Technical Simulation & Validation Playbook (TSVP)

Candidate: Fernando Manuel Gómez Castro

Expertise: Solar Energy R&D | Modeling & Simulation

1. Methodology: The Simulation-to-Validation Loop

The TSVP outlines Fernando's rigorous approach to engineering. He utilizes a closed-loop methodology where computational models are not just theoretical exercises but are continuously refined against physical experimental data.

Step 1: Parametric Modeling

Using Wolfram Mathematica and COMSOL Multiphysics, Fernando establishes the physical constraints of the system, including fluid dynamics, heat transfer coefficients, and optical ray tracing.

2. Advanced Software Competency

- **Wolfram Mathematica:** Expert in symbolic and numerical computation for thermodynamic profiles.
- **COMSOL Multiphysics:** Specialized in 2D and 3D modeling of fluid-structure interactions.
- **EES (Engineering Equation Solver):** High-precision property calculations for working fluids.
- **Programming:** Proficient in Fortran and C++ for custom simulation kernels.

3. Experimental Design & Laboratory Standards

Fernando possesses the rare ability to build the hardware he simulates. His expertise includes:

- **Test Bed Construction:** Designing direct and indirect solar thermal regenerators.
- **Sensor Calibration:** Ensuring data integrity for temperature, humidity, and flow rate sensors.
- **Data Acquisition:** Implementing structured analytical methods to collect and clean experimental datasets.

4. Statistical Validation & Data Science

Modeling is only as good as its validation. Fernando applies advanced statistical tools to confirm accuracy:

Tool	Application
IBM SPSS	Quantitative analysis of complex experimental results and hypothesis testing.
OriginPro	Advanced graphing and trend analysis for publication-ready visualizations.
Mathematica	Verification of custom scripts against standard benchmarks.

5. Standard Operating Procedures (SOPs)

Fernando follows a strict set of SOPs for modeling solar systems:

1. **Literature Synthesis:** Identifying existing performance gaps.
2. **Initial Scripting:** Developing the mathematical core of the simulation.
3. **Controlled Testing:** Running experiments on physical test beds.
4. **Residual Analysis:** Calculating the delta between predicted and actual results.
5. **Model Tuning:** Adjusting parameters to achieve <5% error margin.

6. Application Domain: Solar Air-Conditioning

Specific methodology for liquid desiccant systems involving LiCl (Lithium Chloride) and H2O interactions, focusing on regeneration effectiveness and air cooling capacity.