ROCKET ENGINE NUMERICAL SIMULATOR
OVERVIEW PRESENTATION

presented by

Ken Davidian
Space Vehicle Propulsion Branch
Space Propulsion Technology Division
October 22, 1992

ROCKET ENGINE NUMERICAL SIMULATOR
CONTENTS

• RENS Definition
• Objectives
• Justification
• Approach
• Potential Applications

• Potential Users
• RENS Work Flowchart
• RENS Prototype
• Conclusions
Rocket Engine Numerical Simulator (RENS) Performs Liquid Rocket Engine Propulsion System Analyses and Design

- RENS gives Engineer a 3-D Transient Tool for Analyzing Engine Systems (Tanks - Feed System - Thrust Chamber)
- RENS Will Surpass/Encompass Capabilities of Current System Codes (ROCETS & Generic Power Balance)

REN S DEFINITION

- RENS is Long Term and Large Scope
- RENS Features Include:
  - System Executive - Easy to Use
  - Data Management - Industry/University/ Gov't Advisory Group
  - Graphical User Interface - Public Domain
  - Incorporation of Users' Technical Codes - Evolution of Capabilities
ROCKET ENGINE NUMERICAL SIMULATOR

OBJECTIVES

- Enable spontaneous and adaptive rocket definition, generation, performance evaluation, and failure analysis.
- Develop capability to simulate component and system level performance of rocket propulsion systems.
- Provide rapid and accurate assessment of rocket to increase design efficiency.
- Incorporate and integrate validated computational simulation codes/technologies.

ROCKET ENGINE NUMERICAL SIMULATOR

JUSTIFICATION

- Following capabilities required by NASA to do our job: independent verification of proposed rocket performance, new rocket designs, assess impact of new rocket technologies.
- Standardized industry design/analysis tool (industry-university-government participation).
- Streamline, enhance, and alter research & analysis process to reduce time and cost.
ROCKET ENGINE NUMERICAL SIMULATOR

APPROACH

• The RENS program will be patterned after, and will leverage from, the Numerical Propulsion System Simulator (NPSS), currently under development at NASA LeRC for aircraft propulsion systems.

• RENS will incorporate component level descriptions to predict performance and reliability.

ROCKET ENGINE NUMERICAL SIMULATOR

POTENTIAL APPLICATIONS

• Chemical Propulsion Systems
• Nuclear Thermal Propulsion Systems
• Propulsion System Test Facilities
• Nuclear Electric Propulsion Systems
• Space Power Systems
ROCKET ENGINE NUMERICAL SIMULATOR

POTENTIAL USERS

RENS WORK STRUCTURE

RENS WORK BREAKDOWN FLOW CHART

- Collect codes
- Define sys exec
- Define data mgt
- Define GUI

- Develop tech tools
- Develop sys exec
- Develop data mgt
- Develop GUI

- Integrate codes/tools
- Integrate sys exec
- Integrate data mgt
- Integrate GUI

- RENS testing
- RENS release

NTP: Systems Modeling 736

OF POOR QUALITY
ROCKET ENGINE NUMERICAL SIMULATOR
RENS PROTOTYPE - REDES

- REDES Used to Conduct Various Studies and Model Various Engines:
  - Nozzle Performance Parametrics (SSME, RL10)
  - Nozzle Design (NTR)
  - Rocket Engine Test Facility Capability Assessment (NASA LeRC Rocket Engine Test Facility Ejectors)

ROCKET ENGINE NUMERICAL SIMULATOR
REDES ANALYTICAL DOMAIN

Diagram showing the REDES analytical domain with various components and interactions, including REDES/KEE, Operating System, Lisp Functions, RTE, GASP, ODE, ODK, TDE, TDK, BLM, and RAO.
ROCKET ENGINE
NUMERICAL SIMULATOR

CONCLUSIONS

• RENS Capabilities Required For Simulation Development.
• Simulation Capability Required By Gov't, Industry, and University in Many Technical Disciplines.
• RENS Prototype Exists at LeRC.
Q: How Would You Use RENS?
Q: What Would You Add To the Current RENS Description? What Would You Delete?
Q: What Do You Like About the Current RENS Description? What Do You Dislike?

Q: Would You Be Interested In Developing Some Portion of RENS? What Portion?
Q: How Would You Justify Expending Resources In the Use of RENS to Your Management?
Q: May We Cite Your Responses In Our Advocacy Presentations to NASA Headquarters?