Analysis of Energy Consumption Intensity and Electric Power Quality in UNDIP Campus

by Jaka Windarta

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ANALYSIS OF ENERGY CONSUMPTION INTENSITY AND ELECTRIC POWER QUALITY IN UNDIP CAMPUS

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Abstract— ***National energy security has a very important role in supporting sustainable national development. However, what often becomes a problem is the rate of energy availability that is not balanced with the rate of energy demand, therefore energy consumption efficiency is necessary, which is in line with Government Regulation No. 70/2009 concerning Energy Conservation. To be able to do this, it is necessary to take an initial step by conducting an energy audit, which is a method for calculating the level of energy consumption of a building/building. In this study, the authors will analyze the energy consumption and potential energy efficiency at the Diponegoro University Campus. Energy efficiency analysis will be based on electrical energy consumption data from 2016-2020, calculating the Energy Consumption Intensity (IKE) and Electric Power Quality. The consumption of electrical energy at the Undip Campus reaches 20,253,418 kWh or Rp. 16,415,550,042 in 2019. For the IKE calculation results, the criteria for very efficient are obtained at the Faculty of Psychology and the Faculty of Fisheries and Marine Sciences. The standard used is the 2006 Ministry of National Education on IKE.***

Keywords— Energy Conservation, Energy Consumption Intensity (IKE), Power Quality.

I. INTRODUCING

Energy security has a very important role in supporting sustainable national development. Energy security itself has three aspects, namely: availability of energy sources, affordability of energy supplies, and continued development of new and renewable energy. To maintain national energy security, apart from actively undertaking development and diversification in terms of providing energy sources, energy conservation efforts on the utilization side to reduce the rate of energy use must be made. Energy efficiency or efficient use of energy aims to reduce the amount of energy needed to produce a product or service [1].

The government in PP No. 70 of 2009 has regulated that users of energy sources and energy users who use energy sources and/or energy more than 6000 TOE (Tonne Oil Equivalent) in one year are required to conserve energy through energy management, in addition to users of energy sources. and/or energy below 6,000 TOE (Tonne Oil Equivalent) per year is required to use energy economically and efficiently [2].

In the previous research conducted by Wafid Hudaya and Alif Prasetyo, a web-based energy audit application has been created. The application uses the PHP programming language, but there is no baseline arrangement of energy efficiency levels which are expressed in terms of energy consumption intensity and Energy Saving Opportunities [3]. Galuh Prawestri Citra has made software to study electrical loads in a building using Visual Basic 6.0. The software is connected to Microsoft Access as a database, where the software is designed to successfully read and process the available data [4]. Further studies on load analysis have been carried out by Ahmad Taufik Yunanto, in which the load study carried out produced data on the mix of electricity use, the profile of electrical loads, and the quality of electrical power used by PT SAI Apparel Semarang [5].

In this study, the authors will analyze energy consumption and energy efficiency potential by raising a case study on one of the campuses in the city of Semarang, namely Diponegoro University. The selection of research and energy conservation analysis will be based on data on electricity consumption from 2016-2020 and primary data from field surveys (samples from the Faculty of Psychology and the Faculty of Fisheries & Marine Sciences). The energy consumption intensity analysis is adjusted to the standards of the Indonesian Ministry of National Education in 2006 [6]. Standardization of the quality of electric power in voltage and current Unbalances uses the standard Permen ESDM No.4 of 2009 [7] and SPLN D5.004-1: 2012 concerning Power Quality [8]. To standardize the voltage and current harmmonisa using the IEEE Std standard. 519-2014 [9].

II. METHOD

A. *Secondary Data Collection and Analysis*

At this stage, secondary data collection carried out at Diponegoro University, the secondary data collected were as follows:

1. Historical data on electricity consumption (rupiah and kWh) of Diponegoro University from 2016 to July 2020.
2. Technical data on building area of the Faculty of Psychology and the Faculty of Fisheries and Marine Sciences
3. Data on the number of students, employees, and lecturers per faculty

At this stage, the energy consumption data that has been obtained from secondary data is processed to be able to determine the energy consumption used by Diponegoro University from 2016 to 2020 in units of electrical energy (kWh). Besides, the value of Specific Energy Consumption and Energy Consumption Intensity from Diponegoro University is also calculated in units of kWh / m2.

B. Primary Data Collection and Processing

To obtain energy-saving opportunities, further data collection is required on the conditions of electrical energy utilization at Diponegoro University, therefore primary data collection is required. In this energy audit, primary data collection is carried out by measuring the actual power of electrical equipment at the Diponegoro University Campus.

Primary data collection is carried out to strengthen the initial hypothesis on the calculation of secondary data related to the calculation of energy consumption intensity (IKE). The primary data collected are as follows:

1. Retrieval of Building Area Data
2. Collecting Data on the Number of Students in each Faculty
3. Data Collection Total KWh / m2 for each faculty
4. Asset data for each building (lights, air conditioning, computers, printers, photocopiers, etc.)
5. Measurement of Light Intensity (Lux) per room per faculty/unit
6. Electrical Power Quality in SDP Panel Samples

The primary data that has been obtained is processed into energy consumption intensity data (IKE), light intensity (LUX), specific energy consumption (KES) and, electrical power quality data.

C. Calculation of IKE (energy consumption intensity) and KES (Specific Energy Consumption)

The IKE calculation will use the total KWh data per room and per building divided by the area. The results of the calculation are based on the Standard IKE Value in Buildings Based on as shown in table 1.

TABLE I. STANDARD IKE VALUES IN BUILDINGS

Criteria	Energy Consumption (kWh/m2/month)	
	AC Building	Non AC Bulding
Very Efficient	4,17 - 7,92	-
Efficient	7,92 - 12,08	0,84 - 1,67
Quite Efficient	12,08 - 14,58	1.67 - 2,5
A bit Wasteful	14,58 - 19,17	-
Wasteful	19,17 - 23,75	2,5 - 3,34
Very Wasteful	23,75 - 37,5	3,34 - 4,17

Energy Consumption Intensity (IKE) electricity is the division between electrical energy consumption in a certain period with the building area unit [6]. The sectors that can be calculated include:

a. Details of building area and total building area (m2).
b. Building energy consumption per year (kWh / year)
c. Energy Consumption Intensity (IKE) of buildings per year (kWh / m2 / year).
d. Building energy costs (Rp / kWh).

Specific energy consumption can be used as a baseline in determining the energy efficiency level of an office building / educational institution. To calculate the Industry Specific Energy Consumption (KES), it can be seen in Equation 1. as follows.

D. Electrical Power Quality analysis

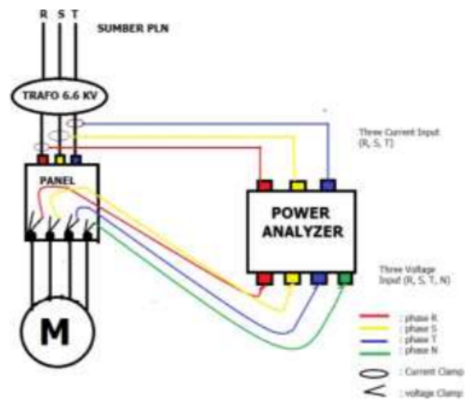

Figure 1. Procedure for installing a power quality analyzer on the MDP and SDP panels

In KDL analysis using a Power Quality Analyzer (PQA) tool and sampling measurements are carried out in the SDP Panel. The results of measurements using PQA will be analyzed with the following parameters:

1. Power Factor
2. Unbalance Flow
3. Unbalance voltage

The measurement results using a Power Quality Analyzer compared with manual calculations and then analyzed the results.

III. Results and Discussion

A. Results of Energy Consumption Analysis

The following is the recapitulation of electrical energy consumption at the Undip Campus in 2016-July 2020:

TABLE II. RECAPITULATION OF TOTAL COSTS OF ELECTRICITY AND KWH FOR 2016-2020 ALL DIPONEGORO UNIVERSITY

No	Year	KWh	Total Cost (Rp)	Percentage Increase (%)
1	2016	-	11.929.715.273	-
2	2017	-	14.181.098.501	18,87%
3	2018	-	14.529.719.483	3,59%
4	2019	20.253.418	16.415.550.042	11,73%
5	s.d Juli 2020	9.237.988	7.846.273.601	-

In table 2. shows the total cost and kWh data from 2016 to 2020. Every year the UNDIP Campus experiences an increase in electricity bill bills. This is accompanied by the addition of new buildings every year.

Figure 2. Graph of Energy Consumption at Undip Campus 2016-July 2020

Electricity energy consumption in 2019 is 20,253,418 kWh if converted into TOE (Ton Oil Equivalent) is 1,704.91 TOE. This value has not reached the mandatory minimum limit for energy conservation, but if necessary it is advisable to conduct energy conservation and audits.

B. Results of the calculation of energy consumption intensity (IKE)

To find the IKE value, building area data is needed for each faculty. The results of the calculation of IKE per year can be converted into IKE per month using table 1. Based on the 2006 Ministry of National Education of the Republic of Indonesia regarding the standard IKE value per month [10], the following results are obtained:

TABLE III. DATA COMPARISON OF IKE VALUE PER MONTH WITH IKE STANDARDS AT THE FACULTY OF PSYCHOLOGY

Year	IKE Per Year (kWh/m²)	IKE Average Per Month (kWh/m²)	Information
2019	54,16	4,51	Very Efficient
2020	26,90	3,84	Very Efficient

TABLE IV. DATA COMPARISON OF IKE VALUE PER MONTH WITH IKE STANDARDS AT THE FACULTY OF FISHERIES AND MARINE SCIENCES

Year	IKE Per Year (kWh/m²)	IKE Average Per Month (kWh/m²)	Information
2019	47,55	3,96	Very Efficient
2020	23,18	3,31	Very Efficient

C. Calculation Results of Specific Energy Consumption

To find out the calculation of Specific Energy Consumption, data on the number of students, employees and lecturers is required as follows:

TABLE V. DATA ON THE NUMBER OF STUDENTS, EMPLOYEES AND LECTURERS OF THE FACULTY OF PSYCHOLOGY BY 2019-2020

Year	Number of Students, Lecturers and Employees	Energy Consumption (Rp)
2019	1318	Rp233.966.674
2020	1482	Rp116.648.280

TABLE VI. DATA ON THE NUMBER OF STUDENTS, EMPLOYEES AND LECTURERS OF THE FACULTY OF PSYCHOLOGY BY 2019-2020

Year	Specific Energy Consumption (Rp/person)
2019	Rp177.516
2020	Rp78.710

The Faculty of Psychology has a new building with an active period of new electricity connection in January 2019. If seen from the graphs and tables in 2019 students, lecturers and employees need Energy Consumption of Rp. 177,516 per person.

TABLE VII. DATA ON THE NUMBER OF STUDENTS, EMPLOYEES OF THE FACULTY OF FISHERIES AND MARINE SCIENCES 2016-2020

Year	Number of Students, Lecturers and Employees	Energy Consumption (Rp)
2016	3692	Rp368.969.640
2017	3745	Rp359.834.971
2018	3655	Rp463.352.851
2019	3873	Rp498.633.574
2020	4021	Rp237.123.840

TABLE VIII. CALCULATION DATA OF SPECIFIC ENERGY CONSUMPTION VALUE, FACULTY OF FISHERIES AND MARINE SCIENCES 2016-2020

Year	Specific Energy Consumption (Rp/person)
2016	Rp99.938
2017	Rp96.084
2018	Rp126.772
2019	Rp128.746
2020	Rp58.971

When viewed from the charts and tables, the yearly from 2016-July 2020 experienced an upward trend. This is due to the addition of new buildings such as the Oceanography Lab, FPIK Hall, and Marine Science Lab to support lectures and research facilities. The highest specific energy consumption occurred in 2019, students, lecturers, and employees need energy consumption of Rp. 128,746 per person.

D. Results of Electrical Power Quality Analysis

To analyze the quality of electric power, a comparison is made with the applicable standards. There are several power quality parameters including:

a. Current Unbalance
b. Voltage Unbalance
c. Power Factor

a. Current Unbalance

Analysis of current Unbalances uses the standard Permen ESDM No.4 the Year 2009 [7] with a maximum standard of 20%. Flow Unbalance data is taken when the Faculty of Psychology is at a minimum load due to the conditions for the distribution of work shifts according to the COVID19 health protocol. The current Unbalance will be analyzed in each distribution panel using the following equation:

$$\%\text{IUnbalance} = 100 \text{ x } \frac{\text{Max. Current Deviasi terhadap Aver}}{} \quad (2)$$

$$\%\text{VUnbalance} = 100\% \text{ x } \frac{\text{Max. Voltage Deviasi terhadap Average Voltage}}{\text{Average Voltage}} \quad \mathbf{(3)}$$

TABLE IX. CURRENT UNBALANCE CALCULATION RESULTS

Measure Terminal	Current (A)		
	R	S	T
MDP AC	48,2	61,2	53,6
MDP PP & STK	5,13	13,81	8,25
SDP AC LT.1	14,14	3,46	0
SDP PP & STK LT.1	0,93	2,28	0
SDP AC LT.2	0,98	0	0,61
SDP PP & STK LT.2	0,63	0	0
SDP AC LT.3	0	0	12,05
SDP PP & STK LT.3	0,88	2,44	1,93
SDP AC LT.4	0	0	14,78
SDP PP & STK LT.4	0,88	2,44	1,93
SDP AC LT.5	10,46	5,6	0
SDP PP & STK LT.5	0,24	0,6	0
SDP AC LT.6	12	7	0
SDP PP & STK LT.6	0,63	0	0
SDP AC LT.7	4,6	17	22,61
SDP PP & STK LT.7	1,94	4,3	3,99

TABLE X. CURRENT UNBALANCE CALCULATION RESULTS (CONTINUED)

Measure Terminal	Current Unbalance Value	Information
MDP AC	12,64%	Standard Agree
MDP PP & STK	52,37%	Not Standard
SDP AC LT.1	60,68%	Not Standard
SDP PP & STK LT.1	42,06%	Not Standard
SDP AC LT.2	23,27%	Not Standard
SDP PP & STK LT.2	0,00%	Standard Agree
SDP AC LT.3	0,00%	Standard Agree
SDP PP & STK LT.3	39,43%	Not Standard
SDP AC LT.4	0,00%	Standard Agree
SDP PP & STK LT.4	39,43%	Not Standard
SDP AC LT.5	30,26%	Not Standard
SDP PP & STK LT.5	42,86%	Not Standard
SDP AC LT.6	26,32%	Not Standard
SDP PP & STK LT.6	0,00%	Standard Agree
SDP AC LT.7	53,43%	Not Standard
SDP PP & STK LT.7	26,10%	Not Standard

The Unbalance of the average current on MDP AC has met the standards of Permen ESDM No.4 of 2009 [7]. However, when measured in MDP PP & STK and SDP for each floor, several distribution panels experience a current Unbalance. This is likely because not all energy consumption equipment is operating and lecture activities are being eliminated due to the COVID19 pandemic. The biggest energy use is AC, so when some rooms are not used and the AC is off, there will be an Unbalance in the current. However, this needs to be re-verified according to the electrical installation diagram to ensure the distribution of the electric phase load in the SDP for each floor. Current Unbalance can potentially cause damage to motor windings, kwh meter, and losses in the distribution system [11].

b. *Voltage Unbalance*

Analysis of the voltage Unbalance uses the standard Permen ESDM No.4 of 2009 [7] with a maximum standard of 3% Voltage Unbalance data is taken when the Faculty of Psychology is at minimum load due to the conditions of distribution of work shifts according to the COVID19 health protocol. The voltage Unbalance will be analyzed on each distribution panel using the following equation:

TABLE XI. CALCULATION RESULTS OF VOLTAGE UNBALANCE

Measure Terminal	Voltage (V)		
	R-N	S-N	T-N
MDP AC	231	233,3	232,3
MDP PP & STK	231,6	233,6	233,8
SDP AC LT.1	231,1	233	233,2
SDP PP & STK LT.1	232,6	234,4	234,7
SDP AC LT.2	233,3	235,6	235,1
SDP PP & STK LT.2	235,6	237,4	237,2
SDP AC LT.3	234,8	236,9	235,2
SDP PP & STK LT.3	234,7	236,8	236,4
SDP AC LT.4	234,8	236,9	235,2
SDP PP & STK LT.4	231	233,9	233,8
SDP AC LT.5	233,9	236,6	235,6
SDP PP & STK LT.5	235,6	237,4	237,2
SDP AC LT.6	233,9	236,6	235,6
SDP PP & STK LT.6	233,2	233,5	236,5
SDP AC LT.7	234	235,2	233,9
SDP PP & STK LT.7	233,3	234,5	234,4

TABLE XII. CALCULATION RESULTS OF VOLTAGE UNBALANCE (CONTINUED)

Measure Terminal	Voltage Unbalance		Keterangan
	Hitung	Ukur	
MDP AC	0,47%	0,6	Standard Agree
MDP PP & STK	0,34%	0,6	Standard Agree
SDP AC LT.1	0,33%	0,5	Standard Agree
SDP PP & STK LT.1	0,34%	0,5	Standard Agree
SDP AC LT.2	0,40%	0,6	Standard Agree
SDP PP & STK LT.2	0,28%	0,4	Standard Agree
SDP AC LT.3	0,54%	0,5	Standard Agree
SDP PP & STK LT.3	0,35%	0,5	Standard Agree
SDP AC LT.4	0,54%	0,5	Standard Agree
SDP PP & STK LT.4	0,43%	0,5	Standard Agree
SDP AC LT.5	0,52%	0,4	Standard Agree
SDP PP & STK LT.5	0,28%	0,4	Standard Agree
SDP AC LT.6	0,52%	0,4	Standard Agree
SDP PP & STK LT.6	0,90%	0,4	Standard Agree
SDP AC LT.7	0,36%	0,3	Standard Agree
SDP PP & STK LT.7	0,19%	0,5	Standard Agree

Based on the results of the calculations in Table 12, it is known that the voltage Unbalance in the Faculty of Psychology in general, the value of the calculation and measurement of the voltage Unbalance on the MDP and SDP distribution panels at the Faculty of Psychology has met the standards.

c. *Power Factor*

The power factor data recorded by the PQA Meter is the overall power factor of the Faculty of Psychology, which consists of the main distribution panel and the equipment & stk sub-distribution panel with air conditioning. Measurements are made during the normal load time of working hours. The value of the base power factor for each distribution panel can be seen in table 13.

TABLE XIII. POWER FACTOR MEASUREMENT DATA

Measure Terminal	Average Power Factor	Information
MDP AC	0,961	Standard Agree
MDP PP & STK	0,935	Standard Agree
SDP AC LT.1	0,99	Standard Agree
SDP PP & STK LT.1	0,881	Standard Agree
SDP AC LT.2	0,882	Standard Agree
SDP PP & STK LT.2	0,922	Standard Agree
SDP AC LT.3	0,989	Standard Agree
SDP PP & STK LT.3	0,731	Not Standard
SDP AC LT.4	0,989	Standard Agree
SDP PP & STK LT.4	0,732	Not Standard
SDP AC LT.5	0,925	Standard Agree
SDP PP & STK LT.5	0,665	Not Standard
SDP AC LT.6	0,925	Standard Agree
SDP PP & STK LT.6	0,563	Not Standard
SDP AC LT.7	0,965	Standard Agree
SDP PP & STK LT.7	0,884	Standard Agree
Total Power Factor	**0,865**	**Standard Agree**

From table 13, it can be analyzed that the average power factor value of the three phases shows a varied value. Overall, the average power factor value across the distribution panels at the Faculty of Psychology is following the standards. In some sub-distribution panels, there are power factor values that are below standard. This is because the panels are mostly used for TL Neon lighting equipment which is inductive and greatly affects the decrease in the power factor value. However, the total average power factor in the electrical system at the Faculty of Psychology is above the standard, namely 0.865.

Based on the regulation of the Minister of Energy and Mineral Resources No. 07/2010 concerning electricity tariffs [12] in some groups of customers the penalty for kVARH is imposed if the average cos Θ value per month is below 0.85. The power factor of 0.85 referred to in the regulation is if the power factor is negative (-), if the power factor is (+) then the VARH value is not calculated.

IV. Conclusion

In the consumption of electrical energy at the Undip Campus, there has been an increase in electricity bills over the last 5 years, the addition of supporting facilities, and several new buildings/buildings. The highest increase was in 2019 the electricity bill increased to Rp. 16,415,550,042 or an increase of around 11.49% with the addition of 3 new building accounts.

Specific Energy Consumption at the Faculty of Fisheries and Marine Sciences from 2016 to July 2020 experienced an increasing trend. This is due to the addition of new buildings such as the Oceanography Lab, FPIK Hall, and Marine Science Lab to support lectures and research facilities. The highest specific energy consumption occurred in 2019, students, lecturers, and employees need energy consumption of Rp. 128,746 per person.

Specific Energy Consumption at the Faculty of Psychology in 2019 students, lecturers, and employees need Energy Consumption of Rp. 177,516 per person.

The intensity of energy consumption is already in the very efficient criteria with the IKE value in 2019 at the Faculty of Psychology of 47.55 kWh / m2 and the Faculty of Fisheries and Marine Sciences of 54.16 kWh / m2.

Analysis of the quality of electric power on the parameter of average current Unbalance on MDP AC has met the standards of Permen ESDM No.4 of 2009, which is a maximum of 20%. However, when measured in MDP PP & STK and SDP for each floor, several distribution panels experience Unbalance current. This is likely because not all energy consumption equipment is operating and lecture activities are being eliminated due to the COVID19 pandemic.

In general, the voltage Unbalance at the Faculty of Psychology, the value of the calculation and measurement of the voltage Unbalance on the MDP and SDP distribution panels at the Faculty of Psychology has met the standard, which is below 3%.

The average power factor value in the Faculty of Psychology has met the minimum PLN standard, namely 0.865.

References

[1] Ministry of Energy and Mineral Resources Indonesia, "*Statistik Ketenagalistrikan 2017*," Dir. Gen. Electr. Energy Util., 2017.

[2] Pemerintah Republik Indonesia. Peraturan Pemerintah Nomor 70 Tahun 2009 Tentang Konservasi Energi. 2009.

[3] Windarta Jaka. 2018. Audit Energi Sistem Pencahayaan Pada Gedung Produksi J PT. PHAPROS, TBK. Prosiding Seminar Nasional Sains dan Teknologi Fakultas Teknik Universitas Wahid Hasyim

[4] Hudaya Wafid. 2019. Analisis Penggunaan Energi Listrik Kampus Undip Tembalang Dengan Menggunakan Perancangan Perangkat Lunak Berbasis Web. Semarang: Departemen Teknik Elektro Universitas Diponegoro

[5] A. T. Yunanto, Studi Peluang Efisiensi Konsumsi Energi Listrik Di PT SAI Apparel Semarang. 2017.

[6] Badan Standarisasi Nasional, SNI 6197 Tahun 2011 tentang Standar Sistem Pencahayaan Pada Gedung. 2011

[7] Kementerian ESDM, "Peraturan Menteri ESDM No 04 Tahun 2009" 2009.

[8] PT. PLN (Persero). 2012. SPLN D5.004-1: 2012 Tentang Power Quality.

[9] IEEE Std. 519-2014, IEEE Recommended Practices and Requirements for Harmonic Control Power System, IEEE-SA. Standard Board, Piscataway, USA, 2014.

[10] G. P. C. Handani, H. Suyono, and R. N. Hasanah, "*Rancang Bangun Perangkat Lunak Audit Energi Listrik Gedung*," J. Mhs. TEUB, vol. 1, no. 3, pp. 1–6, 2014.

[11] Hildegardis, C. 2013. Audit Performa Energi pada Gedung Laboratorium Komputer dan Kantor Yayasan Pendidikan Tinggi Nusa NIPA. Tesis. Yogyakarta: Program Studi Magister Teknik Arsitektur Universitas Atma Jaya

[12] Pemerintah Republik Indonesia. Undang Undang Nomor 30 Tahun 2007 Tentang Energi. 2007.

[13] Salpanio, R. Audit Energi Listrik Pada Gedung Kampus UNDIP Pleburan Semarang.Universitas Diponegoro. 2007.

[14] Windarta Jaka. Analisis Peluang Penghematan Konsumsi Energi Listrik Melalui Sistem Pencahayaan (Studi Kasus: Pada Gedung Pascasarjana Universitas Diponegoro). 2019.

[15] I. Fernaldy, K. Karnoto, and H. Hermawan, "*Redesain Sistem Elektrikal Gedung Inspektorat Provinsi Jawa Tengah (Bagian Pencahayaan) dengan menggunakan Dialux Evo*", Transient: Jurnal Ilmiah Teknik Elektro, vol.8 no.1, pp. 48-56, May. 2019. https://doi.org/10.14710/transient.8.1.9-17

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