N93-26916

REQUIREMENTS MANAGEMENT AND CONTROL

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ANALYTICAL ENGINEERING

DISCUSSION

- Nuclear Thermal Propulsion Systems Engineering
  - Systems Requirements Status
  - Functions That Need To Be Performed
  - Attributes Associated With The Functions

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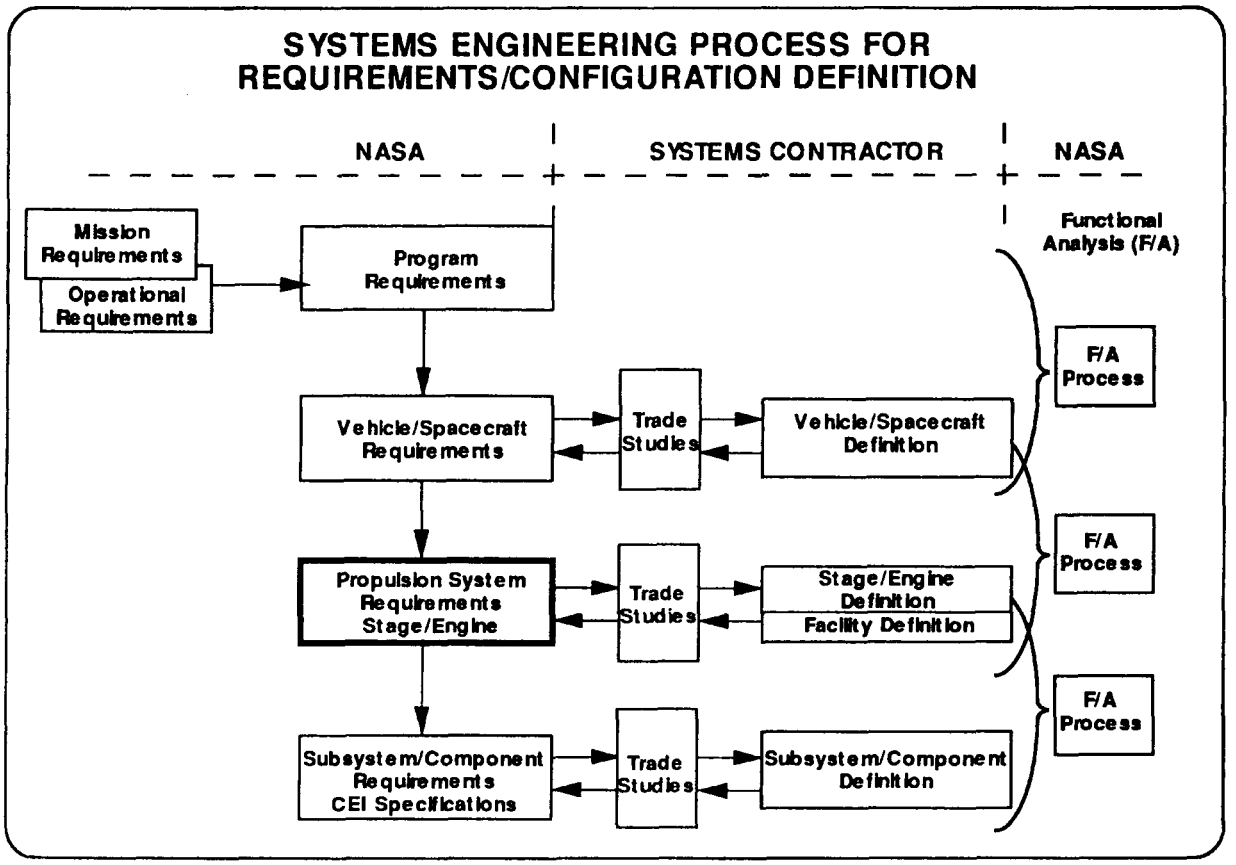
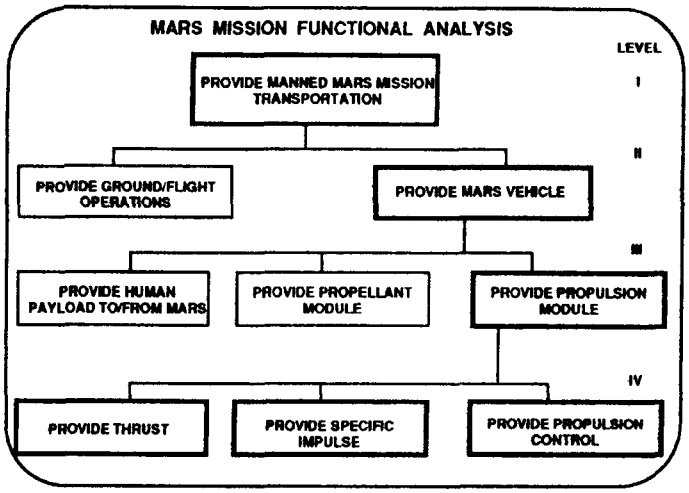
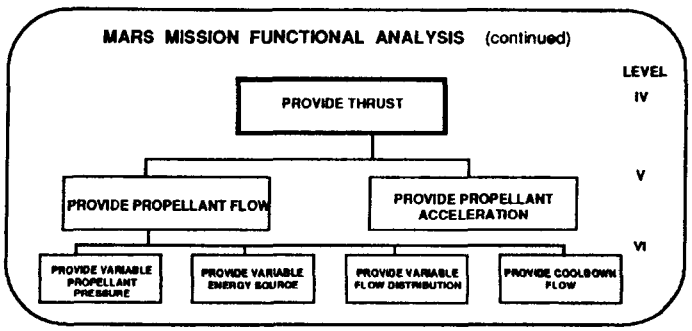
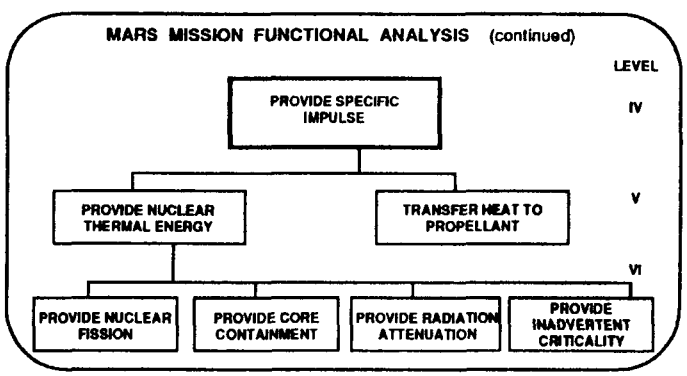
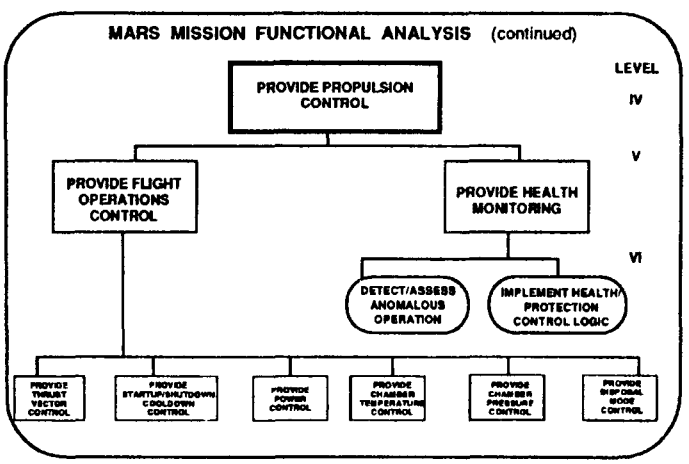


The systems engineering process for requirements and configuration definition, shown in the figure above, includes roles and responsibilities of NASA and the Systems Contractor. The overall program requirements are derived from the mission to be performed. The program requirements, in turn, are utilized as the basis for the definition of all lower level documents that contain increasing detail concerning design requirements associated with performance, safety, operations and environment. The lower level documents are dynamic in nature. Many studies are conducted involving trades between lower level requirements and engineering system definition. The propulsion system requirements are highlighted because they are the focus of this discussion. Stage/Engine requirements have been generated, baselined by NASA and are under formal change control and propulsion system definition is underway. The Functional Analysis activity shown is simply the process of systematically identifying the generic functions to be performed at all levels and leads ultimately to the definition of the System Architecture. Since Program and Vehicle Requirements are not currently available, the propulsion system requirements were generated on the basis of representative manned lunar and Mars missions.

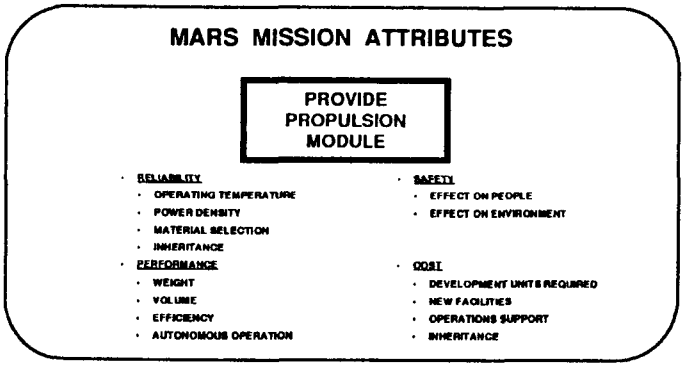


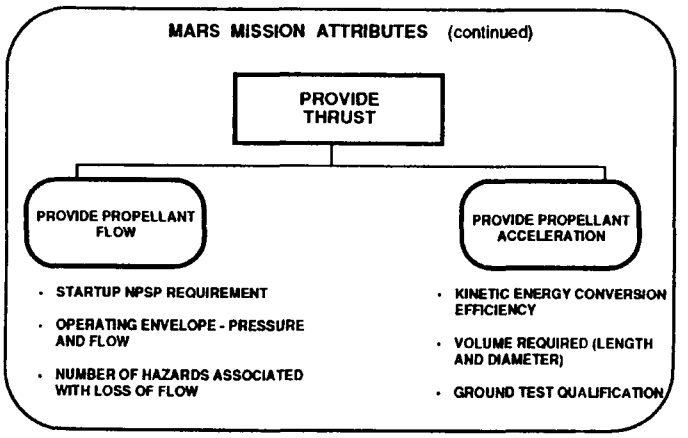


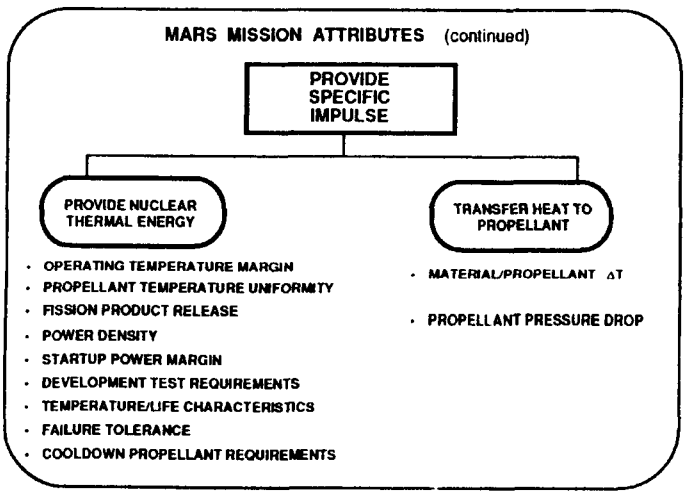


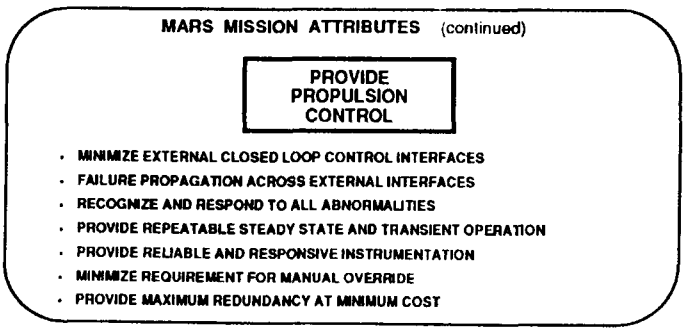


The Mars Mission functional analysis shown defines the mission functions to be performed in successive levels of detail. The highlighted functions at each level are those that are directly related to the propulsion system. Those functions that are not highlighted are the principal interfaces with the propulsion system. The three functions of the propulsion module are to provide thrust, provide specific impulse and control of the engine operations. The three charts which follow are simply functional breakdowns of the main engine functions to successively lower levels of detail. On the basis of this analysis, the system architecture or system definition can be completed. It should be noted that these functions are generic and are required for any nuclear rocket. No design solutions have been assumed. It is the role of the systems definition contractors to perform the system trades which result in the definition of the propulsion system.









The completion of the functional analysis previously described permits the definition propulsion system attributes that can be utilized to assess the relative merits of competing systems and to establish criteria for technology thrusts to enhance performance, safety and reliability. The attributes associated with the functions are outlined in the four charts that follow. These attributes, in addition to the system requirements, can be utilized for the evaluation of any nuclear rocket system and can provide the system contractors guidance about system characteristics that are considered to be important.

SUMMARY REMARKS

- A Consistent Set Of Propulsion System Requirements Has Been Developed By NASA
  - Traceable To Mission Needs
  - Under Formal Change Control
- Propulsion System Functions Traceable To System Requirements Have Also Been Generated
- Preliminary Propulsion System Attributes Traceable To Functions Have Been Derived To:
  - Assess The Relative Merits Of Competing Systems/Elements
  - Establish Criteria For The Definition Of Technology Thrusts
- We Request Feedback From The Program Participants - Particularly The System Definition Contractors
- Future Work Will Be Directed To The Development Of An Integrated Propulsion Systems Model Coupled With Propulsion Systems Requirements Traceable From The Lowest Level To Mission Needs

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