Title:- Thermal & Fallback Resilience of Autonomous DysonNode Power Units During Solar Flare Events.

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Scientific context and Problem statement:-

Dyson Node_000001 is a space based Autonomous Energy Absorbing System operating in Close Stellar Orbit. It's a part of Theoretical Dyson Swarm, Absorbing Solar flux for Conversion into Usable Power. The Key Environmental Hazard Simulated here is a Solar Surge--

a Short Term, High Energy Radiation spikes Caused by;

- ★ *Solar Flares (especially X- Class).*
- ★ *Coronal Mass Ejections (CMEs).*
- ★ *Fluctuating Plasma Ejection Zones*
- ★ *Starspot Oscillations*

In the Context of Such Surges, Power Modules face Rapid Energy inflow, leading to;

- ★ *Internal Thermal Build-up*
- ★ *Systematic Stress on Capacitors*
- ★ *High Risk of Burnout if fallback logic*

Objective of the Scenarios:- (i) Solar radiation spikes over time using a Time-series Sinusoidal Fluctuation Model.

(ii) Thermal Response of Internal Systems due to Excess Flux.

(iii) Fallback Triggering System that protects the node when Safety Thresholds are Breached.

(iv) Generates Logs that could later be Consumed by Diagnostic AI Modules.

Solar Irradiance and FLux Modeling:-

(A) Solar constant

↣ *Earth Receives a constant Average Solar FLux of 1361 W/m^2.*

(B) Flare Induced Surge

↣ Solar flares can Temporarily Increases Localized FLux by +2% to +50%, depending on Orbital Proximity.

$$F(t)=1361+A\cdot\sin(i).,\ i = \text{energy cycle ID (simulation step)}$$

A =2.0 represents amplitude of sinusoidal surge (~+0.14%)

This simulates a Non-Linear, Cyclic Solar Spike, similar to Electromagnetic Oscillation Pattern observed during Real Flare Event.

FallBack Condition:- When;

$$T>78.5\ {}^\circ C \Rightarrow \text{System Fallback Activated}$$

This simulates the thermal cutoff threshold built into real-world spacecraft power systems (similar to thermal fuses in satellites).

References:-

Kopp, G., & Lean, J. L. (2011). A new, lower value of total solar irradiance: Evidence and climate significance. Geophysical Research Letters, 38(1).
↣ (Establishes 1361 W/m² as the modern solar constant)

Hudson, H. S. (2011). Solar flares, microflares, nanoflares, and coronal heating. Solar Physics, 133(2), 357–369.
↣ (Background on solar flare energy scaling)

Liu, W. et al. (2014). Solar flare-driven extreme EUV enhancements and their effects. The Astrophysical Journal, 784(1).
↣ (Surge events and solar flux enhancement during flares)

Gilmore, D. G. (2002). Spacecraft Thermal Control Handbook, Volume I. The Aerospace Press.
↣ (Standard temperature limits & fallback systems in real satellites)

ECSS-E-ST-31C (2008). Thermal Control – European Cooperation for Space Standardization.
⤐ (Fallback thresholds and emergency logic)

J. Wertz & W. Larson. (1999). Space Mission Analysis and Design. Microcosm Press.
⤐ (Structure for satellite systems analysis + scenario testing)

NASA Technical Report: Solar Flare Effects on Power Satellites
Link: ntrs.nasa.gov
⤐ (Energy response simulations under surge exposure)

Ogata, K. (2010). Modern Control Engineering. Prentice Hall.
⤐ (Fallback triggers and stability logic)

Sidi, M. J. (1997). Spacecraft Dynamics and Control: A Practical Engineering Approach. Cambridge University Press.
⤐ (Thermal and radiative damping modeling)

NASA Parker Solar Probe Mission Data Sheets
https://www.nasa.gov/content/goddard/parker-solar-probe
⤐ (Thermal systems operating under 20x Earth flux)

James Webb Space Telescope Thermal Control Systems
https://webb.nasa.gov/content/observatory/thermalControl.html
⤐ (Passive + active temp regulation + shielding from flares)

Authorship & Originality Note:- This simulation model, fallback logic, and code structure are original contributions by Heet Trivedi, independently developed and self-published under the Project SOLIS framework.

Referenced works are cited to support external constants, scientific models, and real-world analogs used for simulation accuracy.