International Journal of ASRO
Volume 14, Number 01, pp.15-24
Januari 2023

STRATEGY OF SOLAR PLANT KNOWLEDGE AND SKILL DEVELOPMENT FOR STUDENTS IN THE INDONESIAN NAVAL TECHNOLOGY COLLEGE

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ABSTRACT

Solar power plants have been widely developed in the Indonesian Navy. However, the development of existing solar power plants is still not accompanied by the ability of skill and knowledge of the Navy personnel, as well as limited maintenance funding. Indonesian Naval Technology college has an important role in resolving these issues. The main problem in this research is the lack of competent human resources in the field of solar power plants owned by Diploma Students in Mechanical engineering and Electrical engineering at Indonesian Naval Technology College. This research aims to analyze the development and utilization of Solar power plants in the Navy and the required competencies, the development of Solar power plant skills and knowledge, and the fulfilment of the Navy's technical workforce needs. The research method used is quasi-qualitative, where the development strategy is obtained using SWOT (Strengths, Weaknesses, Opportunities and Threats), while the development strategy roadmap uses ISM (Interpretative Structural Modeling). Based on the SWOT analysis, the development of Solar Power Plant skills and knowledge at Indonesian Naval Technology College can be done through the implementation of evaluations to add Solar Power Plant courses to the curriculum, improving the competence of lecturers, updating instructional and teaching aids, increasing student enrollment, establishing a fulfilment research program. The fulfilment of Solar Power Plant technical personnel can be started by The Indonesian Naval Technology college by applying the roadmap for the strategy for fulfilling Solar Power Plant technical personnel starting from 2023 to 2025. As a suggestion for the Navy, to increase students in Indonesian Naval Technology college and open a program of New and Renewable Energy, followed by improving the curriculum.

Keywords: *Naval Post, ISM, SWOT*

1. INTRODUCTION

Solar Power Plant is a technology that utilizes the sun light converted into other energy, such as electrical and thermal energy. The technology used to convert sunlight into electrical energy is photovoltaic panels. The solar power plants as a producer of electrical energy has been developed in Indonesia, one of which is in the Indonesian Navy.

The Navy uses solar power plants for electronic media, for supporting power in surveillance radars, communication radios and lighting media on certain bases. The solar power plant is prioritized for Navy bases that have three categories of Frontier, Remote and Disadvantaged, which aims to increase energy security at Navy bases.

One of the energy security principles is maintenance plan is needed so can guarantee that the solar power plant can running optimally. According to Coder, planned maintenance is a maintenance activity carried out based on predetermined planning (Iswanto, 2008). To find out whether planned solar power plant maintenance has been carried out properly, the researchers observed 10 solar power plants that have been installed. As a result of these observations, it was found that the installation of solar power plants carried out from 2016 to 2020 could not function optimally to produce

electrical energy. This indicates that the solar power plant maintenance system is not running well.

The solar power plant maintenance system has not been maximized due to several factors, namely the maintenance budget and Human Resources. In terms of maintenance budget, solar power plants are still not a top priority in financing for maintenance, this is because solar power plants are not the main supporting components of electrical energy in the Indonesian Navy Weapon System Main Equipment such as radio, radar, and postal electricity. Meanwhile, in terms of human resources, currently, the Navy still does not have personnel who have the capability to carry out solar power plant maintenance.

With the absence of solar power plant maintenance budget support and the limited ability of the Navy's human resources to solar power plants, efforts are needed to be able to overcome the problems that occur. Without this effort, disruptions to solar power plants will occur frequently and will cumulatively worsen the condition of all solar power plants that have been installed at this time and in the future. One of the efforts that can be done to prevent solar power plant damage is to develop the Navy's Human Resources to be used as technical personnel in the solar power plant field.

2. LITERATURE REVIEW

Human resources are one of the most important elements in an organization (Benny, 1996). The organization will get a success in achieving its goals if its employees can do work in accordance with their specialization, so that it can be utilized effectively and efficiently to get optimal results (Pristiningsih, 2016). One of the efforts that can be done to prevent solar power plant damage is to develop the Navy's Human Resources to be used as technical personnel in the solar power plant field and ready to be placed in maintenance workshops throughout Indonesia.

Human resource development is an effort that aims to develop quality or improve the performance of human resources in dealing with various types of problems needed in existing work (Ruhana, 2012). In addition, human resource development can also be interpreted as HR management activities in organizing, planning, directing and supervising through various procurement, development, compensation, integration, maintenance and release of human resources to be able to achieve organizational and individual goals (Azmy, 2015). Based on this, it can be concluded that human resource development is an effort carried out by the organization, with various ways to overcome problems that exist in the work environment. Improving human resources is very crucial in an organization, which will be achieved through improving the education sector, with the aim of building a more advanced life order and creating an increasingly advanced life (Somantri, 2021).

One of the Navy educational institutions that serve to organize education based on Science and Technology that is relevant to defense needs is the Indonesia Naval Technology College. To achieve the mission of producing solar power plant technical technicians, graduation competency standards are needed which can be used as guidelines in the preparation of an educational curriculum that is able to accommodate the needs of stakeholders Indonesian Navy as a graduate user of STTAL students.

Competence is something that has an influence on work effectiveness (Hanyeq, 2018). The objectives of the organization will not be achieved optimally if they are not supported by credible competence in carrying out all its duties and responsibilities (Abubakar, 2018). In line with this, Kusuma also conveyed that the world of work or organizations requires input or input of human resources who have technical professional abilities in order to maintain the sustainability of an organization facing free competition (Widiyanto, 2010). From these two opinions, employee competence is the most needed thing by the organization to answer future challenges.

Competence itself has the meaning of a set of knowledge, skills and behaviours necessary to complete a task (Dudung, 2018). According to Marwansyah, employee competence is a combination of knowledge and skills, attitudes and other personal characteristics to achieve success in their work, which can be measured using approved standards and can be improved through training and development (Abubakar, 2018). From the two definitions above, it can be concluded that competence is an ability possessed by an individual to be able to complete work and tasks based on the knowledge, skills and behaviours possessed.

Knowledge is the result of a human thought process, the process in this case is a certain set of thought activities that will eventually produce a conclusion that is knowledge (Suriasumantri, 2015). While technical skills are expertise in science, technology and technical skills related to their field of specialization (Rasid et al., 2018). Therefore, STTAL students who have basic electrical technical knowledge and skills are D-3 students who come from the Mechanical Engineering and Electrical Engineering study programs.

Based on the researcher's observation, the knowledge and skills possessed by D-3 TM and TE students are only intended to overcome the problems on the ship. With these problems, it is necessary to develop the skills and knowledge of D-3 TM and TE STTAL students, to have competence in the field of solar power plants.

According to Kamau, the strategy development efforts must be able to produce a formulation that can be implemented by the organization so that the organization can achieve its goals and educational institutions can understand

the growing needs and desires of students (Wiyono et al., 2019).

Planning strategies for developing solar power plant skills and knowledge is carried out since organizational needs and the needs or input of stakeholders as a user of STTAL student graduates, to anticipate the development of solar power plants in the Navy environment. Assessment of internal and external factors by applying the SWOT analysis method (Strength, Weaknesses, Opportunities, Threats) Strengths are positive aspects shared by institutions, while weaknesses are negative aspects. Threats are external factors that can harm the institution, while opportunities are external factors that provide benefits to the institution. In SWOT analysis, strengths and weaknesses are used as the authorized capital to predict future opportunities and threats (Rangkuti, 2006).

The next aspect is to make a roadmap for the strategy of forming solar power plant technicians at STTAL, using the Interpretive Structural Modeling method. ISM is an analytical tool used as a decision support tool that facilitates a complete understanding of the situation thoroughly by connecting and organizing ideas in visual maps (Darmawan, 2017). This method is considered effective because all the elements that can be processed on a simple matrix, so ISM is an ideal planning method.

The main objective of this study is to identify the competencies needed to support the development and utilization of solar power plants in the Navy environment in the present and future, analyze the development of skills and solar power plants in the D-3 TM and TE STTAL education curriculum and the stages of strategies that must be carried out to meet the needs of solar power plant technical personnel in the Navy. especially solar power plants through the development of Navy human resources who have competence in the field of solar power plants, to optimize the construction of solar power plants at Navy bases.

3. MATERIALS AND METHOD

In general, the research design that will be carried out begins with the preparation stage, the stage of making research designs, the stage of analyzing the development and utilization of solar power plants in the Navy environment, the stage of analyzing competencies in the field of solar power plants, the stage of analyzing the development of skills and knowledge of D-3 TM and TE STTAL students using SWOT and finally the stage of technical personnel in the field of solar power plants using Interpretive ISM. The research method applied in this study is to use a qualitative quasi research approach. The process of quasi-qualitative research begins with looking for problems, conducting literature reviews, obtaining problem gaps, making preliminary conclusions, designing data use, compiling data use using a theoretical framework, collecting data, codifying, obtaining new information, theoretical construction, theory confirmation and the last is to get new theoretical constructions (Bungin, 2020).

a. Research Grounds

The implementation of this research was carried out at the Naval College of Technology located in the city of Surabaya. Research Akarena STTAL is an educational institution of the Indonesian Navy in which there is vocational education.

b. Subject and Object of Research

The subject of this study is an informant / resource person appointed by the researcher to obtain primary data on this study. The determination of research subjects is carried out in a purposive way, where subjects are selected based on certain considerations and objectives (Sugiyono, 2016). The research subjects came from several services in the Navy that have developed solar power plants. As for the object of study, it is a scientific goal set by the researcher to obtain data with certain objectives and uses that are objective, effective, and reliable (Sugiyono, 2016). The object of research in this study is the skills and knowledge of D-3 TM and TE STTAL students to support solar power plant technical personnel in the Navy.

c. Data Collection, Processing, and Analysis Techniques

The data collection technique carried out in the study is by conducting interviews, document studies, observations and questionnaires. Data processing is the process of systematically finding and compiling data, obtained from interviews, field studies, and documentation by organizing in categories, describing into parts, synthesizing, making patterns, selecting important and unimportant data systematically, and making conclusions that are easily understood by researchers or others (Sugiyono, 2016) . In this study, data processing uses two data processing techniques, namely SWOT analysis which is used to obtain current conditions so that it will produce a SWOT matrix in the form of strategy variables, ISM analysis which is used to define problems and entanglements, and identify relationships between strategy variables to obtain priority strategies in developing solar power plant skills and knowledge in STTAL students. For data analysis techniques using the Miles and Huberman model which consists of four activity flows, namely: data collection, data condensation, data presentation and conclusions (Miles et al., 2018)

4. RESULT AND DISSCUSION

a. Development and Utilization of Solar Power Plants within the Navy

The use of solar power plants at Navy bases has enormous potential to be developed, this is based on the results of the analysis of sunlight intensity and air temperature using Retscreen software. Retscreen is an innovative and unique tool for renewable energy awareness, decision support, and capacity building developed by Natural Resources Canadaís CEDRL with contributions from 85 experts from industry, government, and academia. Collaborative organizations include the United Nations Environment Programme and the National Aeronautics and Space Administration. RETScreen is provided free of charge to users worldwide (Thevenard et al., 2000).

The RETScreen data analyzed is data from January to December 2021 on 278 bases consisting of the Main Naval Base, Naval Base and Naval Post. There are as many as 139 bases that have a very high light intensity, which is above or equal to 5 kWh/m^2/d, and as many as 137 bases with a light intensity greater than or equal to 4 kWh/m^2/d and only two bases have a solar light intensity below 4 kWh/m^2/d. Meanwhile, the average of the overall intensity of sunlight and air temperature at Navy bases is 5.09 kWh/m^2/d and the average temperature is 26.9ºC. Overall the power that can be generated has an average of 43,044 kWh/year at Navy bases throughout Indonesia. With the potential for very large light intensity and air temperature, several Navy services have utilized solar power plants as supporting electrical energy including the Naval Research and Development Service, the Naval Communications and Electronics Service, the Naval Weapons and Electronics Service and the Naval Base Facilities Service.

Dislitbangal has currently conducted research by utilizing solar power plants as producers of electrical energy, including Fixed Sonobuoy. Fixed Sonobuoy is a position detector for submarines passing below the surface of the water. The development of Fixed Sonobuoy is strategic research considering the area of Indonesia's ocean of 5.55 million Km^2 and 17,499 islands and a coastline of 95,181 Km^2. With the vastness of Indonesian waters, of course, it will make it difficult for the Navy to secure Indonesian waters, where security includes everything in Indonesian waters, both above the air, above the surface and underwater. In addition, Dislitbangal has also planned to conduct re-research on independent posals that have used solar power plants as a source of electrical energy, where the independent posal research was carried out in 2014. Based on research that has been carried out by Dislitbangal, it can be known that the use of solar energy as a source of electrical energy has become a special concern to be developed today. If the use of Fixed Sonobuoy is developed in straits throughout Indonesia, the Navy will need technical personnel who can carry out maintenance maintenance of Fixed Sonobuoy and its energy support equipment.

Dissenlekal has currently utilized solar power plants as one of the producers of electrical energy in the Integrated Maritime Surveillance System. IMSS is an integrated maritime surveillance system between the Coastal Surveillance Station or surveillance station on the ground and other surveillance centers. The main purpose of the IMSS system is to supervise ships crossing the Indonesian Archipelago Sea Channel. There are already as many as 24 solar power plants that have been used to support electrical energy in the IMSS system. As for the development of solar power plants in the future, Dissenlekal still has no plans to increase the number of solar power plants. Although there is no solar power plant development plan yet by Dissenlekal but the need for technicians in the solar power plant field is still needed, it aims to carry out solar power plant maintenance in a sustainable manner so that it can optimize the electrical energy generated to support the surface radar to operate.

Naval Communications and Electronics Service has currently utilized solar power plants as one of the energy sources in Communication Equipment which aims to improve the reliability of the command and control system. Naval Communication and Electronics Service has developed solar power plants from 2016 until now, there have been as many as 27 solar power plants that are used to support electrical energy in Alkom. The utilization of solar power plants can be seen as shown in Figure 1.

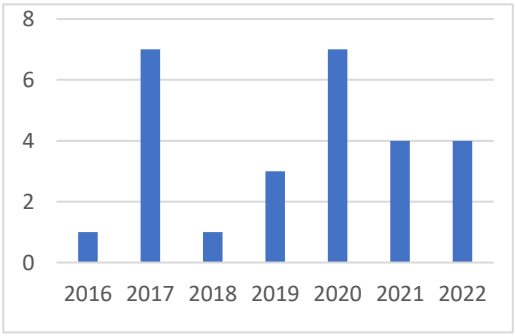

Figure 1. Solar Power Plant Year 2016 – 2022

Meanwhile, based on predictions made by researchers on the development of solar power plants that will be carried out by Naval Communication and Electronics Service in 2023 to 2027 using the least square linear trend function, the results are obtained that in 2023 to 2027 Dikomlekal will continuously develop solar power plants, with an average of 6 solar power plants every year. Naval Communications and Electronics Service plan for solar power plant development seen in Figure 2. By being faced with the development of solar power plants above, technical personnel in the field of solar power plants are needed to be able to design, install and maintain solar power plants.

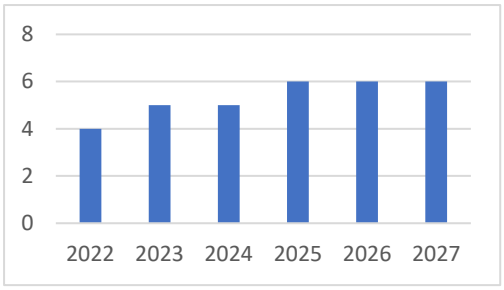

Figure 2. Prediction of Solar Power Plant Development in 2023 – 2027

a. Naval Base Facilities Service has utilized solar power plants on several posts that have limitations on PLN's electrical energy. The use of solar power plants has been carried out by Naval Base Facilities Service from 2015 until now, there have been as many as 32 solar power plants that have been used as energy support in several posts. Solar PV utilization can look like Figure 4.

Based on predictions made by researchers on the development of Naval Base Facilities Service Solar Power Plants from 2023 to 2027 using the least square linear trend function, it was found that Naval Base Facilities Service will not develop solar power plants in the next five years, but it still depends on the situation and conditions of the posal development plan in the next few years. By being faced with the utilization and development of solar power plants that have been carried out by Naval Base Facilities Service , technical personnel in the field of solar power plants from Navy personnel are needed to be able to design, install and maintain solar power plants.

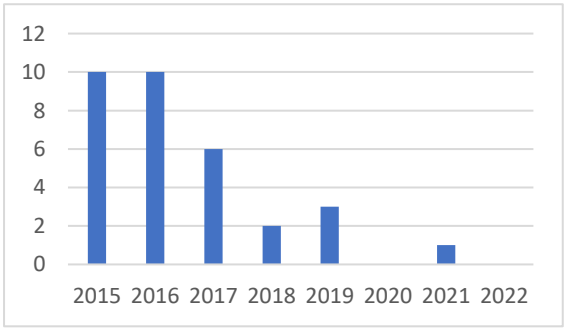

Figure 3. Solar Power Plant Year 2015 – 2022

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Table 1. Technical Competence of Solar Power Plant

No	Category	Competence Expectations
1	Knowledge	- Able to understand the principle of the working mechanism of solar power plant equipment - Able to design solar power plant systems
2	Skills	- Able to install solar power plant systems - Able to perform solar power plant maintenance

b. **Development of Solar Power Plant Skills and Knowledge at STTAL**

In formulating a strategy for developing PLTS Skills and Knowledge in D-3 TM and TE STTAL students, it is carried out by identifying Internal and External factors obtained from interviews and collecting documents from D-3 TM and TE STTAL. From the identification results, 12 Internal factors consisting of 6 strength factors (Strength) and 6 weakness factors (Weakness), as well as 10 External factors consisting of 5 opportunity factors (Opportunity) and 5 threat factors (Threat). Furthermore, weighting of the interaction of strategy combinations in the IFAS-EFAS SWOT matrix with coordinates (-0.01, 0.39) located in quadrant III or Weakness-Opportunity (WO) is carried out, shown in Figure 4. Where the strategy will use opportunities to fight threats (Namugenyi et al., 2019).

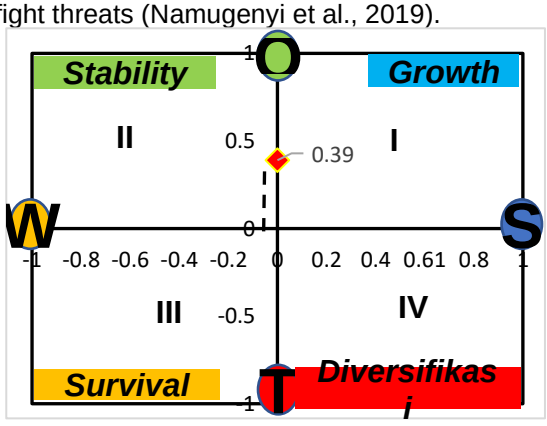

Figure 4. SWOT Matrix Line Disintersection

This WO condition will be beneficial for the D-3 TM and TE Study Programs because it has a much greater opportunity from threats. The WO strategy is as in Table 2.

Table 2. WO Strategy

No	Code	Description
1.	WO1	Carry out self-evaluation to support the improvement of the D-3 TM and TE STTAL curriculum
2.	WO2	Improve the competence of D-3 TM and TE lecturers
3.	WO3	Renewal of Instruction Tools (Alins) and Instruction Helpers (Alongins) Increase the number of
4.	WO4	admissions for D-3 TM and TE
5.	WO5	STTAL students to establish research programs on an ongoing basis

c. **Strategy for Fulfilling Solar Power Plant Technical Personnel in the Navy**

The strategy to meet the needs of solar power plant technical personnel in the Navy can be started from the educational institution. Where the strategic results of the SWOT analysis will be processed using the ISM method to obtain the level of the hierarchy structure. The first step in the ISM method starts from the data obtained from the expert, the data can be seen as in Table 3. Furthermore, included in the Reachability Matrix the indicators are changed to 0 and 1 to obtain a square matrix as in Table 4.

Tabel 3. Structural Self Interaction Matrix (SSIM)

Code	Strategy	WO1	WO2	WO3	WO4	WO5
WO1	Carry out self-evaluation to support the improvement of the D-3 TM and TE STTAL education curriculum	X	In	In	Or	In
WO2	Carry out competency improvement of lecturers in D-3 TM and TE study programs	A	X	X	Or	X
WO3	Implementing the renewal of Alins and Alongins STTAL	A	X	X	Or	In
WO4	Increase the number of admissions for D-3 TM and TE STTAL students	A	A	A	X	A
WO5	Establish research programs on an ongoing basis	A	X	A	Or	X

Table 4. Matrix Reachability (RM)

Code	Strategy	WO1	WO2	WO3	WO4	WO5	Driver
WO1	Carry out self-evaluation to support the improvement of the D-3 TM and TE STTAL education curriculum	1	1	1	0	1	4
WO2	Carry out competency improvement of lecturers in D-3 TM and TE study programs	0	1	1	0	1	3
WO3	Implementing the renewal of Alins and Alongins STTAL	0	1	1	0	1	3
WO4	Increase the number of admissions for D-3 TM and TE STTAL students	0	0	0	1	0	1
WO5	Establish research programs on an ongoing basis	0	1	0	0	1	2
	Dependence	1	4	3	1	4	

After getting the results from the table above, the calculation of Dependent (x) and Driven Power (y) is written as the x and y axes, where the hasil will be depicted in the Mac Mic analysis obtained results as in Figure 5.

The WO4 strategy is located in the sector (Autonomous variable) which means that this variable has a low dependence and has little influence on other variables. WO5 is located in sector II (Dependent Variable) which means that this variable has a very large dependence on other variables, Sector III (Variable Linkage) consists of WO2 and WO3 which means that both variables have a high dependence and high influence on other variables, Sector IV (Independent variable) consist of WO1 which means that this variable has a small dependence and has a large influence on other variables.

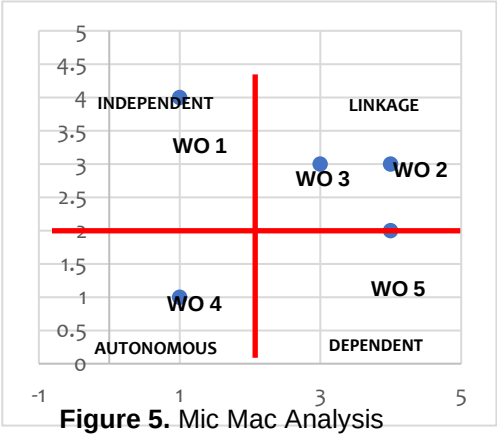

Figure 5. Mic Mac Analysis

A strategic overview of the ISM method can be seen in Table 5.

Table 5. ISM Model

Lev	Sub Strategies
I	WO 4
II	WO 5
III	WO2 ↔ WO 3
IV	WO1

Based on the ISM model, it can be seen that carrying out self-evaluation to support the improvement of the D-3 TM and TE STTAL (WO1) education curriculum is the most influential variable in developing students' skills and knowledge of solar power plants, because the location of these variables is at the most basic level IV. Increasing the number of admissions for D-3 TM and TE STTAL (WO4) students is at the top level, which means that these variables must be the focus of attention of educational institutions to be able to face the challenges of solar power plant technology development in the future. The implementation of self-evaluation and curriculum improvement will affect the implementation of the Alins and Alongins STTAL (WO3) renewal and the improvement of lecturer competencies in the D-3 TM and TE (WO2) study programs, both variables can be developed simultaneously. Furthermore, the establishment of an ongoing research program (WO5). After all is done, STTAL can increase the number of admissions for D-3 TM and TE STTAL (WO4) students.

From the model obtained, a Roadmap for the strategy for fulfilling solar power plant technical personnel in the Navy will be made in the 2023-2025 time period. This can be seen in Table 6.

Table 6. Roadmap of Strategies for Fulfilling Solar Power Plant Technical Personnel in the Navy

Strategy / Time	2023	2024	2025	Moon	
Self-Evaluation of Curriculum Improvement Duk				1	12
Duk Alins and Alongins PLTS				13	17
Improving Kom Dosen				13	17
Research Determination				17	20
Solar Power Plant Education Practices				18	~
Improving student Jml				20	24
Provide input student placement data				25	~

The entire stages of the solar power plant skills and knowledge development strategy roadmap will be described in Table 8.

Table 8. Stages of Strategy for Fulfilling Solar Power Plant Technical Personnel in the Navy

Development of Solar Power Plant Skills and Knowledge in the Indonesian Navy		Road Map		Achievement Objectives
No	Substrategi	Start of the Moon	Length of Time	
1	Carry out self-evaluation to support the improvement of the D-3 TM and TE STTAL education curriculum	1	12	Adding PLTS courses to the D-3 TM and D-3 TE curricula, so that STTAL can organize PLTS education/learning activities, both independently and in collaboration with other universities.

2	Implementing the renewal of Alins and Alongins STTAL	13	17	Support of instruction tools and instruction helpers in the laboratory by adjusting to the PLTS learning material
3	Improving the competence of lecturers in D-3 TM and TE study programs	13	17	Increasing the competence of lecturers towards the use of solar power plants that are tailored to the needs of teaching, research and community service.
4	Establishment of research programs on an ongoing basis	18	20	There are references in planning, developing, implementing and evaluating research on the use of solar power plants that are being developed within the Navy
5	Implementation of Solar Power Plant Education	18	~	Implementation of the PLTS teaching and learning process for D-3 TM and TE students
5	Increase the number of admissions for D-3 TM and TE STTAL students	21	24	The fulfillment of all the needs of technical personnel in the field of solar power plants.
6	Provide data input to Navy leaders on graduates of D-3 TM and TE students	25	~	Fulfillment of solar power plant technical personnel at Fasharkan-Fasharkan throughout Indonesia

The table above explains the plan for the stages of developing solar power plant skills and knowledge in the Navy within a period of two years starting from the implementation of self-evaluation in the D-3 TM and TE STTAL Study Programs which are carried out in the first month to the twelfth month. Self-evaluation is an activity that aims to obtain data and information both internally and externally which will be implemented in the student academic process with the help of a competency-based curriculum for the development and utilization of solar power plants in the Navy environment. D-3 TM and TE, then the TM and TE study programs can carry out PLTS learning activities for D-3 TM and TE students.

In the thirteenth to the seventeenth month, STTAL can update Alins and Alongins which are adjusted to the PLTS learning materials to be carried out and improve the competence of D-3 TM and TE study program lecturers on the use of solar power plants. Both strategies can be implemented by conducting comparative studies to universities that already have experts in the field of solar power plants and have equipment that can be used as Alins and Alongins to conduct learning. One of the universities that has been able to carry out PLTS learning is Hang Tuah University (UHT) Surabaya. UHT is one of the private universities under the Navy. Where the UHT electrical engineering study program has included renewable energy courses, which contains material discussing solar power plants. In addition, the UHT electrical engineering study program also opened solar power plant training in collaboration with the Ministry of Energy and Mineral Resources, the results of the training will be given competency certification in the field of solar power plants issued by the Ministry of Energy and Mineral Resources.

With the addition of PLTS material to the D-3 TM and TE curriculum, adequate laboratories to carry out solar power plant development and the availability of lecturers who have competence in the field of PLTS, then in the 18th month onwards the D-3 TM and TE study programs can carry out teaching and learning activities regarding solar power plant material for D-3 TM and TE STTAL students. The determination of a sustainable research program can be carried out in the eighteenth to twentieth month, where this strategy aims to establish a reference in planning, developing, implementing and evaluating research on the use of solar power plants that are being developed within the Navy. located in the 3T area can be resolved through the results of research by D-3 TM and TE STTAL students.

The next step is toincrease the number of admissions for D-3 TM and TE STTAL students, where this strategy will be implemented in the twenty-first month to the twenty-fourth month. This strategy aims to fulfill technical personnel in the field of solar power plants within the Navy by being faced with increasing technological developments and the increasing demand for D-3 STTAL student graduates by stakeholders. Additional student admissions activities can be carried out in student admissions in the 2025 academic year.

With the implementation of the stages of developing solar power plant skills and knowledge by STTAL, in 2025 STTAL will be able to graduate technical personnel in the field of solar power plants. With the competencies possessed by D-3 TM and TE STTAL graduates, STTAL can provide data input to their respective professional and corps coaches as well as the Naval Personnel Administration Service (Disminpersal) to be able to place several STTAL graduates each year in the position of technical non-commissioned officer found in the electrical workshop at the Maintenance and Repair Facility (Fasharkan). Currently there are as many as nine fasharkans spread throughout Indonesia, ranging from Fasharkan Belawan, Fasharkan Sabang,

Fasharkan Jakarta, Fasharkan Mentigi, Fasharkan Surabaya, Fasharkan Makassar, Fasharkan Bitung, Fasharkan Ambon and Fasharkan Manokwari. With the fulfillment of solar power plant technical personnel in each facility, it is hoped that it can support the development and utilization of solar power plants within the Navy.

5. CONCLUSION

Based on the results of research that has been carried out, it is concluded that the use of solar power plants in the Navy environment has very good potential, with the average intensity of sunlight and air temperature at Navy bases is 5.09 kWh / m 2 / d and the average temperature is 26.9 ºC. Several services in the Navy have also utilized this potential to be used as a means of national defense and as a research tool.

The development of PLTS skills and knowledge that can be carried out by STTAL is by conducting a self-evaluation to improve the D-3 TM and TE STTAL education curriculum, carrying out competency improvement for education lecturers in the D-3 TM and TE study programs in the field of PLTS, carrying out the renewal of Alins and Alongins STTAL, increasing the number of admissions for D-3 TM and TE STTAL students and establishing research programs on an ongoing basis. As for the strategy of fulfilling the needs of technical personnel in the field of solar power plants at Navy bases, it can be started from the development of skills and knowledge of D-3 TM and TE STTAL students.

The roadmap for the strategy of meeting the needs of solar power plant technical personnel is carried out for 24 months which starts from conducting self-evaluation for 1 year, carrying out the renewal of Alins and Alongins STTAL and carrying out increasing the competence of educational lecturers in D-3 TM and TE study programs for 5 months, then establishing a continuous research program carried out for 3 months, PLTS learning which is carried out in the 18th month onwards, increasing the number of admissions for D-3 TM and TE STTAL students held in months 22-24, then the last in month 25 is to provide suggestions for entering data to Navy leaders to be able to place D-3 TM and TE graduates throughout the fasharkan.

Based on the results of the research conducted, the researcher provides recommendations to the Navy so that it can increase the number of STTAL student admissions that are adjusted to the development of renewable energy technology within the Navy, and the Navy can encourage STTAL to open new study programs in the field of renewable energy level D-3 at STTAL. So it is hoped that graduates from D-3 TM and TE students can be placed in all facilities in Indonesia. Meanwhile, further research is expected to conduct research related to renewable energy development policies in the Navy.

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