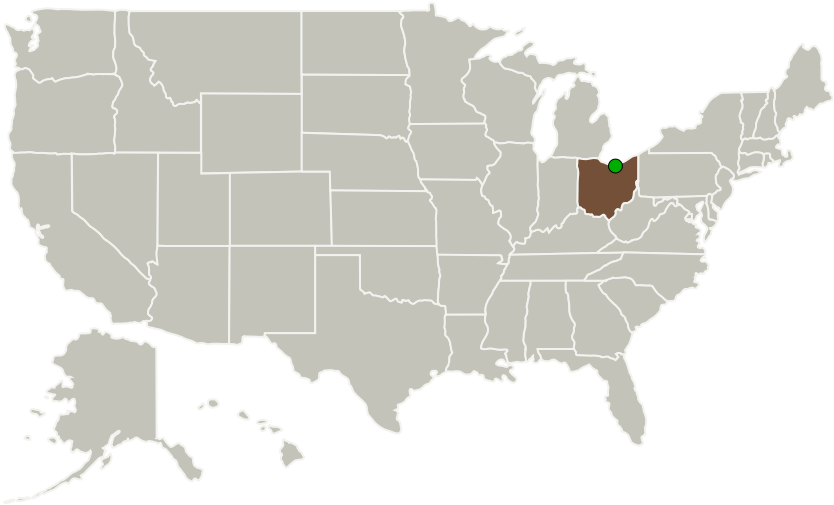
# Cooled Ceramic Turbine Vane, Phase I

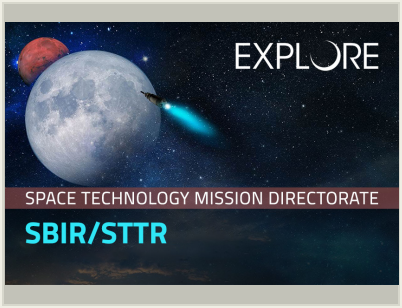
Completed Technology Project (2010 - 2010)

## Project Introduction

N&R Engineering will investigate the feasibility of cooled ceramics, such as ceramic matrix composite (CMC) turbine blade concepts that can decrease specific fuel consumption while reducing NOX emissions. The conflict between efficiency and emissions will require a careful balancing of material selection, turbine inlet temperature, and cooling air. Parametric aero-thermal and structural analyses of selected ceramic blade concepts will be performed to identify blade design and cooling concepts, and to quantify vane and rotor cooling flow rates. Tailoring of the cooling flows allows for optimization of efficiency and emission reductions. Both internal only and film cooling flows will be determined for a range of material properties, loads, and mainstream air and coolant temperatures. Probabilistic thermal/structural analysis will identify the sensitivity of heat transfer and structural parameters to uncertainties in blade thermal conductivity and other material properties, as well as loads and geometry. The proposed effort goes beyond previous laboratory demonstrations of cooling concepts by determining more precisely ceramic blade cooling required to achieve specified performance metrics. The methodology will be developed to a level that will permit validation in an environment relevant to commercial jet engines. This will take the TRL from a current level of 4 to 5.

## Primary U.S. Work Locations and Key Partners



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## Table of Contents

Project Introduction 1
Primary U.S. Work Locations and Key Partners 1
Project Transitions 2
Organizational Responsibility 2
Project Management 2
Technology Maturity (TRL) 2
Technology Areas 3
Target Destinations 3

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Completed Technology Project (2010 - 2010)

| Organizations Performing Work | Role | Type | Location |
|---|---|---|---|
| N&R Engineering | Lead Organization | Industry Small Disadvantaged Business (SDB) | Parma Heights, Ohio |
| Glenn Research Center(GRC) | Supporting Organization | NASA Center | Cleveland, Ohio |

| Primary U.S. Work Locations |
|---|
| Ohio |

## Project Transitions

**January 2010:** Project Start

**July 2010:** Closed out

**Closeout Documentation:**

- Final Summary Chart*(https://techport.nasa.gov/file/140536)*

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Organization:**

N&R Engineering

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

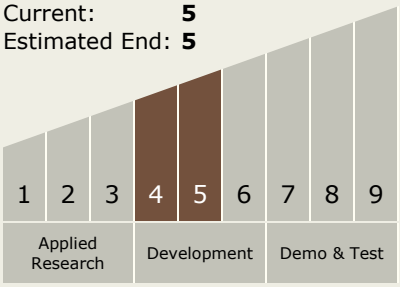
Carlos Torrez

**Principal Investigator:**

Robert J Boyle

## Technology Maturity (TRL)

Start: **4**
Current: **5**
Estimated End: **5**



## Technology Areas

**Primary:**

- TX01 Propulsion Systems
  └ TX01.3 Aero Propulsion
    └ TX01.3.1 Integrated Systems and Ancillary Technologies

## Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System