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Team 27: Modeling for Safety and Integrity of Grid-Scale Solar Energy

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Introduction: The project develops a unified framework for grid-scale energy by integrating the following models to ensure the safety and integrity of solar renewable energy storage: fire detection and suppression response, and hotspot and bypass diode failure detection.

Theory: Using UL 9540A and NFPA 855 safety standards as design foundations, the system models heat, smoke, and electrical anomalies through ESP32 and Arduino sensor networks, with suppression logic simulating emergency cooling or shutdown and dashboard integration enabling centralized safety monitoring.

Results: The detection module accurately identifies abnormal gas and temperature conditions; the suppression subsystem autonomously triggers simulated extinguisher actions; the thermographic and PV fault models visualize panel stress; and all modules transmit synchronized data to a unified safety dashboard.

Conclusion: This project demonstrates predictive analytics and smart monitoring, thus improving safety and stability in the face of the critical technical and environmental stressors standing against modern energy infrastructure, and especially against solar renewable energy.