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Research Paper

INDIAN ENERGY SECURITY PHASE-2 "hybrid train technology"

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Abstract

Now a day's energy is most needed facility for the human being. All the conventional energy resources are depleting day by day. So we have to shift from conventional to non-conventional energy resources. In this the combination of two energy resources is takes place i.e. wind and solar energy. This process reviles the sustainable energy resources without damaging the nature. We can give uninterrupted power by using hybrid energy system. Basically this system involves the integration of two energy system that will give continuous power. Solar panels are used for converting solar energy and wind turbines are used for converting wind energy into electricity. This electrical power can utilize to fulfill the energy demand in the various sector i.e. Transportation sector . Generation of electricity will be takes place at affordable cost. This paper deals with the hybrid energy system as power genration unit in railway and designing the hightech modernalized PIR Sensor and logic gate informative system to obtain information about unneccessary failure of railway track automatically.

Literature Review

In the remainder of this chapter, the context for understanding the usefulness of the review will be set by discussing the nature of survey data. The concept "attitudeM is defined and its relationship to action described. Public opinion is distinguished from private opinion, and the importance of this distinction is

discussed. Individual and collective action is distinguished, and the relevance of survey data to each is discussed. Finally, what policymakers would (or possibly should) like to know from public opinion surveys, why they would (should) like to know it, and what they are likely to get will be described.

In short, surveys of public opinion tell us only part of what we need to know about people and energy. That part is significant when it is the product of sound methods, but it does not yield the complete story about the human dimensions of energy.

Introduction

Hybrid energy system is the combination of two energy sources for giving power to the load. In other word it can defined as “Energy system which is fabricated or designed to extract power by using two energy sources is called as the hybrid energy system.” Hybrid energy system has good reliability, efficiency, less emission, and lower cost. In this proposed system solar and wind power is used for generating power. Solar and wind has good advantages than other than any other non-conventional energy sources.

- To find out the extent of power that can be drawn from solar panels and wind turbines, how much of that can be stored effectively. To design coaches that will draw power from the sun for interior lighting and cooling.
- Being the world’s biggest railway system, it plans to use innovative technology to tap alternative sources of energy.

General Overview of Transport Sector

The transport sector in India plays an integral part in the country’s economic growth and development while consuming a large volume of the total commercial energy of the country. It is the second highest energy consuming sector after industry in India. Not only that, it is also responsible for consuming the largest share of the nation’s petroleum products. However, it is road transport that is responsible for meeting the major share of both passenger and freight transport in India. resulted in a large volume of the passenger and freight traffic moving to the generally more energy intensive private modes of road transport. This is a critical cause of concern given that India imports about 84% (in 2011-12) of the crude oil processed in the country (TERI, 2013) and an increasing reliance on petroleum products could quite easily become a concern from the point of view of the national energy security.

In the aims of providing connectivity to large sections of the country, of all the modes of transport, the road based transport has seen much higher shares of investments over the 9th, 10th and 11th Five Year Plans. Even in the Railways, there has been a clear focus towards increasing capacities of the national network. While passenger train loads have increased due to increased engine capacities. The railways have also focused on electrification of the major trunk routes. Of the total 20,275 electrified rail route kilometres, over 6,000 kilometres (total 64,460 km), were electrified in the decade between 2000-01 and 2010-11 alone (MoR, 2013).

In terms of types of fuel use, the transport sector in India is driven largely by petroleum products such as high-speed diesel (HSD) and petrol (i.e. motor spirit/gasoline). While HSD is used to drive varying types of road transport vehicles, railways and ships, the use of motor-spirit or petrol is limited mostly to the road transport passenger sector. Other fuels used to drive transport are electricity used for railway traction and pipelines, and airline turbine fuel (ATF) used exclusively for aviation. The use of alternate fuels such as compressed natural gas (CNG) and liquefied petroleum gas (LPG) remain very limited to road transport in a handful of urban centres across the country. Although electric traction has several merits such as much higher motor efficiencies than fossil fuel engines, the penetration of electric vehicles have been very limited in India largely due to the prohibitively high costs of these vehicles. Given the vital role that the transport sector plays for the economy it is critical for the country to ensure that it is able to meet this rapidly growing energy demands. To cut down the energy demand for freight transport it also suggests that necessary planning should be undertaken for the creation of transport hubs around manufacturing centres and ports. The plan has also emphasized on increasing the traffic movement of both passenger and freight on railways given its relative energy efficiencies over road (Planning Commission, 2013). India tries to identify the potential energy savings benefits by simulating the impacts of various alternative energy savings scenarios for the sector.

Annually the railways, 239 tonnes of co2 emissions by consumption approximately 90,800 lts of diesel per rake.

Based on the various studies as has been described in the previous, there is a large potential for reducing the total demand of energy from the transport sector.

1. Improvement in the public and private share of passenger road transport.

2. Improving the share of railways in passenger transport mode.
3. Increasing the penetration of efficient vehicles.

So we need to develop such technology over railway transport sector to save energy demand, and its sustainability with environment. Hence we find one solution along with this sector.

Technical Specification

Solar panel

Solar panel is used to convert solar radiation to electrical energy. The physical of PV cell is very similar to that of the classical diode with a PN junction formed by semiconductor material. When the junction absorbs light, the energy of absorbed photon is transferred to the electron-proton system of the material, creating charge carriers that are separated at the junction. The charge carriers in the junction region create a potential gradient, get accelerated under the electric field, and circulate as current through an external circuit. Solar array or panel is a group of several modules electrically connected in series-parallel combination to generate the required current and voltage. Solar panels are the medium to convert solar power into electrical power.

Turbo mechanical Vanes /Wind turbine

Wind turbine is that system which extracts energy from wind by rotation of the blades of the wind turbine. Basically wind turbine has two types: one is vertical and another is horizontal. As the wind speed increases, power generation also increases. The power generated from wind is not continuous; it fluctuates. To obtain non-fluctuating power, we have to store it in a battery and then provide it to the load.

Charge controller/ Pulse transformer

Charge controller has a basic function: it controls the source which is to be active or inactive. It simultaneously charges the battery and also gives power to the load. The controller has over-charge protection, short-circuit protection, pole confusion protection, and automatic dumpload function. Its function is that it should vary the power as per the load demand. It adds both the power so that the load demand can be fulfilled. And when power is not generating, it should extract power from the battery and give it to the load.

Battery Bank

We have to choose battery bank size per the load requirement so that it should fulfill the requirement of load for calculating the battery bank size we need to find following data

1. Find total daily use in watt-hour (Wh).
2. Find total back up time of the battery

For increase in battery bank size we need to connect cell in series so that we can get the larger battery bank size.

Inverter

We have to choose greater rating inverter than the desired rating .The pure sign wave inverter is recommended in other to prolong the lifespan of the inverter. Inverter is need to convert DC power into AC power. As our load working on the AC supply so we need to convert DC power. The input voltage Output voltage and frequency, and overall power handling depends on the design of the specific device or the circuitry. The inverter does not produce any power. The power is provided by the DC source.

Synchronous Genrator Regenerative Loading System

To drive,speed control and to conduct Regenerative loading of Synchronous Generator with vector control/VVVF.The supplied Drive Motor,Torque transducer,Synchronous Generator and slip ring assembly with supporting structure will be mounted on a skid.Converter System for supplying power to Driving motor and conduct Regenerative loading on Generator with loading system as per details Available Grid supply;

A. NO. Of phases:3-phase

B. Voltage:415V +/-

C. Frequency:50Hz +/- 3%

Synchronous Generator Data (Unit under Test and Over all dimensions).Synchronous Generator AC Voltage is rectified to DC by a rotating rectifier mounted on the rotor.

A. Output DC Voltage Range:250V TO 450V

B. Output Rated DC Voltage:350V

C. Output Rated DC Current:450A

D. Overload capacity: 180kW(360V,500A)

E. Ripple Frequency:450Hz Rated

F. Rated Power:158kW output

G. Rated speed:375R.P.M.

H. Loading speed Range:250R.P.M.

I. Efficiency: 82%

Drive Motor The Generator should be coupled through Gear box(if used) to the Drive motorwith in-line Troque transducer. The Drive motor should be capable of driving the Generatorfrom 250 rpm to 500 rpm with the electrical power of 180kW (consedering 14% continuous over loading capacity and 82% efficiency of Synchronous Generator) at Generator DC Output.Drive.Drive motor should be compatible with normal motors(non-inverturduty) without de- rating.Drive motor should be with cooling fan coupled to the shaft or forced air cooling blower mounted on drive motor stator frame only. Other type of coolingi.e. External water cooling is not acceptable.Gear-Box Scheme with or without Gear-Box Scheme with or without Gear-box meeting all the technical requirements is acceptable.

Logic Gate

Gate is a digital circuit with one or more input voltages but only one output voltage. The most basic gates are called the NOT gate the OR gate & the AND gate. By connecting these gates in different ways we can build circuits that performs arithmetic and other functions associated with the human brain. Because they stimulate mental processes, gates are often called logic circuits.

Buzzer

A Buzzer or Beeper isan audio signalling device .which may be Mechanical,Electrical or Piezoelectrical.Typical uses of buzzers and beepers includ alarm devices,timers and confirmation of user input such as a mouse click or keystroke.

PIR Sensor

A passive infrared **sensor (PIR sensor)** is an electronic **sensor** that measures infrared (IR) light radiating from objects in its field of view. They are most often used in **PIR**-based motion detectors.

Resistance

To making motion detector , load resistance is used are 100 ohm, 1 kohm

Technical Specification**Design of Hybrid Energy System**

For design of the hybrid energy system we need to find the data as follows

A. Data required for Solar System -:

1. Annual mean daily duration of Sunshine hours
2. Daily Solar Radiation horizontal (KWH/m²/day)

B. Data required for Wind System:

1. Mean Annual Hourly Wind Speed (m/sec)
2. Wind Power that can be generated from the wind turbine

Above figure shows the block diagram of the hybrid power generation system using wind and solar power. This block diagram includes following blocks.

- i. Solar panel
- ii. Wind turbine
- iii. Charge controller
- iv. Battery bank
- v. Inverter

Methodology

In modern era of technology the global world countinously developing new technology and leads to transforming the world. The hybrid train technology is innovative technology using electrical and renewable sources to operate it. It is consisting of solar pv panel and wind turbine with synchronus generator and pulse transformer operated traction system which is governing advancement of technology in railway, and leads to sudden acceleration of train and fullfill the energy demand inside the coaches ie lightning fans and for human comfort. This paper also include the solution of avoiding unnecesary incident in railway due to breakage of railway track because of thermal stresses, friction.

- 5.1 Solar power and economics in hybrid train technology
- 5.2 Wind power and economics in hybrid train technolog
- 5.3 Hightech motion detector system in railway track.

Solar power and economics in hybrid train technology

Solar panel is use to convert solar radiation to the electrical energy. The physical of PV cell is very similar to that of the classical diode with a PN junction formed by semiconductor material. When the junction absorbs light, the energy of absorbed photon is transferred to the electronproton system of the material, creating charge carriers that are separated at the junction. The charge carriers in the junction region create a potential gradient, get accelerated under the electric field, and circulate as current through an external circuit. Solar array or panel is a group of a several modules electrically connected in series parallel combination to generate the required current and voltage. Solar panels are the medium to convert solar power into the electrical power.

Substantial growth in electricity demand in diesel generator sets is adding pressure on the electricity utilities to meet their peak electricity demand. With an average 300 sunny days and high solar insolation , distributed solar PV has the ability to play an important role in the coming years , distibuted solar pv is expected to grow singnificantaly in the coming years due to increase in economic viability for certain segments ie commercial, industrial and resedential purpose.

Such solar pv system with pulse transformer installed in rooftop of railway coaches. Solar rays directly strikes on solar panel which connected to no. Of batteries and capicitors with pulse transformer which supply electrical energy to the traction motar leads to sudden acceleration of train and other appliances purpose.

- Install 12 solar panel in each coach, which is capable of 300 watts at ideal condition or 2.6 kw in each coaches.
- 1.5 kw power required inside the railway coaches for lighting and fans appliance.
- IGBT/VVVF traction system with microprocessor based 3 phase AC motor.
- Each coaches solar pv system supplied 1.5 kw power to pulse transformer for sudden acceleration of train capable increament in overall speed upto 10 m/s. And is having very high output voltages will full fill electrical energy demand in lighting appliances. Specifiacation will mention in next blog.

Wind power and economics in hybrid train technology

By means of wind energy in hybrid train technology install no. of turbo mechanical vens wind turbine in side wall of railway coaches with synchronus generator with sets capable to generate power thogh wind energy when train at high speed. Though modern technology has made dramatic improvements to the efficiency of windtech which are now extensively use for electricity generation, they are still dependent on the vagaries of the weather. Not just on the wind direction but on the intermittent and unpredictable force of the wind. Too little wind and they can't deliver sufficient sustained power to overcome frictional losses in the system. Too much and they are susceptible to damage. Between these extremes, cost efficient installations have been developed to extract energy from the wind.

In practical designs, inefficiencies in the design and frictional losses will reduce the power available from the wind still further. Converting this wind power into electrical power also incurs losses of up to 10% in the drive train and the generator and another 10% in the inverter and cabling. Furthermore, when the wind speed exceeds the rated wind speed, control systems limit the energy conversion in order to protect the electric generator so that ultimately, the wind turbine will convert only about 30% to 35% of the available wind energy into electrical energy. Note that the power output from commercially available domestic wind turbines is usually specified at a steady, gust free, wind speed of 12.5 m/s.

Hightech motion detector system in railway track

Now today in indian railway we got a news about an accidental cases due to breaking or failure of tracks i.e. Recent update from RAJYSABHA which is publised on 17 MARCH 2017 in news india express a total of 99 consequential train accident to place during 1st aprail 2016 to 28 feb 2017,out of which 64 were due to failure of railway staff.19 were caust due to failure of factor other than railway staff.

Due to long time action with udlloading stress developed in tracks and it may cause creeping , or may thermal stresses due to friction tracks are creaked or it may be broaken and due to uncertainty or due to lack of information we can not repair it as per our logic gate concept the short inputs are disconnected due the breaking of track and the cercuite output is started and completethe supply voltage and buzzer is stars sounding as much and notify about breaking of tracks .

And 2nd when train passes through it may lead to turning, tipping of railway coaches Hence we are developing the motion detector high tech informative system with railway tracks working on principal of logic gate and sensor based techonlogy. In this system the device are mounted with railway track when the train reached 2km before the failure region a motion detecktor can send information to nearest station, upcoming train and safety enggs about the problem via a audible sound using PIR Sensor.

After crossing this 1st step the second logic gate will complete the circuit and the **alarm buzzer** is sounds highly this information will recieved by the train operator and will stop the train successfully.

Mathematical Calculation

The total power generated by this system may be given as the addition of the power generated by the solar PV panel and power generated by the wind turbine. Mathematically it can be represented as,

$$\mathbf{PT = NW * Pw +Ns * PS}$$

Where, **PT** - is the total power generated , **PW** - is the power generated by wind turbines,

PS- is the power generated by solar panels, **NW**- is the no of wind turbine

Ns- is the no of solar panels used .

A. Calculations for solar energy

To determine the size of PV modules, the required energy consumption must be estimated. Therefore, the power is calculated as

$$\mathbf{PS = Ins (t) * AS*Eff(pv)}$$

Where, **Ins (t)** = isolation at time t (kw/ m2), **AS** = area of single PV panel (m2),

Effpv = overall efficiency of the PV panels and controllers.

Overall efficiency is given by,

$$\mathbf{Eff(pv)= H * PR}$$

Where, **H** = Annual average solar radiation on tilted panels, **PR** = Performance ratio, coefficient for losses.

B. Calculations for wind energy

The power generated by wind energy is given by,
 Power = (density of air * swept area * velocity cubed)/2

$$PW = \frac{1}{2} \cdot \rho (AW) (V)^3$$

Where, **P** = is power in watts (W) , **ρ** = is the air density in kilograms per cubic meter (kg/m³),

AW = is the swept area by air in square meters (m²) ,

V= is the wind speed in meters per second (m/s).

C. Cost

The total cost of the solar-wind hybrid energy system is depend upon the total no of wind turbines used and total no of solar panels used. Therefore the total cost is given as follows

Total cost=(No. of Vanes Wind Turbine * Cost of single Vanes Wind Turbine) + (No. of Solar Panels * Cost of single Solar Panel) + (No. of Batteries used in Battery Bank * Cost of single Battery)+(No. Of modern high technology* cost of each)

$$CT = (NW * CWT) + (NS * CSP) + (NB * CB)$$

Where, **CT**= is the total cost in Rs,
 wind turbine in Rs,

CWT= is the cost of single

CSP= is the cost of single solar panel in Rs', **CB**= is the Cost of single Battery in Rs,

NW= is the number of wind turbine used, **NS**= is the number of solar panels used ,

NB= is the number of Batteries used in Battery Bank.

Solar-wind hybrid energy systems needs only initial investment. It will compete well in generation with the conventional energy sources. When accounted for a lifetime of reduced or avoided utility costs. For minimize the cost of the system we need to increase the use of non conventional energy sources. So that production of solar and wind power generator will be increase. That will reduce cost of the whole system

Cost and efficiency

Through an extensive literature review of various publications on present and projected costs (capital as well as operating) data was systematically compiled as the first step. based on combination of approaches, we have estimated future capital costs for RE in India beginning with the starting capex and opex values from CREC 2012. Most estimates for nearly all renewables expect a cost reduction in real terms over the time period in question. However many studies estimate costs for shorter time periods and not till 2047.

Efficiency of occupancy, utilization of hybrid train

The efficiency numbers in terms of litres of diesel consumed or kilowatt hour per passenger kilometre or tonne-kilometre for railways is arrived at from the actual national averages of the Indian Railways as published in its Annual Statistical Statements (MoR, 2013).

Conclusion

Solar energy and wind energy has large potential to be major fraction of a future carbon free energy portfolio and due to its inexpensive availability and sustainability. It leads to energy security and transform the word Technology using renewable sources of Energy. And the hybrid energy system in railway will successfully reduce the energy demand in the railway coaches as much. Also the hightech modernized PIR Sensor informative system in railway track will give information automatically to substation in accordance of any type of breakage or failure of railway track which will reduce the accidental cases.

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