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GREEN DATA CENTER POWER MANAGEMENT DESIGN AND ANALYSIS IN PDII-LIPI USING TIA-942 STANDARD

Algadilan Susanto[1] , Mochammad Teguh Kurniawan[2].

[1] Information System Major, Industrial Engineering Faculty, Telkom University
[2] Information System Major, Industrial Engineering Faculty, Telkom University
Telekomunikasi 1 Street, Dayeuh Kolot, Bandung, 40247
Telp: (022) 7564108, Fax: (022) 7565200.
[1]algadilan@gmail.com
[2]teguhkurniawan@telkomuniversity.ac.id

ABSTRACT

Pusat Dokumentasi dan Informasi Ilmiah - Lembaga Ilmu Pengetahuan Indonesia (PDII-LIPI) is a provider of publishing services in Indonesia. PDII-LIPI has a lot of publications list, so it is necessary using data center to store the entire list of publications for the continuity of PDII-LIPI's business processes. Data center is an important component in ensuring the sustainability of information technology. At the current state, PDII-LIPI has several servers that are not optimized well so it takes large amount of power usage. Based on PDII-LIPI business strategic planning, the existing data center of PDII-LIPI will be located in second floor of PDII-LIPI building from sixth floor of PDII-LIPI building. Therefore, it needs new design and analysis for developing data center instruments. Designing PDII-LIPI data center, we use TIA-942 standard as best practice. Using TIA-942 standard we focused on power management section. Beside of that, it needs method for guideline for building new data center. PPDIOO Network Life-Cycle Aprroach is chosen for the three first stages which is Prepare, Plan and Design. The purpose of this research is to produce a design of the PDII-LIPI data center compliance with standards and achieve tier 2 referenced to the TIA-942 standard. The final results are new location with support area, electrical systems including implementation of uninterruptible power supply (UPS), raised floor design, room layout, and power management optimization tools with virtualization method
Key words: data center, server, TIA-942, power management, PPDIOO Network Life-Cycle Approach

1. INTRODUCTION

1.1. Sub Title for Introduction

The rapid development of information technology is able to answer almost all of the business needs in the current era of globalization. In fact, most have become a business enabler which plays an important role for the sustainability of the wheels of business of an organization. One aspect and an important asset for an organization in running business process that data. Special steps are needed so that data can be stored and utilized effectively and efficiently.

Data management is an important component in an organization. Data management is considered good if it is accessible anytime and anywhere by organizations stakeholder. One way to accommodate all the organization's data is by using data center.

The data center is one of the important components in business continuity. As one of the important components of business services, data center is expected to provide optimal service, eventhough unexpected conditions. (Sandi Putra & Kurniawan, 2014) In order to provide optimum service, there is a correlation with the power consumption in the data center. According to the US Department of Energy, electricity usage associated with the state server and data center grew significantly from 2000 to 2006. In 2006, electricity use for servers and data centers is estimated at about 61 billion kilowatt-hours (kWh), or 1.5 percent of the total electricity consumption in the United States. Electricity use has more than doubled since 2000 and reached about 4.5 billion

dollars to the cost of electricity. (U.S. Department of Energy, 2007)
To make efficient use of computing and communications systems, as well as reducing the impact on the environment and the social, green computing movement started many voiced by various groups. The energy used in the data center also took part in contributing to gas emissions and climate change if not treated immediately. Green computing solutions to answer the above problems, one of them with energy management to minimize the impact on the environment. (Ferrero, et al., 2013)
Pusat Dokumentasi dan Informasi Ilmiah - Lembaga Ilmu Pengetahuan Indonesia (PDII-LIPI) is an institution that focuses on three main types of activities documentation services, information services, training and development in the field of documenting information. Activities undertaken by PDII-LIPI need the ability which is largely tacit knowledge, one of which is the preservation of library materials with especially for articles on Indonesia. (PDII-LIPI, 2011)
At the current state of the existing data center at the Pusat Dokumentasi dan Informasi Ilmiah - Lembaga Ilmu Pengetahuan Indonesia (PDII-LIPI) needs right redesigning programs. Designing the data center is the main thing in managing and providing data and information quickly and securely. Data center infrastructure on a PDII-LIPI still requires adjustment to some aspects, such as the electrical system in order to boost the performance of the data center and power management to minimize power usage with the aim to support green computing.
In conducting this research, the method used is the method Prepare, Plan, Design, Implement, Operate, Optimize (PPDIOO) and refers to the TIA-942 standard for electrical design domains. This research until the design phase and implementing phase will be submitted to PDII-LIPI. PPDIOO method approach focuses on how to design a good network infrastructure, including the life cycle in network management. This method helps companies to succeed in the development of technology end-to-end aligned with the core business of CISCO. This method of aligning business and technical requirements of each phase. (Cisco, 2005)

2. THEORETICAL BACKGROUND

According to the definition of the Telecommunications Industry Association (TIA-942), the data center is a building or part of a building that serves as the main computer room and supporting areas. The main function of the data center is to consolidate and centralize all resources information technology, home networking operations, facilitate electronic business, and to provide uninterrupted service for critical data processing operations. (Telecommunications Industry Association, 2005)

According to the definition of Michael Bullock, known as a data center or computer room collection server, where the data center is the room most of servers and data storage company is located, operated and regulated. There are four main components of the data center: (1) white space, (2) infrastructure, (3) information technology equipment, and (4) operation. (Bullock & CIO, 2009)

Green just another term for the efficient use of technology. Green computing is the efficiency that aims to reduce waste and unnecessary expenditure. In some case studies, energy-saving technologies will be needed to reach the expenses. (Yulianti & Nanda, 2008)

According to the definition of Michael Bullock, green data center is a data center that can operate with maximum energy efficiency and minimal environmental impact.

Telecommunications Industry Association (TIA-942) is an American national standard that specifies minimum requirements for telecommunications infrastructure of data centers and computer rooms including a data center owned by a single company or a data center is used by more than one company. This standard was first published in 2005 in the form of TIA/EIA-568 and renewed in April 2013 to ANSI/TIA-942 in the engineering event subcommittee. TIA-942 in which to discuss the procedures for (1) Network architecture, (2) Electrical design, (3) File storage, backup and archiving, (4) System redundancy, (5) Network access control and

security, (6) Database management, (7) web hosting, (8) Application hosting, (9) Content distribution, (10) Environmental control, (11) Protection against physical hazards (fire, flood, Windstorm) and (12) Power management. (Telecommunications Industry Association, 2005)

PPDIOO is a method of analysis to the development of computer network installation developed by Cisco on the material Designing for Cisco Internetwork Solutions (desgn) that defines the continuous life cycle services required for the development of a computer network or related technologies. There are six stages in PPDIOO methods are: (1) prepare, (2) plan, (3) design, (4) implement, (5) operate, (6) optimize.

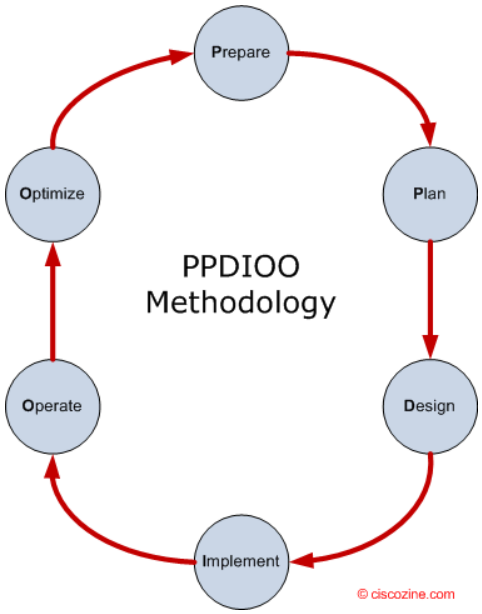

Figure 1. PPDIOO Network Life-Cycle Approach

3. RESEARCH METHOD

In the conceptual model described framework thesis research design and analysis of power management in the PDII-LIPI's data center.

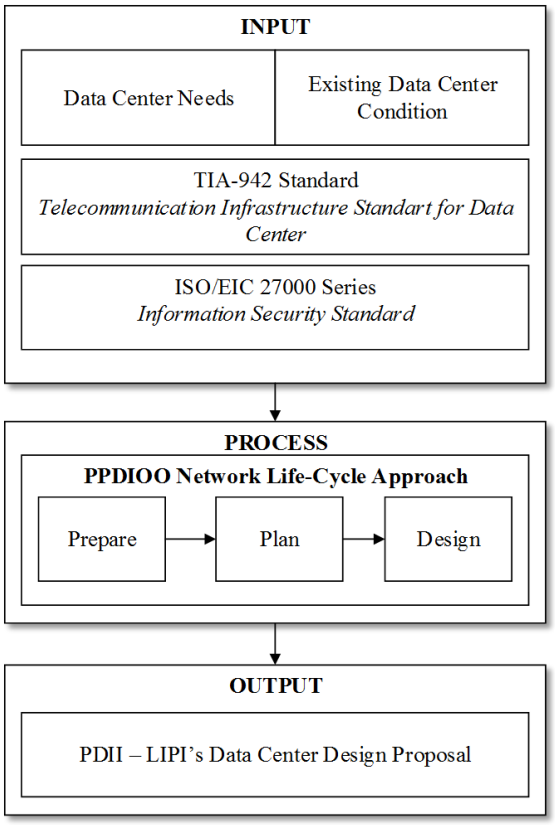

Figure 2. Conceptual model

There are several inputs in the design and analysis of green data center, the need for PDII-LIPI's data center and the TIA-942 (Telecommunications Infrastructure Standard for Data Center). At this stage of the study, the input is processed using the PPDIOO Network Life-Cycle Approach method which uses only three initial phases, namely, (1) Prepare, (2) Plan, and (3) Design. Resulting output (output) in the form of the design of PDII-LIPI's green data center.

In doing scientific research, there are systematic research outlined in the form of descriptive steps about things to do in this research.
Based on predetermined boundary problem, use the PPDIOO CISCO Network Life Cycle method can not be used in its entirety because the research was not until the implementation phase. Research by this method only reached the design stage.
Systematics research is divided into six main stages, namely the preparation, planning, design, simulation, and the final stage. During the preparation stage there is problem identification, preliminary studies, determine

the boundaries of the problem, determine the formulation of the problem, and determine the objectives of the study. Then in the planning stage begins with identify current conditions, conduct a site survey of the research object to get information on the necessary requirements. After that go into the design stage with based on the needs of the data center that is obtained from the analysis phase so as to produce the design of green data center power management in accordance with that specified in TIA-942 standard. At this stage of the simulation testing (prototyping) with test results data center design is in accordance with the requirements or not. If they do then proceed to the final stage ie containing conclusion and its documentation in the form of a report.

4. RESULT AND DISCUSSION

Data Center Design

In designing the data center to the PDII-LIPI with the length x width of 10 m x 5 m which this proposal in accordance with PDII-LIPI plan to move the data center space from the sixth floor to the second floor PDII-LIPI.

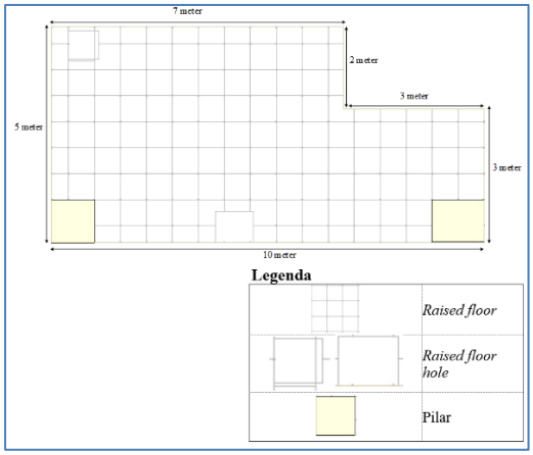

Figure 3. New PDII-LIPI's data center space proposal looked from top

Ceiling height minimum in accordance with the TIA-942 standard that is 2.7 meters. While the data center room design results PDII-LIPI has a height of 3.4 m. So that the data center design proposal PDII-LIPI already meet the standards of TIA-942.

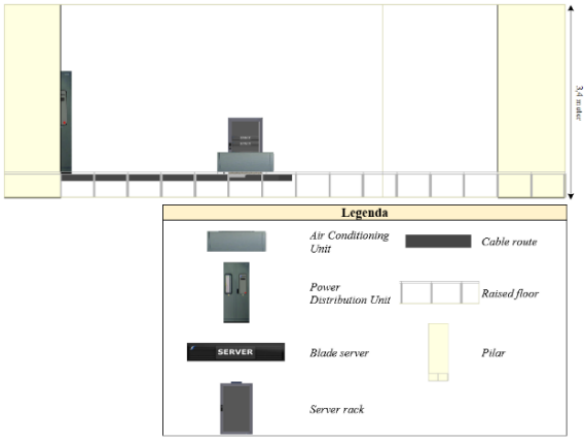

Figure 4. Ceiling high PDII-LIPI's data center proposal

In designing data center technology is the use of raised floor, it is necessary raised floor made of calcium sulphate raised floor panels with a layer of High Pressure Laminate (HPL) that is resistant to pressure. Specifications in accordance with the election of raised floor, with a size of 60 x 60 x 3.81 cm with HPL coating as shown in Figure 5.

Figure 5. PDII-LIPI's raised floor data center proposal plan

The use of floor height in Figure 5 can provide benefits including a grounding power, the ability to withstand heavy loads, and the raised floor height settings that can be adjusted. Thus, it can be concluded that the proposed design of raised floor data center PDII-LIPI has a raised floor height of 45 cm, a thickness of 3.81 cm and the grid size is used measuring 60 cm x 60 cm.

To get the maximum results, the data center must be equipped with the sharing of some space advocates, among others, can be explained in Figure 6.

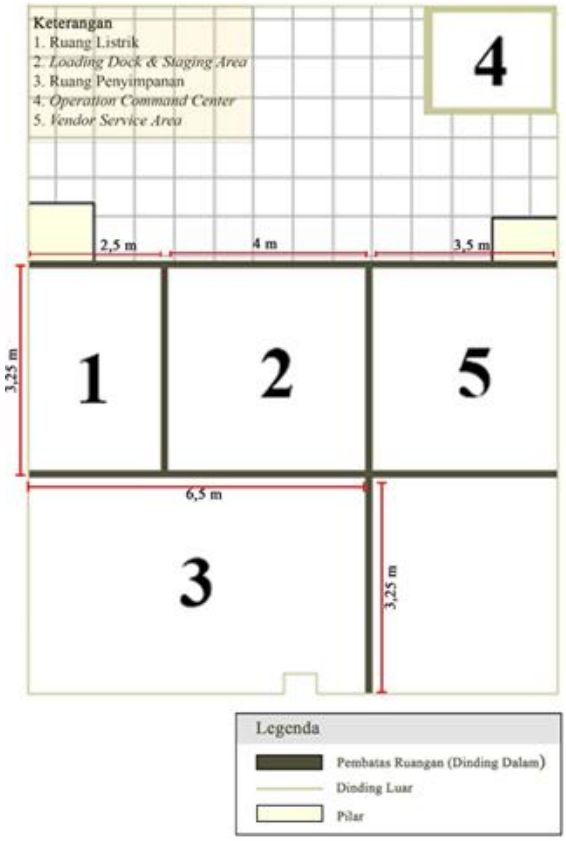

Figure 6. PDII-LIPI's data center space and support space proposal looked from top

Remarks in Figure 6 is as follows.

1. Electric space (area #1)

Creating a support space such as an electric space in the data center PDII-LIPI can avoid electromagnetic interference generated by electrical elements of the device is in the data center. In the room were placed source electric power (energy) reserves are used as intermediates at the turn of the primary power to UPS.

2. Staging area (area #2)

Serves for configuration of devices used data center, and is used to store temporary device until the configuration is done on the device is finished.

3. Loading dock (area #2)

This place used to unload cargo for use in the data center room.

4. Storage space (area #3)

This storage space is used to store device data center for long term.

5. Operation command center (area #4)

This room is used for employees from the data center and IT monitoring of the server in the data center room..

6. Vendor service area (area #5)

Made for vendors who will do the work of the data center.

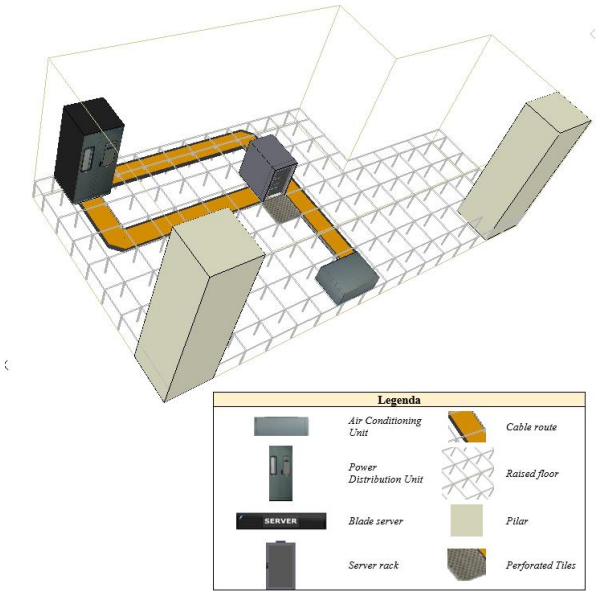

Figure 7. Three-dimensional shape of the data center space along with the proposed plan of the data center room with tools

Analysis of Electrical System

In the design of the PDII-LIPI data center's proposal need for separation of the electrical room to room data center that aims to avoid short circuit or electrical short-circuit is not normal events when the conductor (cable) the voltage is connected directly to the neutral conductor.

Referring to the gap between the current conditions with the TIA-942 standard that to build a data center tier-2 it is necessary to redundant Uninterruptible Power Supply (UPS) of at least N + 1. PDII-LIPI's data center using only the power source (power source) from the main electrical service providers, namely the Perusahaan Listrik Negara (PLN). To be able to build a different UPS sources with the main power source is needed a system that can generate its own power source independently. In this instance the system of solar panels (solar cell). Selection of a solar panel system for pollution-free solar panels and derived from

100% renewable resources (renewable energy). It is based on the original plans in designing a green data center-friendly environment, the use of the UPS using a solar cell is the right choice.

Differences in distribution methods and distribution of electricity directly using a panel of circuit lies in the efficiency in the use of cables. Distribution using a panel of circuit more efficient in the use of the cable, because of the PDU to the circuit panel using a long cable and then from the circuit panel supplied to each server rack with a cable within a short.

In support of interest on tier 2 data center according to TIA standard that has up to 99.741% reliability, then the use of Automatic Transfer Switch (ATS) is necessary. In electrical systems ATS serves to move the electric lines automatically. The transfer is intended that the electrical pathways resulting risk of power failures such as the failure of the primary power (primary power source) in the electricity supply can be minimized. In designing the ATS system should pay attention to the selection of electrical lines that supply power to the data center. There are at least two different electric lines (two different electrical line transformer).

Figure 8. Automatic Transfer Switch (Emerson Network Company, n.d.)

The use of Emergency Power Off (EPO) as a security in case of power failure with power outages method deliberately, taking into account if the device is still alive will give damage than the deadly devices directly. Therefore, the PDII-LIPI's data center system is required to apply the EPO in order to turn off or disconnect the power supply in case of emergencies associated with the electrical system.

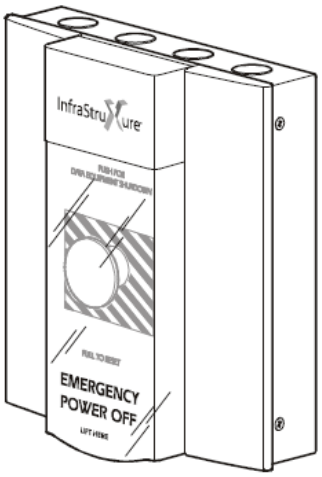

Figure 9. Emergency Power Off with button protector (American Power Conversion, 2004)

The need for realtime observation of the electrical system so that the necessary environmental sensor support for the calculation of the efficiency of power usage in detail by each server rack and can be monitored remotely (remote). The advantage of the use of environmental sensors that provide information support temperature and humidity in the server rack. Tools that can be used is a Temperature / Humidity Monitor Watchdog 15 of vendor ITWatchdog shown in Figure 10.

Figure 10. Watchdog 15 (ITWatchDog, 2001)

Cable Structure Analysis

Structured cabling methods are needed in the design of the data center. Especially for putting a neat rack server suckler necessary cabling methods that each device is regulated and orderly part rack server side in order not to disrupt the flow of air in and out of the server rack.

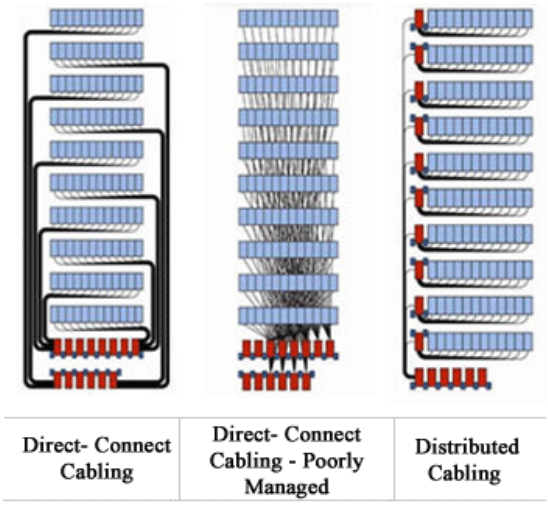

Figure 11. Illustration of wiring method comparison (Cisco System, Inc, n.d.)

Direct connect cabling architecture is one of the three major cable architecture in a data center environment that provides simplicity in the design, implementation, and management. With limited scalability, architecture direct connect cabling suitable for data centers with small and medium scale used widely around the world. CommScope recommend direct connect architecture for the data center cabling small scale. (Frank Yang, Data Center Business Unit CommScope, Inc, 2010)

The use of this standard is intended to enhance the investment value system infrastructure owners to reduce labor costs in the maintenance of the system, by extending the economic benefits of the system, and by providing effective services to users. (Telecommunication Industry Association, 2012) The standards used in cable labeling examples are TIA-606-A / B which is the standard published by the Telecommunications Industry Association (TIA).

Cable tray is a place that is used for laying cables. Cable tray is preferably made of a lightweight yet sturdy materials, for example, is using the material of aluminum. Then for the selection of cable lines, the proposed use of the structure through the floor under dileawtkan cable through the room under the raised floor. The advantage is the cable structure looks neat because the cable structure is not visible immediately and facilitates the maintenance process.

Figure 12. The use of cable tray under the raised floor (Frank Yang, Data Center Business Unit CommScope, Inc, 2010)

Design Proposal and Current Conditions Testing Comparison

Scenario testing is done to prove that the optimization of server hardware in this case, was undertaken with virtualization can reduce power consumption needed so that it can support to design environmentally friendly data center.

In the current conditions, there are nine service provided by PDII-LIPI. Unfortunately, the implementation of the service is installed and running in a single server blade causing increased power consumption, which is used if all services run on each blade server simultaneously.

In testing the use of power (power usage), nine services performed virtualization methods to obtain the results of the use of power (power usage) smaller than the current conditions. In this test the server run four proposals in the form of a virtual machine (VM) simultaneously which covers the whole of the nine services provided by PDII-LIPI. Specification used in this test server equated the proposal with the three other proposals server.

Table 1. Table contains list of application, server type, and the total power usage based on the server data sheet

#	Server Name	Server Tape	Power Usage (watt)
1	Server Aplikasi ISJD (Indonesian Scientific Journal Database)	HP ProLiant DL380p Generation8 (Gen8)	750
2	Server Aplikasi LARAS (Library Archive and Analysis System)	HP ProLiant DL380p Generation8 (Gen8)	750
3	Server Web PDII	HP ProLiant DL380p Generation8 (Gen8)	750
4	Server Aplikasi e-Book	HP ProLiant DL380p Generation8 (Gen8)	750
5	Server Aplikasi membership	HP ProLiant DL380p Generation8 (Gen8)	750
6	Server Aplikasi IDWOS (Indonesian Web Of Science)	HP ProLiant DL380p Generation8 (Gen8)	750
7	Server Aplikasi Sirkulasi	HP ProLiant DL380p Generation8 (Gen8)	750
8	Mail Server	HP ProLiant DL380p Generation8 (Gen8)	750
9	Proxy Server	HP ProLiant DL380p Generation8 (Gen8)	750
TOTAL			6,750

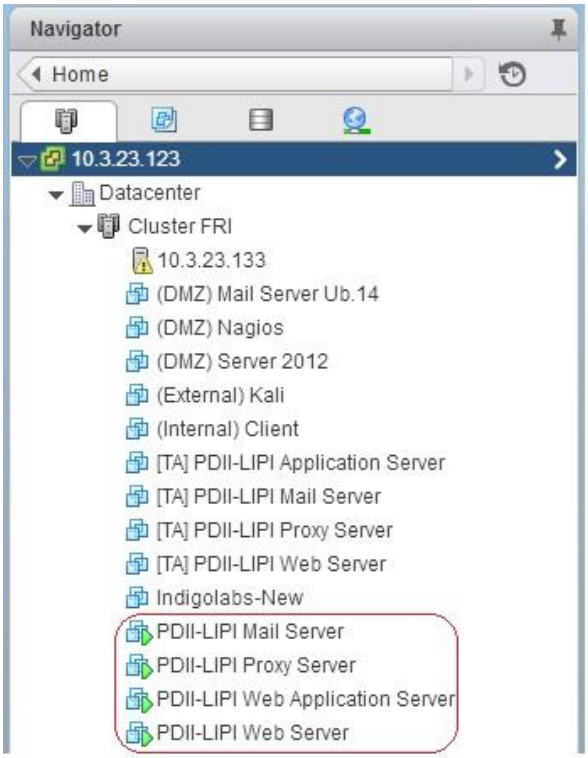

Figure 13. Virtual machine list proposal

To determine the use of used, stress testing is done by giving a load to the process at the Central Processing Unit (CPU) which runs in a single hardware server that holds four servers in the form of a virtual machine.

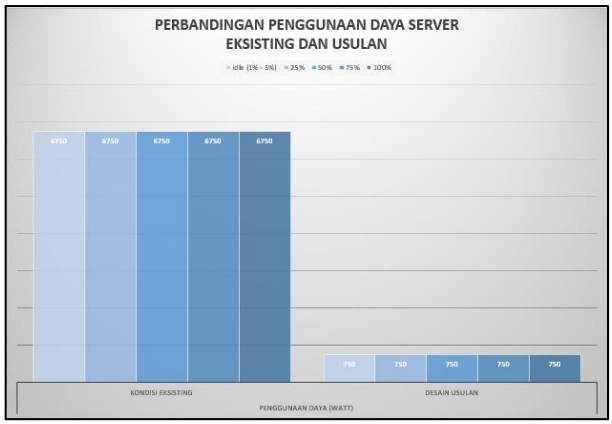

Figure 14. Power usage comparison chart (power usage) server based on the current and proposed datasheet

5. CONCLUSION

Conclusion

The conclusion reached in the design of green data center PDII-LIPI as follows:

a. There are five supporting rooms to assist in the performance of the data center PDII-LIPI namely electrical room, storage space, staging area, loading dock, operations and command center, and vendor service area. Thus increasing the work function of the PDIII-LIPI's data center.
b. The use of technology on a raised floor data center space PDII-LIPI made of calcium sulphate raised floor panels and a layer of pressure laminate which is resistant to pressure and the floor height is 45 centimeters, so that the management of the cable (cable route) can be applied.
c. Power management is applied to the management of electricity, namely the use of emergency power off (EPO), automatic transfer switches (ATS), and environmental sensor support .Electrical systems use redundant power by implementing solar panels (solar cell) so that there is more than one source of electricity and reliable electricity system
d. Virtualization technology is used in the application server so that the server hardware there are a lot of virtual servers. So the use of less power.

Suggestion

The advice can be given of the proposed data center design PDII-LIPI there are, required documentation in detail on the device and the changes that occur in the data center or server so that the subsequent development can be optimally. The second floor of the building is devoted to the PDII-LIPI data center space and space supporters. And last this research can be continued at this stage of the implement, operate, and optimize the methods PPDIOO the object of research data center PDII-LIPI Jakarta

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