Tower Receiver Development

Concentrating Solar Power Program Team

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May 26th, 2010

Overview

Timeline

- Project start: Oct. 2008
- Project end: Sept. 2011
- Percent complete: 30%

Barriers

- Barriers addressed
  - Performance
  - Reliability
  - O&M cost

Budget

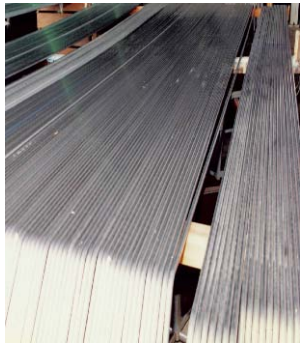
- Total project: $2.88M
  - DOE share: $1.86M
  - Contractor share: $1.02M
- FY09: $389K
- FY10: $817K

Partners

- Project lead: Pratt & Whitney Rocketdyne
- Interactions: Sandia Test Facility & sub-tier vendors

Capital Cost Barrier

- Technical risk was demonstrated with Solar II
  - Main barrier is overall CSP plant capital cost
- Capital cost is being addressed
  - Selecting more cost effective materials
  - Removing design complexity
  - Reduce amount of parts
- Importance of reducing the capital cost is very high
  - Make CSP competitive with traditional energy plants
  - Capital cost dominates LCOE
    - Requires less external financing
    - Increases likelihood that CSP plants will be built



Tubes

Manufacturing

Installation

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Performance Barrier

- Performance important to the economic viability of CSP
  - Higher performance
    - Higher energy efficiency
      - Lower LCOE
- Performance barrier addressed in Phase II design
  - Receiver designed for optimum thermal characteristics
  - Materials & coatings selected based on optimum optical characteristics
    - High absorptivity/low emissivity for sunlit regions
    - Low absorptivity/high emissivity for heat shield regions

Performance barrier

Tube materials

Tube coatings

Reliability and O&M Cost Barriers

- Reliability and O&M costs are related
  - Addressed in the design phase
  - Designing in durability to lower frequency of O&M
- Reliability / O&M barriers evaluated during testing
  - Will be implementing and practicing on-site
    - Tube crack repairs
    - Tube replacements
  - Will be monitoring the O&M issues concerned with:
    - New header and tube designs
    - Tube coatings
    - Heat shield design & materials

Reliability/O&M cost barrier
Tube durability
Re-application of coatings
Tube repairs/replacements

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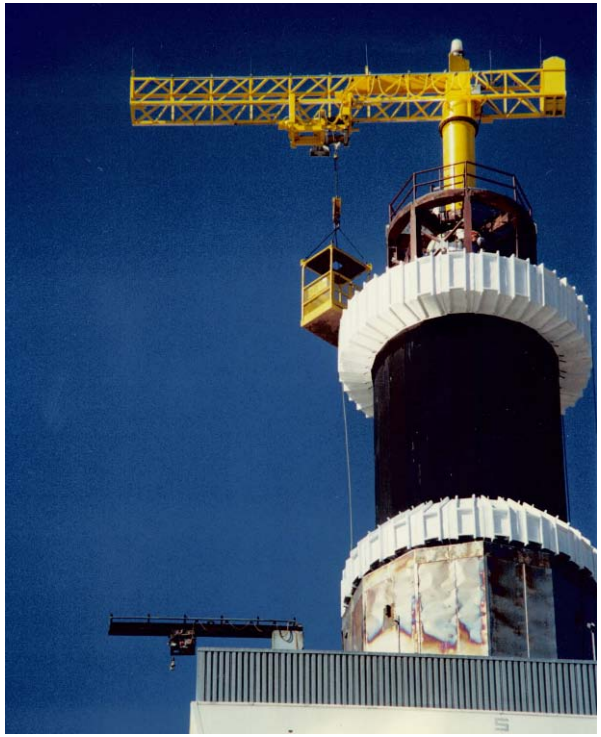
Reliability and O&M Cost Barriers (cont.)

- Solving O&M cost issues critical to the future success of CSP
  - Understanding issues will limit plant downtime
  - Known fixes for problems will speed repair time
  - Goal is to perform O&M in a set timeframe throughout the year



Relevance

- Overall project objective:
  - Validate manufacturability of large scale receivers
  - Test receiver in prototypic on-sun conditions
  - Design for lowering the LCOE
- Objectives for the period May 09 – May 10
  - Design for lowering the capital cost and lowering the O&M cost
  - Select materials for improving the reliability and lowering the O&M cost
  - Select tube coatings that improve performance and increase reliability
  - Select heat shield materials that improve reliability and lower the O&M cost

Approach

- Overall technical approach
  - Review what was achieved in the past (Solar II)
  - Understand current design of large receivers
  - Understand solar operating conditions
  - Innovate design
    - Geometries
    - Materials & processes
  - Finalize design
  - Fabricate hardware
  - Test subscale receiver article
  - Evaluate data
  - Make recommendations for future designs
- Design/Build/Test addresses technical barriers by:
  - Providing opportunity to optimize the cost
  - Implementing higher performance characteristics
  - Learning from the process of build & test
    - Discover valuable information on reliability & O&M

Facility to be new from this level up

Receiver installed at Sandia

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Approach (cont.)

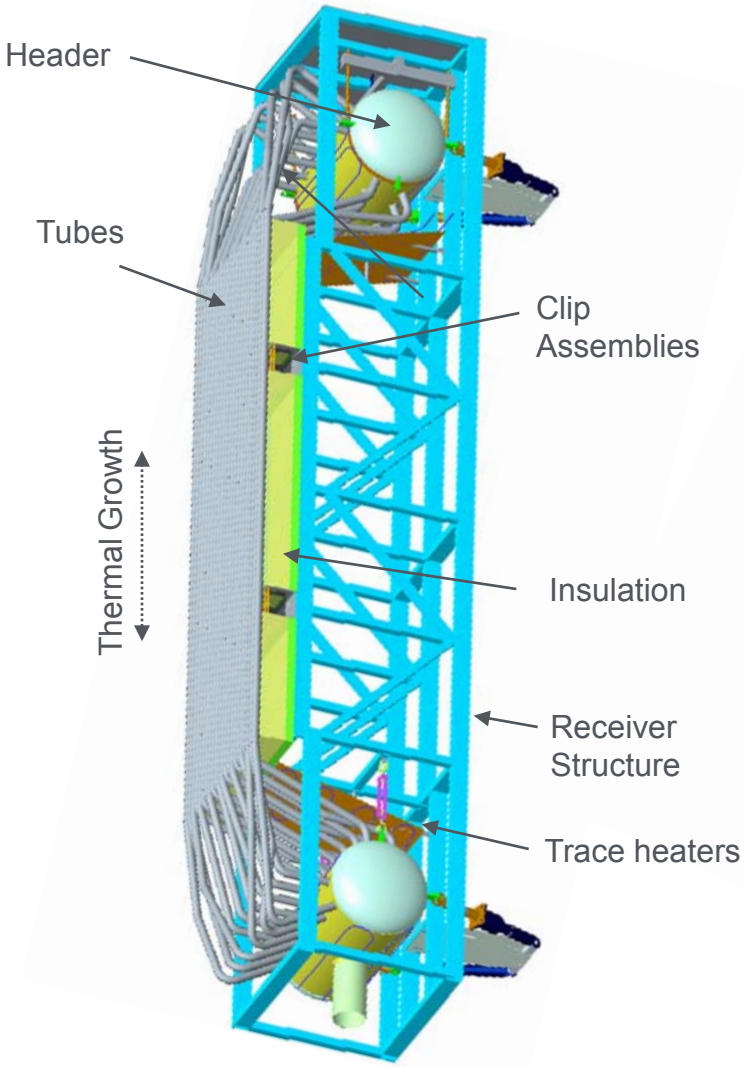
- Receiver project not integrated with other Solar Program research
  - Would integrate with the Baseload Concentrating Solar Power FOA
    - Assuming project was approved
      - Receiver could be utilized again
- FY10 – Milestones & Go/No go decision
  - Milestone #1: Hold Critical Design Review on June 29, 2010
  - Milestone #2: Submit Phase II Report by August 31, 2010
  - Go/no go decision is scheduled for Sept 2010
    - Currently on schedule
      - Complete design
      - Design review
      - Phase II report
- FY11 - Milestones
  - Finish fabrication of receiver by March 31, 2011
  - Complete testing by Sept. 30, 2011
  - Finish project report and production scenarios by Oct. 31, 2011

Accomplishments / Progress / Results

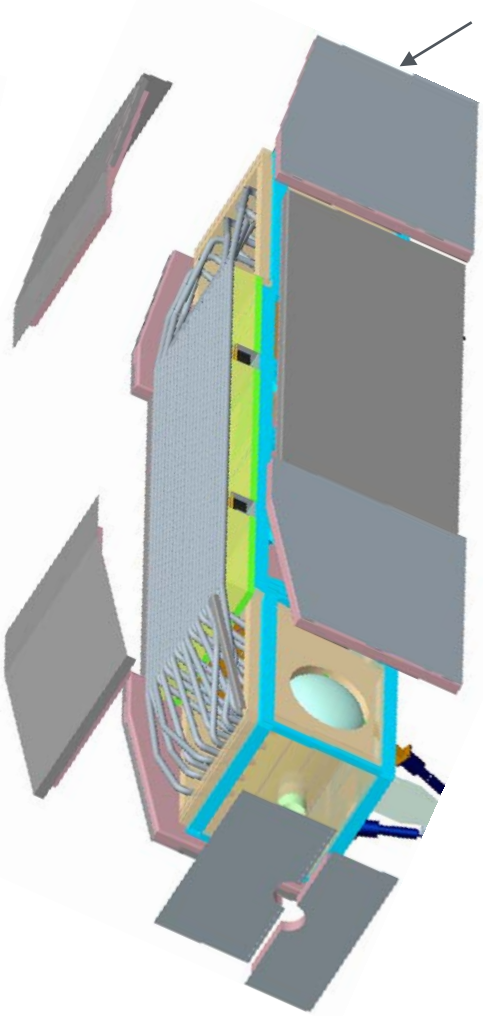
- Previous accomplishments in FY 09
  - Completed Preliminary Design Review and Phase I report
  - Received authorization to proceed to Phase II
  - Created a preliminary design that addressed the three barriers
    - Capital cost, performance, and reliability/O&M cost
- May 09 – May 10
  - Finalized overall design of the receiver
    - Designed to address all the barriers
  - Finalized two tube materials
    - Achieves objective on lowering capital cost and improving reliability
  - Finalized repair processes to be demonstrated during testing
    - Remove & replace a tube and In-place tube repairs
  - Finalizing four tube coatings
    - Objectives: lower capital cost, increase reliability & lower O&M

Note: No data to present at this time. Data from testing will be gathered during Phase III.

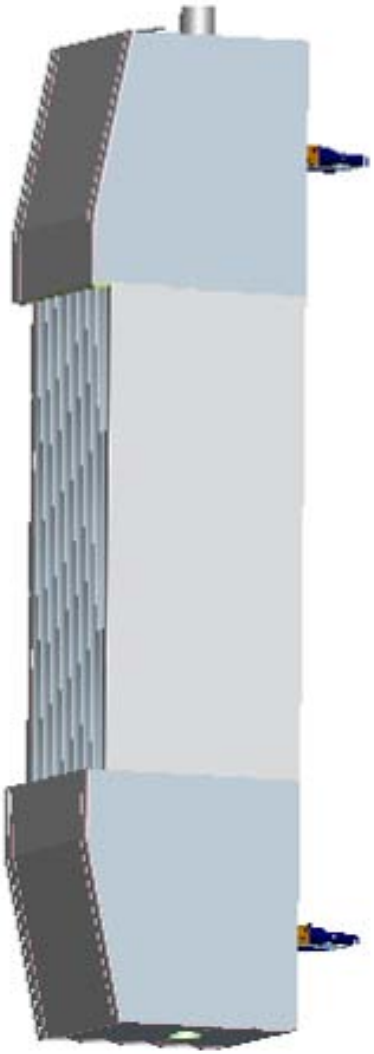
Current Receiver Design



Receiver Showing Internal Details



Receiver Insulation



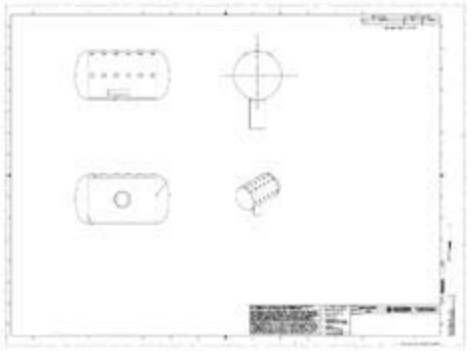
Assembled Receiver

Future Plans (FY 2010 & FY 2011)

- FY10 Project Plans
  - Finalize design
  - Perform Critical Design Review
  - Release all drawings
  - Procure long lead hardware
  - Submit Phase 2 report
  - Proceed thru Go/No Go gate with a “Go” decision
- FY11 Project Plans
  - Procure remaining hardware
  - Fabricate & test receiver panel at Sandia
  - Issue final report including test results & production scenarios

Risk Mitigation

- Project path well defined
- Risks mitigation in place
  - Drawing risk managed by:
    - Correct level of personnel
    - Tools needed to complete the task
  - Fabrication risk is managed by:
    - Selecting proficient vendors
    - Maintaining good communication
    - Involved in fabrication process
  - Testing risk is managed by:
    - Good upfront communication
    - Coordination with Sandia
    - Clear & concise test plan
    - On site personnel during testing



Collaborations/Interactions

- No collaborators for this project
- Project interactions with Sandia (NSTTF)
  - Test facility for this project
  - Federal laboratory
  - Within the DOE Solar Program
  - Extensive interaction
    - Plan & coordinate testing
    - Integration of the hardware in the facility
- Project interactions with sub-tier vendors
  - Hardware procurement & fabrication
  - Independent companies
  - Outside the DOE Solar Program
  - Extensive interaction
    - Communicate design requirements
    - Answer questions

Summary Slide

- On schedule
  - Finish design
  - Hold Critical Design Review
  - Submit Phase II report, end of August 2010
- Very encouraged with the design
  - Addressing three technical barriers
    - Capital cost
    - Performance
    - Reliability & O&M cost
- Fabrication and testing in 2011
  - Data will assist design of future CSP plants