GROUND POWER UNIT

WITH SOLAR POWER

Submitted in partial fulfilment of the requirement for award of

The

BACHELOR OF SCIENCE-

IN

AERONAUTICS (AVIONICS)

By

Robin Das Thottathil

PRN NO. - 2017016402240704

Under the guidence of

Mr. Pankaj Salunkhe (qualification)

WINGSSS COLLEGE OF AVIATION TECHNOLOGY,PUNE

UNIVERSITY OF MUMBAI

September, 2020

➢ INDEX

➢ INTRODUCTION

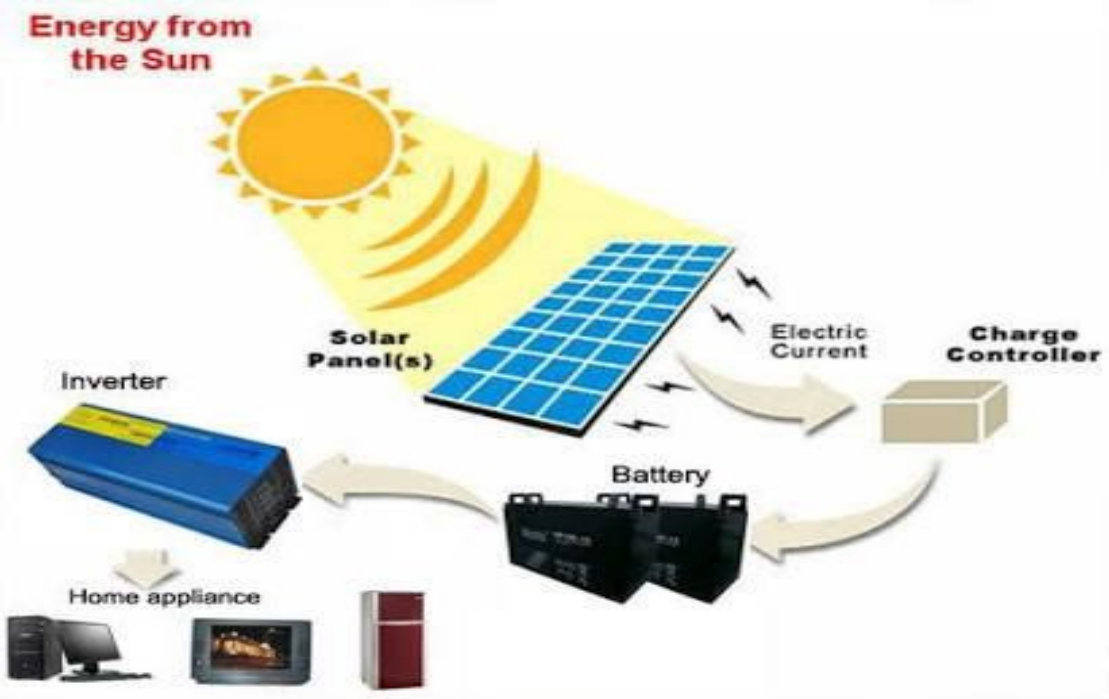
Nelson has a high average rate of sunshine hours annually, and percentage of sunny days, making solar power generation the most accessible alternative power source for local residents, depending on the site location and positioning of the building.

Stand-alone power systems (SAPS) are becoming more accessible for home power generation, and not just in remote locations, but they are complex and need to be well designed and
installed to work well.

A stand-alone solar power system needs to be carefully tailored to your situation and energy requirements. It is important from the outset to get expert advice on the various system, design and installation options, to help assess which options are best for you.

Energy efficiency key to sufficient solar power generation.

Using less electricity is a lot cheaper than building a system that can generate or store extra. The first step in achieving a workable solar power system is to make your property as efficient as possible.



A Ground Power solar power system is designed so it covers your electricity needs and has a calculated amount of stored electricity for high drain uses, or periods of low generation.

Operating a stand-alone power system also means you need to pay close attention to how and when you use energy. It's important to reduce your peak electricity demand as much as possible.

Ground Power will not only help you design the right solar power system for your property, we can show you how to monitor your power savings and manage your usage to capitalise on power generation peaks.

Battery storage and back-up generation for continuous power supply.

All stand-alone power generation systems require some form of energy storage, usually involving a set of batteries, and a back-up system for generating power when the primary generation sources fail to supply enough electricity.

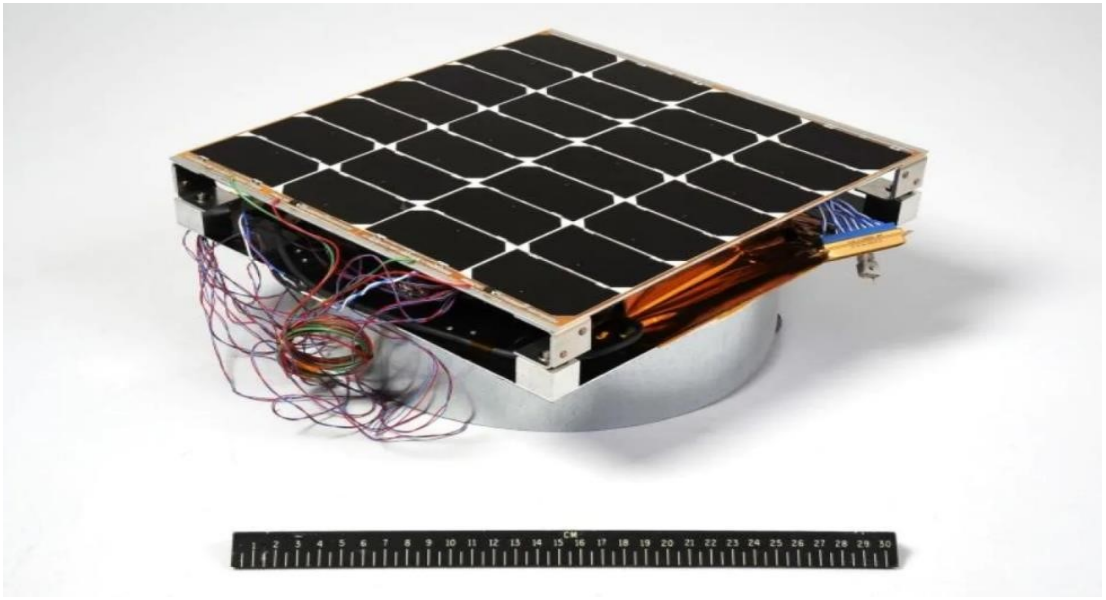
Electricity stored in your battery bank is then available when the sun isn't shining. This also allows you to use more electricity, for short periods of time, than the maximum your generation sources can supply. It is still necessary, however, to keep the electricity demand of your house within the capability of your battery bank and the amount of generation you have.

Stand-alone power systems are often backed up by a diesel or petrol generator. This back-up may come into play, for example, when it's cloudy and your solar photovoltaics can't work and your batteries are run down.

Careful design of your stand-alone power systems and close management of your energy use will reduce your need for using your back-up generator. You can also avoid having to use your diesel generator too often, or not need one at all, through agreater investment in generation and battery storage.

A secret military space plane is carrying an experiment to harvest power from space

An unmanned military space plane called the X-37B, which resembles a smaller version of the space shuttle, is carrying a device that converts solar energy into microwaves that could be beamed to Earth to provide emissions-free energy. This is proofof principle of an attractive idea that is not without risks, challenges, and enormous potential costs.



3This concept of space-based solar power has been around for decades. It holds promise as a technology that could capture huge amounts of free energy from the sun and convert it into clean electrical energy. In space, sunlight is more intense because it doesn't pass through the atmosphere, and a satellite in the proper orbit could remain in sunlight almost 24/7 collecting
energy. That power could be converted into an intense microwave energy beam aimed at receivers on the ground which would convert it into clean electricity.

➢ ADVANTAGES OF THE SOLAR POWER GPU

- Solar power is pollution free and causes no greenhouse gases to be emitted after installation. Reduced dependence on foreign oil and fossil fuels. Renewable clean power that is available every day of the year, even cloudy days produce some power.

- Renewable Energy Source. Among all the benefits of solar panels, the most important thing is that solar energy is a truly renewable energy source.

- Reduce electricity bill

- Low maintenance cost

- If there's lack of sunlight we can use at least 30% to 40% solar power and other regular electricity

➢ DISADVANTAGE OF THE SOLAR POWER GPU

- Solar panels are dependent on sunlight to effectively gather solar energy. Therefore, a few cloudy, rainy days can have a noticeable effect on the energy system. You should also take into account that solar energy cannot be collected during the night.

- Some toxic chemicals, like cadmium and arsenic, are used in the PV production process. These environmental impacts are 5minor and can be easily controlled through recycling and proper disposal.

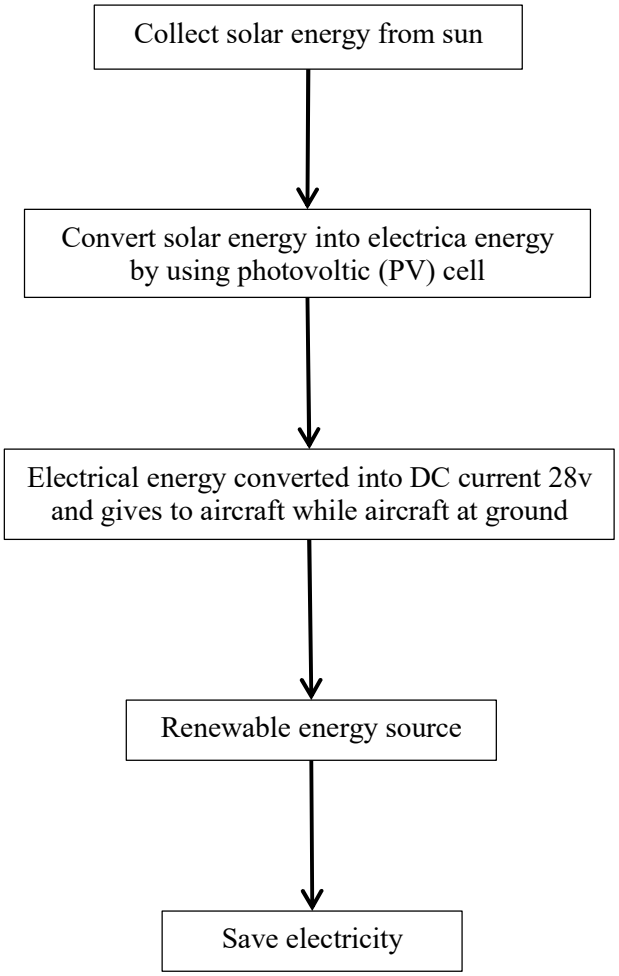
- Solar power is a variable energy source, with energy production dependent on the sun. Solar facilities may produce no power at all some of the time, which could lead to an energy shortage if too much of a region's power comes from solar power.

➢ SCOP OF THE PROJECT

- The main scope of solar power GPU is to save electricity by using solar energy.
- Eco- friendly
- And solar energy is renewable Energy.
- If there's lack of sunlight we can use at least 30% to 40% solar power and other regular electricity
- If we use electricity by conversion of solar power electricity bill can be reduced
- India is the 4th most lucrative market for renewable energy across the globe. It has also earned the 5th position in the world for total solar capacity installed so far. As the country has recently emerged as the largest market for solar PV worldwide, the industry offers voluminous opportunities for growth.
- Generation of solar energy has tremendous scope in India. The geographical location of the country stands to its benefit for generating solar energy. The reason being
- India is a tropical country and it receives solar radiation almost throughout the
- year, which amounts to 3,000 hours of sunshine. This is equal to more than 5,000
- trillion kWh. Almost, all parts of India receive 4-7 kWh of solar radiation per Square
- This is equivalent to 2,300–3,200 sunshine hours per year. States like Andhra
- Pradesh, Bihar, Gujarat, Haryana, Madhya Pradesh, Maharashtra, Orissa, Punjab,
- National Solar Mission (JNNSM) launched by the Centre is targeting 20,000 MW of
- solar energy power by 2022, iii).Gujarat's pioneering solar power policy aims at
- 1,000 MW of solar energy generation, and Rs. 130 billion solar power plan was

- unveiled in July 2009, which projected to produce 20 GW of solar power by 2020.
- Apart from above, about 66 MW is installed for various applications in the rural
- area, amounting to be used in solar lanterns, street lighting systems and solar water
- pumps, etc.

➢ METHODOLOGY



➢ THE PROJECT WORK DIVIDED IN TWO PART AS

A] THEROTICAL WORK:-

Theoretical study of solar GROUND POWER UNIT

B] ACTUAL WORK:-

- **Design of unit**
- **Development of setup**
- **Actual working of setup**

A] Theoretical work :-

Ground Power Unit, or GPU for short, is the name given to power supply equipment that provides clean power for both maintenance and engine starting aircraft that are on the **ground**.

A ground power unit is a vehicle capable of supplying power to aircraft parked on the ground. Ground power units may also be built into the jetway, making it even easier to supply electrical power to aircraft. Many aircraft require 28 V of direct current and 115 V 400 Hz of alternating current.

Many aircraft require 28 V of direct current and 115 V 400 Hz of alternating current. The electric energy is carried from a generator to a connection on the aircraft via 3 phase 4-wire insulated cable capable of handling 261 amps (90 kVA).

Normally the aircraft generates it own power, but when parked with the engines switched off power provided by the airport would be connected to the plane. This connected power is typically 115 V at 400 Hz and is called ground power.

Contents:-

- Fixed ground power unit
- Electrical characteristics
- Technical consideration
- Voltage drop
- Frequency converter
- Final power deliver
- Connection to the aircraft

- **Fixed Ground Power:-**

Fixed ground power is the supply of suitable 400 Hz power using a permanently installed installation for use on parked aircraft. How Many Ground Power Units (GPU)

For point of use systems, the number of GPU is dependant on aircraft size.

Best practice from an operational and reliability view is one GPU per plug:

Narrow-Body: 1 x 90 kVA

Wide-Body: 2 x 90 kVA

A380: 4 x 90 kVA

Conversion of the mains power to 400 Hz power is typically done either centralised or at the point of use by frequency converters.

In a centralised system, large quantities of power are converted at a central location and then the 400 Hz power is distributed to the aircraft. In point of use, the mains power is taken close to the aircraft, and the frequency conversion carried at it's point of use.

Centralised power systems while cheaper to construct, do have several disadvantages. These include the balancing of the system, maintaining adequate voltage drops amongst others.

Mobile Power

Where fixed ground power is not available, mobile power units can be deployed. These are typically towed or mounted on vehicles and deliver power by utilising diesel generators.

- **Electrical Characteristics:-**

Aircraft have strict specifications for the quality of power: *115 V ±3 V, 400 Hz*

The amount of kVA required is dependant on the aircraft type and size. During design processes, the amount of power required is calculated and suitable equipment installed. For point of use converters (see blow), these are often standard

Unbalanced and Balanced Cables

400 Hz power needs additional technical considerations above that for standard 50 or 60 Hz. Within any cable, the impedance presented by the inductive reactance is proportional to frequency ($X = 2\pi\omega f$). For 400 HZ systems, the impedance will be around eight times larger than normal mains systems and consequently voltage drop becomes a major issue.

In addition for normal four core cables, the distance between the centres of each phase is not equal [due to the neutral conductor taking up space (in the image a3 is larger than a1 or a2)]. This creates an imbalance and consequently the inductance of each phase varies. This variation of inductance between phases, while not that important at mains frequency, become more pronounced at 400 Hz and can lead to imbalanced voltages.

To reduce any imbalance in inductive reactance, often special symmetrical seven core cables are used - with interspersed phases wrapped evenly around a neutral conductor.

- **Voltage Drop :-**

History of 400 Hz

400 Hz was first chosen for aircraft design as it ensured a more compact design (and hence lighter weight) for the electrical systems.

Generators providing 400 Hz power use less copper in their windings and smaller magnetic cores than those of 50 or 60 Hz - making them lighter.

Given the relative short transmission distances in aircraft, the negative aspects of larger voltage drops at 400 Hz are not so serious. The reduction in weight of equipment more than compensates for this.

Maintaining 115 V at the aircraft plug in connector can be difficult; this is especially so where each phase is unbalanced. Several methods exist for ensuring the correct voltage level at the aircraft. Two methods which yield reliable results for point of use converters are:

1. measurement wires embedded in the main cable measure the voltage at the aircraft. Each individual phase output of the inverter is then adjusted to give the correct voltage at the plane.

2. characteristics of the supply system and cable are determined by automatic measurements. The output of each inverter phase is then adjusted according to the measured current.

- **FREQUENCY CONVERTERS:-**

Two 90 kVA point of use frequency converters

Commercial mains power at most airports operates on either 50 or 60 Hz. Frequency converters are required to change this to the 400 Hz required for aircraft operation.

- **Final Power Delivery :-**

Bridge Mounted Cable Coiler

Two common methods employed at larger airports are bridge mounted cable reel devices or apron buried pit systems

.

Bridge mounted devices are attached to the passenger embarkation/disembarkation bridges and electrically controlled to dispense the 400 Hz cable. After operations, the device will electrically rewind the cable back onto it's cable reel.

Pit systems typically contain the 400 Hz cable, which is accessed by lifting a lid on the pit. Additionally, some pop-up type pit systems are available, which simply the cable handling. In addition to cable handling, pits systems also need to be designed to take the mechanical load of aircraft driving over them. Being buried, they are also considered to be confined spaces.

- **Connection to the Aircraft** :-

Standard aircraft connection plug

Standard aircraft connection plug Connection to the aircraft itself is made using special plug in connectors. Depending on the size of the plane, the number of required connectors varies from one to four.

Aircraft connectors are standardised and rated at IP67. Connectors are often integrated with push buttons and LEDs for operating frequency converters and power delivery systems. Typical specification ratings would be 200 V, 200 A continuous within a temperature range: -55°C to +125°C.

C] ACTUAL WORK

• Solar power energy collected by solar panel by using sun rays

• Solar panel made by bunch of solar, Solar cell mainly made by Silicon which is type of semiconductor

• Silicon or sandwich between two conducting layer of silicon. Solar cell has two type of silicon layer first N type and second p type PN junction P – Positive & N- Negative

• Negative charge electron or negative charge wholes free to move but PN junction has electric field so electric flow take One Direction and electricity produced

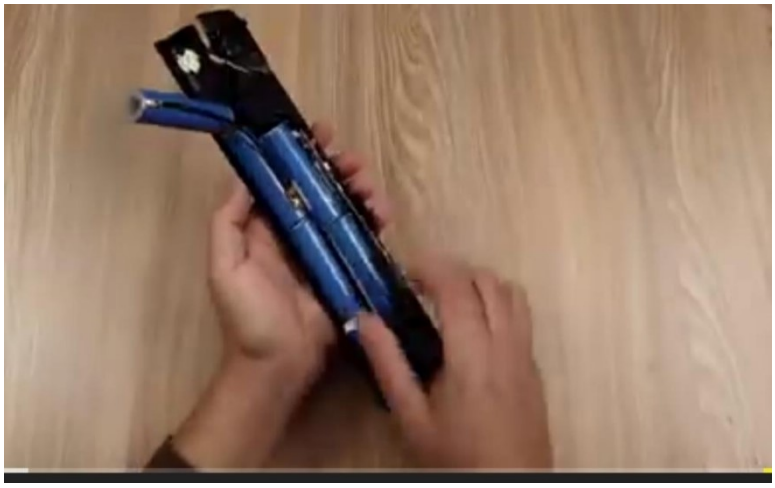
• 1 cell produced – ½ volt electricity

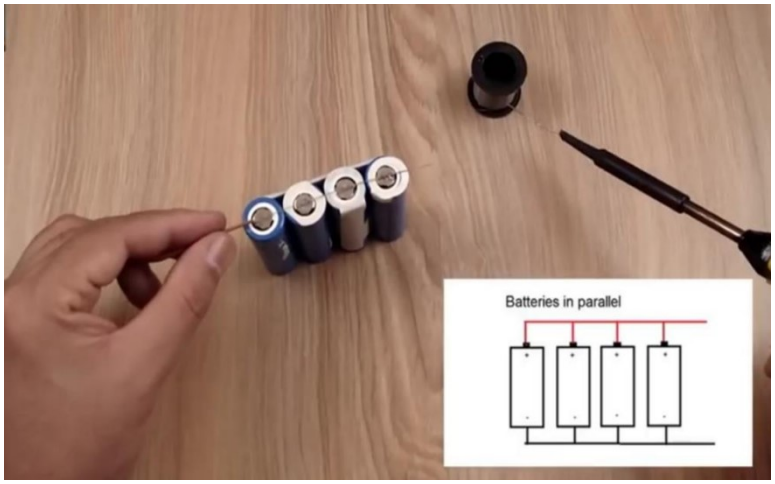
• Because of changing weather solar cell can produce only 20% to 40 % of solar power converted into electricity

• That electricity used for charge batteries of ground power unit and restore and whenever required to aircraft it gives to DC or AC to aircraft

➢ Design of unit

1818650 Batteries ×4(from old laptop batteries)

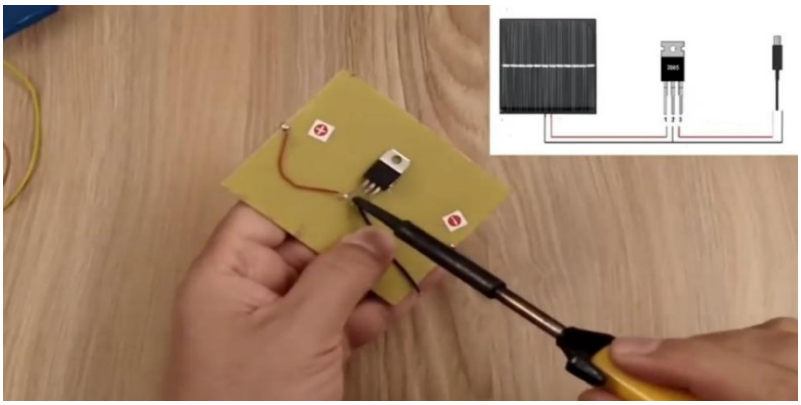




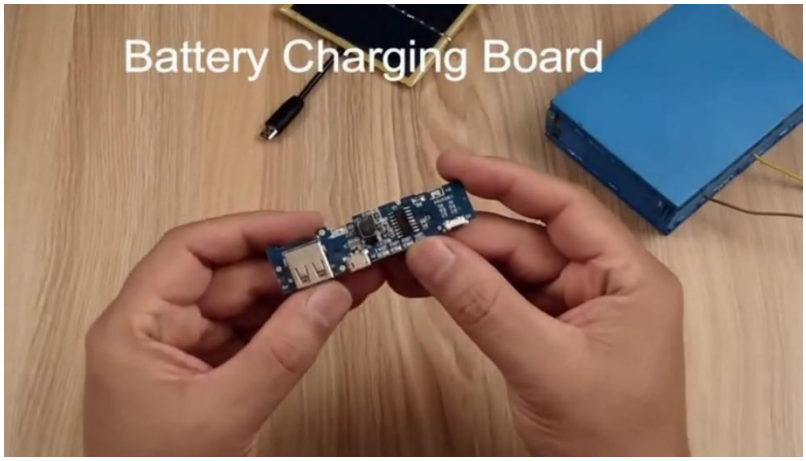
• Some pieces of plywood

• 6v solar panel

• **5 volt voltage regulator 7805**



• **Lithium battery charging board**



➢ WORKING OF DESIGN

• Solar panels are made from silicon and convert solar energy to electrical energy. There are simple steps in which solar cells convert solar power to electrical energy. These are discussed below:

• Firstly, set up solar panels at the top of your house where maximum sunlight is available during the day. There are 22three different types of solar panel array mountings: adjustable, fixed and tracking solar panel mounts. You can choose the best solar panel mount as per your requirements. Tracking solar panel mounts are more efficient as they can move in the direction of sun.

• The solar panel is connected to the solar charge controller . The charge controller controls the charging of the battery and prevents it from overcharging. It also prevents the reverse flow of current during the night when no charging takes place.

• In the next step, connect the charge controller to the battery. The battery will start charging in the presence of sunlight if it is not fully charged. When the battery is fully charged, the charging process stops automatically and it restarts again when the indicator detects that the battery is to be charged.

• The power generated in the battery is 12-volt DC voltage and convert it to AC current to charge battery cell.

• install a power inverter to convert the DC power of the battery to an AC power for supporting to battery

• Thus, the process of generating electrical energy from solar energy begins with the collection of sunlight by the solar cells

• Store solar converted power in battery and use for aircraft as
ground power unit

• If there’s lack of sunlight we can use half of solar power and another half is electric power.

Final design of solar power GPU

➢ CONCLUSION

• This project analysis has observed the use of solar energy. It is easily assumed that when the use of solar power increase then rate of consumption of electricity will reduces

• Instead of electricity we used solar power energy to save electricity

• Solar energy systems/power plants do not produce air pollution, water pollution, or greenhouse gases. … However, some toxic materials and chemicals are used to make the photovoltaic (PV) cells that convert sunlight into electricity

• The implementation of this project can developed best opportunities in aviation industry

• If there's lack of sunlight we can use at least 30% to 40% solar power and other regular electricity

• The main purpose of this project is to reduced electricity by using natural resources

• Eco friendly – no harm to environment

➢ REFERENCES

[1] R. J. Boucher, History of Solar Flight, AIAA Paper 84- 1429, June 1984 [2] A. J. Coloz, Preliminary Design of a Long-Endurance Mars Aircraft, AIAA 26th Joint Propulsion Conference, AIAA 90-2000, Orlando, FL, July 16-18, 1990 [3] Andre Noth

https://youtu.be/1IzWSbJ5Ff8

Mr. Suresh kumar sir (principal of wingsss college of aviation technology)

Mr. Pankaj salunkhe sir (aircraft maintenance engineer)

BONAFIDE CERTIFICATE

This is to certify that the project report titled "Ground Power Unit is a bonafide record of work carried out by "Mr. Robin Das Thottathil " during the final semester from "Mont h and ye ar" to "mont h and under my guidance, in partial fulfilment of 2020

the requirements for the award of BACHELOR OF SCIENCE – in AERONAUTICS (AVOINICS)

Prof.Dr.M Suresh Kumar
Principal

DECLARATION

I, Mr. Robin Das Thottathil hereby declared that this project report titled

Ground Power Unit submitted in partial fulfilment of the requirement

for the Award of "BACHELOR OF SCIENCE – in AERONAUTICS (AVOINICS)**" is my original work and it has not formed the basis for the award of any other degree.**

(Signature of the Student)

Robin Thottathil

Place: PUNE

Date: