

Electronic High Voltage Power Supply Device: A Trainer Marine Electro-Technology

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Abstract: Competency is the strong area of interest for STCW Convention Code, training and education be equipped with the upgraded training materials that bring the realistic simulation on board the ship to hone their knowledge and skills. State of the arts simulator is too expensive to provide and become complacent to the real world of maintenance and operation which is the prime implication of the computer technology since total awareness and safety practices may jeopardize. The purpose of this study was to the development, designing and constructing an electronic high voltage power supply to be used in supplementing the minimum standard of competence relevant to monitoring and maintenance, the practical workshop skills in safe working practices, testing procedures, and maintenance activities for marine high voltage systems. The study was conducted at the Norwegian Training Center Manila. It was evaluated on the efficiency and effectiveness of the constructed trainer, which is an Electronic High Voltage Power Supply Device. The trainer was specifically evaluated on the technical requirements in the development on its design, construction, installation, and function; and the performance on its efficiency and effectiveness for instruction. Furthermore, it looked into the significant mean difference between efficiency of the trainer and its effectiveness for instruction upon use. The output is the technology package, which will be used upon implementation of the trainer. Descriptive method particularly survey research was employed on this study. Questionnaires were given to 10 instructors and 40 participants for evaluation. Gathered data were treated using total weighted points, weighted mean, and t-test. It was found out that the trainer is highly consistent in terms of design, construction, installation, and function; the trainer's performance is highly efficient in terms of trainer's output voltage and trainer's effectiveness for instructions; and there was no significant difference between the trainer's efficiency and the trainer's effectiveness for instruction for the instructors. And there is a significant difference between the trainer's efficiency and the trainer's effectiveness for instruction for the students.

Keywords: Vocational Education, electronic high voltage power supply device development design.

I. Rationale Of The Study

Every power supply must obtain the energy it supplies to its load, as well as any energy it consumes while performing that task, from an energy source. Depending on its design, a power supply may obtain energy from various types of energy sources, including electrical energy transmission systems, energy storage devices such as a batteries and fuel cells, electro-mechanical systems such as generators and alternators, solar power converters, or another power supply. Power supply -Wikipedia

In Marine Practice majority of merchant ships have a 3-phase 3 wire, 440 V insulated neutral earth power systems. This power system falls in the category of Low Voltage and meets the power demands of medium capacity motors up to 200 kW. Voltages up to & including 1000V is known as Low Voltage system and Voltages above 1000V is called as High Voltage system.

The Tug Simulators allow captains to experience and train the handling of tugs with different propulsion systems. The simulator includes an easy-to-use set of instructor tools to prepare and control maneuvering exercises, multi-tug operations and ship maneuvering parameters. The simulator provides a compact yet natural look and feel for realistic tug training.

To simulate LCD type Power Management System controllers, a precisely developed small touch screen display simulates the controller functionality. The simulator is connected to the breaker using a Wago COTS automation interface which may also be used for automation training. The bus ties and generator breakers are installed in the main switchboard and are normally 'front loading' Vacuum Circuit Breakers.

This research assessed the electronic power supply device trainer for marine instruction at Norwegian Training Center (NTC), Philippines during training year 2019 as basis for a technology package.

II. Methods

The study used the descriptive method during the giving of discussion, details in planning, designing, and constructing the trainer. A normative survey will be the mode of acquiring data which uses the questionnaire as the main instrument.

In the research flow, the input of the study involved in planning and designing stage. It included preparation of working drawings, materials and cost, schematic diagram, the actual construction using as much as possible the local materials and modified gadgets to be economical, and the installation of the electronic high voltage power supply device was tested by the researcher whether it functions or performs as it is expected. After revision and perfecting, it was ready for demonstration. The validation of the functional trainer by the training officers, and seafarer participants in terms of efficiency and the effectiveness of instruction use through sets of questionnaires follow.

The process involved the approval of the request from the training center to conduct the simulation during their instructions, and distribution of a test questionnaire in measuring the understanding of efficiency and effectiveness with corresponding rubrics for rating of the trainer by the training officers and to the seafarer participants for the treatment of data.

An Electronic High Voltage Power Supply

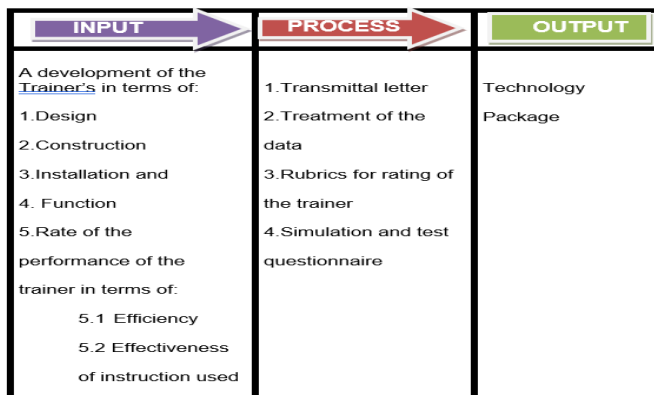


Fig. 2
Flow of the study

The research was conducted in the Norwegian Training Center Manila (NTC-M) located at Pacific Drive Entrance 6th floor Five E-com Center Building, Pacific Drive Extension, Mall of Asia Complex, Pasay City. It served as one of the teaching materials for the practical workshop skills in safe working practices, testing procedures, and maintenance activities for Marine High Voltage and Marine Electro-Technology Courses.

The area conducted was the training classroom of Norwegian Training Center Manila a Marine High Voltage and Marine Electro-Technology courses. The area fitted with a high voltage breaker being used in the training instruction. The high voltage trainer will serve as a simulated three phase power supply which may undergo a series of measurement through the line breaker.

The Norwegian Training Center – Manila offers upgrading courses to seafarers in 6 categories namely: Ship and Cargo handling Courses, Management Courses, Technical / Electro-technical Courses, Safety Courses, Welding courses, Culinary Courses.

NTC-M is also in partnership with major certifying & accrediting bodies and leading suppliers in the shipping industry, both local and international, to develop training programs for specific requirements, products, and equipment that provide development and enhancement of capability and technical skills to the seafarers.

DNV GL	Maritime Industry Authority (MARINA)
Framo	Technical Education and Skills Development Authority (TESDA)
Norwegian Maritime Authority (NMA)	National Telecommunications Commission (NTC)
Alfa Laval	Oxford Aviation Academy MCRM
Wilhelmsen Ship Service UNITOR	Wesmans AS
TERO MARINE	KONGSBERG
SpecTec	
The Nautical Institute	

The respondents of the study were determined by purposive sampling method because they have the needed skills intended in the study, specifically, the marine engineer officer participants taking the Marine High Voltage (MAHIVO), Marine Electro-Technology (MET) Courses and the instructor in-charge in giving instructions in Norwegian Training Center Manila. Ten instructors chosen to validate the efficiency and the effectiveness of the trainer and forty seafarer participants are chosen to validate the effectiveness of the trainer upon usage.

Technical Requirements Of The Trainer

Technical requirement of the trainer was validated according to the four aspects: design, construction, installation and functions. In the aspects of design, technical requirement is broken down into four categories: working drawing; schematic and line diagram; supplies, materials, and cost; and ergonomics.

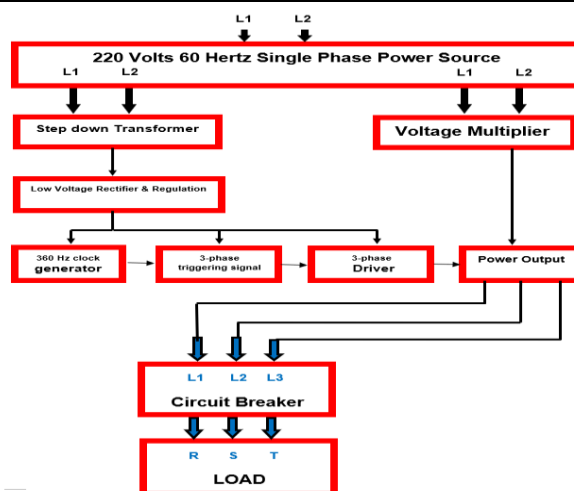


Table 1 Distribution of Respondents

Respondents	Population	Sample Size	Percentage
MARINE ENGINEER OFFICERS and ELETRO-TECHNICAL CADETS and OFFICERS Participants	40	40	80%
NTC-M Instructors	10	10	20%
TOTAL	50	50	100%

The main tool or instrument used to gather relative data was a consolidated questionnaire adopted from Capuno (2002). There are two sets of structured questionnaires used in gathering the data needed in the study: one for the participants, the other one is for the instructor. Although the study used two (2) sets of questionnaires one for the instructor but they are almost the same. It has drawn responses only on the technical requirements of the trainer from its design, construction, function and effectiveness of the instruction. The two (2) sets differ only on the last part; also, it used informal and formal interview and other documentary analysis to clarify uncertain information.

After the approval of the survey instruments, permission was sought from the training manager and the managing director was sought. Upon granting the approval, the proponent was personally distributed the questionnaire to the seafarer participants, and the instructors. Before the respondents filled up the survey questionnaire, an explanation on the purpose of the study and a demonstration on the features and function of the trainer were explained. Later, the questionnaires were collected to insure 100% retrieval.

Gathered data on the technical requirements and performance rate of the trainer in terms of its design construction, installation, function, efficiency and effectiveness of the instruction were tabulated, sum-up, and analyzed.

Simple percentage (P) was the total weighted score of respondents and multiplied by one hundred to determine the distribution of the respondents.

Total Weighted Points (TWP) this formula was used to get the total weight of each category as rated by the respondents.

Average Weighted Mean (X) the result is summed and the total is divided by the sum of the weights to determine the concentration of each item or category, this average weighted mean used.

t -test of Significant Mean Difference calculate both the sample statistic of the sample mean and the standard error, on the significance level set at 5% and the type of comparison to determine the significant difference between the trainer's efficiency and trainer's effectiveness "t-test" was used.

Scoring Procedure

The data were scored by the given weighted points and their category:

Weight	Category	Verbal Description
3	2.34 - 3.00	HC
2	1.67 - 2.33	C
1	1.00 - 1.66	NC

The weighted mean is interpreted using the following “Parametric Scale”:

Weight		Category	Verbal Description
3	2.34 - 3.00	HE/HC	Highly Effective or Highly Consistent , if the trainer met the standards and functions well
2	1.67 – 2.33	E/C	Effective or Consistent , if the trainer met the standards and functions
1	1.00 – 1.66	NE/NC	Not Effective or Not Consistent , if the trainer met the standards and functions

III. Results And Discussion

The data on this research were taken from the responses of forty (40) junior and senior marine engineer officers’, Electro-Technical Cadet and Marine high Voltage participants and ten (10) NTC Instructors in terms of the efficiency of the trainer and effectiveness of the trainer’s performance for the instruction. Specific discussion was on technical requirements performance of the trainer, and significant difference between perception and performance.

Table 2 Consistency of Trainer in terms of design as to Trainer’s Working Drawing

WORKING DRAWING	INSTRUCTORS N=10	
	X	VD
European standards are strictly followed in the drawing	2.90	HC
Clarify of placing dimension on different views for direct measuring	2.80	HC
Clarify of drawing details needed for construction	2.70	HC
Correct usage of lines and symbols	3.00	HC
Correct usage of surface symbols and specification	3.00	HC
Clarity of pictorial views	2.40	HC
Average Weighted Mean	2.80	
Verbal Description	Highly Consistent	

Table 2 presents the data gathered on the consistency of the trainer’s design in terms of trainer’s working drawing as rated by the instructors.

It is composed of six indicators, such as: European standards are strictly followed in the drawing; clarity of placing dimensions on different views for direct measuring; clarity of drawing details needed for construction; correct usage of lines and symbols; correct usage of symbols and specifications; and clarity of pictorial views.

The trainer’s design in terms of the working drawing is Highly Consistent as manifested in the average weighted mean of the instructors of 2.80.

It means that the trainer’s design in terms of its working drawing met the European standards and this will be the basis for other designs.

Table 3 Consistency of Trainer in terms of Design as to Schematic and Line Diagram

Schematic and Line Diagram	INSTRUCTOR N= 10	
	X	VD
European Standards are strictly followed in the drawing	2.80	HC
Correct usage of electronic symbols	3.00	HC
Clarity of line and symbols	3.00	HC
System trouble can easily be trace- up	2.80	HC
Power lines trouble can easily be trace-up	2.90	HC
Average Weighted Mean	2.90	

The trainer's design in terms of schematic and line diagram was considered Highly Consistent as manifested in Table 3. Instructors gave the average weighted mean of 2.90. The responses justify that the trainer's design as to schematic and line diagram comply the European standards. Schematic diagram and line diagram were provided to the instructors during the validation of the trainer.

Table 4 Consistency of the trainer in terms of Design as to Supplies, Materials, Cost

SUPPLIES, MATERIALS, AND COST	INSTRUCTOR N= 10	
	X	VD
Availability of supplies and materials in the locality	2.70	HC
Availability of the accessories and spare parts	2.70	HC
Affordable cost of the supplies and materials.	2.60	HC
Average Weighted Mean	2.67	
Verbal Description	Highly Consistent	

The "availability of the supplies and materials in the locality and availability of the accessories and spare parts" were assessed by the instructors to be Highly Consistent with a weighted mean of 2.70; and for the "affordable cost of the supplies and materials", the instructors assessed it to be Highly Consistent with a weighted mean of 2.60.

The data prove that the trainer's design as to supplies, materials, and cost are marketable, available, and affordable.

Table 5 Consistency of the Trainer in terms of Design as to Ergonomics

ERGONOMICS	INSTRUCTORS N= 10	
	X	VD
Rigidity of the trainer	2.80	HC
Utility of the trainer	2.60	HC
Safety in using the trainer	2.90	HC
Time saving upon usage	2.80	HC
Average Weighted Mean	2.78	
Verbal Description	Highly Consistent	

It gives four indicators, such as: rigidity of the trainer, utility of the trainer, safety in using the trainer, and time saving upon usage.

Consistency of the trainer in terms of design as to ergonomics is statistically Highly Consistent as proven by the evaluation of the instructor of the weighted mean of 2.78. The trainer's design as to ergonomics is proven good, safe, durable, and time saving.

Table 6 Summary Table of the Consistency

DESIGN	INSTRUCTORS N=10
	WEIGHTED MEAN
Working drawing	2.80
Schematic and line Diagram	2.90
<u>Supplies ,Materials, and Cost</u>	2.67
Ergonomics	2.78
<u>Average Weighted Mean</u>	2.79
Verbal Description	Highly Consistent

Table 6 presents the consolidated data on the consistency of the trainer's design in terms of working drawing; schematic and line diagram; supplies, materials, and cost; and ergonomics. The instructors rated the four categories as 2.80, 2.90, 2.67, and 2.78,

respectively. The over-all rating on the consistency of the trainer's design by instructors is Highly Consistent as manifested in the average weighted mean of 2.79.

The summary of the Consistency of the trainer proves that the design of the trainer met the required standards for planning and designing. It can be the basis for the construction of the trainer.

Construction

In the construction category, the trainer was validated based on the validations of time frame, usage of tools and machines, ventilation, safety, housekeeping, and the quality.

Table 7 illustrates the Consistency of the trainer in terms of its construction. It shows six indicators, namely: construction time frame is enough, proper usage of tools and machine, adequate ventilation of the working area, safety habits is being applied, proper housekeeping of the work place, and quality of the finish trainer.

Table 7 Consistency of the Trainer in terms of Construction

CONSTRUCTION	INSTRUCTORS N = 10	
	X	VD
Construction time frame is enough	2.60	HC
Proper usage of tools and machine	2.80	HC
Adequate ventilation of the working area	2.70	HC
Safety habits is being applied	3.00	HC
Proper housekeeping of the working area	3.00	HC
Quality of the finished trainer	2.70	HC
Average Weighted Mean	2.80	
Verbal Description	Highly Consistent	

The items "safety habits is being applied" and "proper housekeeping of the working area", instructors described both as Highly Consistent with the weighted mean of 3.00. The item "proper usage of tools and machine" instructors described as Highly Consistent with the weighted mean of 2.80. The item "construction time frame is enough", instructors described as Highly Consistent with the weighted mean of 2.60.

It means that the trainer is being constructed in the proper way of safety and proper ventilation of the working area; thus, the trainer is in good quality.

Installation

In the category of installation, the trainer was validated based on the consideration of proper usage of tools; schematic and line diagram are strictly followed; low and high voltages were labelled boldly; placement of power source over-current protection; placement of banana jacks; arrangement of circuit components; and clarity of symbols, values and polarities.

Table 8 Consistency of the Trainer in terms of Installation

INSTALLATION	INSTRUCTORS N=10	
	X	VD
Proper use of tools	2.70	HC
Schematic and line diagram are strictly followed	3.00	HC
Low and high line are labelled boldly	2.80	HC
Proper placement of over current protection	2.80	HC
Placement of banana jacks	2.90	HC
Arrangement of circuit components	2.90	HC
Clarity of symbols, values and polarities	2.90	HC
Average Weighted Mean	2.86	

Verbal Description	Highly Consistent
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The overall rating of the consistency of the trainer in terms of installation is Highly Consistent by the instructors as manifested in the average weighted mean of 2.86. It means that the installation met the standards and the placements of parts were correct.

Functions

In the category of the function, the trainer was validated based on the two aspects, the efficiency and the effectiveness for the instruction.

Table 9 Consistency of the Trainer in terms of Function

Table 9 shows the **consistency** of the trainer in terms of its function

FUNCTION	INSTRUCTORS N=10	
	X	VD
Trainer's efficiency	2.80	HC
Trainer's effectiveness for the instruction	2.90	HC
Average Weighted Mean	2.85	
Verbal Description	Highly Consistent	

The Consistency of trainer in terms of function is Highly Consistent by the instructors as manifested in the average weighted means of 2.85. It is concluded that the trainer's function is needed for the trainer.

Table 10 Summary of the Consistency of the Trainer in terms of Design, Construction, Installation, and Function

VARIABLES	INSTRUCTORS N= 10
	Weighted Mean
Design	2.79
Construction	2.80
Installation	2.86
Function	2.85
Average Weighted Mean	2.82
Verbal Description	Highly Consistent

Table 10 collates the data on the Consistency of the trainer in terms of design, construction, installation, and function. In the aspect of "Design" the instructor give an average weighted mean of 2.79; in "Construction", the instructors gave an average weighted mean of 2.80; "Installation", with an average weighted mean of 2.86; and "Function", with an average weighted mean of 2.85.the over-all rating on the Consistency of the trainer as to design, construction, installation, and function by the instructors indicates that it is Highly Consistency as manifested in the average weighted mean of 2.82.

It is proven that the trainer followed the standards in design, construction, installation, and function.

Perception Of The Respondent Groups On The Performance Of The Trainer

Trainer's performance is evaluated under two specific functions that the trainer is efficient and effectiveness for instruction. Both functions shall be proficient enough to deliver a three-phase high voltage power and serves as a simulator in performing the activity during the training instruction for validation.

In this research study, precise figures were given importance. So, to keep the input constant at all times built-in regulated 15 volt in series of 5 volt for IGBT driver supply and a separate single 5-volt power source for three phase processor and clock system was installed.

Efficiency

This study presents a simple converter topology for simulating a high voltage three phase power supply. Using only six active switches IGBT's the converter supplies 120 degrees out of phase voltages at rated frequency, the designed topology permits to reduce the rectifier switch currents, the harmonic distortion at the input converter side, and presents improvements on the fault and control approaches are supported by test results. The converter takes single phase supply and converts it into three phase supply with the help of power insulated gate bi-polar transistor. The single-phase supply is first converted into dc supply by using rectifier,

again dc supply of rectifier is given to inverter where IGBT's are used and converts the dc supply again into three phase ac supply. The experimental result showed that the voltage output produced remained high as determined with the increase in DC supply in the output stage of IGBT and the developed hardware has satisfactory converted the single-phase power to three phase power supply. Keywords: AC to DC to AC converter, IGBTs, drive system, inverter.

One key benefit of utilizing a 1 phase to 3 phase converter is that convenience and cost-savings of operating a converter instead of installing utility three phase power. Three phase power is often unavailable or expensive to implement. www.frequencyconverter.net/how-to-convert-single-phase-to-three.

Table 11 Efficiency of the Trainer in terms of Performance

Output Voltage Level	INSTRUCTORS N=10		PARTICIPANTS N=40	
	X	VD	X	VD
Voltage level in 1 hr	2.90	HE	2.95	HE
Voltage level in 2 hrs	2.80	HE	2.87	HE
Voltage level in 3 hrs	2.70	HE	2.85	HE
Voltage level in 4 hrs	2.70	HE	2.85	HE
Voltage level in 5 hrs	2.60	HE	2.77	HE
Average Weighted mean	2.74		2.86	
Verbal Description	Highly Effective		Highly Effective	

Both instructors and seafarer participants described the trainer's efficiency performance as to the trainer's output voltage level to be Highly Effective as manifested in the average weighted mean of 2.74 and 2.90 respectively. It means that the trainer's is efficient to generate output voltage level that met the required standards and functions very well.

Trainer's effectiveness for instruction

This five-hour training session provides employees with tools and resources for effective training delivery. The focus is on instructional strategies that foster a deep approach to learning.

Training is instruction provided for the purpose of improving performance on the present job. The goal of training is to have participants acquire new skills, knowledge, or attitude.

"Practice doesn't make perfect; it makes permanent."

It's not merely "participating" or "discussing" an issue; it's solving it or reconstructing it, or analyzing it, or defining it, or categorizing it, etc. CBI is actually doing something.

Table 12 Effectiveness of the Trainer in terms of Performance as to Instruction

TRAINING ACTIVITIES	INSTRUCTORS N= 10		STUDENTS N= 40	
	X	VD	X	VD
Relevance of the trainer to enhance safety to your field of work or present job.	2.90	HE	2.92	HE
Consistency of the trainer to the topics, lessons and activities to the course objectives.	3.00	HE	2.95	HE
Usefulness of the trainer as instructional aids and materials.	2.80	HE	2.92	HE
Effectiveness of the trainer used in activities and exercises.	2.80	HE	2.92	HE
Organization of the course topics with respect to succession and flow of lesson, discussions, and activities	2.80	HE	2.90	HE
Duration of the course in relation to attaining the learning objectives and coverage by the trainer	2.60	HE	2.75	HE
Effectiveness of theoretical and / or practical instructions by the trainer.	3.00	HE	2.95	HE
Average weighted Mean	2.84		2.90	

Verbal Description	Highly Effective	Highly Effective
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Both instructors and students described the trainer's performance as to trainer's effectiveness for instruction to be Highly Effective as manifested in the average weighted mean of 2.84 and 2.93 respectively. It means that the trainer's effectiveness for instruction met the required standards and functions very well.

Table 13 Test on Significant mean Difference between the Trainer's Efficiency and Trainer's effectiveness for instruction as Rated by the Instructors and Students

Respondents	EFFICIENCY		EFFECTIVENESS FOR INSTRUCTION		COMPUTED T-TEST	Table t-value @DF=48 a= 0.05 two-Tailed test	Decision
	X1	SD1	X2	SD2			
Instructors (N=10)	2.74	0.10	2.84	0.13	1.92	2.01	Accept Ho
Students (N=40)	2.86	0.056	2.90	0.062	3.25	2.01	Reject Ho

It means that the instructors and the students have different validation. The evidence (data) collected by the students in validating the performance is unlikely in light of the initial assumption, while instructors validated the ELECTRONIC HIGH VOLTAGE POWER SUPPLY trainer is very efficient and effective in meeting the standards and functions based on their knowledge, skills, and expertise.

Output Of The Study

The author tends to formulate an instructional gadget in which its primary objective is to bring the recipient into a pragmatic way of learning acquisition.

Basically, the prime focus is to materialize the gadget which introduces students to the physics and devices involved in electronic technology systems. In effect, the program progresses to more advanced training in simulation source of high voltage power supply for marine electro-technology application.

The technology package is the wholesome composition of ideas, principles, skills, and knowledge. It is being integrated in order to come up with a certain project that can help solve problems in teaching and learning situation.

The set of practical activities gives the information of the operations and functions of the trainer. It has the steps of operation to be followed such as:

- How to get started?
- Building a Clock (Astable) Circuit.
- Building a low voltage rectifier
- Building a Low voltage regulator
- Building a Voltage multiplier
- 3 Phase signal triggering circuit
- Building a IGBT driver circuit
- Building a IGBT power output circuit
- The Making of an Electronic high voltage power supply Circuit.
- Steps to connect three phase high voltage output supply
- Steps before the circuit activation
- Steps in activating the trainer.
- Closing the procedures

General Objectives

This manual will guide and teach the students to:

1. Construct and assemble an Electronic high voltage power supply trainer;
2. Install the necessary parts;
3. Estimate the bill of materials needed.
4. Identify passive and active components.
5. Familiarized analog and digital circuits;
6. Differentiate AC and DC power sources;
7. Distinguish the stages during signal inversion; and
8. Design and create an Electronic high voltage power supply.

Construction Guide

This manual shows on how an Electronic high voltage power supply Trainer is being constructed. It gives all the information and operations needed for the casing of an Electronic high voltage power supply trainer.

Work Stages

The students can construct the trainer without difficulties and hassles by following the dimensions given in this manual. It is important to take note that possible sequence of operations are given, so that:

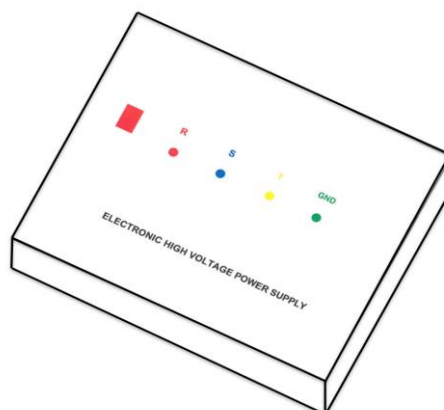
Workflow is continuous; Each can work on piece part; Eliminates down times during assembling of parts.

The tools, equipment, and materials should be prepared before implementation of the project.

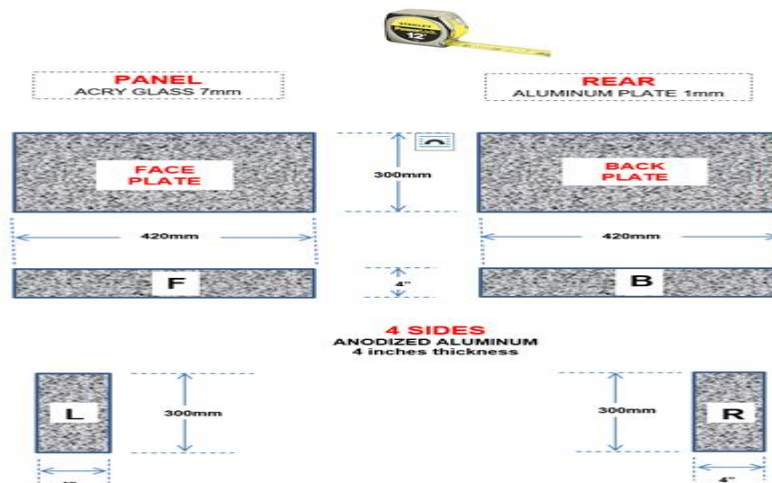
Tools And Equipment

Drawing instruments	Steel tape
Try square	Ruler
Computer	Philip screw driver
Soldering iron	Portable electric drill
Flat screw driver	Multi-tester
Riveter	Center punch
Soldering iron stand	Hacksaw
Poly glass cutter	Printer
Crimping tool	Bastard round file

Three-Dimensional View of the Electronic High Voltage Power Supply Trainer



Marking And Lay-Out



Cutting, And Filing

Before cutting the materials do not forget to double check the measurements. This will save time and material. Fine tooth saw such as hacksaw is the tool used for smooth cuts. Further smoothing can be achieved through filing.

Boring And Drilling

The alignment of holes should not be given less importance during the works. Before drilling a hole, first, locate the center and make a guide or a crib using a nail tip or a center punch. Let the bit rest on the crib and start drilling.

Assembling

The trainer casing is easy to assemble once the desired length was measured and cut the total measurement of aluminum to form into a box. With the given length of left, front, right, and at the rear sides which are 300 millimeters, plus 420 millimeters, plus 300 millimeters, plus 420 millimeter and for the total length of 1,440 millimeter. Provide a 45 degrees angle cut-out for each dimension and bend to form a casing as illustrated in Fig. 1. The final edge joint is applied with rivets as illustrated in Fig. 3. Aluminum back plate is provided at the bottom side, while the top are the 420mm x 300mm x 4mm fiber board and clamp with the 420mm x 300mm x 5mm poly glass. As illustrated below in Fig. 2.

Installation Of Parts

Fill each hole with banana jack or binding post. Tighten the jacks or posts with an electrician plier. Apply a little amount super glue to keep the jacks or posts in place. Printed circuit board is ready for parts installation and solder the components in its assign terminals at the back of the printed circuit board and to the panel. The illustration below may point the location of each component.

Nosing And Finishing

Roughness on the surface can cause accident to self and others. It can also bore hesitation in the mind of a user to perform a task. Thus, surface shall be smoothened by sanding to remove the roughness. The trainer shall be pleasant and soothing to the eye; so, an angular aluminum (analok) $\frac{1}{2} \times \frac{1}{2}$ nosing were installed at the edges to add a color contrast of the finished casing and corner bolt also serves as a stand at the back plate with fixed rivets as shown below.

Testing And Checking

The trainer was tested on each stage to determine the output coupling. Oscilloscope can check the voltage and frequency of the clock oscillator (astable) circuit at 360 Hertz, pulse triggering circuit, inverter circuit, IGBT driver circuit, and to the power output stage in a sequential manner with its peak-to-peak square waveform response which is required in the pulse triggering circuit as shown below.

Checking the pulse output voltage and frequency at phase 1 (pin 1) and phase 2 (pin 15) and phase 3 (pin 14) with respect to ground and feed to the inverter input which is in a full bridge with low side and a high side drive that complimentary on each phase.

Checking the high side and low side pulse output voltage and frequency on phase 1, phase 2, phase 3 with respect to ground. Note, input pulses are always inverted to both high side and low side output.

Checking the high side and low side pulse output voltage and frequency on phase 1, phase 2, phase 3 with respect to ground. Note; input pulses are always proportion to both high side and low side output

Checking the AC output voltage and frequency on phase 1, phase 2, phase 3 in relative to each other. Note, AC voltage output is about to range on 70.7 to 80 percent of the injected from DC bus voltage.

Voltmeter can check the multiplied DC voltage output and the regulated power supply that supply to different stages of the trainer. Note: 220 volts ac input is multiplied into four times than the input Voltage. Various voltage input was injected in the multiplier from 24 volts AC with the quad output DC voltage as shown in Fig. 1, from 100 volts AC to doubling DC output voltage as shown in Fig. 2, and the four times voltage DC output with respect to 110 volts AC voltage input as shown Fig. 3. Input voltage was raised to 220 volts AC with the total 933 volts DC, a three times output DC voltage as the IGBT can withstand and draw 786 volts three phase AC output voltage.

AC voltmeter is design to read AC voltages within the range from 0 Volts up to 1000 Volts. This meter can be used to check the Convenience outlet voltage and the Electronic High Voltage Supply output voltage as illustrated below.

The purpose of the trainer is to provide a three-phase high voltage output to simulate the practice activity of MAHIVO Marine High Voltage. Thus, a non-contact high voltage tester is usually needed to measure the output voltage.

User's Manual

This manual contains the ways on how the Electronic high Voltage Power Supply Trainer operates. This complete package of trainer consists of Line 1 (R), Line 2 (S), Line 3 (T), and Ground (GND) power post.

It follows the necessary steps such as:

How to get started?

1. Remove all the connectors from the panel before using the Electronic high Voltage Power Supply Trainer.
2. It is the best practice to turn off all the switches before working with the trainer.

Preparation for Simulation *(please the video for the simulation for data gathering)*
<https://youtu.be/Se5E1nJJkiU?si=tzyKXOF14oovsYvy>

3. Interface the Electronic High Voltage Power Supply into its respective line phase to the bus bars of the High Voltage switch gear to simulate the presence of power supply during the practice activity.

Steps Before Activation.

4. Double check all the connectors from the trainer to the bus bars of the high voltage switch gear.
5. Notify the instructor concern before giving power to the trainer must be practiced.
6. The main switch of the power supply is located at the upper left side portion of the trainer.
7. This will assure that the connections are correct and authorized for activation

Steps in Activating the Trainer.

8. Insert the AC cord on the rear part then plug it to the nearest convenience outlet.
9. Giving of power to the Electronic high Voltage Power Supply circuit at the same time noting the source power light indicator will be made.
10. Check the AC voltage source from the convenience outlet using AC volt meter as they perform the work activity.
11. Check the phase 1 and phase 2 voltage output of the high voltage power supply trainer.
12. Check the phase 2 and phase 3 voltage output of the high voltage power supply trainer.
13. Check the phase 1 and phase 3 voltage output of the high voltage power supply trainer.
14. Check the phase 1 and phase 2 voltage output at the bus bar of the high voltage switch gear with proper Personal Protective Equipment (PPE) which is interfaced into the high voltage power supply trainer.
15. Check the phase 2 and phase 3 voltage output at the bus bar of the high voltage switch gear with proper Personal Protective Equipment (PPE) which is interfaced into the high voltage power supply trainer.
16. Check the phase 1 and phase 3 voltage output at the bus bar of the high voltage switch gear with proper Personal Protective Equipment (PPE) which is interfaced into the high voltage power supply trainer.
17. Continuous energizing of the Electronic high Voltage Power Supply circuit shall be made until the activity is done.

Maintenance and Repair of HV Switchgear and HSB

18. Racking-in and racking-out activity, caution and awareness of the desired working parameters in performing the safe isolation procedure of high voltage equipment using the personal protective equipment in dealing with high voltage supply. Participant prepare for safety isolation of the high voltage switchgear and high voltage switch board as shown in fig.1. De-energizing the high voltage switchgear and high voltage switch board as shown in fig. 2. Racking-out the high voltage switchgear and high

voltage switch board as shown in fig. 3. Removing the draw-out high voltage switchgear in a safe area for possible repair and maintenance.

19. Measure the voltage using a non-contact voltage detector.

Closing the procedure.

20. Turn-off the main switch located at the left side of the trainer before unplugging it from the convenience outlet.
21. Remove and secure all the connectors on the panel.

IV. Conclusion

Summarily, the trainer met the standards in its design, construction, installation, and function. It is efficient in delivering a high AC three phase output voltage which is more or less 800 volts depending on the input source voltage applied, using a single phase 220 volt line source. It is an effective simulator for the course instructions.

Recommendation

It is recommended that the trainer be mass produced to carry out the basics and develop skills in Marine electro-electrical technology and increase the training facility resources; likewise, the technology package is highly recommended for adoption and utilization.

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