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ROCKET ENGINE NUMERICAL SIMULATOR

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RENS DEFINITION

- **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)**

RENS 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**

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.**

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.**

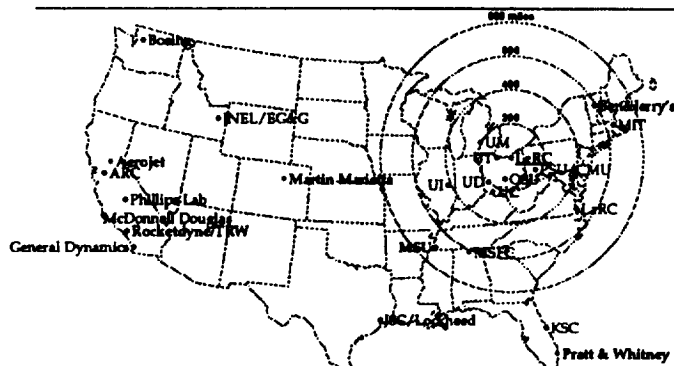
APPROACH

- 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.

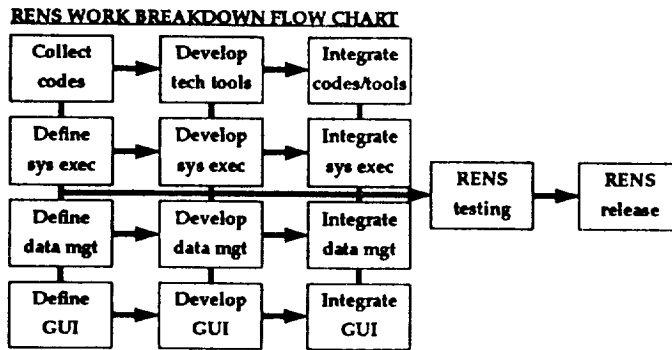
POTENTIAL APPLICATIONS

- Chemical Propulsion Systems
- Nuclear Thermal Propulsion Systems
- Propulsion System Test Facilities
- Nuclear Electric Propulsion Systems
- Space Power Systems

POTENTIAL USERS



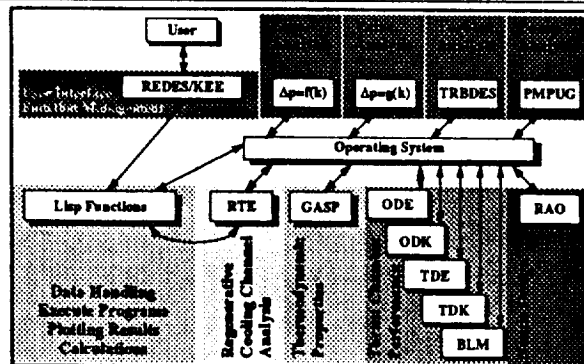
RENS WORK STRUCTURE



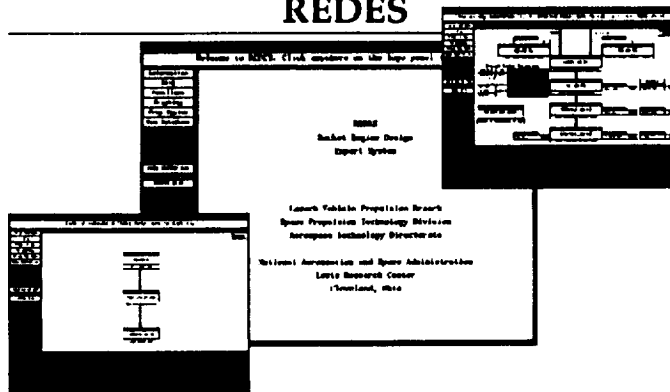
RENS PROTOTYPE - REDES

- Prototype Capability Initiated in 1989 with Rocket Engine Design Expert System (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)

REDES ANALYTICAL DOMAIN



REDES



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.**
- **Grant Work in Critical Development Areas Initiated**

