ON-ORBIT OPERATIONAL SCENARIOS, TOOLS AND TECHNIQUES

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Statement of technical details of the capability being described

This paper concentrates on methods and techniques used to the develop operational scenarios for orbital missions, including development of models to analyze alternatives, modification of tools and refinement of techniques for future missions. Many of these tools and techniques have been derived from previous tools, techniques and experience from the Orbital Maneuvering Vehicle (OMV) program. Results from use of these tools show the current Cargo Transfer Vehicle nominal mission scenario, with 95 discrete events defined for the CTV mission from the NLS Heavy Lift Launch Vehicle(HLLV) to Space Station Freedom(SSF).

History of the origins and evolution of the capability

The capabilities were originally developed for use on the OMV program in order to assess missions and parameters. The tools and techniques were used to define, analyze and refine the sequences of events for the twelve (12) design reference missions defined for the OMV. In addition, the capabilities proved valuable in analysis completed for other OMV studies such as "Manrating OMV", Shuttle C studies and the OMV/ELV compatibility study.

The preliminary orbital mission definition for the Cargo Transfer Vehicle (CTV) was defined by a NASA/MSFC data package dated May 28, 1991. The on-orbit missions defined for the CTV are payload deployment and delivery of payload to Space Station Freedom(SSF). These missions are very similar to some of the OMV design reference missions mentioned previously. The requirements for the CTV/SSF mission are stabilization, attitude reference, transfer of a 100,000 lb payload from the NLS Heavy Lift Launch Vehicle (HLLV) to the Space Station control zone, rendezvous, proximity operations and stabilization for berthing by the SSF. Alternatives for completion of this mission are described along with the tools used to complete the tradeoffs. Operational drivers for the CTV design include the Space Station location(altitude and ascending node),

History of the origins and evolution of the capability (continued)
mission time, time for phasing to the Space Station, holds near the Space Station, return phasing coming back to the SSF after a recovery mission, approach to and interfaces with the SSF, propellant requirements for the nominal and alternative missions and the resulting power requirements (driven by time and the vehicle state). A design reference (worst case) sequence of events has been defined for requirements development purposes. These sequences are shown on detailed tables which illustrate use of the tools developed to to quickly assess alternatives and summarize mission plans. These tools will be refined and expanded for the current CTV/Space Station delivery mission and future CTV mission requirements.

The level of maturity of the capability
The tools and techniques described in this paper were very mature when developed for the OMV program. The evolving tools and techniques for the CTV program are, because of the similarity to OMV mission requirements, very mature compared to other NLS program tools and techniques. There will be a period of refinement of the tools and techniques as the CTV program continues to develop.

Test experience and/or experimental results
To illustrate the capabilities described, a comparison of the primary mission options & para versions of the CTV mission are shown. Techniques for accomplishing the mission are discussed in detail including how the tools are used, alternatives developed, requirements for phasing back to the Space Station after a disposal mission, and the cumulative mission planning effects of long "holds" currently baselined for the mission. Conclusions are presented which identify future refinements recommended for these tools and techniques.

Source/sponsorship and current funding estimates
These tools and techniques were initially developed on the OMV program under contract to NASA/MSFC. Refinement is continuing as part of the NLS Definition Study funded by NASA/MSFC through April, 1992.

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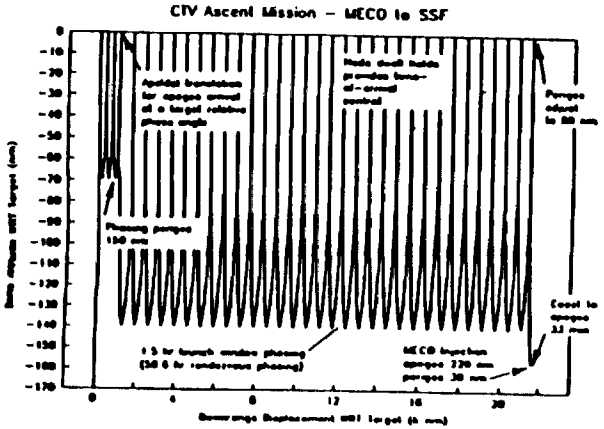

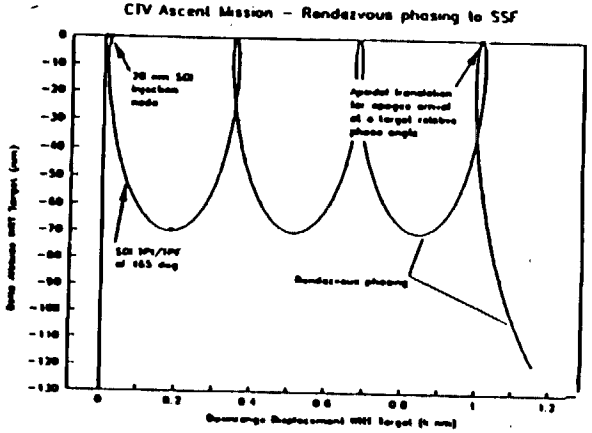

COMPARISON OF MISSION SCENARIOS
MSFC VS. TRW ALTERNATIVES

PARAMETER	UNITS	MSFC REFERENCE 5/20/91	TRW VERSION 8/19/91	TRW ALTERNATE #1 (20 MIN L.W)	TRW BASELINE (1.5 HR L.W 9/19/91)	DISPOSE OF PAYLOAD CONTINGENCY
INITIAL ORBIT	NM X NM	30 X 200	30 X 200	30 X 220	30 X 220	30 X 220
L.W.PHASING ORBIT	NM X NM	100 X 200	100 X 200	80 X 220	80 X 220	80 X 220
RENDEZ PHASE ORBIT	NM X NM	200 X 200	200 X 200	80 X 220	150 X 220	150 X 220
COAST-L.W.PHASING	HOURS	10.5 HR	10.5	10.5	48.3	48.3
HOLD OUTSIDE CCZ	HOURS	0	40	40	48	48
TIME-BERTH AT SSF	HH:MM	15:01	57:07	54:47	112:28	N/A
TIME OF DEORBIT BURN	DD:HH:MM	14:21:48	16:13:36	16:10:16	19:01:10	4:20:07
TIME-DEORBIT TO BERTH	HH:MM	3:42	14:44	13:09	31:00**	31:00**
UNLOAD TIME AT SSF	DAYS	14 DAYS	14 DAYS	14 DAYS	14 DAYS	N/A
TOTAL ELAPSED TIME	DD:HH:MM	14:28:00	17:04:20	17:00:57	20:08:25	01:11:20***
TOTAL DELTAV	FPS	1463	1892*	1892	1893	1893
EST. TOTAL ENERGY	KILO-WATTS	28	41	39	83 (Est.)	82 (Est.)
COMMENTS		MSFC baseline in NRA Contractors' package	* Includes Delta V reqd to phase back to SSF after disposal		** Includes an additional 12 hrs hold prior to entering SSF CCZ	*** Includes 3 attempts to berth, then disposal of P/L s and return to SSF

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DRAFT
CTV MISSION TIMELINE

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