

conceptual techniques for the transfer and checkout of cryogenic and non-cryogenic liquids under zero g conditions and to aid in determining both ground and inflight experiments for validating conceptual system designs.

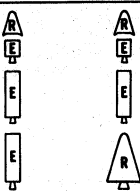
Advanced vehicle systems

Recovery and reuse of Saturn stages could have a major cost impact on future space operations; conceptual studies have been conducted of the recovery and reuse of large ballistic stages such as the Saturn V first stage. Economic promise was indicated for modest launch programs, but basic questions are as yet unanswered concerning system design and operations which critically affect the estimated economic impact for the ballistic mode of recovery. An experimental program could aid in reducing uncertainties relating to ballistic flight and terminal recovery, refurbishment operations, and stage or major subsystem reuse, as applicable to both existing Titan and Saturn stages and future ballistic launch vehicle systems. A study has been initiated to determine and to assess the test program alternatives that could aid in verifying the feasibility of ballistic stage recovery and reuse and which could provide data that are presently not available to designers.

A second area of interest here is the evolution of a versatile second-generation aerospace transportation system that could provide routine earth surface to orbit and return transportation for passengers and cargo. These reusable logistics support systems are being investigated to determine system candidates that can offer order of magnitude changes in improved operational flexibility and in reduced operational costs. Air transport type operational features including reliability, economy, payload flexibility, passenger safety/comfort, and inflight/intact abort capability have been considered in this planning activity. Such studies of advanced vehicle systems and operational modes for future earth orbital flight operations are being performed to determine and compare the options for cost-effective space logistics support and to provide advanced technology requirements.

Transportation trends for manned programs support are summarized in these charts (fig. 125, MT66-8032; fig. 126, MT67-5865). The areas as shown

TRANSPORTATION TRENDS - EARTH TO ORBIT AND RETURN (MANNED PROGRAM SUPPORT)

TIME PERIOD	CURRENT	INTERMEDIATE	FUTURE
GENERALIZED VEHICLE CONCEPTS			
OPERATIONAL OBJECTIVES	• EXPERIMENTAL SYSTEMS DEVELOPMENTS • EXPLORATORY SPACE PROGRAMS	• INITIAL SPACE SYSTEMS LOGISTIC SUPPORT • IMPROVED OPERATIONAL FLEXIBILITY • GROWTH IN SPACE FUNCTIONAL CAPABILITY	• INCREASED LOGISTICS TRAFFIC • INCREASED SPACE SYSTEMS CAPABILITY • REDUCED OPERATIONAL AND SUPPORT SYSTEMS COST • IMPROVED OPERATIONAL CHARACTERISTICS-NOMINAL AND CONTINGENCY
DESIRED VEHICLE CHARACTERISTICS	• EXPENDABLE LAUNCH AND SPACECRAFT VEHICLES • WATER RECOVERY OF SPACECRAFT	• FLEXIBLE MAN-RATED LAUNCH VEHICLE CAPABILITIES • REUSABLE ENTRY SPACECRAFT • ORBITAL MANEUVERING PROPULSION • NOMINAL LAND-RECOVERY OF SPACECRAFT	• FULLY-REUSABLE VEHICLE SYSTEMS

E - EXPENDABLE UNIT

R - REUSABLE UNIT

NASA HQ MT66-8032
12-30-66

FIGURE 125