

Nuclear Thermal Rocket by 2000: A DOE Perspective

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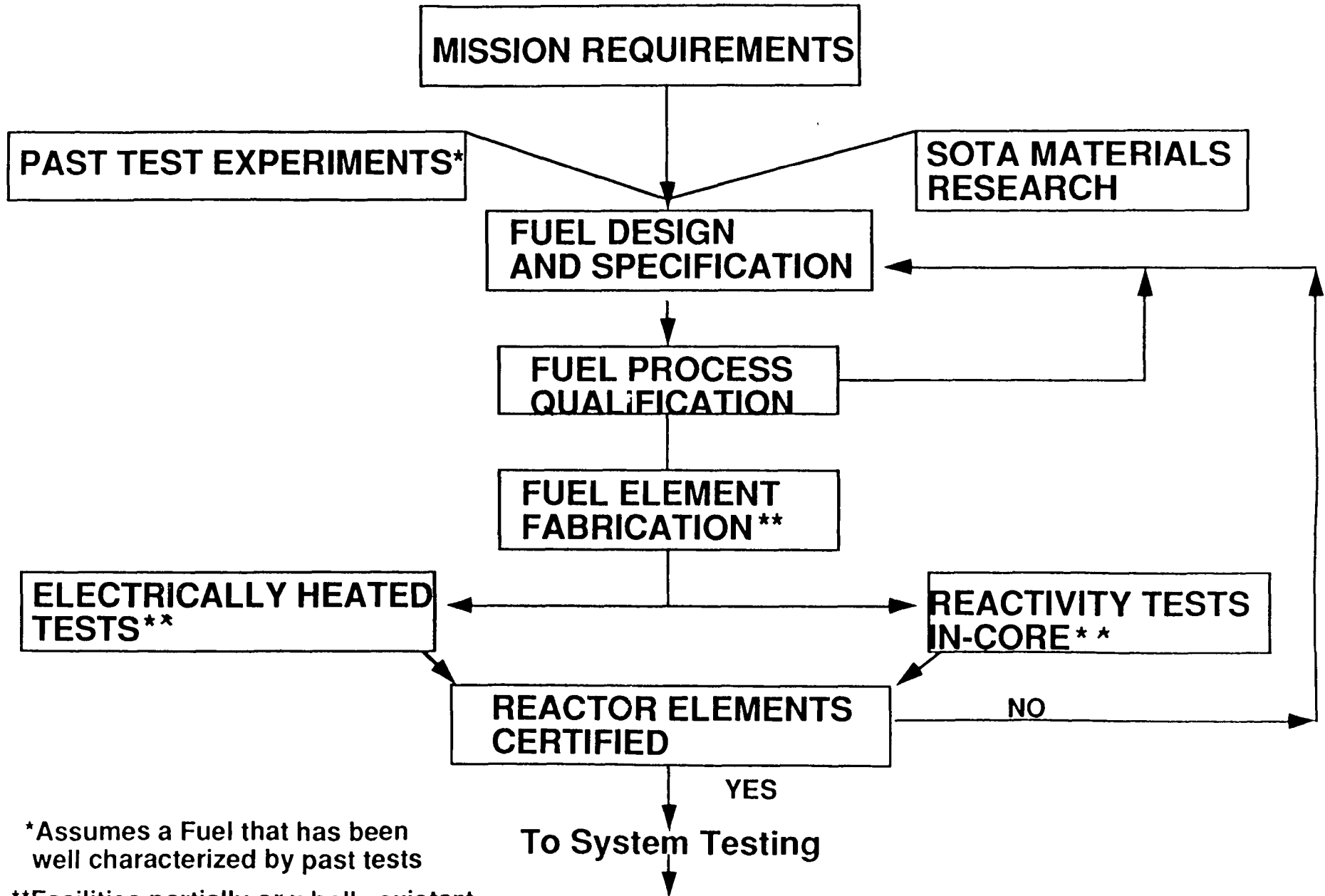
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LOS ALAMOS NATIONAL LABORATORY
Space Nuclear Propulsion Technology

PREMISE

- **A NUCLEAR PROPULSION SPACE TRANSPORTATION SYSTEM IS REQUIRED FOR THE MANNED MARS MISSION AND CAN SUPPORT A WIDE VARIETY OF FUTURE SPACE MISSIONS.**
- **AN NTR STAGE CAN SIGNIFICANTLY BENEFIT LARGE- SCALE LUNAR BASE IMPLEMENTATION AND SUPPORT.**
- **THE ROVER/NERVA PROGRAM DEMONSTRATED THAT A SAFE, RELIABLE NTR CAN BE DEVELOPED AND OPERATED FOR SUFFICIENT RUN TIMES, AT DESIRABLE TEMPERATURES, AND WITH MULTIPLE RESTARTS.**
- **OTHER REACTOR CONCEPTS AND FUEL FORMS SHOULD BE INVESTIGATED AS THE SCHEDULE PERMITS AND WOULD REQUIRE APPROPRIATE EXPERIMENTAL VALIDATION BEFORE SUPPLANTING THE BASELINE TECHNOLOGY**
- **REFURBISHING EXISTING FACILITIES MAY REDUCE COST AND SHORTEN SCHEDULE SIGNIFICANTLY.**

FUEL DEVELOPMENT PATH *

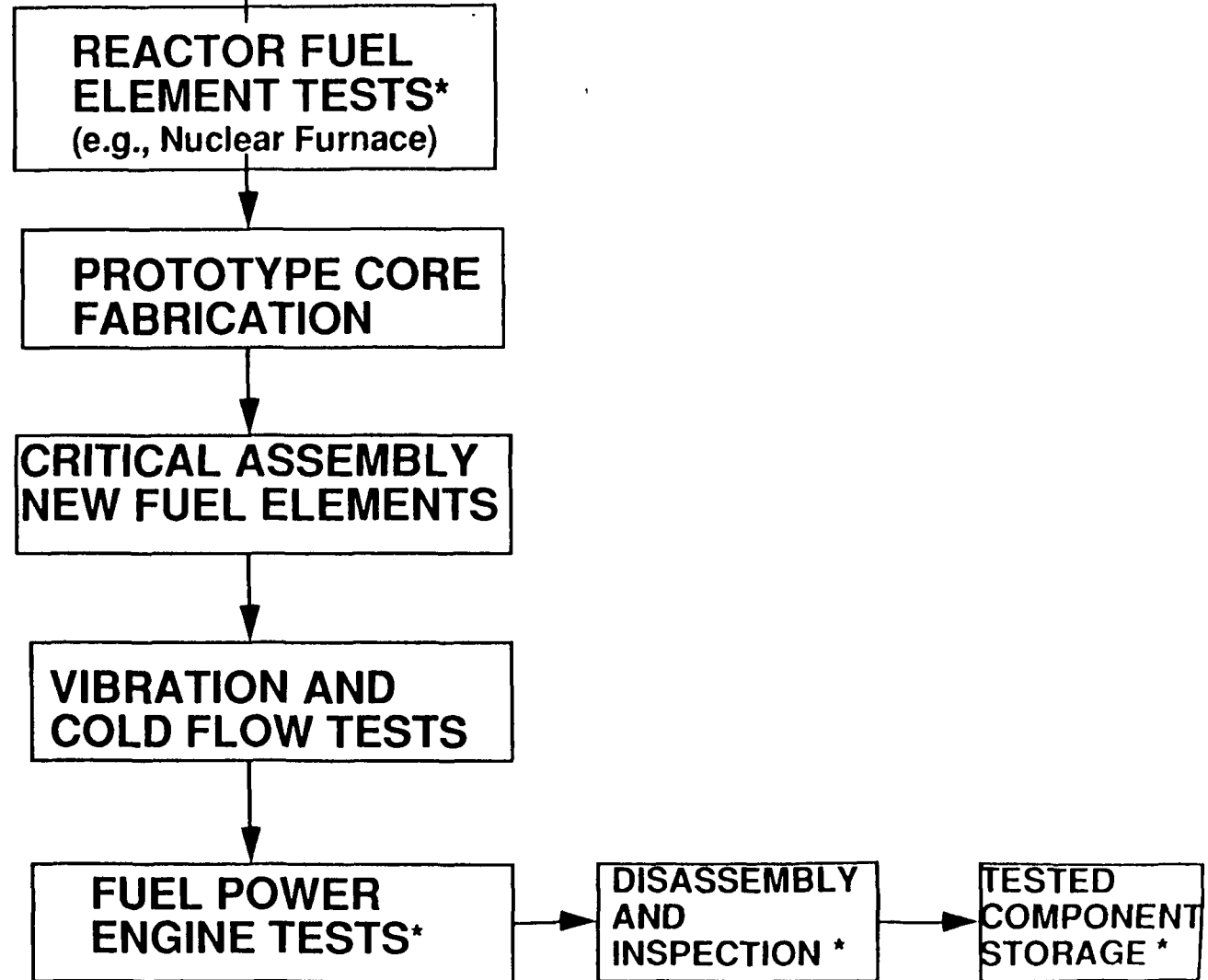


*Assumes a Fuel that has been well characterized by past tests

**Facilities partially or wholly existant

SYSTEM TESTING PATH

FROM FUEL DEVELOPMENT



*Potential refurbishable sites exist

SUMMARY

- NASA AND DOE TEAMS HAVE RECENTLY INVESTIGATED AN "NTR FAST TRACK" PROGRAM PLAN TO DEVELOP A FLIGHT- READY ENGINE BY THE 2000-2002 TIMEFRAME.
- BASELINE ASSUMPTION OF THE STUDY RELIED ON UPGRADING THE ROVER/NERVA FUEL FORM AND USING TESTED TECHNOLOGIES TO PRODUCE AN ENGINE WITH POTENTIAL FOR Isp BETWEEN 900-925s.
- IMPROVED FUEL RECOVERY AND CHARACTERIZATION CAN BE ACHIEVED WITH A COMBINATION OF ELECTRICAL TESTS AND REACTIVITY MEASUREMENTS. (MAJORITY OF FACILITIES CURRENTLY EXIST.)
- COMPLETE FUEL VALIDATION COULD BE ACCOMPLISHED IN A GENERIC FUEL ELEMENT TEST REACTOR TO SIMULATE ENGINE OPERATIONAL CONDITIONS. (CURRENTLY INVESTIGATING APPLICABILITY OF LOFT AT INEL.)
- FULL-POWER, GROUND TESTING APPROACHES ARE BEING EXPLORED - LANL AND INEL ARE CURRENTLY INVESTIGATING THE REFURBISHMENT AND UPGRADE OF THE PREVIOUS ROVER/NERVA FACILITIES-EMAD AND ETS-1.

SEI FACILITY ACTIVITIES - INEL

- **DOE Construction Short Form Data Sheets submitted for SEI Facilities with FY-94 Budget Request**
 - **Formal submittal for Test Reactor Hydrogen Loop (HFIR and ATR) to DOE-NE**
 - **Informal submittal of Fuel Element Test Facility, Reactor Test Stand, and Engine Test Stand at undetermined site made to DOE-NE**
- **LOFT Containment Building re-activation study completed (using INEL internal funds)**
- **Prepared draft environmental compliance plan for DOE's SEI ground test facility**
- **Supporting NASA-LERC non-nuclear test facility evaluations**
- **Supporting NASA-LeRC "Fast-Track" proposal**
- **Top Level Scoping Evaluation of use of SNTP PIPET for SEI NTP fuels testing**
- **Limited Evaluation of use of ETS-1 and E-MAD at NTS for SEI engine testing (internal LANL and INEL funds)**
- **Supporting review of EIS for SNTP**
- **Developing overall nuclear test selection strategies and plans**

Engine Maintenance and Disassembly Facility

Jackass Flats, Nevada

Preliminary Status Report 4/15/92

- General Description:

Designed for the assembly, disassembly, and maintenance of a NERVA-type engine. A T-plan, multi-story structure, 280ft by 350ft divided into 7 separated sections based on specific functions and material traffic flow

 - Cold Assembly Area
 - Hot Maintenance and Disassembly Area
 - Post Mortem Cells
 - High and Low Level Cells
 - Operating Galleries
 - Shop and Service Areas
 - Office Area
- Preliminary Inspection Results:
 - Building generally in excellent shape
 - All major equipment items from hot-cell windows and manipulators to machine tools present and in good shape.
 - Overhead cranes in good shape and functional.
 - Electrical system grounding and labeling in compliance and functional.
 - No PCB electrical equipment on site.
 - Plumbing system in place and functional.
 - HVAC major components in good shape and functional.
 - Large shielding doors in place and in good shape.
 - RR system in place complete with engines, load cars, and turntables.
 - New cooling tower needed.
 - Sprinkler system needed.
 - Covering of asbestos flooring needed.
 - Roof leaks need patching.
 - Water tank leak needs patching.
 - Seismic assessment needed but no obvious problems.

Engine Test Stand No. 1 Complex

Jackass Flats, Nevada

Preliminary Status Report, 4/15/92

- General Description:

Designed for ground developmental testing of a downward firing NERVA-type engine in a flight simulated environment. The ETS-1 complex includes:

 - A 160ft, 100t aluminum structure supporting a 77,000 gal LH2, vacuum jacketed run tank with associated below grade pipe chase and process piping, exhaust duct vault, and a 3ft wide by 40ft high by 100ft long concrete shadow shield.
 - A below grade control point building supporting 2000 channels of diagnostics
 - A cryogenic dewar and high pressure gas vessel tank farm with interconnecting process piping
 - An engine compartment radiation shield.
 - A diffuser/ejector exhaust duct.
 - A 2.5 Mgal water storage tank.
 - Required I&C, electrical and water systems, HVAC and other support systems.
- Preliminary Inspection Results:
 - Complex facilities generally in good shape.
 - Aluminum superstructure in good shape.
 - 250,000 gal LH2 tank in good shape.
 - 77,000 gal LH2 run tank in good shape.
 - Process piping in place.
 - Engine compartment radiation shields in good shape.
 - RR track in place.
 - Electrical switch-gear in good shape.
 - Significant scavenging of HP gas tanks --- one remaining.
 - Above ground buildings need significant repairs.
 - Below grade control point building needs significant upgrading.
 - Some flame-proof electrical boxes missing at test stand.
 - Some stairway sections missing.
 - Shadow shield bracing for seismic shock needs upgrading.
 - Seismic assessment needed.
 - Move LH2 dewar from Test Cell C for longer run times.