Commisioning Test of 3 x 3kW Solar Power Plants for Laboratory Purpose

by Marhatang Marhatang

Submission date: 30-Jul-2023 06:12PM (UTC-0700)
Submission ID: 210885404
File name: 10._Jurnal_INTEK_2022.pdf (499.85K)
Word count: 1332
Character count: 6729

INTEK Jurnal Penelitian
Vol. 10, No. 1, pp. 60-63, April 2023

Commisioning Test of 3 x 3kW Solar Power Plants for Laboratory Purpose

A. M. Shiddiq Yunus[1,*,a], Nur Hamzah[1], Musrady Mulyadi[1], Firman[1], , Yusuf Yunus[1], Marhatang[1], Chandra Bhuana[1], and Yiyin Klistafani[1]
[1] Mechanical Engineering Department, State Polytechnicof Ujung Pandang,
Jalan Perintis Kemerdekaan KM. 10 Makassar 90245
[*,a] Corresponding Author: shiddiq@poliupg.ac.id

***Abstract*— The laboratory is an important thing in the learning and teaching process so it is very necessary to upgrade both in terms of equipment and in terms of laboratory management standards. State Polytechnic of Ujung Pandang has carried out the design process for a solar power plant (SPP) system with a capacity of 3 x 3kW to support the learning process related to alternative and renewable energy lectures and practicum. One part of the procedure for activating newly installed laboratory equipment is the commissioning test. From the commissioning results, the results show that 3 x 300 Wp and independent 375 Wp SPP can work well with an average DC voltage rating of 80 V and for AC loads with an average voltage of 220 V. All types of loads, both AC and DC can work properly after going through the DC Couple and AC Couple with the inverter.**

Keywords—SPP; Commisioning; DC Couple; AC Couple

I. Introduction

The need for new and renewable energy is increasing from year to year so that construction projects and installations of power plants based on new and renewable energy throughout the world have reached 3064 GW in 2021 [1]. One of the popular energies is SPP which until the end of 2020 has installed 788 GW globally [2]. Some of the advantages of solar power plants are free energy sources, low maintenance costs and not very site specific [3]-[5].

To support the need for skilled workers in the field of renewable energy such as SPP, educational institutions need to prepare resources, both human resources and supporting facilities and infrastructure.

One strategy that can be applied is the teaching factory, which is an approach to industrial activity that is brought to the laboratory or class to conform to industry standards [6].

The laboratory is a very important part of the education and teaching system, especially in vocational higher education. Activities in the laboratory are not only for practicum but also for research activities [7]. Therefore laboratory development is a must, especially if the laboratory is related to curriculum development and study programs that also use the laboratory.

State Polytechnic of Ujung Pandang as a leading vocational education institution in eastern Indonesia, continues to improve itself by opening several new study programs and continuing to develop its curriculum based on industry needs. One of them is related to the need for a laboratory to support the learning process of theory and practice related to alternative energy. Therefore in 2022 the design and procurement of a 3x3 kW solar will be carried out. To ensure the appropriateness of the laboratory that is manually designed, a commissioning test is required to fulfill the experimental results [8].

DOI : http://dx.doi.org/10.31963/intek.v10i1.4279

II. Methodology

The study was carried out using the stages as shown in Figure 1.

Figure 2 shows the layout of a SPP system consisting of a DC coupling and an AC coupling, including SCC, battery, inverter and generator.

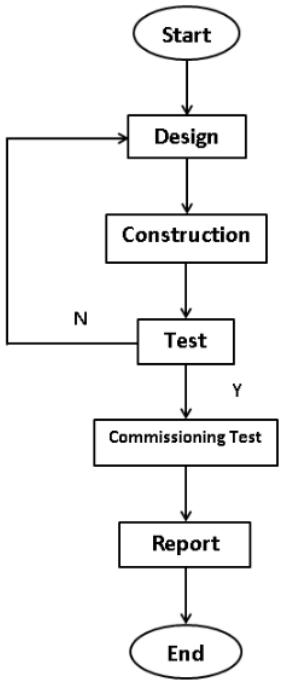

Figure 1. Stages of the study

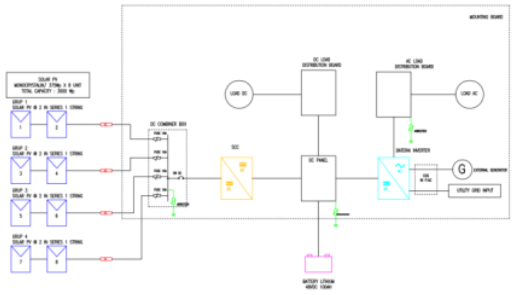

Figure 2. Singe line Diagram of the SPP system for the Laboratory Purpose.

DOI : http://dx.doi.org/10.31963/intek.v10i1.4279

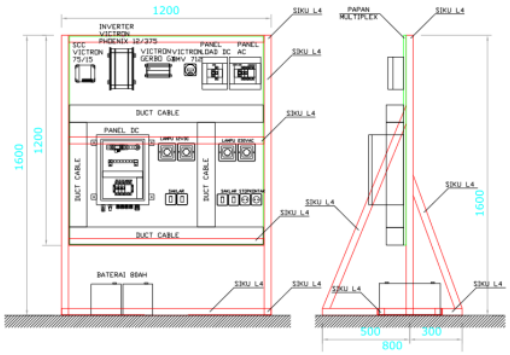

Figure 3. Layout of the SPP system for the Laboratory Purpose.

III. Results and Discussion

Figure 4-Figure 7 shows the physics of the SPP located in the Renewable Energy Building at the Ujung Pandang State Polytechnic.

Figure 4. 375 Wp Solar Panel

Figure 5. 3 kWp Solar Panel-1

Figure 6. 3 kWp Solar Panel-2

Figure 7. 3 kWp Solar Panel-3

Commisioning results is shown in Tabel 1- Table 3.

Table 1. SCC Commissioning Test Result

Merk and Type	Outback FM80	SMA Sunnyboy	Victron SCC
Installed Capacity	4000 Watt	3000 Watt	400 Watt
Number of Installed SCC	1	1	1
Output Voltage	48 V	220 V	24 V

Table 2. Battery Commissioning Test Result

Merk and Type	BiruBatt 6648100	Nagoya	Nagoya
Capacity and Voltage per Cell	100 Ah, 48 V	100 Ah, 12 V	100 Ah, 12 V
Number of Total Battery	1	4	2
Number of Battery in Series	1	4	2
Number of Battery in Parallel	1	1	1

Table 3. Inverter Commissioning Test Result

Merk and Type	Outback	Sunny Island	Viction
Installed Capacity	5700VA	3000 W	375 W
Number of Total Installed Inverter	1	1	1
Number of Phase	1	1	1
Input Voltage	220 V	220 V	-
Output Voltage	220 V	220 V	220 V
Frequency	50 Hz	50 Hz	50 Hz

AC Couple Voltage

Group Array 1: 344.7 Volt

Current at Array 1: 0.4 A

DC Couple Voltage

Group Array 2: 81.8 Volt

Current at Array 2: 13.2 A

SHS

Group Array 3: 27. 5 Volt

Current at Array 3: 1.42 A

Measurement of DC Load

Lamp 1: 24 Volt, 5 Watt

Lamp 2: 24 Volt, 5 Watt

Measurement of AC Load

Lamp 1: 220 Volt, 5 Watt

Lamp 2: 220 Volt, 5 Watt

The possible jobs that would be applied to students including stand-alone DC and AC Couple, grid connected and also hybrid with other sources such as gen-set.

DOI : http://dx.doi.org/10.31963/intek.v10i1.4279

IV. Conclusion

From the commissioning tests, the results show that 3 x 3 kWp and independent 375 Wp SPP can operate well with an average DC voltage rating of 80 V and for AC loads with an average voltage of 220 V. All types of loads, both AC and DC can work properly after going through the DC Couple and AC Couple with the inverter.

Acknowledgement

Authors would like to thank RESD-SWISS and Matching Fund Support for the realization of this study.

References

[1] https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2022/Apr/IRENA_-RE_Capacity_Highlights_2022.pdf?la=en&hash=6122BF5666A4BECD5AAA2050B011ECE255B3BC7

[2] https://www.pv-magazine.com/2022/03/15/humans-have-installed-1-terawatt-of-solar-capacity/

[3] R. Klyuev, O. Gavrina and M. Madaeva, "Benefits of Solar Power Plants for Energy Supply to Consumers in Mountain Territories," 2019 International Multi-Conference on Industrial Engineering and Modern Technologies (FarEastCon), 2019, pp. 1-6, doi: 10.1109/FarEastCon.2019.8934222.

[4] Q. Wang, W. B. Hobbs, A. Tuohy, M. Bello and D. J. Ault, "Evaluating Potential Benefits of Flexible Solar Power Generation in the Southern Company System," in *IEEE Journal of Photovoltaics*, vol. 12, no. 1, pp. 152-160, Jan. 2022, doi: 10.1109/JPHOTOV.2021.3126118.

[5] I. M. Kirpichnikova and A. A. Maliugina, "The energy efficiency of photovoltaic power plants," 2016 2nd International Conference on Industrial Engineering, Applications and Manufacturing (ICIEAM), 2016, pp. 1-3, doi: 10.1109/ICIEAM.2016.7911464.

[6] F. Behrendt, O. Lehner, A. Rettmann, N. Schmidtke and T. Wollert, "Process analysis of a teaching and learning factory environment to demonstrate Industry 4.0 solutions by using the Smart Logistics Zone approach," 2022 IEEE 6th International Conference on Logistics Operations Management (GOL), 2022, pp. 1-10, doi: 10.1109/GOL53975.2022.9820054.

[7] O. Chornyi, S. Serhiienko, A. Yudyna and V. Sydorenko, "The analysis of the process of the laboratory practicum fulfillment and the assessment of its efficiency on the basis of the distance function," 2017 International Conference on Modern Electrical and Energy Systems (MEES), 2017, pp. 328-331, doi: 10.1109/MEES.2017.8248924.

[8] J. B. Cornette, J. D. Sterrett, J. R. Lippert and R. W. Williams, "Final design and commissioning test results for the hypervelocity launcher research complex battery power supply," 7th Pulsed Power Conference, 1989, pp. 131-133, doi: 10.1109/PPC.1989.767441.

DOI : http://dx.doi.org/10.31963/intek.v10i1.4279

Commisioning Test of 3 x 3kW Solar Power Plants for Laboratory Purpose

ORIGINALITY REPORT

14%	14%	11%	10%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to School of Business and Management ITB Student Paper	7%
2	Submitted to Queen Mary and Westfield College Student Paper	2%
3	www.abdoslifesciences.com Internet Source	2%
4	mts.intechopen.com Internet Source	1%
5	Muhammad Arsyad. "Sodium Hydroxide and Potassium Permanganate Treatment on Mechanical Properties of Coconut Fibers", IOP Conference Series: Materials Science and Engineering, 2019 Publication	1%
6	autodocbox.com Internet Source	1%

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	On		