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

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G3P3 Objectives

- **De-risk, design, construct, and operate** a multi-MW$_t$ particle receiver system
  - Heat working fluid (e.g., sCO$_2$ or air) to $\geq 700$ °C
  - 6 hours of energy storage
  - $> 2,000$ hours of on-sun operation
  - Meet SunShot cost and performance goals

- **Leverage** international expertise and CSP activity

- Accelerate **commercialization** of G3P3 technology

**Phase 1**
- **Risk Mitigation**
  - Receiver
  - Storage
  - Heat exchanger
  - Particles, Lift
- 18 months
  - FY19 – FY20

**Phase 2**
- **G3P3 Integrated System Design**
- 6 months
  - FY20

**Phase 3**
- **G3P3 Test and Operation**
- 3 years
  - FY21 – FY23

**DOE downselection**
Value Proposition

- Proposed particle receiver system has significant advantages over current state-of-the-art CSP systems
  - Sub-zero to over ~1000 °C operating temperatures
  - No freezing and need for expensive trace heating
  - Use of inert, non-corrosive, inexpensive materials
  - Direct storage (no need for additional heat exchanger)
  - Direct heating of particles (no flux limitations on tubes)
Gen 3 Particle Pilot Plant (G3P3)
Integrated System

National Solar Thermal Test Facility (NSTTF), Albuquerque, NM
Gen 3 Particle Pilot Plant (G3P3) Integrated System

G3P3-USA system next to the existing 200-ft tower at the NSTTF

Baseline Design

High-Temperature Bucket Elevator

Elevator Buffer Volume

Multi-Aperture Falling Particle Receiver

High-Temperature Storage Bin

Particle-to-sCO₂ Heat Exchanger

Low-Temperature Storage Bin

35 m (115 ft)

33 m (107 ft)
Major Components

- Particles
- Receiver and Feed Bin
- Particle Storage
- Particle Heat Exchanger
- Particle Lift and Conveyance
- Balance of System
G3P3 Summary

- **Significant advantages**
  - Direct heating of particles
    - Wide temperature range (sub-zero to >1000 °C)
    - Inexpensive, durable, non-corrosive, inert
  - Demonstrated ability to achieve >700 °C on-sun with hundreds of hours of operation

- **Gaps and risks**
  - Particle attrition and wear; dust formation
  - Heat loss (receiver, storage, heat exchanger, lift)
  - Particle-to-working-fluid heat transfer
  - Thermomechanical stresses in heat exchanger and storage tanks
  - Materials erosion

On-sun testing of the falling particle receiver at Sandia National Laboratories
Questions?

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