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RISK APPROACH FOR POTENTIAL OF SOLAR, HYDROGEN AND CONVENTION POWER MULTI - HYBRID FOR SUSTAINABLE MARINE POWER SYSTEM

O. Sulaiman[*1], A.Saman A. Kader[2] and A.H. Saharuddin[3]

[1,3] Faculty of Maritime Studies and Marine Science, Universiti Malaysia Terengganu
21030 Kuala Terengganu, Terengganu, Malaysia
[2] Marine Technology Department, Universiti Teknologi Malaysia,
81310 Skudai, Johor, Malaysia

ABSTRACT

Sources of alternative energy are natural. There has been a lot of research about the use of free energy from the sun to the use of reverse electrolysis to produce fuel cell. For one reason or the other these sources of energy are not economical to produce. Most of the problems lie on efficiency and storage capability. Early human civilization use nature facilities of soil, inland waterways, waterpower which are renewable for various human needs. Modern technology eventually replaces renewable nature with non renewable sources which requires more energy and produces more waste. Energy, Economy, Ecology and Efficiency (EEEE) have been the main driving force to sustainable technological advancement in shipping. Environmental problem linkage to source of energy poses need and challenge for new energy source. The paper discuss risk based iterative and integrative sustainability balancing work required between the 4 Es in order to enhance and incorporate use of right hybrid combination of alternative energy source (solar and hydrogen) with existing energy source (steam diesel or steam) to meet marine system alternative energy demands (port powering). The paper will communicate environmental challenges facing the maritime industry. Effort in the use of available world of human technocrat to integrate sources of alternative energy with existing system through holistic proactive risk based analysis and assessment requirement of associated environmental degradation, mitigation of greenhouse pollution. The paper will also discuss alternative selection acceptable for hybrid of conventional power with compactable renewable source solar / hydrogen for reliable port powering. And hope that the Decision Support system (DSS) for hybrid alternative energy communicated in this paper to improve on on-going quest of the time to balance environmental treat that is currently facing the planet and contribution to recent effort to preserve the earth for the privilege of the children of tomorrow.

Keywords : Alternative energy, sustainability, hybrid, port, power energy

1.0 INTRODUCTION

Scale, transportation, language, art, matter and energy remain keys to human civilization. The reality of integration of science and system lies in holistically investigation of efficiency of hybridizing alternative energy source with conventional energy source. This can be achieved

[*]Corresponding author : o.sulaiman@umt.edu.my

with scalable control switching system that can assure reliability, safety and environmental protection. Option for such sustainable system is required to be based on risk, cost, efficiency benefit assessment and probabilistic application. Green house gas (GHG) pollution is linked to energy source. Large amount of pollution affecting air quality is prone by reckless industrial development. GHG release has exhausted oxygen, quality of minerals that support human life on earth, so has the reduction in the ozone layer that is protecting the planetary system form excess sunlight. This is due to lack of cogent risk assessment and reliability analysis of systems before building.

Recently the marine industry is getting the following compliance pressure regarding environmental issues related to emission of GHG to air under International Maritime Oganisation (IMO) Marine Pollution (MARPOL) Annex VI. A world without port means a lot to economy transfer of goods, availability of ships and many things. Large volume of hinterland transportation activities import tells a lot about intolerant to air quality in port area. Adopting new energy system will make a lot of difference large number of people residing and working in the port. Most port facilities are powered by diesel plant. Integrating hybrid of hydrogen and solar into the existing system will be a good way for the port community to adapt to new emerging clean energy concept. Hybrid use of alternative source of energy remains the next in line for the port and ship power. Public acceptability of hybrid energy will continue to grow especially if awareness is drawn to risk cost benefit analysis result from energy source comparison and visual reality simulation of the system for effectiveness to curb climate change contributing factor, price of oil, reducing treat of depletion of global oil reserve. Combined extraction of heat from entire system seems very promising to deliver the requirement for future energy for marine system. This paper discuss available marine environmental issues, source of energy today, evolution of alternative energy due to the needs of the time and the barrier of storage requirement, system matching of hybrid design feasibility, regulations consideration and environmental stewardship. The paper also discusses holistic assessment requirement that can be used for stochastic evaluation, using system based doctrine, recycling and integrated approach to produce energy.

2.0 ENERGY, ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

Since the discovery of fire, and the harnessing of animal power, mankind has captured and used energy in various forms for different purposes. This include the use of animal for transportation, use of fire, fuelled by wood, biomass, waste for cooking, heating, the melting of metals, windmills, waterwheels and animals to produce mechanical work. Extensive reliance on energy started during industrial revolution. For years there has been increased understanding of the environmental effects of burning fossil fuels that has led to stringent international agreements, policies and legislation regarding the control of the harmful emissions related to their use. Despite this knowledge, global energy consumption continues to increase due to rapid population growth and increased global industrialization. In order to meet the emission target, various measures must be taken, greater awareness of energy efficiency among domestic and industrial users throughout the world will be required, and domestic, commercial and industrial buildings, industrial processes, and vehicles will need to be designed to keep energy use at a minimum. Figure1 shows that the use of fossil fuels (coal, oil and gas) continue to increase [1, 2].

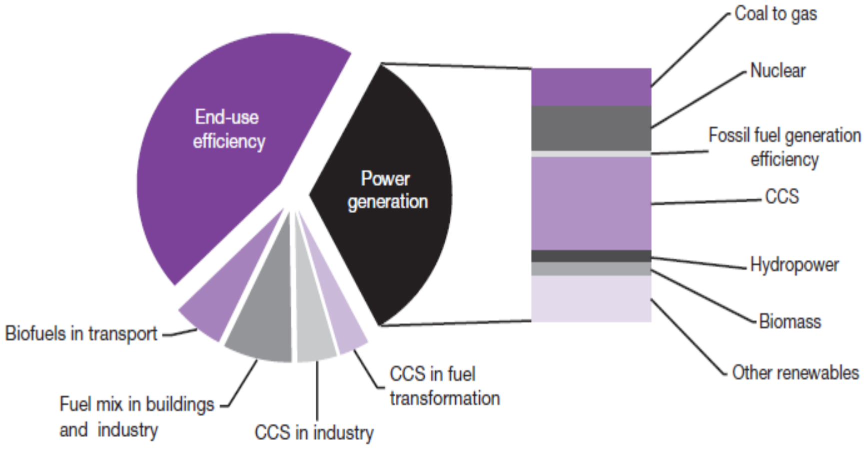

Figure 1: GHG Emissions Reductions through 2050, by Consuming Sector [EIA, 2007]

Various measures must be taken to reduce emission targets. The current reliance on fossil fuels for electricity generation, heating and transport must be greatly reduced, and alternative generation methods and fuels for heating and transport must be developed and used. Sustainable design can be described as system work that enhances ecological, social and economic well being, both now and in the future. The global requirement for sustainable energy provision is becoming increasingly important over the next fifty years as the environmental effects of fossil fuel is becoming apparent. As new and renewable energy supply technologies become more cost effective and attractive, a greater level of both small scale and large scale deployment of these technologies will become evident. Currently, there is increasing global energy use of potential alternative energy supply system options, complex integration as well as switching for design requirement for sustainable, reliable and efficient system.

Moreover, because conventional assessment focus more on economics while environment and its associated cycle is not much considered [1, 8]. Human activities are altering the atmosphere, and the planet is warming. It is now clear that the costs of inaction are far greater than the costs of action. Aversion of catastrophic impacts can be achieved by moving rapidly to transform the global energy system. Sustainability requirement that can be solved through energy conservation (cf. IPCC 2007: 13) are energy and associated efficiency, development, environment, poverty. Stakeholder from government’s consumers, industry transportation, buildings, product designs (equipment networks and infrastructures) must participate in the decision work for sustainable system.

The issues surrounding integration of renewable energy supplies need to be considered carefully. Proactive risk based decision support system (DSS) important to help the technical design of sustainable energy systems, in order to encourage planning for future development for the supply of electricity, heat, hot water and fuel for transportation. Renewable energy systems have intermittence source, this make assurance reliability of the supply and subsequent storage and back-up generation a necessity. Generic algorithms of the behavior of plant types and methods for producing derived fuels to be modeled, available process and manufacturers’ data must be taken into consideration. Today, simulation tool for analysis that allow informed decisions to be made about the technical feasibility of integrated renewable energy systems are available. Tool that permit use of supply mix and control strategies, plant type and sizing, suitable fuel production, and fuel and energy storage sizing, for any given area and range of supply should be adopted.

3.0 ENERGY CONSUMPTION, DEMAND AND SUPPLY

Energy is considered essential for economic development, Malaysia has taken aggressive step in recent year to face challenges of the world of tomorrow, and this includes research activities and strategic partnership. One example is partnership with the Japanese Government on construction on sustainable energy power station in the Port Klang power station, Pasir Gudang power station, Terengganu hydro-electric power station and Batang hydro-electric power station which are main supply to major Malaysian port. The above enumerated power stations are constructed with energy-efficient and resource-efficient technologies. Where power station are upgraded the power station by demolishing the existing aging, inefficient and high emission conventional natural gas/oil-fired plant (360MW) and installing new 750MW high efficiency and environment friendly combined cycle gas fired power plant built at amount of JPY 102.9 billion. The combined-cycle generation plant is estimated to reduce the power station's environmental impact, raise generation efficiency and make the system more stable. The total capacity of power generation of 1,500MW is equal to 14% of total capacity of Tenaga National (TNB) in peninsula Malaysia of 10,835MW and indeed this power station is one of the best thermal power stations with highest generation efficiency in Malaysia of more than 55%. The rehabilitation, the emissions of Nitride oxide (NOx) is reduced by 60%, Sulfur dioxide (SO2) per unit is reduced by almost 100% and Carbon dioxide (CO2) emission is reduced by 30%. Port operation energy demands are for transportation, hot water and heat. This third generation plan can easily be integrated with alternative energy [3, 4]. Table 1 shows Malaysia energy environment outlook.

Table 1: Malaysia environmental review

Energy-Related Carbon Dioxide Emissions	163.5 million Metric tons, of which Oil (44%), Natural Gas (41%), Coal (15%)
Per-Capita, Energy-Related Carbon Dioxide Emissions ((Metric Tons of Carbon Dioxide)	6.7 Metric tons
Carbon Dioxide Intensity	0.6 Metric tons per thousand 96.0 billion kilowatt hours

The energy use in all sectors has increased in recent years, most especially the energy use for transport has almost doubled it continues to grow and becoming problem. This trend is being experienced in industrialized and developing world.

Energy demand for port work is supply from grids which are well established in most developed world. The method and sizing of generating conventional energy and renewable energy determine system configuration. Hierarchy systems that can be deduced from these two variables are:

- Limited capacity energy
- Limited energy plant
- Intermittent energy plant

3.1 Emerging Renewable Energy System

The design of integrated sustainable energy supply technology systems that are reliable and efficient for transport, heat, hot water and electricity demands can be facilitated by harnessing weather related sources of energy (e.g. wind, sunlight, waves, and rainfall). In order for a reliable electricity supply, reduce energy wastage, and enable the energy requirements for heat and transport to be met, the outputs of intermittent sources may be supplemented by various means [5,7]. The intermittent nature of most easily exploited sources of alternative energy remains the major problem for the supply the electricity network. This has implications for the management of this transitional period as the balance between supply and demand must be maintained as efficiently and reliably as possible while the system moves towards the ultimate goal of a 100% renewable energy supply over the next fifty to one hundred years. It important to take the amount intermittent electricity sources that can be integrated into a larger-scale electricity supply network into consideration. Excess supply could be supplied by plant run on fuels derived from biomass and waste. The renewable hybrid age require utilities, local authorities and other decision makers to be able to optimization constraints, potentials, and other energy requirements from marine system powering.

The sizing and type of storage system required depends on the relationship between the supply and demand profiles. For excess amount electricity produced this could be used to make hydrogen via the electrolysis of water. This hydrogen could then be stored, used in heaters or converted back into electricity via a fuel cell later as required. Using excess electricity, this hydrogen could be produced centrally and piped to for port or produced at vehicle filling stations for haulage, or at individual facilities in the port. Alternatively, excess electricity could be used directly to fuel electric haulage trucks, recharging at times of low electricity demand, or use for HVAC system or water heating for immediate use, or to be stored as hot water or in storage heaters [6,8].

4.0 ENERGY SUPPLY AND DEMAND MATCHING

Fossil fuel use for transportation and port activities has increased dramatically over the past decade, and shows little signs of abating. This has caused concern about related environmental and health effects. There is need for to develop alternatively fuel system that produces little or no pollution. The main fuels that can be used in a variety of land, sea and air vehicles are biogas in natural gas and fuel cell vehicles, biodiesel in diesel vehicles, ethanol and methanol in adapted petrol and fuel cell. Fuel cell powered engine can run on pure hydrogen, producing clean water as the only emission. Fuel cell source is redundant as it can be derived from many sources. Solar fall time determined its energy usage. Biogas can be converted to run on natural gas and in some fuel cell. It must be cleaned first to create a high heating value gas (around 95% methane, a minimum of heavy gases, and no water or other particles). Biodiesel can be used directly in a diesel engine with little or no modifications, and burns much more cleanly and thoroughly than diesel, giving a substantial reduction in unburned hydrocarbons, carbon monoxide and particulate matter. The main barriers to the implementation of alternative fuels is the requirement for a choice of fuel at a national level, the necessity to create a suitable refueling infrastructure, the length of time it will take to replace or convert existing vehicles, and the need for a strong public incentive to change [9, 10, 11]. Choice of conventional energy sources could be derived from the following:

- Diesel Engines
- Steam Turbines
- Stirling Engines
- Gas Turbines

4.1 Choice of Alternative Energy

Fuel Cells: The principle of the fuel cell was discovered over 150 years ago. NASA has improved the system in their emission free operation for spacecraft. Recent years has also seen improvement in vehicles, stationary and portable applications. As a result of this increased interest, stationary power plants from 200W to 2 MW are now commercially available, with efficiencies ranging from 30 to 50% and heat to electricity ratios from 0.5:1 to 2:1. Fuel cell load follow energy, the efficiency of a fuel cell typically increases at lower loadings. Fuel cell systems also have fast response. This make them well suited to load following and transport applications. Fuel cell is advanced alternative energy technology with electrochemical conversion of fuel directly into electricity without intermediate stage, the combustion of fuel by-pass the restriction of second law of thermodynamic. The basic fuel supply in the fuel cell systems is hydrogen and carbon dioxide. The simplified fuel cell is exact opposite of electrolysis.

The four basic element of the system are hydrogen fuel, the oxidant, the electrodes and the electrolyte chemicals. The fuel is supplied in the form of hydrogen and carbon dioxide which represent electrode and oxidant cathode, the electrolyte material that conduct the electric current can be acid or alkaline solid or liquid. Cycle of operation begin with hydrogen carbon dioxide to the anode, where hydrogen ion are formed, releasing a flow of electron to the cathode through the electrolyte medium. The cathodes take oxygen from the air and transform it into ion state in combination with anode electron. The oxygen carrying ion migrates back to the anode, completing the process of energy conversion by producing a flow of direct current electricity and water as a by-product.

$$2H_2 - \geq 4e -+4H+ \quad (1)$$

$$4h+ +4e- +O_2\text{->}2H_20 \quad (2)$$

$$2H_2+0_2 \text{->} 2H_20 +Heat \quad (3)$$

The fact that it can be produced from sources including water has promise for its unlimited supply the fact that water is the by-product also guarantee vast reduction of pollution on earth, solving problem of green house gas release and global warming. Fuel cell system involve combination of groups of small chemical reactions and physical actions that are combined in a number of ways and a in a number of different sections of the generator. This energy source uses the principles of thermodynamics, physical chemistry, and physics. The net result is a non-polluting, environmentally sound energy source using air or even water cooling with a minimum temperature rise of 20 C above ambient and no emissions. The chemicals, metals, and metal alloys involved are non-regulated. The chemical reactions are encased within the process unit where they are recovered, regenerated, and recycled. This process produces no discharge or emission [4, 7].

Fuel cells are classified by the type of electrolyte they use, and this dictates the type of fuel and operating temperature that are required. The most commonly used fuel cell for small scale due to its low operating temperature, and compact and lightweight form, is the Proton Exchange Membrane fuel cell (PEMFC). Phosphoric Acid and Molten Carbonate fuel cells (PAFC and MCFC) are also available for larger scale applications, and require higher operating temperatures (roughly 200°C and 650°C), which means they must be kept at this temperature if fast start-up is required. All of these fuel cells may be run on pure hydrogen, natural gas or biogas. Certain PAFCs may also use methanol or ethanol as a fuel. If pure hydrogen is used, the only emission from a fuel cell is pure, clean water. If other fuels are used, some emissions are given off, though the amounts are lower due to the better efficiencies achievable with fuel cells. Table 2 shows the types of fuel cell and their characteristics [7, 11].

Table 2: Type of electrolyte fuel cell

Types	Electrolyte	Operating temperature,°C
Alkaline	Potassium hydroxide	50 - 200
Polymer	Polymer membrane	50 - 100
Direct methanol	Polymer membrane	50 - 200
Phosphoric acid	Phosphoric acid	160 -210
Molten carbonate	Lithium and potassium carbonate	600 - 800
Solid oxide	Ceramic compose of calcium	500 - 1000

Comparing the efficiency of fuel cell to other source of alternative energy source, fuel cell is the most promising and economical source that guarantee future replacement of fossil fuel. However efficiency maximization of fuel cell power plant remains important issue that needs consideration for its commercialization. As a result the following are important consideration for efficient fuel cell power plant - Efficiency calculation can be done through the following formula:

$$E_C = g \frac{G}{nF} \quad (4)$$

$$G= H*T *Si \quad (5)$$

where: Ec = EMF, G = Gibbs function, nF = Number of Faraday transfer in the reaction, H = Enthalpy, T = Absolute temperature, S = Entropy change, i=Ideal efficiency

Advantages of fuel cell include size, weigh, flexibility, efficiency, safety, topography, cleanliness. Mostly use as catalyst in PAFC, and however recovery of platinum from worn -out cell can reduce the cost and market of the use of P ACF economical. It has cost advantage over conventional fossil fuel energy and alternative energy. Disadvantages of fuel cell are adaptation, training, and cost of disposal. Fuel cell has application in transportation, commercial facility, residential faculty, space craft and battery

Solar Energy System: Photovoltaic (PV) solar system use silicon photovoltaic cell to convert sunlight to electricity using evolving unique characteristic of silicon semiconductor material and accommodating market price of silicon is good advantage for PV fuel cell. Silicon is grown in large single crystal, wafer like silicon strip are cut with diamond coated with material like boron to create electrical layer, through doping the elementary energy particle of sunlight – photon that strike the silicon cell. They are converted to electron in the P-N junction, where the p accepts the electron and the n reject the electron thus setting into motion direct current which can be subsequently inverted to AC current as needed. Electrical conductor embedded in the surface layer in turn diverts the current into electrical wire consideration for solar installation includes [3, 12]:

- Collector module need to face south for case of photovoltaic, this depends on modular or central unit’s modular
- Module storage unit need maintenance
- The system need power inverter if the load requires AC current
- Highlight of relevant procedural differences needed
- Requirements of benefits and issues of using new procedures, and incorporating that into the total cost
- Procedure to build on, hybrid system and integration system and analyzed
- System successful compliance with all regulations
- Efficiency penalty caused by extra power control equipment

Solar collector can be plate or dish type. Stefan` law relates the radiated power to temperature and types of surface:

$$\frac{P}{T} = \varepsilon\sigma T^4 \quad (6)$$

Where P/A is the power in watts radiated per square meter, ε is surface emissivity, σ is

Stefan-Boltzman constant = 5.67×10e8 W/$m^2.K^4$

The maximum intensity point of the spectrum of emitted radiation is given by:

$$\lambda_{\max} = \frac{2898}{T(K)} \tag{7}$$

5.0 HYBRID SYSTEM

Focus is given on developing applications for clean, renewable, non-fossil fuel and energy systems. The emphasis is on maritime related activities; however, as marine practitioner are required to devote to promotion of all types of alternative and sustainable energy technologies. Various types of engine, turbine and fuel cell may be run on a variety of fuels for combined heat and power production. Hybrid system can provide control over power needs, green and sustainable energy that delivers a price that is acceptable and competitive. The power plants can be located where it need less high power lines are required, not only reducing costs but assisting health by reducing magnetic fields that people are so worried about, Global warming is addressed by direct action by providing power that does not release any emissions or discharges of GHG. The technology associated with the design, manufacture and operation of marine equipment is changing rapidly.

The traditional manner in which regulatory requirements for marine electrical power supply systems have developed, reactive based approach largely on incidents and failures, is no longer acceptable. Current international requirements for marine electrical power supply equipment and machinery such as engines, turbines and batteries have evolved over decades and their applicability to new technologies and operating regimes is now being questioned by organizations responsible for the regulation of safety and reliability of ships. Figure 2 and 3 shows hybrid configuration for conventional power, solar and hydrogen, and Figure 4 shows physical model of hybrid of solar, wind and hydrogen being experimenting in UMT campus.

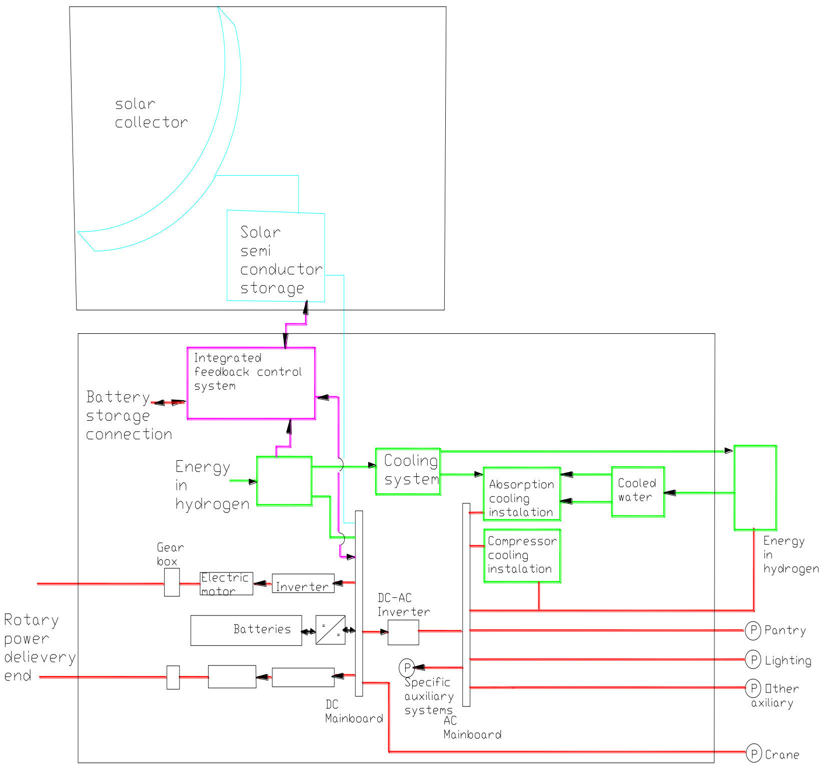

Figure 2: Hybrid configuration

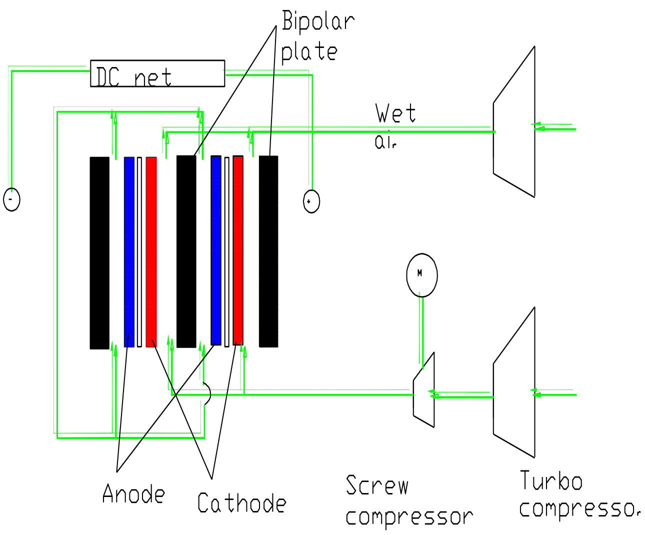

Figure 3: Hybrid configuration

Various technologies have been employed towards the use of alternative free energy of the sun since the first discovery in the 18th century. Improvement and development has been made towards making it available for use like existing reigning fossil source of energy. Major equipment and hardware for the hybrid configuration are:

- Semiconductor solar with high efficient storage capability
- Hybrid back- up power design based on integrative capability to other alternative power source like wind and hydrogen
- Controller design for power synchronization
- Inverter and other power conversion units selecton based on power needs
- Solar collector or receiver with high efficiency collection capacity Software development and simulation
- Compatibility with conventional power system
- Robust and light weight storage system

Figure 4: Physical model of hybrid system under experimentation in UMT

The power plants can be built in small units combined, which allow greater control over the output and maintains full operational output 100% of the time. The plant can be located close to the areas where the power is required cutting down on the need for expensive high convetional power lines. For port excess energy produced can be connected to the grid under power purchase arrangement. The system can be built in independent power configuration and user will be free from supply cut out. One of the unique features of hybrid system is the sustainable, clean energy system that uses a hydrogen storage system as opposed to traditional battery. It's design construction and functionality can be enhanced by the theme of regeneration and the philosophy of incorporating energy reuse and recycling source. High efficiency solar panels can also be achieved by with an electrolyser to generate the hydrogen for fuel cell.

The hybrid system can provide means to by- pass and overcome limitation posed by past work in generating replaceable natural energy of the sun and other renewable energy source. Reliable deployment of hybrid system developments of mathematical model follow by prototyping, experimentation and simulation of the system are key to the design and its implementation. The main advantages of hybrid configurations are: Redundancy and modularity, high reliability of hybrid circuitry embedded control system, improve emergency energy switching and transfer, low operating cost through integrated design, low environmental impacts due to nature of the energy source [3, 12, and 13].

6.0 RISK APPROACH REQUIREMENT

Various studies have been carried out to find the best hybrid supply for given areas. Results from specific studies cannot be easily applied to other situations due to area-specific resources and energy-use profiles and environmental differences. Energy supply system, with a large percentage of renewable resources varies with the size and type of area, climate, location, typical demand profiles, and available renewable resource. A risk based decision support framework is required in order to aid the design of future renewable energy supply systems, effectively manage transitional periods, and encourages and advance state-of-the-art deployment as systems become more economically desirable. The DSS could involve the technical feasibility of possible renewable energy supply systems, economic and political issues. Reliability based DSS can facilitate possible supply scenarios to be quickly and easily tried, to see how well the demands for electricity, heat and transport for any given area can be matched with the outputs of a wide variety of possible generation methods. DSS can provide energy provision for marine system and help guide the transition towards higher percentage sustainable energy provision for larger system demand. The hybrid configuration of how the total energy needs of an area may be met in a sustainable manner, the problems and benefits associated with these, and the ways in which they may be used together to form reliable and efficient energy supply systems. The applicability and relevance of the decision support framework can be shown through the use of a can simulate case study of the complex nature of sustainable energy supply system design.

6.1 Regulatory Requirement

The Unifies International association of classification society (IACS) harmonized requirements are applicable to marine power plant and electrical installations. They IACS requirement provide prescriptive statements that provide a definition or identify what has to be done and in some cases how to do it. They relate to safety and reliability of marine power plant system and support systems and arrangements. The current requirements have been developed based on reactive approach which leads to past system failure. Reactive approach is not suitable for introduction of new technology of modern power generation systems. This call for alternative philosophy to the assessment of new power generation technologies together with associated equipment and systems from safety and reliability considerations, such system required analysis of system capability and regulatory capability [5,14]. System based approaches for regulatory assessment is detailed under goal based design as shown in figure.

6.3 Risk Based System

The approach to risk assessment begins with risk analysis, a systematic process for answering the three questions posed at the beginning of this chapter: What can go wrong? How likely is it? What are the impacts? The analysis that describes and quantifies every scenario, the risk estimation of the triplets can be transformed into risk curve or risk matrix of frequency versus consequences that is shown in Figure 7 and 8.

6.4 Quantitative Risk Assessments

Analysis tools that now gaining general acceptance in the marine industry is Failure Mode and Effects Analysis (FMEA). The adoption of analysis tools requires a structure and the use of agreed standards. The use of analysis tools must also recognise lessons learnt from past incidents and experience and it is vital that the background to existing requirements stemming from SOLAS or IACS are understood. Consistent with the current assessment philosophy, there needs to be two tenets to the process - safety and dependability. A safety analysis for a hybrid power generation system and its installation on board a ship could use a hazard assessment process outlined in Figure 5. The hazard assessment should review all stages of a systems life cycle from design to disposal, reuse and recycling.

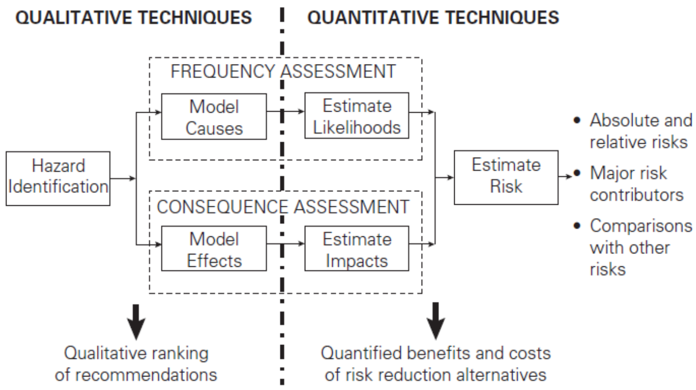

Figure 5: Components of risk and reliability analysis

Figure 7 and 5 shows the components of risk assessment and analysis. The analysis leads to risk curve or risk profile. The risk curve is developed from the complete set of risk triplets. The triplets are presented in a list of scenarios rearranged in order of increasing consequences, that is, $C_1 \leq$ □ $C_2 \leq$ □ $C_3 \leq$ □CN, with the corresponding probabilities as shown in Table 3. A fourth column is included showing the cumulative probability, Pi (uppercase P), as shown. When the points < Ci, Pi > are plotted, the result is the staircase function. The staircase function can be considered as discrete approximation of a nearly continuous reality. If a smooth curve is drawn through the staircase, that curve can be regarded as representing the actual risk, and it is the risk curve or risk profile that tells much about the risk and reliability of the system. Combination of qualitative and quantitative analyses is advised to for risk estimates of complex and dynamic system.

Table 3: components of risk and reliability analysis

Scenario	**Probability**	**Consequence**	**Cumulative Probability**
S_1	P_1	C_1	$P_1=P_1+P_2$
S_2	P_2	C_2	$P_2=P_3+P_2$
Si	Pi	Ci	Pi=Pi+3+Pi
Sn+1	Pn+1	Cn+1	Pn-1=Pn+Pn+1
Sn	Pn	Cn	Pn=Pn

n=N

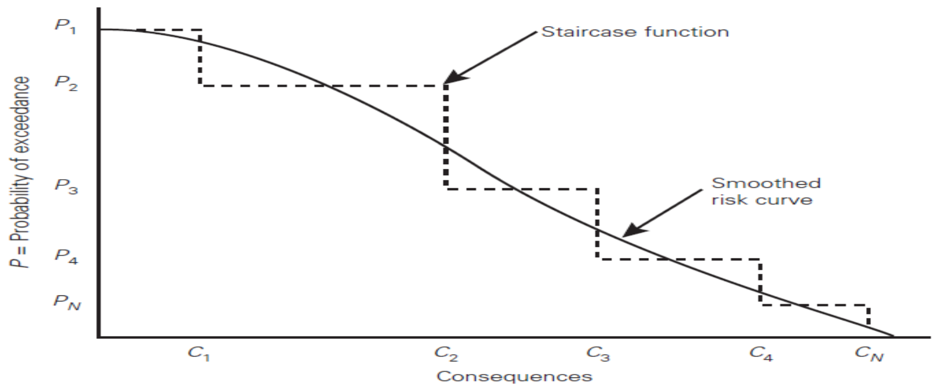

Figure 6: Stair case risk curve

Frequency of Occurrence (or Likelihood)	Consequences (Severity of Accident)				
	Incidental (1)	Minor (2)	Serious (3)	Major (4)	Catastrophic (5)
Frequent (5)	M	H	VH	VH	VH
Occasional (4)	M	M	H	Risk without measure	VH
Seldom (3)	L	M	H	H	VH
Remote (2)	L	L	Risk after measure	H	H
Unlikely (1)	L	L	M	M	H

Figure 7: Risk priority matrix
L = low risk; M = moderate risk; H = high risk; VH = very high risk

The design concept needs to address the marine environment in terms of those imposed on the power plant and those that are internally controlled. It is also necessary to address the effects of fire, flooding, equipment failure and the capability of personnel required to operate the system. In carrying out a hazard assessment it is vital that there are clearly defined objectives in terms of what is to be demonstrated. The assessment should address the consequence of a hazard and possible effect on the system, its subsystems, personnel and the environment. An assessment for reliability and availability of a hybrid power generation system and its installation on a ship could use a FMEA tool. An effective FMEA needs a structured approach with clearly defined objectives and IACS is currently developing standards that can uniformly be applied to marine systems and equipment where an analysis is required. The work currently being undertaken by IACS will identify those systems and machinery that require analysis. For a hazard and failure mode analysis it is necessary to use recognised standards and there are a number of generic standards that can be applied and adapted for analysis of a hybrid system:

i. IEC 61882, Hazard and operability studies (HAZOP) studies,
ii. IEC 60812, Analysis techniques for system reliability, application guide, Procedure for failure mode and effects analysis (FMEA).
iii. IEC 61508, Functional safety of electrical/ electronic/programmable electronic safety-related systems.

The assessment analysis processes for safety and reliability need to identify defined objectives under system functionality and capability matching. These issues are concerned with system performance rather than compliance with a prescriptive requirement of the standard. The importance of performance and integration of systems that are related to safety and reliability is now recognised and the assessment tools now available offer such means. Formal Safety Assessment (FSA) is recognised by the IMO as being an important part of a process for developing requirements for marine regulations. IMO has approved Guidelines for Formal Safety Assessment (FSA) for use in the IMO rule-making process (MSC/Circ.1023/MEPC/ Circ.392). Further reliability and optimization can be done by using stochastic and simulation tools [13, 14]. The development of requirements for fuel cells in the marine environment power plant application could usefully recognize the benefits of adopting a goal-based and risk based approach. In order to determine the power supply capacity and system architectural arrangements required and to give specific requirements for services that affect the propulsion and safety of the vessel.

It is clear that stand alone alternative energy system may not survive until more tests has been performed on available technology. Hybrid system represents the next in line for energy system optimization for low pollution and high efficiency. However it is recommended that the system configuration, control switching, intermittent requirement should be designed and developed based on risk before their deployment. The use of solar, hydrogen, wind, wave and Waste base hybrid also promise more environmental and cost saving for future hybrid. Each source has their unique strength where science needs to tap more to hybrid them with each other and with existing system [15].

7.0 CONCLUSIONS

Energy, environment, economic and efficiency and safety are the main technology driver of today sustainable technology development. Issue of energy and environment has been address. Problem associated with choice of energy system in the face of current environmental challenges has been discussed. The paper also discussed Standards and issues that are applicable to marine power generation systems. Alternative methods of assessment that can be applied to technology to satisfy the current standards that do not fit a recognized design, operating scenario and matter of lessons learnt from experience and from failures need to be understood before using and deployment evolving alternative energy methods and system.

Thus, solar energy has been existing for a long time, different parties have done various research programs on solar energy and hydrogen energy in different ways, a lot have been achieved in alternative energy technology. The state of the planet, surrounded with issue of energy pollutant shows current need for development of reliable production of alternative energy, since, previous work has shown lack of reliability on standalone system. Incorporating risk based DSS scheme for hybrid system that integrate conventional system with new system could bring a break through to counter problem associated with production of alternative energy. Previous regulatory work for system design has been prescriptive by nature. Performance based standards that make use of alternative methods of assessment for safety and reliability of component design, manufacture and testing is recommended for hybrid alternative energy system installation.

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