**Cloud based Real-time Analytical Monitoring of Photovoltaic Systems and Weather Parameters**

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**Document Control**

1. **Document History**

The following table tracks information regarding new and revised versions of this document and briefly describes the changes made.

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1. **Document Approvals/Key Contacts**

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1. **INTRODUCTION**

## Purpose

The Solar Energy Research Institute of Singapore (SERIS) conducts research, development, testing and consulting on solar energy technologies and their integration into power systems and buildings. SERIS is globally active but focuses on technologies and services for tropical regions, in particular for Singapore and South-East Asia.

The aim of the project is to develop a cloud-based platform for integrating and managing real-time Analytical Monitoring of PV systems performance - from small rooftop systems to large ground-based PV power plants in the multi-MW range across different climate zones. Collected data will be used for extensive research programmes on yield projections, which are of vital importance to project developers as well as investors and degradation studies of PV modules & systems.

## Intended Audience

The intended audience of this document includes following:

1. Research Cluster of PV Modules.
2. Research Cluster of Solar Energy Systems.
3. Project developers.
4. **SCOPE AND BENEFITS**

This software requirement specification document is stating the detailed explanation of the architecture, functionalities and specifications of the Cloud based Real-time Analytical Monitoring of Photovoltaic Systems project. This document is going to serve as a guideline for the users as well the development team.

The objective of the Technical Supplement is to describes how to establish requirements and define specifications for these systems and how to assure traceability of the data that is generated. The specific target audience within these organizations includes those who have direct responsibility for Researchers.

The Cloud based Real-time Analytical Monitoring of Photovoltaic Systems solution will provide the functional framework/process flow for all the sections of the process with the necessary validations, the interfaces and reports for the corresponding sections.

Main features which fall under this business requirements scope for Cloud based Real-time Analytical Monitoring of Photovoltaic Systems are as follows.

| **No** | **Scope** | **Benefits** |
| --- | --- | --- |
|  | **Central Web portal** | Development and Design of the Web Framework for efficient visualization of the incoming data from remote stations. This includes the interaction between the backend systems and database. |
|  | **Integration with Central Monitoring System** | Design and Develop Integration Modules for data communication to remote stations, Database and customised services. Integration systems will enable information exchange and between various sources into easy to deliver format. |
|  | **Setting up Cloud Database** | Design and Development of database for acquired data from real-time workloads. |
|  | **Access Control and Data Security** | It is required to developed and configure VPN connections between remote devices to Central Monitoring Server Application with highest data security by using Virtual Private Cloud. |
|  | **Dashboards and Analytics** | Design graphs and charts, to display the weather and DC/AC electrical parameters from various remote sites. Based on the real-time data, data analytics shall be done on system health and performance. |

## Business Benefits

The business benefits of the solution are as follows:

1. Single and Centralized platform for users to process the structured data from remote stations.
2. Automated data capture for the structured and semi structured parameters.
3. Interface with other backend systems within the organization.
4. Audit trail capability and reconciliation of the incoming data

## RoadMap Alignment

This System is aligned to the technology road map of SERIS Technology to seamlessly integrate with other system for data communications.

## Constraints and Assumptions

The business benefits of the solution are as follows:

1. Base version of application with following set of interfaces will be available.
2. All partner systems will provide the required interface to integrate with Cloud based Real-time Analytical Monitoring of Photovoltaic Systems.
3. Required Hardware and Software infrastructure will be made available in SERIS. The server and database are stored, managed and maintained by the SERIS, which is also responsible for maintaining the system and ensuring its qualification.
4. The Sensors and Readers is installed at the Remote site, but the software, server and database are hosted by the system. The data are collected, stored and managed by the system whilst the SERIS has access to the data through a secure web interface.
5. Application Development would be done by the MTECH SE25-PT07.

## Definitions, acronyms, and abbreviations

This System is aligned to the technology road map of SERIS Technology to seamlessly integrate with other system for data communications.

1. **OVERVIEW OF REQUIREMENTS**

## Introduction

## System Perspective

## System Functions

Main System Functions which needs to be implemented are as follows:

1. The Function allows the user to enter into the application. The user is required to provide username and password. It specifies the access and usage privileges of authenticated users and client applications. After authentication user will have access to main menu. Availability of menu functions depends on user’s level.
2. This function allows the user with appropriate permissions to combine list of Devices/locations into a group. The System should allow the Users to create, edit, copy and delete User Groups.
3. The System should allow the Users to maintain roles to be assigned to the business users. It is through these Roles that the User Permissions are controlled. As a first step you must maintain at least an administrator role.
4. The System allows the user with appropriate permission to browse list of all roles existing in the system.
5. The System should allow the Users to create, edit, copy and delete configurable parameter for each created IOT devices. The system allows all sensor parameters to be configured and customized by users.
6. The System allows the user with appropriate permission to browse list of all devices existing in the system.
7. The system allow Sensors continuously collect and buffer data, even during network outages and power cuts. The buffered data should then be sent to the host server when the connection is re-established. Ideally, sensors should have a built-in data storage capability so that they can also act as data loggers.
8. The system allows the wireless sensor network should automatically detect and incorporate newly installed sensors.
9. The System allows to build a cloud-based monitoring system to reduce the cost of maintaining servers, to avoid data losses and to make the access easy with multiple internet connected devices (computer, tablet, mobile phone) at the same time anywhere in the world.
10. The System allows to build Cloud technology to offer high degrees of agility and the ability to collect huge volumes of data from the enterprise and beyond.
11. The System allows PV system device to generates a very high volume of 1SECOND and 1MINUTE unstructured data at high velocity. The System able to collect and retrieve 1SECOND and 1MINUTE of unstructured data from a variety of devices and store it in Cloud Database. There are various industrial and remote areas it requires to monitor and update the status to the Cloud database.
12. The System allows these unstructured data to be formatted into structured data format based on the device parameters configuration.
13. System allows Data Synchronization and provides consistency among the "Synchronizer systems" that have access to Structured data. Data synchronization prevents data conflicts. Synchronized, trustworthy structured data is essential for security, and a wide variety of operational functions.
14. The system allows user to record structured data to be accurately and in real-time, and should be provided in the form of reports, charts, and graphs, which users are able to customize.
15. The Web-based systems to be user-friendly and they are required to perform complex operations. Web-based systems allow the data to be stored in the internet ‘cloud’ rather than at a specific facility.

## User Characteristics

1. **FUNCTIONAL REQUIREMENTS**

This section describes the functional requirements of the Real-time Analytical Monitoring of Photovoltaic Systems. The functional requirements Real-time Analytical Monitoring of Photovoltaic Systems are structured in terms of:

1. **User Management Requirements** – The User management requirements of the modules implemented in this project.
2. **Central Monitoring System along with Predictive Analytics** –
3. **Data, Storage and Data Security Requirements** – The data, storage and Data security requirements generic to the whole system and for the modules defined in this document.
4. **Dashboards and Analytics Requirements** – Perform Real-Time, Big data and Predictive Analytics to deliver the enriched enterprise data to identify services and to improve customer satisfaction for the modules defined in this document.

## User Management Requirements

The User Management System can control unauthorized access in this project. User management system provides functionality to manage personal profiles and users. Personal profiles contain information such as profile identification number, email, first and last name, etc. Personal profiles are used for personal information such as names, addresses, etc. In order to access personal profile for reading and modification PIN number is used for authentication. User information contains user identification number, username, password and session for authentication. User information is used for high-level authentication and privileges definitions. One or more personal profiles are assigned to a user. In addition, there are user groups for the purpose of group specific privileges and profile roles for application specific need related to the user’s role in the system.

1. Implement advanced login with encrypted passwords, brute force protection and Highly secured access control.
2. An advanced admin panel is provided with access to managing users and Multi-level user access.
3. All registered users are viewed in report page
4. A powerful User Role function allows to give access to specific members to various areas of the site.
5. Administrators can easily determine who is logged in at any time and also view other information such as the associations between users and IP addresses.

## Central Monitoring System along with Predictive Analytics

## Data, Storage and Data Security Requirements

## Dashboards and Analytics Requirements

1. **NON-FUNCTIONAL REQUIREMENTS**