PROJECT NAME: Gen 3 Particle Pilot Plant (G3P3): Integrated High-Temperature Particle System for CSP

Last 5 digits of project number: **34211**
Principal Investigator (PI): **Clifford K. Ho, SNL**
PI Email: **ckho@sandia.gov**

BACKGROUND / INDUSTRY IMPACT

- Particle-based systems can enable higher temperatures (>700 °C) with direct energy storage for concentrating solar power (CSP), process heating, thermochemistry, and solar fuels

PROJECT OVERVIEW / OBJECTIVES

- De-risk key components, including receiver, storage, heat exchanger and particle lift
- Design pilot plant with 6 MWh of thermal storage that heats working fluid to over 700 °C at 1 MW_t

METHODS

- Optimize design of components to meet cost and performance metrics using simulations and models validated with experiments
- Develop system models to perform LCOE analyses and market adoption studies

KEY OUTCOMES / MILESTONES

- Simulated and tested several new receiver design features that can increase efficiency by >10 percentage points
- Developed new design for hot particle storage that reduces heat loss and wall erosion
- Improved heat exchanger to reduce pressure losses and increase particle-side heat transfer
- Performed probabilistic LCOE analyses

CONCLUSION / REMAINING RISK

- Over 20 publications on G3P3 R&D, risk-reduction, and design & analysis activities
- Engineering drawings, process flow diagrams, equipment list, and piping & instrumentation diagrams drafted for G3P3 system
- Needs: Evaluate particle heat-exchanger performance and scalability, obtain final quotes, ensure scalability

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CONCENTRATING SOLAR-THERMAL POWER TRACK

Performed R&D to **de-risk particle technologies** for CSP, **designed integrated pilot plant (G3P3),** and performed **technoeconomic analyses**

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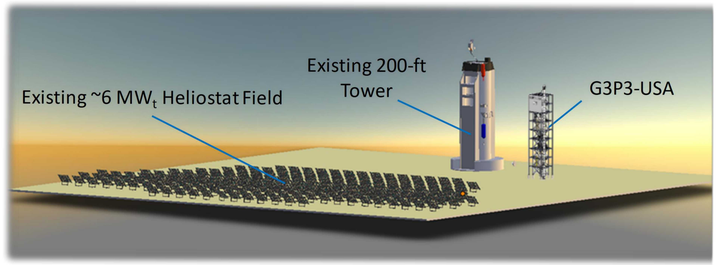
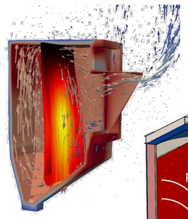
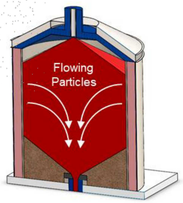


Proposed location of G3P3 at the National Solar Thermal Test Facility, Sandia National Laboratories, Albuquerque, NM

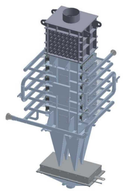
R&D and design of major components



Receiver

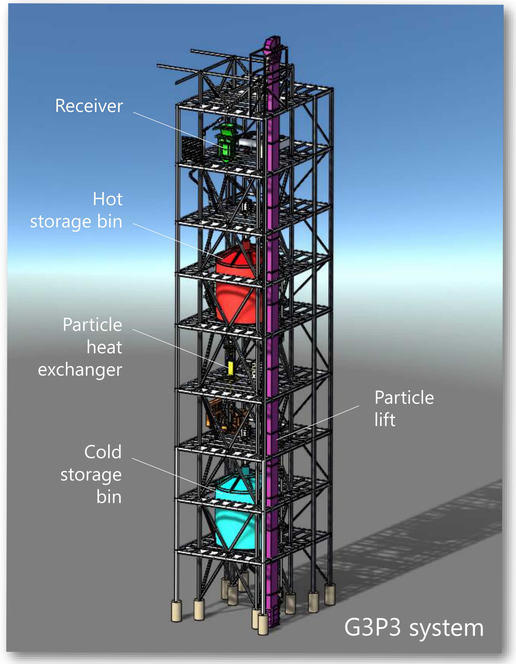


Storage Bin



Particle heat exchanger

Ceramic particles



Particle receiver testing at Sandia

Project contributors: Sandia National Laboratories, Georgia Institute of Technology, King Saud University, CSIRO, Australian National University, U. Adelaide, PROMES-CNRS, DLR, EPRI, Bridgers & Paxton, Solar Dynamics, SolarReserve, Carbo Ceramics, Solex Thermal Science, Vacuum Process Engineering, Allied Mineral Products, Matrix PDM, Saudi Electricity Company