The Implementation of the Automatic Dispatching System (ADS) to Support the Smart Grid Pilot Project for Distribution Grid Improvement in Sumba Island

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Education

- **Received Master of Science in Electrical Engineering, University of Arkansas, USA, 2017**
- **Received Bachelor Degree of Electrical Engineering, University of Brawijaya, IDN, 2003**

Awards

- **Fulbright Scholarship Degree Program, funded by US State Bureau of Educational and Cultural Affair and US Fulbright Scholarship Board. 2017**

Professional Experiences

- **Manager of Digitalization in Power Generation & Transmission, Digital Management Division**
- **Manager of Project Management and Integration, PMO Division**

Publications and Activities

- **The Future of PV Photovoltaic Development in Indonesia. 2nd International Conference Green Technology and Engineering (2nd ICGTE 2009), Indonesia, ISSN 1978-5933, 2009**
- **Transformer Diagnostic Methods on its Insulation System. Diagnostic Measurement on International Power Transformer Seminar (DMPT 2010), Omicron Asia, Singapore, 2010**
- **Renewable Energy Grid Integration In Indonesia. Asia Clean Energy Forum, Manila. 2015**
- **Investigation of Low-Voltage Solid-State DC Breaker Configurations for DC Microgrid Applications. PEDG Conference, Austin. TX, 2016**
- **DC Arc Fault Detection System in PV Using Discrete Wavelet Transform. PLN Energy and Electrification Journal. Jakarta. 2017**
- **The Grid Interconnection Study of Renewable Energy in the Distribution system to ensure Safe Grid Integration: Case Study of PV Grid Connected in Indonesia, The 2019 General Meeting and PIESA-IERE South Africa Forum. 2019**

Purpose and Contribution of Our Paper

In our paper, we aimed at :

1. Evaluate the system performance of distribution grid using ADS (Automatic Dispatch System), and impact of the PV's penetration level in the power system.
2. Develop model of ADS in isolated Grid

Contributions of Our Study :

1. We suggested the proposed algorithm of ADS, and its model through simulation study under different conditions
2. We proposed the ADS conceptual and installation design in the isolated grid
3. We informed how the ADS capability to maintain the system stability during the fluctuations of PV's operation

Sumba is one of the Favourite Tourist Destination

The Current Condition of Sumba Power System

Power Generation Composition

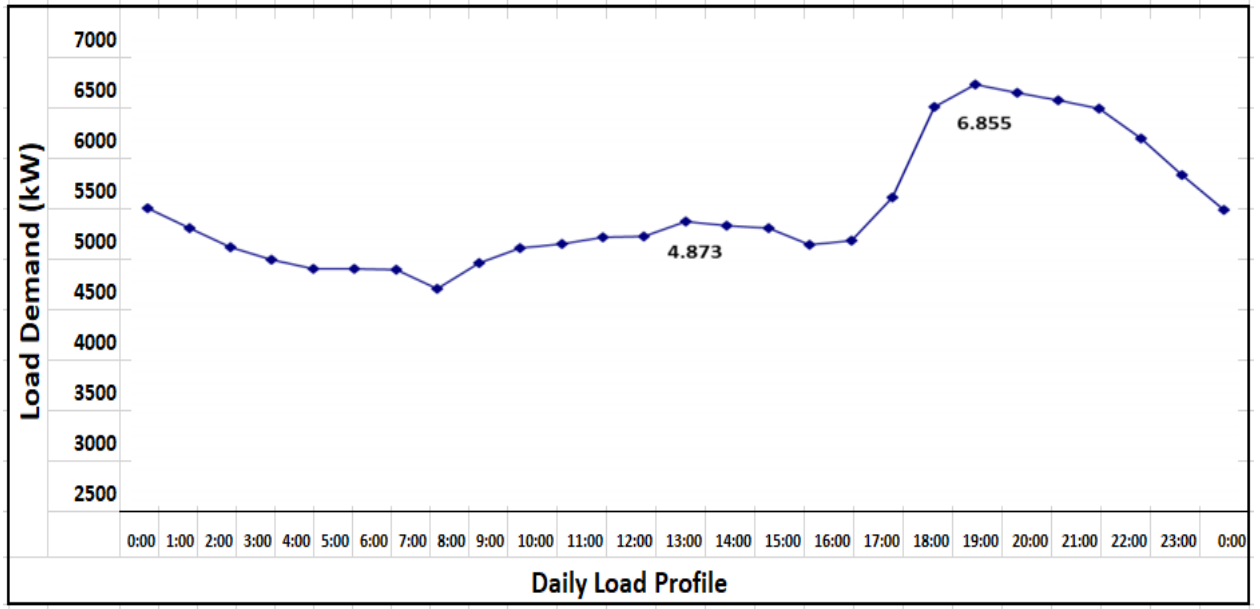
Diesel Generation : 11 MW

Biomass power : 1 MW

PV : 1 MW

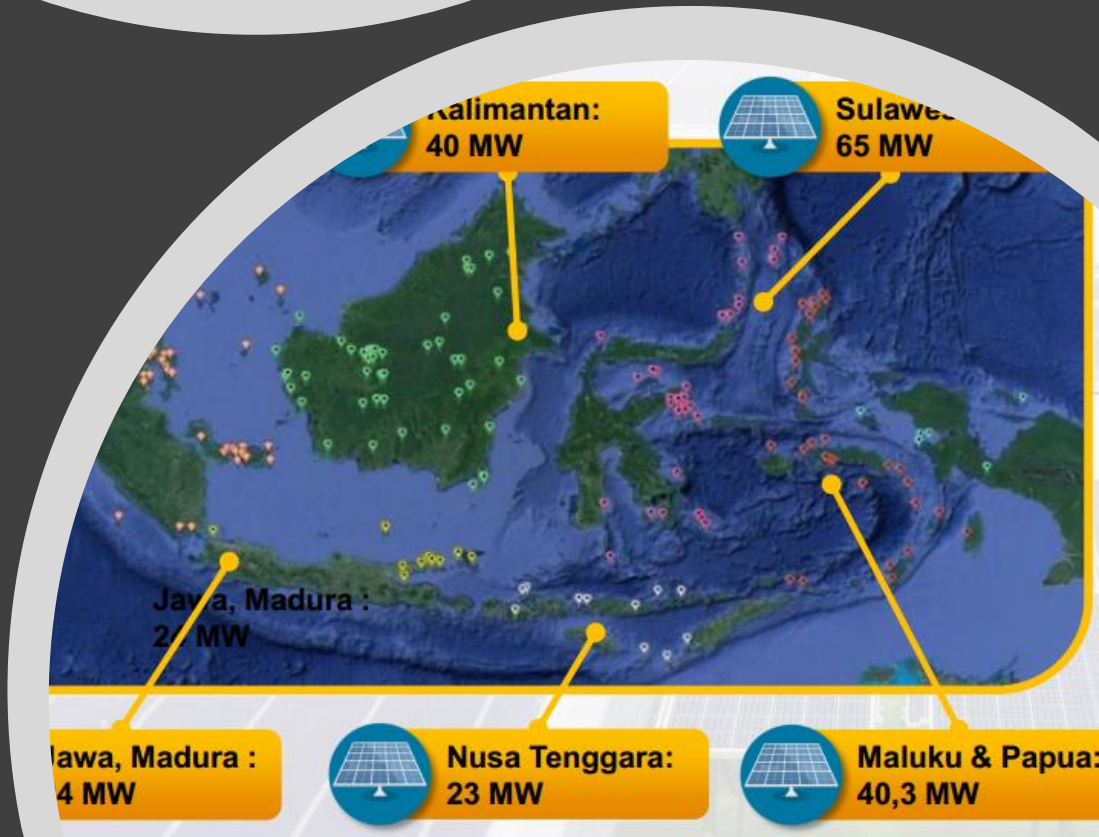
Micro hydro : 1 MW

The peak-load occurred at 6.8 MW, and during the daytime load, concurrent with the maximum Solar PV generation, fluctuates between at 3.7 MW – 4.8 MW



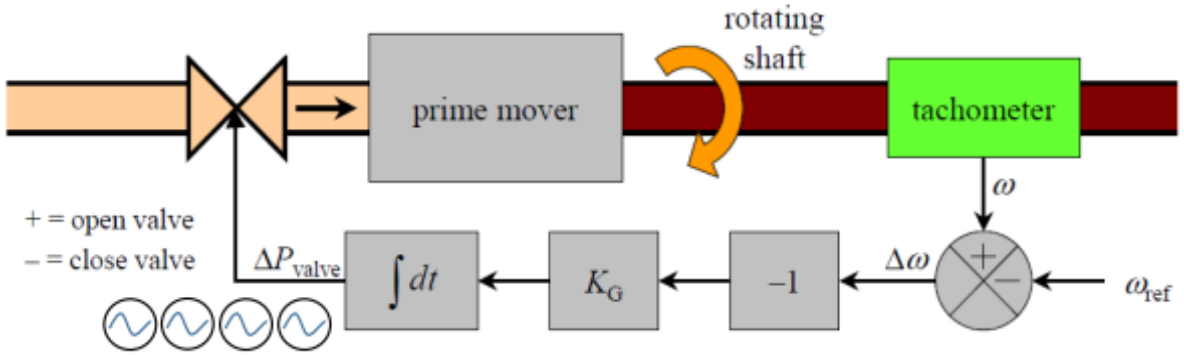
Problem Statement

1. The penetration of PV on the isolated grid makes it difficult to maintain the frequency stability of the isolated grid
2. This intermittent power output causes frequency fluctuation
3. Manual dispatch of electrical power manually by isolated grid's DTG has a low ability to respond to rapid changes
4. The Challenges from PLN's Breakthrough Program to expand de-dieselization with total installed capacity 200 MW



What is ADS ?

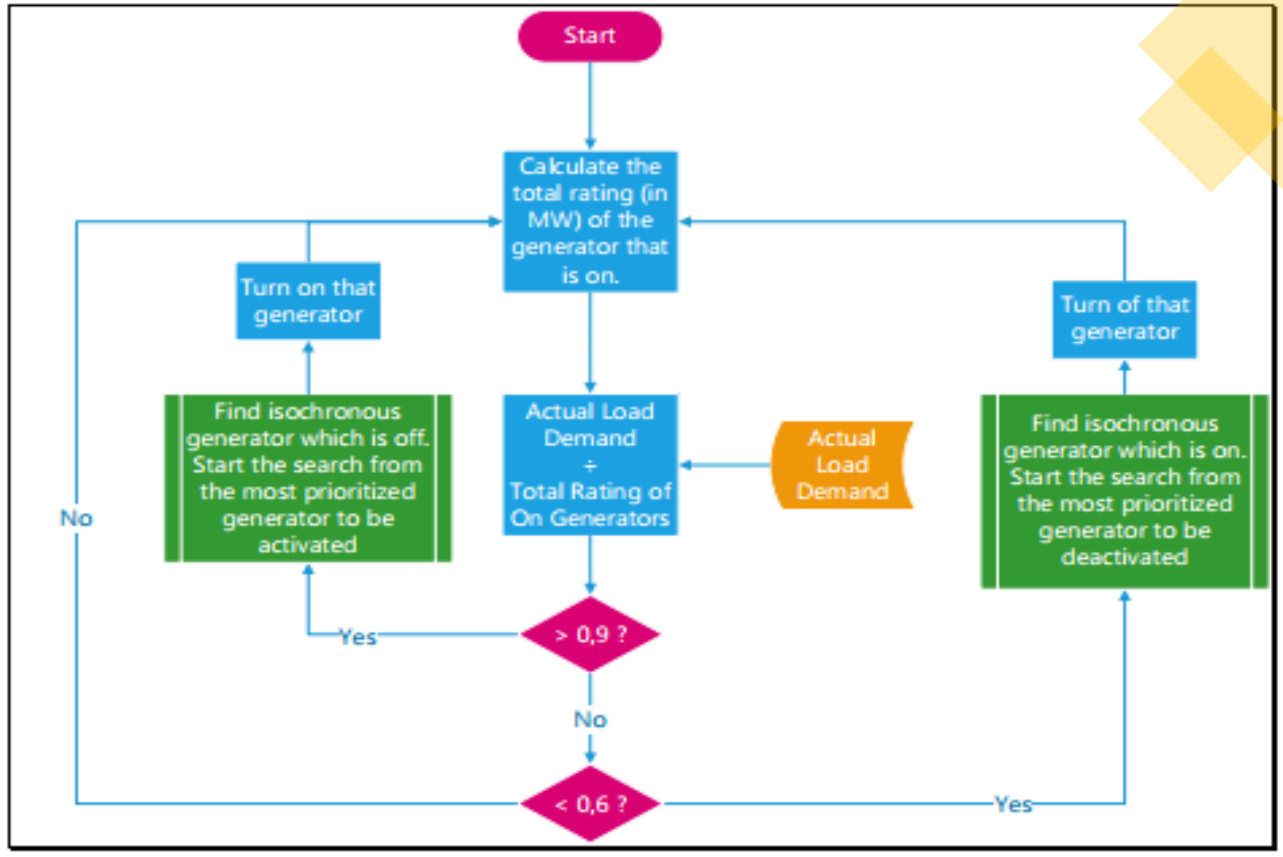
1. Automated dispatching control system (ADS) is a control system tool which has function to monitor the system of the load flow in power network from various power generation
2. ADS is a monitoring and power management system which has role to control the frequency and switch the generation sources based on the load demand.
3. It is used to manage the various power supply characteristics capable of meeting the fluctuation of their load demands.



Control Basic Architecture Design of the ADS System

ADS Work Mechanism

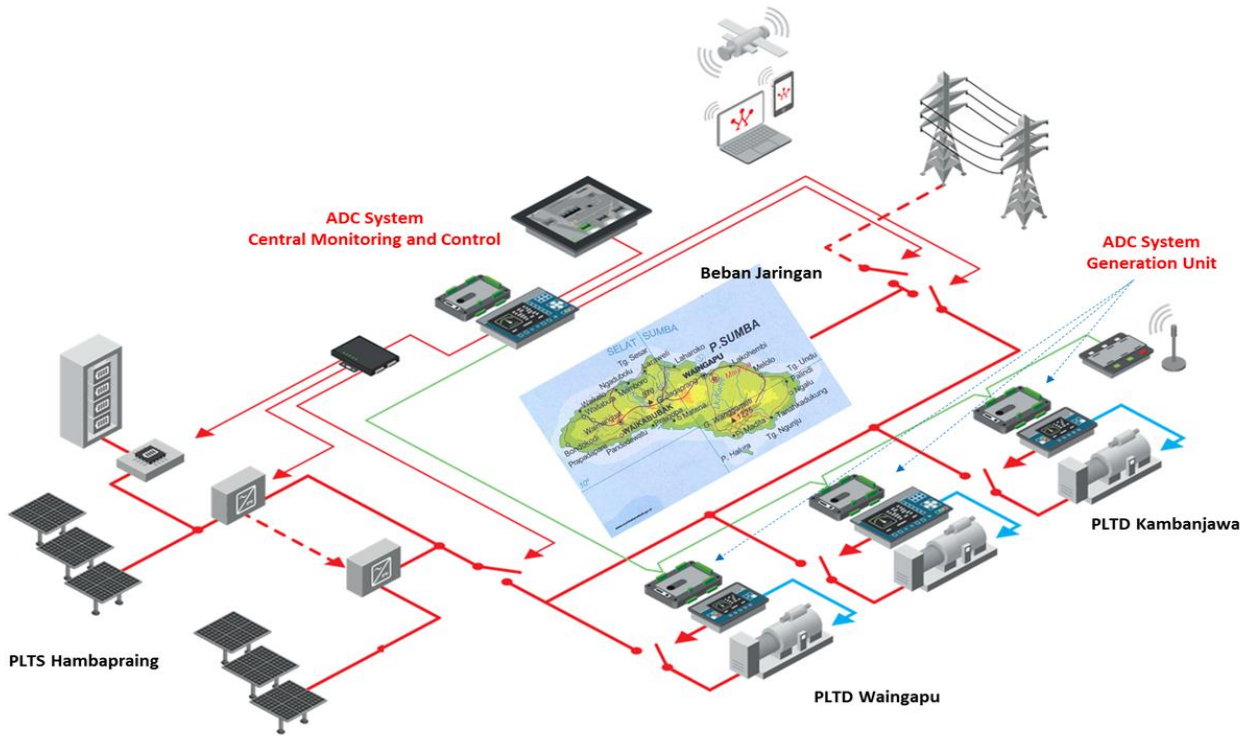
1. PLN's DG will be given the ability to respond to changes in load. These used to supply peak loads. So, DGs can work with droop governor or with the isochronous governor.
2. ADS is provided with an algorithm to turn the isochronous generator off and on when the load is either too low or too high.
3. the generator needs to be switched on when the load is getting high since the load will not get sufficient sources.
4. ADS reflects Multiple Generator status and



Algorithm of ADS Operation

Generation Range Capacity (MW)	Unit Number	Installed Capacity per Unit Size
DG > 1	1	1.2 MW
0.3 < DG < 1	4	0.5 and 0.7 MW
DG < 0.3	7	0.25, 0.27 and 0.3 MW

ADS Configuration in Distribution Grid



The proposed of ADS configuration

Design Principles

Definition

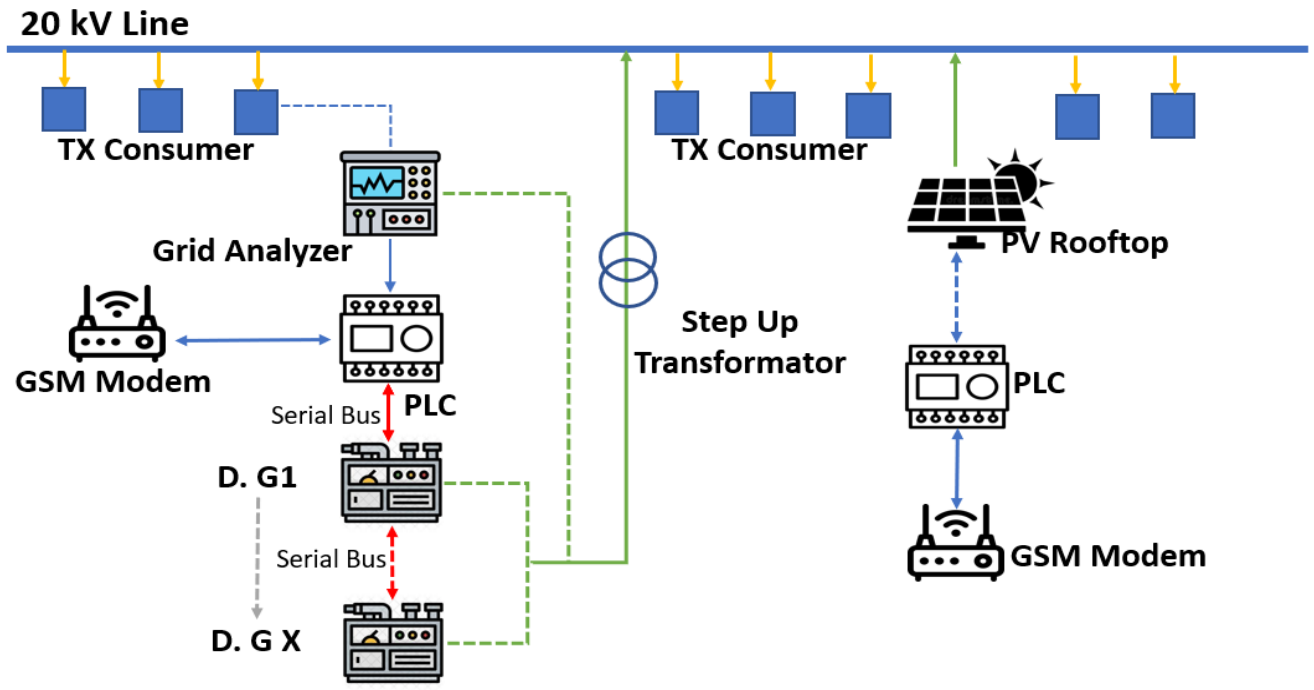
ADS is capable to enter the electricity and energy market, as well as to accommodate the energy mixed. Thus, it integrates grid analyzer, data acquisition, main control unit, communication module, PLC, sensors and modem to provide distributed multi-level measuring and information centralized system of real-time operating. Hence, It is designed for monitoring and control of technological processes and equipment of electric power facilities in the island

Capabilities

1. Determination of the current status of switching elements;
2. measuring of current values of process parameters activation/ deactivation of controlled site;

Conceptual Layout of Proposed ADS

ADS Configuration



Basic Layout of Proposed ADS

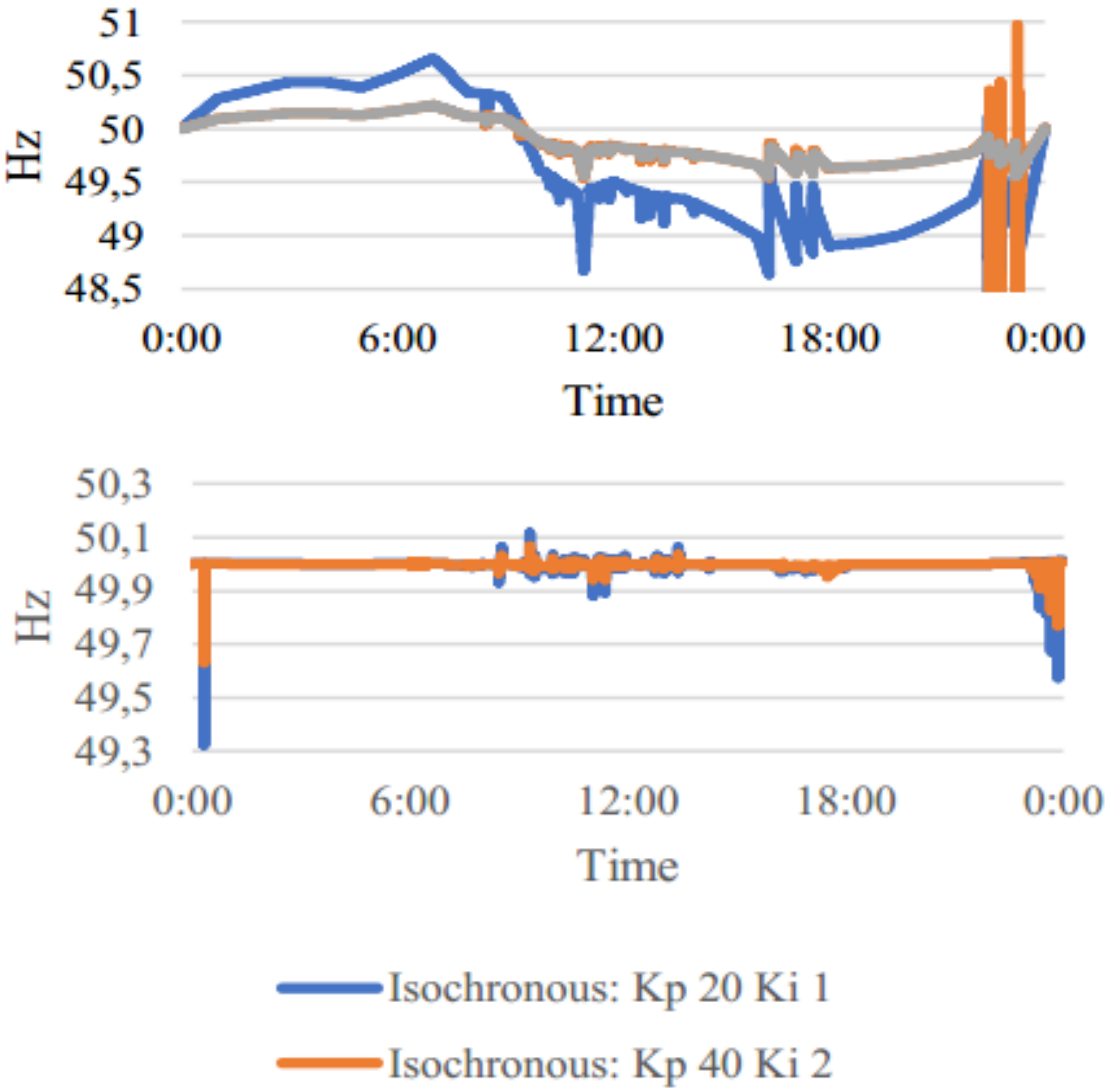
Depending on model, grid analyzer can read the grid from the LV bus (Op 1) or from a consumer type step down transformer on the main HV out comer (Op 2). The PLC can be replaced by a full-size computer or a Laptop computer. GSM modems or more complex telecoms can be implemented for remote management and/or integrate with an
active solar Scada.
The basic requirements to be implemented for a smart grid, consists of [1] :

1. All flexible generators to be operated exclusively in full range load following mode, with minimum operation setting defined at 30% or lower and maximum operation setting defined at 80%
2. All flexible generators to have ECU's, electronic governors and Modbus and, optionally, TCP/IP protocols.
3. Integrate them in the ADS/AGC system for automatic and sequential dispatching of the generators according to grid load behavior

operated exclusively in full range load following mode,

Simulation Study

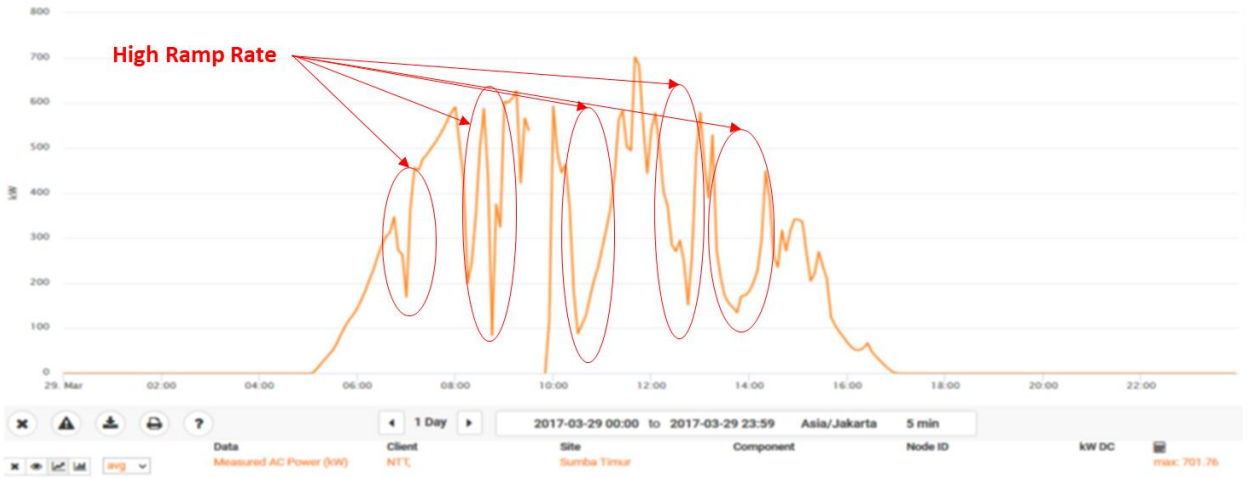
1. The simulation study conducted in different use cases which consisted : the combination of 9-unit PLN's DG with primary controller, and 3 units Isochronous governor; and fully 12 units DG with Isochronous governor.
2. Those scenarios are simulated to verify the output frequency within its in normal range. The study indicated that frequency trajectory from the interconnection of Unit PLN's DG with Droop Governor and Unit PLN's DG with Isochronous Governor.
3. Maximum duration of ADS communication delay that the control system can manage (so the frequency does not overshoot/undershoot outside the range) is around 998 to 1109 milliseconds.



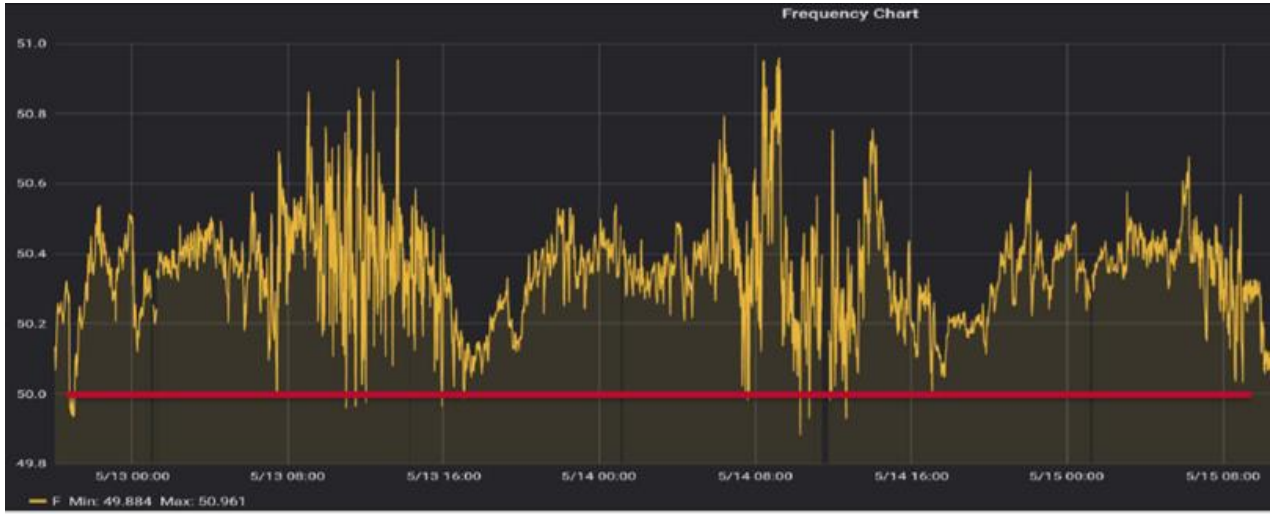
Frequency path with combination of Droop and Isochronous governor

Before ADS Installation

Design Principles



Typical electricity production of the Solar PV 1 MWp



Typical electricity production as the impact of the Solar PV's operation

the PLN East Sumba electricity network is also equipped with a Hambapraing PV with a capacity of 1 MWp. It can be seen that the Hambapraing PV has a power output that varies with time.. It can be seen that the
PV has a power output that varies with time. The penetration of PV on the isolated grid makes it difficult to maintain the frequency stability of the isolated grid network in the event of intermittent PV's power output.

Before ADS installation through manual management, fluctuated frequency occurred above the normal range.

After ADS Installation

Design Principles

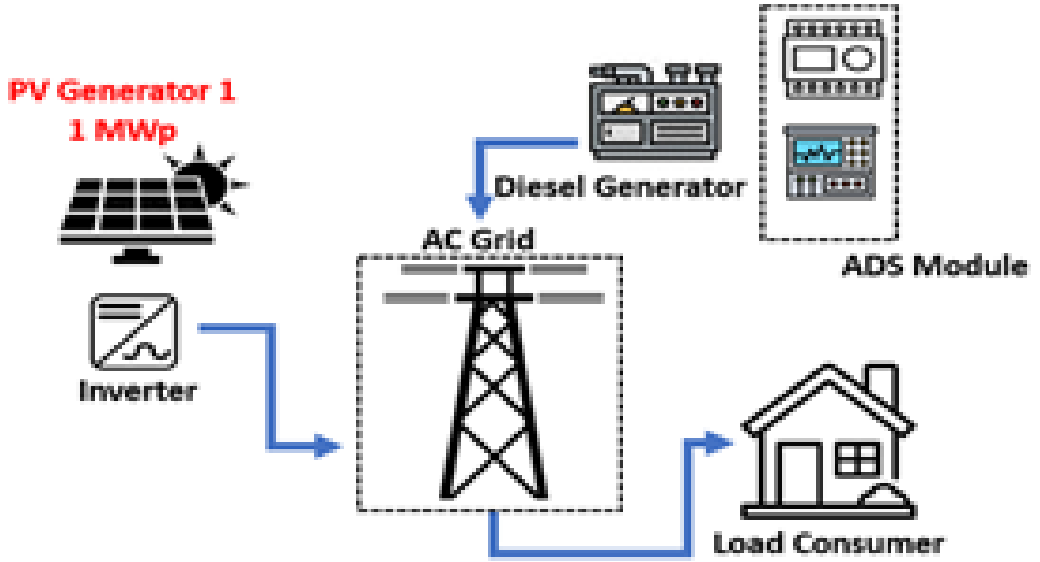
Typical electricity production in the system

ADS has primary roles to maintain the frequency stability in its nominal ranges (+/- 5%) by adjusting mechanical power in the power generations. Consequently, the fluctuated of the frequency range is minimized to normal level. Hence, by having ADS implemented, it reduced spillage losses and maintain ramping rate in its nominal value.

In addition, ADS has the option to have selectable Interconnection to other grids to share resources, for example in smart grid dan hybrid power system technology

The development Strategy for smart grid can be executed by

1. Conduct Simulation and Grid impact study
2. Sizing and design of diesel buffering engine/engines
3. DG units should be equipped with ECU/Modbus controls
4. Sizing Solar PV up to 20 – 40 % of DG's capacity
5. Apply Data acquisition units in all grid key nodes



The project outline for Diesel Reduction and PV integration

CONCLUSION AND FUTURE WORKS

- ADS has proven capable of maintaining frequency stability in the system that contains intermittent power generation. Both the simulation, and actual measurement testing, it can maintain the stability frequency within normal range (49,5<Hz<50,5)
- The ADS implementation is possible to raise smart grid's operational performance, and provide reliability, thus service quality power to their consumers, while minimizing the operation cost
- ADS implementation and grid monitoring system can be considered as the main part in integrating variable renewable energy into small power network, not only to compensate the fluctuations characteristics of VRE
- The Lesson Learned from ADS installation, testing and operation boosted PLN's understanding and confidence to replicate the innovation to increase VRE integration in the upcoming de-dieselization program

PLN

TERIMA KASIH

MUCHAS GRACIAS !