Figure 1. Advanced Triple-Junction EMCORE photovoltaic cell

NANOSATC-BR – ENERGY GENERATION AND STORAGE

Rafael Lopes Costa[1], Petrônio Noronha de Souza[2], Nelson Jorge Schuch[1], Otávio Santos Cupertino Durão[3], Lucas Lopes Costa[1], Rubens Zolar Gehlen Bohrer[1].

[1] – Southern Regional Space Research Center - CRS/INPE - MCT, in collaboration with the Santa Maria Space Science Laboratory - LACESM/CT- UFSM, Santa Maria, RS, Brazil.
[2] – Integration and Testing Laboratory - LIT/INPE-MCT, São José dos Campos, SP, Brazil.
[3] – Coordination for Strategic Planning and Assessment – CPA/INPE-M CT, São José dos Campos, SP, Brazil.

1. INTRODUCTION

The NanosatC-BR will be the first Brazilian CubeSat. A CubeSat is a cubic satellite with a volume of one liter (10x10x10 cm) weighting no more than 1 kg. This poster shows the Power Supply Subsystem preliminary concept for this satellite.

2. THE POWER SUPPLY SUBSISTEM

The Power Supply Subsystem, one of the most important subsystems of the satellite, is responsible for many essential tasks that shall ensure the operation of the spacecraft. These tasks include supplying power to the satellite, distribute, storage, regulate and control the power supply.

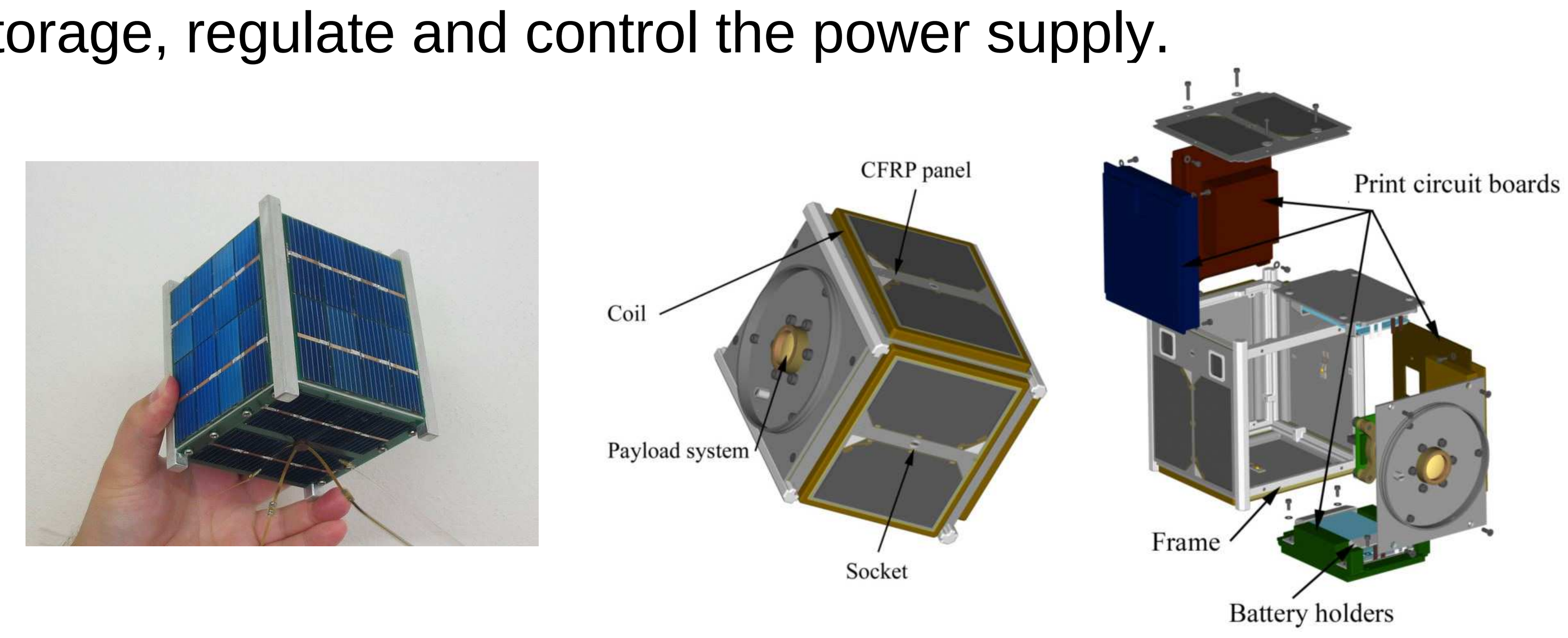

Figure 1. CubeSats Examples
(http://www.lcto.dk/download)

3. ENERGY GENERATION

When the satellite is in orbit, the power supply subsystem shall generate enough power to supply all other subsystems. The power is obtained from Sun's light, which is the only available energy source in space.

In order to estimate the power available for the satellite the following conditions will be considered:

- *The Solar irradiance (Φ)* = 1366.1 W/m² (ASTM)
- *The Solar Cell efficiency (ε)* = 27,5% (EMCORE's Advance Triple-Junction cells).
- *The Efficiency of the power supply unit (k)* = 90% (Clyde Space 1U CubeSat Power).
- *The effective area of the solar cells (A)* = 0.0532 m²
- The power available for the spacecraft subsystems is approximately 1.8 W that is obtained considering all parameters listed above.

Figure 2. ATJ EMCORE photovoltaic cell
(http://www.emcore.com)

4. ENERGY STORAGE

When the satellite is illuminated by the Sun, the power that is generated supplies all the subsystems that require energy and, in parallel, charges the batteries. When the satellite is not illuminated, the subsystems are supported by the batteries.

To determine the depth of discharge (DOD) at the eclipse periods, a power budget is necessary, presenting the subsystems power consumption at the different operation modes, Table 1.

Table 1. Power consumption on operating modes

SUBSYSTEM	STANDBY (W)	TRANSMITTING (W)
Structure Subsystem	0	0
Thermal Control Subsystem	0	0
Power Supply Subsystem	0.1	0.1
TTCS Band Subsystem	0	1
Attitude and Orbit Control Subsystem	0	0
On-Board Data Handling Subsystem	0.025	0.025
Payload	0.02	0.02
TOTAL CONSUMPTION	**0.145**	**1.145**

Figure 3. Clyde Space lithium polymer battery
(http://www.clyde-space.com)

The DOD of the batteries was calculated considering two lithium polymer battery cells and can be better seen through the diagram in Figure 4.

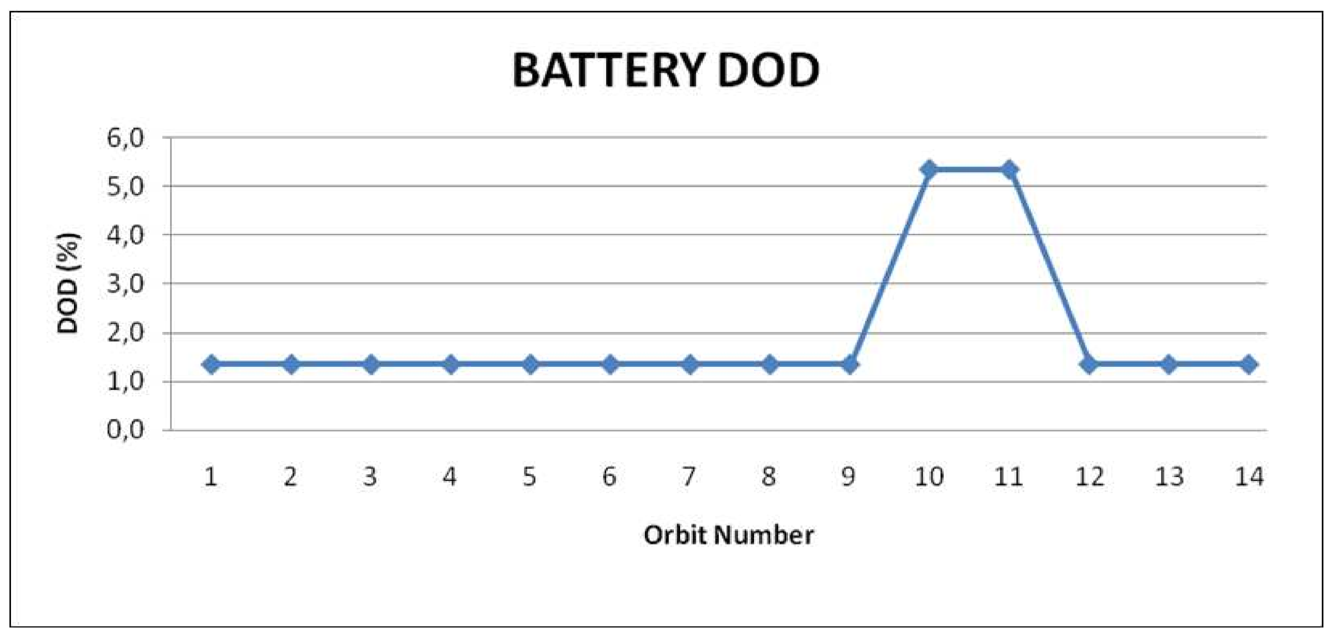

Figure 4. Battery DOD diagram

5. CONCLUSIONS

This work presents the importance of the Power Supply Subsystem, especially the generation and storage of energy showing the average power consumption of the satellite on different operating modes and the DOD for each orbit, considering 14 orbit periods/day. The launch date of NanoSatC-BR is scheduled for the end of 2010, thus allowing the initiation of the acquisition of data for scientists.

6. ACKNOWLEDGEMENTS

The authors would like to thank the Brazilian Program PIBIC/INPE – CNPq/MCT, for the scholarships and to the Space Science Laboratory of Santa Maria – LACESM from the Federal University of Santa Maria – UFSM for financial support.