

I. Introduction and Motivation

A. Motivation

B. Scope of Work

II. Background and Literature Review

A. Previous Space Reactor Work

1. RTGs
2. SP-100
3. INL paper
4. Kilopower

B. Cermet Fuel Work

1. INL paper
2. NASA testing

III. Reactor Physics Parameter Sweeps

IV. Mass Modeling Methods

A. Initial Reactor Design Choices

B. Thermal Hydraulic Analysis Methods

1. Core Geometry
2. Flow Properties
 - a. Temperature
 - b. Pressure
 - c. Thermal Conductivity
 - d. Viscosity
 - e. Specific Heat
3. Fuel Properties
 - a. Thermal Conductivity
 - b. Density
 - c. Maximum Temperature
4. Flow Analysis
 - a. Mass Flux
 - b. Reynold's Number
 - c. Nusselt Number
 - d. Heat Transfer Coefficient
5. 1D Heat Transfer
 - a. Plane Wall Conduction Approximation
 - b. Radius of Conduction

C. Critical Radius Requirements

1. Critical Radius Search with MCNP6
2. Results
 - a. CO₂-UW Cermet
 - b. CO₂-UO₂
 - c. H₂O-UW Cermet
 - d. CO₂-UW Cermet

D. Mass Modeling Iterations

1. Reflector Design
2. Core Aspect Ratio
3. Martian Regolith Reactivity Impact

E. Mass Modeling Results

V. Coupling With Power Cycle Optimization

- A. Coupling Scheme
- B. Optimal Reactor Design

VI. Full-Core Concept Model

- A. Modeling Methods
 1. Neutron Transport
 2. Depletion
 3. Data
- B. Fuel Design
- C. Cooling
- D. Reactivity Control
- E. Depletion
- F. Shielding
- G. Safety Analysis

VII. Summary and Future Work