CERTIFICATE

ICMA SURE 2022
INTERNATIONAL CONFERENCE ON MULTIDISCIPLINARY APPROACHES FOR SUSTAINABLE RURAL DEVELOPMENT

THIS CERTIFICATE IS PRESENTED TO

Hari Prasetijo

WITH THE TITLE

Improved Over Current Relay (OCR) Coordination Using Time Multiple Setting (TMS)

IN RECOGNITION OF THE OUTSTANDING CONTRIBUTION AS

Presenter(s)

ON INTERNATIONAL CONFERENCE

5 th International Conference on Multidisciplinary Approaches for Sustainable Rural Development 2022

" ICMA-SURE 2022 "

" The Advanced Strategies To The Development of Rural Resources For A Smart Society "

Purwokerto - Indonesia, November 8-9, 2022

Prof. Dr. Rifda Naufalin, S.P., M.Si.
Head of LPPM Jenderal Soedirman University

Improved Over Current Relay (OCR) Coordination Using Time Multiple Setting (TMS)

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Abstract. Proper coordination between overcurrent relay (OCR) is needed to improve the reliability of the power distribution system. By choosing the proper time multiple setting (TMS), an optimum setting of OCR coordination can be achieved. This study improve working time coordination of OCR bay transformer using time multiple setting. Simulations were carried out to see the performance of the OCR bay transformer against a 3 phase short circuit on the 20 kV outgoing bus. The 3 phase short circuit was chosen because it produces the largest fault current among other types of short circuits. The discussion focuses on the OCR bay transformer, consist of OCR incoming 20 kV and OCR outgoing 150 kV. Existing data and calculation results were used as a parameter in the simulation. Simulation results with existing tms 0.21 and 0.23 for OCR incoming 20 kV and OCR outgoing 150 kV, respectively, have the potential to cause miscoordination of the OCR working time. Smaller short circuit current, bigger potential miscoordination. Resetting tms improves coordination of OCR bay transformer working time according to the standard used. Bigger value of tms, as long as it meets the standar, better OCR working time coordination to protect phase-phase fault current.

1. Introduction

About 80% of faults in the electric power system are in the electric distribution system. About 70–80% of this fault is a ground fault, whereas 10–17% is a phase–phase to ground fault, 8%–10% is a phase–phase fault, and 2%–3% is a three–phase fault [1,2,3,4]. Although less common than phase-ground faults, the phase--phase fault currents are larger. Three phase fault current is a phase to phase fault with the largest fault current [5,6].

Overcurrent protection is the easiest technique to safeguard a power distribution system. In the event of a fault, the current would grow to several times the maximum load current. The overcurrent relay is a type of overcurrent protection, particularly for phase-phase faults [7,8]. The overcurrent relays measure the fault current and compare it to the preset for the relay current. When the current level exceeds the relay's current setting, the relay sends a trip signal to the Circuit Breaker (CB) after a delay, isolating the faulty region [9].

Improving the reliability of the power distribution system necessitates coordinated efforts amongst OCR. A power distribution system's reliability is defined as its capacity to provide uninterrupted service to customers. If the circuit breaker closest to the source was operational, it would indicate a decrease in system reliability due to an increase in customer power outages [10].

The relay settings should therefore be properly updated in every region of the power system. By choosing the time multiple setting (TMS), an optimum setting of overcurrent relay coordination (OCR) coordination can be achieved [11]. The range of the time multiple setting is 0 to 1. Therefore, when the

time setting is 0.1, the moving portions of the relay only need to move 0.1 times their entire distance in order to close the contact. An electrical relay's operating speed is dependent on the fault current's intensity. Relays will respond more quickly (higher shortcircuit currents) or more slowly (lower shortcircuit currents) depending on the current value detected by CTs in inverse-time OCRs because of their inverse time-current characteristic (higher short-circuit currents). In general, definite-time characteristics (with an instantaneous trip function) are designated for larger currents whereas inverse-time characteristics are often reserved for lower currents [12].
This study improve working time coordination of OCR bay transformer using time multiple setting. OCR in electric distribution system consist of feeder OCR and bay transformer OCR. Bay transformer consist of medium and high side OCR, for example side of 20 kV and 150 kV OCR. When fault current is relatively small, working time delay between OCR of 20 kV and 150 kV side is small. This condition can cause miscoordination.

2. Methodology

The method in this study is calculation and simulation based on figure 1:

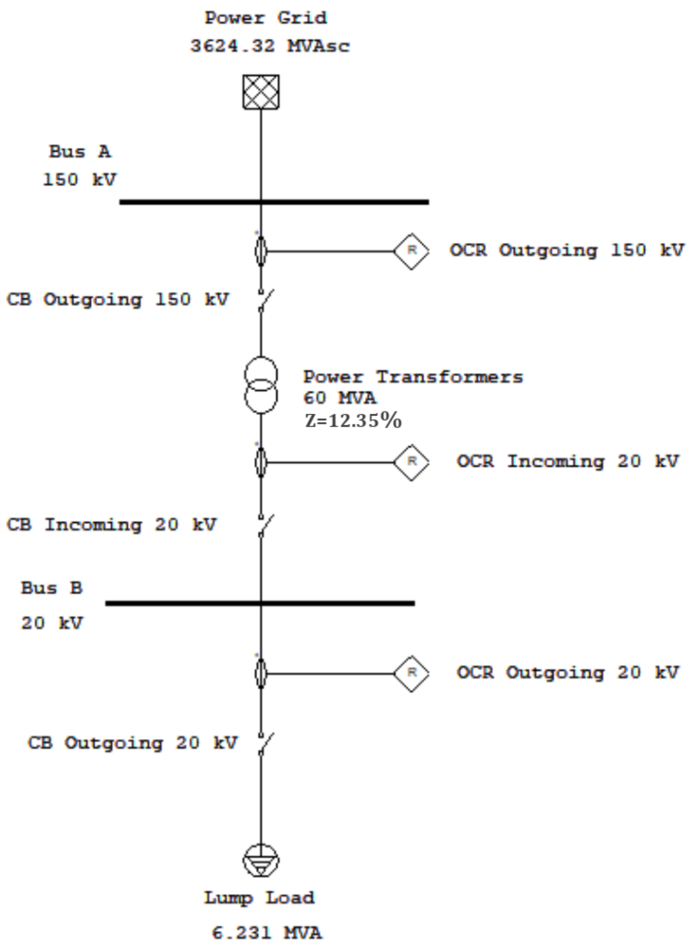

Figure 1. Single line study

There were calculations done to get:

a. Three phase fault current value (If_{3p}) at outgoing of 20 kV bus
b. Setting time and tms outgoing 20 kV, incoming 20 kV, incoming 150 kV

Simulations were done to analyze and improve bay OCR coordination, consist of OCR incoming 20 kV and incoming 150 kV.

3. Result

3.1. Three phase fault current at outgoing of 20 kV bus

Fault current value influence by a positive sequence fault impedance at outgoing of 20 kV bus :

$$Z_1 = Z_s + Z_t$$

with :

Z_1 = positive sequence fault impedance at outgoing of 20 kV bus

Z_s = network positif sequence impedance at 20 kV side,

Z_t = transformer positif sequence impedance at 20 kV side.

The impedance of a network's positive sequence on the 150 kV side is:

$$X_s = \frac{(V_p)^2}{MVA_{(sc)}}$$

$$= \frac{(150\ kV)^2}{3624,32\ MVA}$$

$$= 6.21\ \Omega.$$

Transformer positif sequence impedance at 150 kV side is :

$$X_t = 12,35\%\ x\ \frac{(V_p)^2}{S_t}$$

$$=12,35\%\ x \frac{(150\ kV)^2}{60\ MVA}$$

$$= 46.31\ \Omega$$

Positive sequence fault impedance at outgoing of 150 kV bus is :

$$Z_1 = 6.21\ \Omega + 46.31\ \Omega = 52.52\ \Omega$$

Three phase fault current value at primary side of transformer is:

$$If_{3p} = \frac{V_{ph}}{Z_1} = \frac{\frac{150.000\ V}{\sqrt{3}}}{46.31} = \frac{11,547}{\sqrt{52.52}^2} = 1648\ A = 12.284\ kA$$

The impedance of a network's positive sequence on the 20 kV side is:

$$X_s = \frac{(V_p)^2}{MVA_{(sc)}} \times \frac{(V_s)^2}{(V_p)^2}$$

$$= \frac{(150\ kV)^2}{3624{,}32\ MVA} \times \frac{(20\ kV)^2}{(150\ kV)^2}$$

$$= 0.11\ \Omega.$$

Positive sequence impedance at 20 kV side of a transformer is :

$$X_t = 12{,}35\% \times \frac{(V_s)^2}{S_t}$$

$$= 12{,}35\% \times \frac{(20\ kV)^2}{60\ MVA}$$

$$= 0.83\ \Omega$$

The positive sequence fault impedance at outgoing of 20 kV bus is :

$$Z_1 = 0.11\ \Omega + 0.83\ \Omega = 0.94\ \Omega$$

The three phase fault current value at secondary side of transformer is:

$$If_{3p} = \frac{V_{ph}}{Z_1} = \frac{\frac{20.000\ V}{\sqrt{3}}}{0{,}94} = \frac{11{,}547}{\sqrt{0.94}^2} = 12{,}284\ A = 12.284\ kA$$

3.2. OCR Current setting (Iset) calculation

Primary current setting ($I_{set(p)}$) of OCR outgoing 150 kV :
The OCR setting is 1.2 is equivalent to the lowest nominal current (In) of the equipment. In this case is the transformer. The primary side current of the transformer is 230.95 A.

$$I_{set\ (p)} = 1.2 \times I$$

$$= 1.2 \times 230{,}95\ A$$

$$= 277.14\ A$$

Primary current setting ($I_{set(p)}$) of OCR incoming 20 kV :
The secondary side current of the transformer is 1734.05 A.

$$I_{set\ (p)} = 1.2 \times I$$

$$= 1.2 \times 1734.05\ A$$

$$= 2080.86\ A$$

3.3. Time multiple setting (Tms)

Tms OCR outgoing 150 kV :

Tms can be determined using OCR working time (t). In this study the existing t = 0,92 s. The tms OCR outgoing 150 kV using the very inverse (VI) characteristic is:

$$t = tms \times \frac{0{,}14}{\left(\frac{If_{3p}}{I_{set}}\right)^{0{,}02} - 1}$$

$$0{,}92 = tms \times \frac{0{,}14}{\left(\frac{1.648{,}94}{277{,}14}\right)^{0{,}02} - 1}$$

$$tms = \frac{0{,}92}{3{,}89} = 0{,}23$$

Tms OCR incoming 20 kV :

In this study the existing OCR incoming 20 kV working time, t = 0,76 s. The tms OCR incoming 20 kV using the very inverse (VI) characteristic is:

$$t = tms \times \frac{0{,}14}{\left(\frac{If_{3p}}{I_{set}}\right)^{0{,}02} - 1}$$

$$0{,}76 = tms \times \frac{0{,}14}{\left(\frac{12.284{,}05}{2080{,}86}\right)^{0{,}02} - 1}$$

$$tms = \frac{0{,}76}{3{,}89} = 0{,}20$$

3.4. Simulation

Simulations were carried out to see the performance of the OCR bay transformer against a 3 phase short circuit on the 20 kV outgoing bus. The 3 phase short circuit was chosen because it produces the largest fault current among other types of short circuits, such as 2 phase and phase to ground. Existing data and calculation results from point 3.3. used as a parameter in the simulation circuit in Figure 2. The simulation results in the form of a coordination graph are shown in Figure 3. The discussion focuses on the OCR bay transformer, namely OCR incoming 20 kV and OCR outgoing 150 kV.

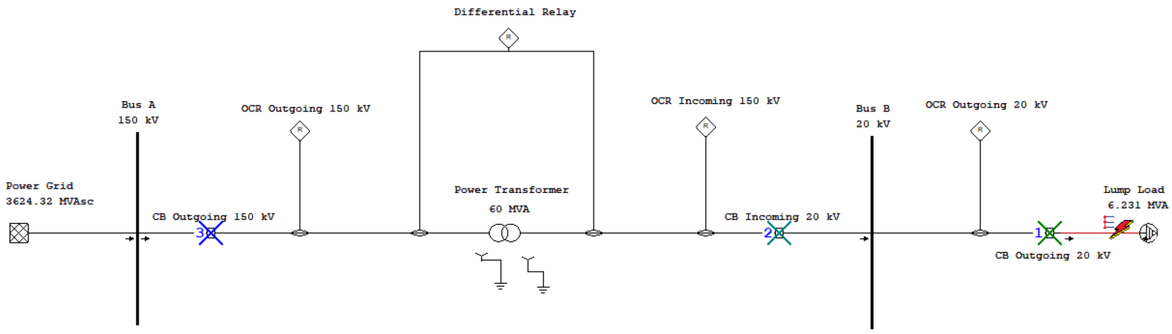

Figure 2. Three phase fault simulation at outgoing 20 kV

From the working time coordination curve in Figure 3, the x-axis shows the magnitude of the short-circuit current and the y-axis is the working time of the relay. If there is a phase-phase short circuit on the 20 kV outcoming bus, the 20 kV incoming OCR serves as the main protection of the bay transformer while the 150 kV outgoing OCR acts as a back up. The difference in working time for OCR incoming 20 kV with tms 0.21 and OCR outgoing 150 kV with tms 0.23 is very small and tends to get smaller when the current is getting smaller. This condition can cause incorrect operation, either the two OCR bays work at the same time or the outgoing 150 kV OCR works.

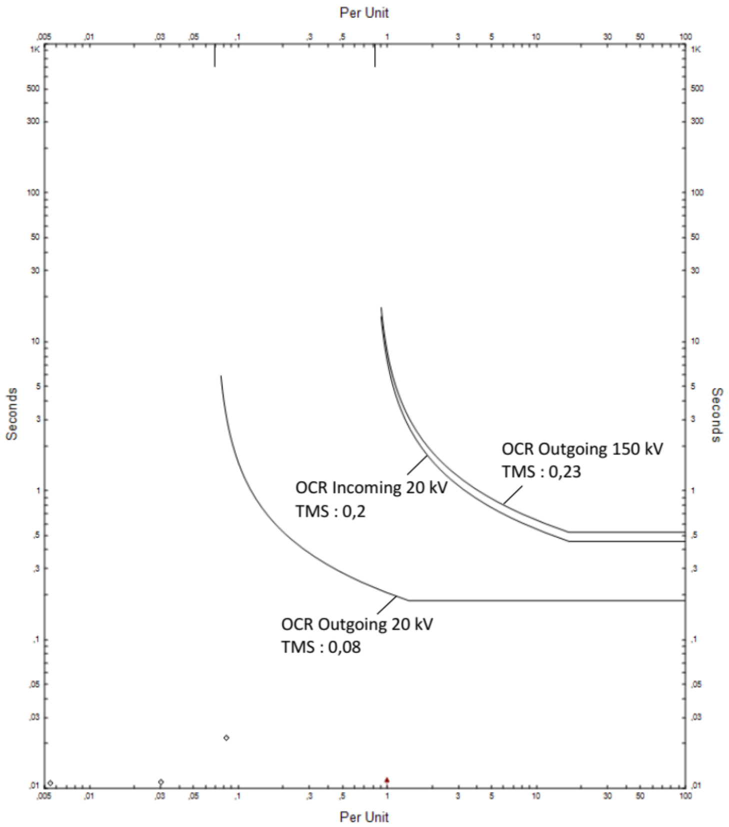

Figure 3. Result existing coordination OCR curve of three phase fault simulation at outgoing 20 kV

Resetting the OCR outgoing 150 kV dengan menaikkan the tms akan improve the working time coordination. Figure 4 shows the simulation results after resetting the tms on the OCR outgoing 150 kV from 0.23 to 0.53. The working time curve between the 20 kV incoming OCR as the main protection for the bay transformer and the 150 kV outcoming OCR has a better performance as a backup.

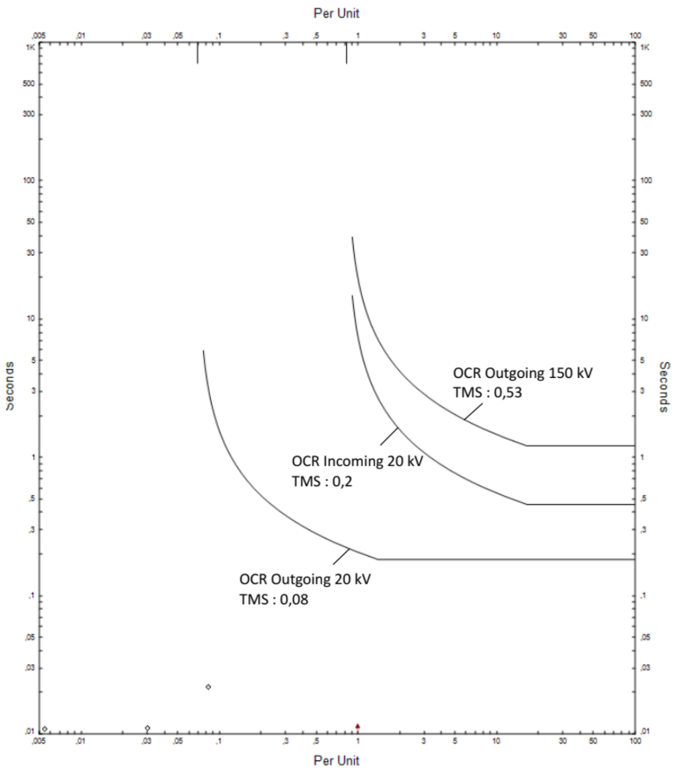

Figure 4. Result improvement coordination OCR curve of three phase fault simulation at outgoing 20 kV using tms

In implementation, resetting tms to improve the working time coordination OCR, must refer to international standards, such as IEC 60255 standards or other international standards. Working time coordination between relay according to IEC 60255 standard is 0.4-0.5 s. Figure 5 shows the results of resetting OCR outgoing 150 kV based on IEC 60255 standard, with a delay time between 20 kV incoming OCR and 150 kV outgoing OCR of 0.45 s, so the working time of 150 kV outgoing OCR is 0.76 s + 0.45 s = 1.21 sec.

$$1{,}21 = \text{tms} \times \frac{0{,}14}{\left(\frac{12.284{,}05}{2080{,}86}\right)^{0{,}02} - 1}$$

$$\text{tms} = \frac{1{,}21}{3{,}89} = 0{,}31$$

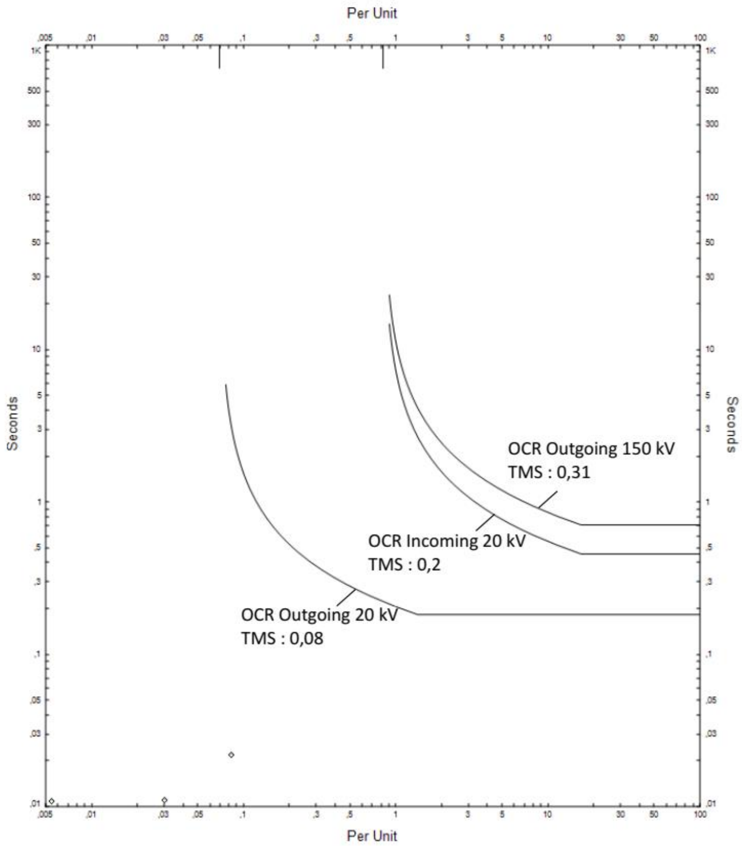

Figure 5. Improvement coordination OCR curve of three phase fault simulation at outgoing 20 kV using tms based on IEC 60255 standard

4. Conclusion

1. Coordination of working time of the existing OCR bay transformer with tms OCR incoming 20 kV = 0.21 and tms OCR outcoming 150 kV = 0.23, potential for miscoordination, especially at relatively low short circuit currents.
2. Resetting tms improves coordination of OCR bay transformer working time according to the standard used.
3. For the same short-circuit current, the larger the tms the longer the OCR working time. This can be seen from the graph of working time that shifts up.

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5 th International Conference on Multidisciplinary Approaches for Sustainable Rural Development (ICMA - SURE)

LETTER OF ACCEPTANCE AND INVITATION

Date : November 5, 2022
No. : 070/LoA/ICMA-SURE-2022

Dear **Hari Prasetijo**

Thank you for submitting your abstract for presentation at the 5th International Conference on Multidisciplinary Approaches for Sustainable Rural Development (ICMA-SURE) 2022. After reviewing your abstract, we are pleased to inform you that your abstract entitled:

Improved Over Current Relay (OCR) Coordination Using Time Multiple Setting (TMS)

ID Paper: 3268

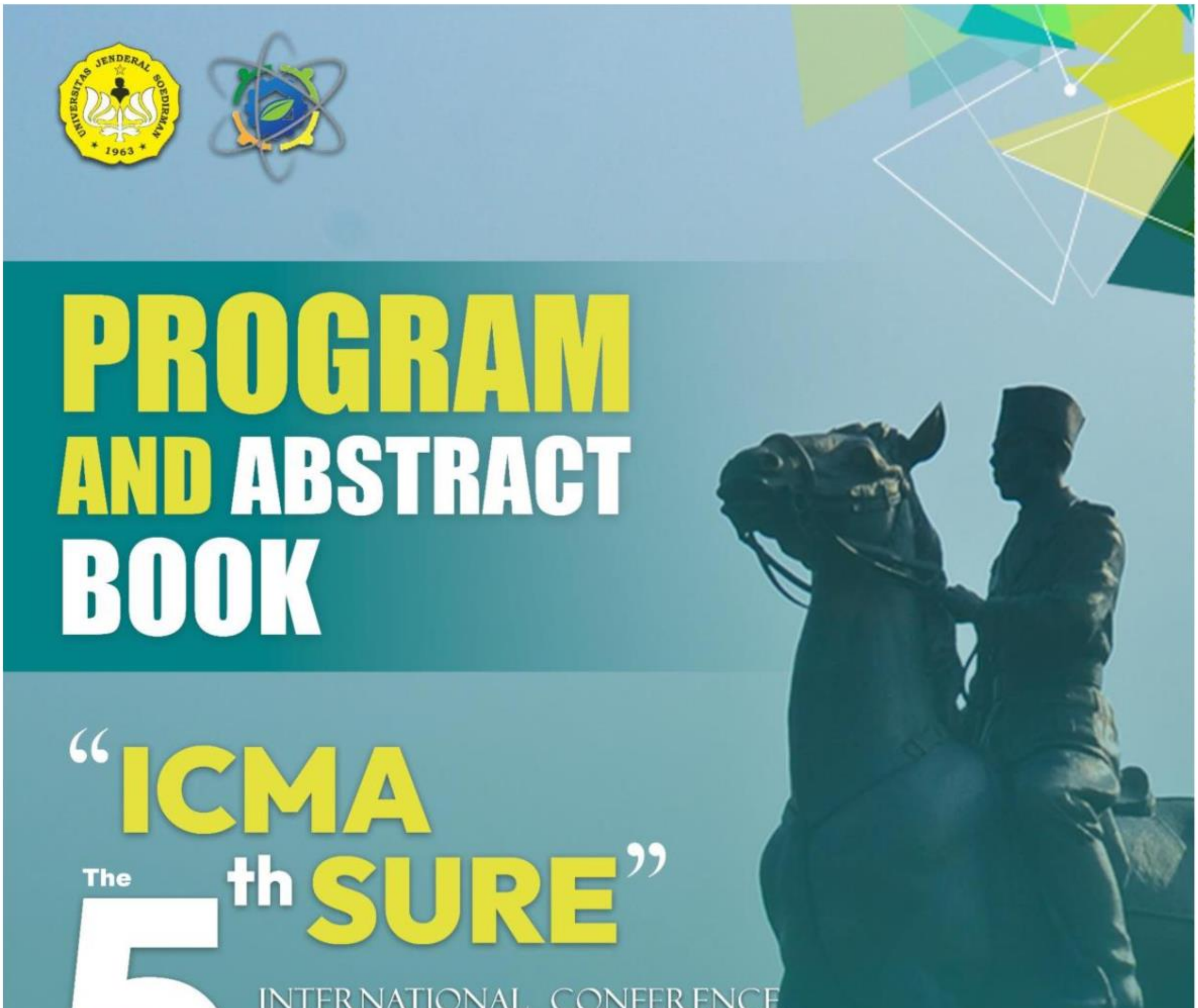
meets preliminary acceptance requirements set forth by our Scientific Committee to be presented as Oral Presentation at the conference. The conference will be held online on 8-9 November 2022 using the Zoom application.

The Oral/Poster Presentation Guidelines can be found at the following link:
https://icmasure.lppm.unsoed.ac.id/
Regarding the payment, you also need to re-register to get a bill number. Please make bill payments before 6 November 2022. The payment and re-registration steps are explained in the ICMA SURE 2022 Payment Guideline.

If you require any further information, please do not hesitate to contact us or visit our website.We look forward to seeing you at the conference.

Yours Sincerely,

Amin Fatoni, S.Si., M.Si., Ph.D.
Chairman of ICMA-SURE 2022


PROGRAM
AND ABSTRACT
BOOK
"ICMA
The 5th SURE"
INTERNATIONAL CONFERENCE
ON MULTIDISCIPLINARY
APPROACHES FOR SUSTAINABLE
RURAL DEVELOPMENT
ORGANIZED BY:
INSTITUTE OF RESEARCH AND COMMUNITY SERVICE (LPPM)
JENDERAL SOEDIRMAN UNIVERSITY
PURWOKERTO, CENTRAL JAVA
NOVEMBER, 8-9 2022

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COMMITEE

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GREETING FROM THE CHAIRMAN OF 5TH ICMA SURE 2022

Assalammualaikum Warrahmatullah Wabarakatuh

On behalf of the Committee, I am very pleased that the ***5th International Conference on Multidisciplinary Approaches for Sustainable Rural Development (ICMA-SURE)*** has attracted many scientist from Indonesia, Malaysia, Thailand, China, Vietnam, Korea and Japan as well as other countries. The registered abstracts in this conference were more than 100 articles covering wide variety of subject grouped, divided in three symposia of Material Science and Engineering, Life and Applied Science, and also Arts and Humanities. The given oral and poster presentation would show outputs for future need as indicated in the conference theme of "**The Advanced Strategies to The Development of Rural Resources for A Smart Society**".

The purposes of the conference are:

- to provide a forum for scientific discussion, professional networking, research collaboration, education, and dissemination of scientific research, innovation and industrial products.
- to increase the quality of research and development in the multidisciplinary approach for sustainable rural development.
- to encourage the local and regional young scientists to attend and present their works at the international level.

The success of the Conference would not have been attained without strong supports from contributing scientists and as well as Research and Society Service of Universitas Jenderal Soedirman Committee. I would like to thank all of them for helping to make a very successful conference. We hope that you will enjoy a pleasant and valuable conference organized by the Research and Society Service Institute, Jenderal Soedirman University.

Thank you

Wassalamualaykum *Warrahmatullah Wabarakatuh*

Amin Fatoni, Ph.D.

5th ICMA-SURE Chairman

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ICMA SURE 2022
INTERNATIONAL CONFERENCE ON MULTIDISCIPLINARY APPROACHES FOR SUSTAINABLE RURAL DEVELOPMENT

PLENARY SESSION SPEAKERS

Invited Speakers

Prof. (Em) Zainal Aznam Mohd Jelan
University Putra Malaysia

Dr. MD Sayed Uddin
University Malaysia Sabah

Amy Purwoko
Sealedair Singapore

Prof. Tao Liu
Xiamen University

Warissara Sorat, Ph.D.
Prince of Songkla University

Prof. Zhang Jing
University of Toyama

Dr. Ing. Suroso, S.T., M.Sc.
Jenderal Soedirman University

Dr. Icuk Rangga Bawono, S.H., S.E., M.Si., M.H.Ak.
Jenderal Soedirman University

Room 5 (Day-1)		
Moderator: Dr. Dadan Hermawan, S.Si., M.Sc.		
Zoom Link: https://bit.ly/ICMAParallel_Room5		
Time: 12.30 – 14.30 GMT+7		
No.	**Name**	**Title**
1.	Ari Asnani, Dadan Hermawan, Hendri Wasito	Phytochemical Analysis of Strobilanthes cusia
2.	Uyi Sulaeman, Yusuf Mathiinul Hakim, Dian Riana Ningsih	Design of Ag_3PO_4/AgCl/g-C_3N_4/PtCl62â€' quaternary photocatalyst for enhanced photocatalytic and antibacterial activity
3.	Dadan Hermawan, Salsabil Rahmadina, Irmanto Irmanto, Mudasir Mudasir, Hassan Y Aboul-Enein	Chiral Separation of Hydroxychloroquine by High-Performance Liquid Chromatography Method using Amylose Tris (3,5-dimethyl phenyl carbamate) as Chiral Column
4.	Dadan Hermawan, Annisa Mutiara Fitri, Cacu Cacu, Amin Fatoni, Ponco Iswanto, Uyi Sulaeman	High-Performance Liquid Chromatography Method for Chiral Separation of Sulconazole using Cyclodextrin as Chiral Column
5.	Hari Prasetijo	Improved Over Current Relay (OCR) Coordination Using Time Multiple Setting (TMS)
6.	Zein Hanni Pradana, Solichah Larasati, Khoirun Ni'amah	Planning and Prediction Coverage Area Using Urban Macro LOS for New Industrial Area
7.	Triyani Triyani, Marwah Daud Wijayanti, Siti Rahmah Nurshiami	The implementation of eccentric digraph to determine the center of the earth region and division of the time zone of the world
8.	Hasyim Asyari	Performance Analysis of Work Skills Training and Stress Level in Completing Cognitive Task on Students with Special Needs Using Virtual Reality Video
9.	Mardiyah Kurniasih	Application of N-methyl chitosan as an antifungal of *C. Albicans* on nylon fabrics
10.	Zaskia Alifia, Nurianah Tri Puji Astuti, Misbachul Syurur Ramadhan, Rizqi Afifah, Anung Riapanitra	Green Synthesis of BiVO4 Nanorods by *Nigella Sativa* Extract and Evaluation of Their Antibacterial Activity Against *Pseudomonas Aeruginosa*
11.	Zohan Syah Fatomi, Sholihun, Wahyu Tri Cahyanto, Mukhtar Effendi	Phonon Effect on the Vacancy Concentration in Diamond and α-Tin: A DFT-based Quantum calculations
12.	Imron Rosyadi	Multivariate soft sensor for product monitoring in the debutanizer column with deep learning

ICMA SURE 2022
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No. 69
EAS-3268

Improved Over Current Relay (OCR) Coordination Using Time Multiple Setting (TMS)

Hari Prasetijo

Proper coordination between overcurrent relay (OCR) is needed to improve the reliability of the power distribution system. By choosing the proper time multiple setting (TMS), an optimum setting of OCR coordination can be achieved.Â This study improve working time coordination of OCR bay transformer using time multiple setting.Â Simulations were carried out to see the performance of the OCR bay transformer against a 3 phase short circuit on the 20 kV outgoing bus. The 3 phase short circuit was chosen because it produces the largest fault current among other types of short circuits. The discussion focuses on the OCR bay transformer, consist of OCR incoming 20 kV and OCR outgoing 150 kV. Existing data and calculation results were used as a parameter in the simulation. Â Simulation results with existing tms 0.21 and 0.23 for OCR incoming 20 kV and OCR outgoing 150 kV, respectively, have the potential to cause miscoordination of the OCR working time. Smaller short circuit current, bigger potential miscoordination. Resetting tms improves coordination of OCR bay transformer working time according to the standard used.Â Bigger value of tms, as long as it meets the standar, better OCR working time coordination to protect phase-phase fault current.

CONFERENCE SCHEDULE

CONFERENCE DAY-1
Tuesday, November 8, 2022

Time (GMT+7)	Session	Description
Onsite: LPPM Building, Universitas Jenderal Soedirman		
Online: Zoom https://bit.ly/ICMA_MainRoom		
07.30 – 08.00	Participants join the Zoom	
08.00 – 08.05	Opening	MC: Nadia Gitya Yulianita & Indriyati Hadiningrum
08.05 – 08.10	National anthem “Indonesia Raya”	
08.10 – 08.15	Remark by the Head of LPPM Universitas Jenderal Soedirman **Prof Dr. Rifda Naufalin**	
08.15 – 08.25	Opening remark by the Rector of Universitas Jenderal Soedirman **Prof Dr. Akhmad Sodiq**	
08.25 - 08.30	Short break	
08.30 – 09.00	*Islamic Perspectives of Welfare and Cruelty in Intensive Livestock Production* **Prof. (Em) Zainal Aznam Mohd Jelan, Malaysian Society of Animal Production, Malaysia**	PLENARY 1: **Moderator: Dr. Afik Hardanto**
09.00 – 09.30	*Estimation of Meteorological Droughts over Cimanuk-Cisanggarung Watersheds using Standardized Precipitation Index Considering Climate Changes* **Dr. Ing. Suroso, Jenderal Soedirman University, Indonesia**	
09.30 - 10.00	Discussion	
10.00 - 10.15	Tea Break	
10.15 - 10.45	*Impact of Climate Changes on Water and Nutrient Transport Into The Coastal Area and Its Leading Adaptation* **Prof. Zhang Jing, University of Toyama, Japan**	PLENARY 2: **Moderator: Probo Hardini, Ph.D**
10.45 – 11.15	*Biosecurity of Seaweed Farming in China* **Prof. Tao Liu, Xiamen University, China**	
11.15 – 11.45	Discussion	
11.45 – 12.30	Lunch break	
12.30 – 14.30	Parallel Session Day-1	Room Moderator and Host
14.30	Announcement End of Day-1 Session	Moderator

ICMA SURE 2022
INTERNATIONAL CONFERENCE ON MULTIDISCIPLINARY APPROACHES FOR SUSTAINABLE RURAL DEVELOPMENT

CONFERENCE DAY-2
Wednesday, November 9, 2022

Time (GMT+7)	Session	Description
Onsite: LPPM Building, Universitas Jenderal Soedirman		
Online: Zoom https://bit.ly/ICMA_MainRoom		
08.30 – 08.55	Participants join the Zoom Room	
08.55 – 09.00	Opening	MC: Nadia Gitya Yulianita & Indriyati Hadiningrum
09.00 – 09.30	*The role of social cohesion in community resilience during COVID-19 pandemic* **Dr. MD Sayed Uddin, University Malaysia Sabah, Malaysia**	PLENARY 3: **Moderator: Intan Shaferi**
09.30 – 10.00	*National Economic Recovery (PEN) Through Data Strengthening and Digitization of General Trade in Micro, Small, and Medium Enterprises (UMKM) in Indonesia* **Dr. Icuk Rangga Bawono, Jenderal Soedirman University, Indonesia**	
10.00 - 10.20	Discussion	
10.20 - 10.30	Tea Break	
10.30 – 11.00	*Packaging for Food Processing and Food Manufacturing* **Amy Purwoko, Sealedair Singapore**	PLENARY 4: **Moderator: Ns. Dian Ramawati**
11.00 – 11.30	*Development of Competency, Standard of Practices, and Community-based Management System for Preparedness and Response to Emergency Situations from COVID-19 Pandemic in Risk Areas* **Warissara Sorat, Ph.D, Prince Songkla University, Thailand**	
11.30 – 11.50	Discussion	
11.50 – 12.30	Lunch break	
12.30 – 14.30	Parallel Session Day-2	Room Moderator and Host
14.30 – 15.00	Closing Ceremony	