireless is available
Non-secured transfer of data	Non-secured transfer of data	More secured transfer of data
	Non-feasible access	HMI availability
Simple	Complex configuration	Simple configuration
	High power consumption	Moderate power consumption
High lifetime cost	High lifetime cost	Low lifetime cost

Cost Analysis

System	Cost ($)	Operation & Maintenance
Thermography	29895	High
W.S.N.	14478	Very High
SCADA (ArmorBlock)	4501.39	Medium
SCADA (ArmorPoint)	17504.46	Medium
SCADA(Flex)	13749.09	Medium

Conclusion and Future Work

- Maintenance and optimization of PV systems are essential needs.
- The proposed SCADA is more reliable than current systems.
- The proposed SCADA is expandable and can handle several scenarios and situations.
- The proposed SCADA is characterized by cost effectiveness.
- It has the capability to handle inputs, outputs, and power.
- New horizons to get more precise feedbacks to be considered.
- Increasing efficiency by controlling outputs (Rotary axes).

Thank You
Q & A