Systems for COMET

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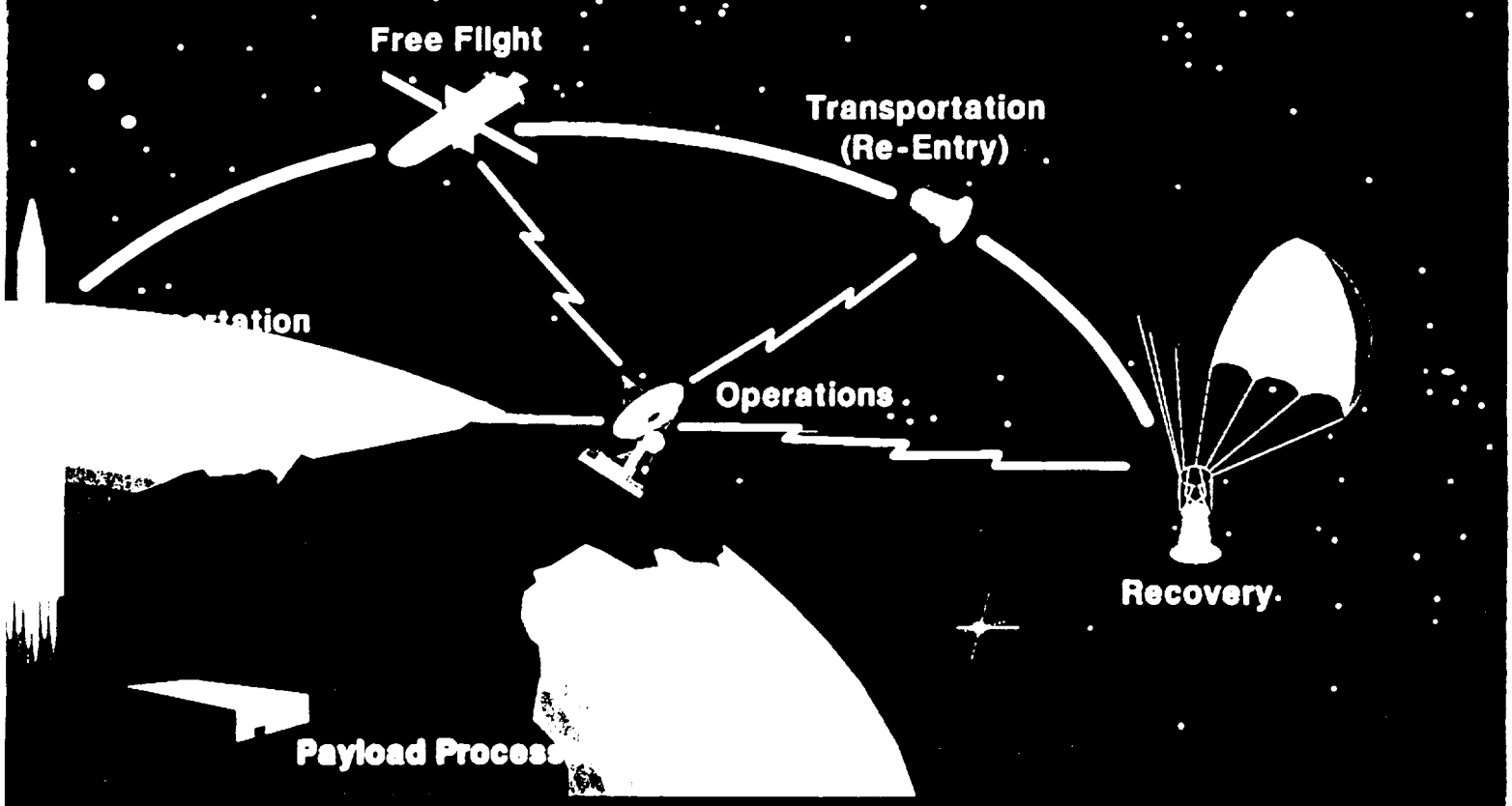
The COMmercial Experiment Transporter

nited States' First Complete Commercial Space Servic



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Provided and Operated by the Team of:

SPACE INDUSTRIES

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SPACE SERVICES DIVISION

SYSTEMS FOR COMET

H.N. ANDREWS
WESTINGHOUSE ELECTRIC CORPORATION

THE CENTERS FOR THE COMMERCIAL DEVELOPMENT OF SPACE (CCDS) HAVE BECOME OUR NATION'S PRIMARY FOCUS FOR STIMULATING PRIVATE SECTOR INVESTMENT IN SPACE. IN ESTABLISHING THE COMMERCIAL EXPERIMENT TRANSPORTER (COMET) PROGRAM, THE CCDS'S HAVE TAKEN A MAJOR STEP TOWARD THE FULL SCALE COMMERCIAL DEVELOPMENT OF SPACE. THE COMET PROGRAM WILL ENABLE THE CCDS COMMUNITY TO TURN THE GOAL OF COMMERCIAL SPACE INTO REALITY, AND IN THE PROCESS, ESTABLISH U.S. LEADERSHIP IN THE GLOBAL MARKET FOR SPACE SYSTEMS AND SERVICES.

THIS MORNING, IN OUR ROLE AS SYSTEM ENGINEERING CONTRACTOR AND PROVIDER OF SERVICE MODULE SERVICES, I WILL PRESENT SOME DETAIL ON THE SYSTEMS THAT MAKE UP THE COMET MISSIONS, SPECIFICALLY AS THEY DESCRIBE THE ACCOMMODATION FOR POTENTIAL USERS AND MISSION PARAMETERS.

FURTHER, I WILL DISCUSS SOME OF THE COMMERCIAL PLANS WE ENVISION FOR COMET DERIVED SPACE INFRASTRUCTURE.

IN THE COMET PROGRAM, W, SII AND EER, TOGETHER WITH THE CENTER FOR ADVANCED SPACE PROPULSION AT THE UNIV. OF TENN. WILL IMPLEMENT A SERVICE DESIGNED TO MEET THE NEEDS OF THOSE WHO REQUIRE ROUTINE LOW COST ACCESS TO SPACE. THIS SERVICE, SCHEDULED TO BEGIN OPERATION IN 1992, WILL CARRY EXPERIMENTS AND PRODUCTION PAYLOADS TO SPACE AND BACK, AND PROVIDE BASIC SUPPORT UTILITIES SUCH AS ELECTRIC POWER, COOLING, AND ATTITUDE CONTROL WHILE IN ORBIT. THE SYSTEM PROVIDES THE FLEXIBILITY TO ACCOMMODATE A WIDE VARIETY OF PAYLOADS; IN EITHER ENVIRONMENTALLY CONTROLLED, PRESSURIZED COMPARTMENTS OR WITH DIRECT EXPOSURE TO THE VACUUM OF SPACE. MISSIONS CAN BE

SCHEDULED ON A REGULAR BASIS TO ALLOW CONVENIENT TURNAROUND OF RESEARCH AND PRODUCTION RUNS.

EACH MISSION WILL LAUNCH A TWO PART SPACECRAFT CONSISTING OF A REENTRY CAPSULE WITH A RECOVERABLE PAYLOAD AND A SERVICE MODULE THAT PROVIDES BASIC SUPPORT SERVICES AS WELL AS ACCOMMODATIONS FOR NON-RECOVERABLE PAYLOADS. THIS CONCEPT PROVIDES THE CAPABILITY FOR TWO TYPES OF ON-ORBIT PAYLOAD SERVICES:

- RECOVERABLE PAYLOAD SERVICE - EXPERIMENTS FLOWN FOR APPROX. 30 DAYS, THEN RECOVERED IN A BALLISTIC REENTRY CAPSULE.

- NON-RECOVERABLE PAYLOAD SERVICE - EXPERIMENTS OR EQUIPMENT WHICH WILL REMAIN IN ORBIT FOR ABOUT 100 DAYS, WITH CONTINUED SUPPORT FROM THE SERVICE MODULE.

THIS FIRST OVERHEAD ILLUSTRATES THE SALIENT ASPECTS OF THE COMET PROGRAM.

(SLIDE #1)

- BEGINNING AT THE TOP, THE COMET PROGRAM AND THE LOGO WAS CONCEIVED BY THE CENTERS FOR THE COMMERCIAL DEVELOPMENT OF SPACE. THESE 16 CENTERS ARE DEPICTED BY THE 16 STARS CLUSTERED AROUND THE COMET.

- THE UNITED STATES' FIRST COMPLETE COMMERCIAL SPACE SERVICE IS ILLUSTRATED AS A SYSTEM AND INFRASTRUCTURE WHICH ALLOWS EXPERIMENTS TO BE PLACED INTO ORBIT, OPERATED, AND BROUGHT BACK TO A RECOVERY LOCATION WITHIN THE UNITED STATES.
- THE PROGRAM IS BEING MANAGED BY THE NASA'S CENTER FOR ADVANCED SPACE PROPULSION AT THE UNIVERSITY OF TENNESSEE.

- THE INDUSTRIAL TEAM SUPPORTING THIS CENTER IS:
  - SPACE INDUSTRIES OF HOUSTON, TEXAS
  - SPACE SERVICES DIVISION OF EER SYSTEMS CORPORATION OF SEABROOK, MARYLAND
  - AND WESTINGHOUSE ELECTRONIC SYSTEMS GROUP NEAR BALTIMORE, MARYLAND

THE WORK ELEMENTS COMPRISING THE SERVICE DEPICTED HERE ARE SIX:

SYSTEMS ENGINEERING (NOT SHOWN)	W
PAYLOAD INTEGRATION	SII
LAUNCH VEHICLE & SERVICES	SPACE SERVICES DIV. OF EER
SERVICE MODULE	W
RECOVERY VEHICLE	SII
ORBITAL OPERATIONS	SII

W SYSTEMS ENGINEERING WILL PROVIDE THE OVERALL SYSTEM SUPPORT TO THE CCDS PROGRAM MANAGER FOR SUCCESSFUL INTEGRATION OF THE SYSTEMS AND TO FACILITATE COMMUNICATION BETWEEN VARIOUS CONTRACTORS.

PAYLOAD INTEGRATION WILL CONVERT THE EXPERIMENTS INTO PAYLOADS, GENERATE ALL APPROPRIATE DOCUMENTATION AND SUPPORT THE INTEGRATION AND OPERATION OF THE PAYLOADS.

DEKE AND THE GUYS AT EER (AS HE HAS DESCRIBED) WILL SUPPLY THE VEHICLE AND ALL SERVICES NECESSARY TO GET THAT FREE-FLYER YOU SEE INTO THE PROPER ORBIT, WHICH FOR COMET IS 300 NAUTICAL MILES.

THIS FREE-FLYER CONSISTS OF THE SERVICE MODULE AND THE RECOVERY SYSTEM. THE SERVICE MODULE CONTAINS POWER, ATTITUDE CONTROL, COMMUNICATIONS AND THERMAL SYSTEMS TO SUPPORT EXPERIMENTS MOUNTED IN BOTH THE RECOVERY SYSTEM AND SERVICE MODULE. THIS SATELLITE BUS WILL HAVE

A PAYLOAD VOLUME OF AT LEAST 3 FT^3 AND CARRY 150 LB. OF PAYLOAD (MIN.)

THE RECOVERY SYSTEM WILL CONTAIN AT LEAST 6 FT^3 OF PRESSURIZED PAYLOAD VOLUME AND ACCOMODATE 300 LB. OF PAYLOAD WEIGHT (MIN.)

FINALLY, ORBITAL OPERATIONS INCLUDE TRACKING THE SATELLITE, COMMUNICATIONS FOR DATA RECEPTION AND COMMAND AND CONTROL AND THE LIKE.

THESE SIX ELEMENTS, PERFORMED BY THESE THREE COMPANIES, AND CONDUCTED BY THE CCDS COMET PROGRAM MANAGER, JOE PAWLICK AT CASP, WILL FORM THE INTEGRATED SPACE SERVICE SHOWN HERE.

THE MISSION SCENARIO LOOKS LIKE THIS:

1. CANDIDATE PAYLOADS ARE SELECTED BY A COMMITTEE LED BY THE CCDS CENTER FOR ADVANCED MATERIALS LOCATED AT BATTELLE COLUMBUS LABORATORIES IN COLUMBUS, OHIO.

2. THE PAYLOADS ARE INTEGRATED WITH THE RECOVERY SYSTEM AND THE SERVICE MODULE.

3. THE RECOVERY SYSTEM AND SERVICE MODULE WITH THE EXPERIMENTS ARE INTEGRATED WITH THE LAUNCH VEHICLE.

4. LAUNCH TAKES PLACE MOST LIKELY AT WALLOPS ISLAND.

5. THE FREE-FLYER WITH EXPERIMENTS IS INSERTED IN A 300 NAUTICAL MILE ORBIT AT A 40• INCLINATION.

6. THE RECOVERY MODULE WILL HAVE A 30-DAY FLIGHT SEPARATE AND RETURN TO EARTH. THE SERVICE MODULE AND ITS PAYLOADS WILL CONTINUE IN ORBIT FOR ANOTHER 100 DAYS.

MORE DETAILS ON THE MISSION PARAMETERS ARE SHOWN HERE (SLIDE #2). WE ARE DESIGNING TO ACHIEVE < 10^{-5}g ON ORBIT TO GET THE MOST STABLE, CONTINUOUS ENVIRONMENT FOR OUR USERS. SOME PAYLOAD ACCOMMODATION PARAMETERS ARE PRESENTED ON THIS NEXT SLIDE.

(SLIDE #3)

OUR CURRENT DESIGN CONCEPTS WILL ALLOW US TO FLY AND RECOVER AT LEAST 6 FT^3 OF PAYLOAD VOLUME IN THE RECOVERY SYSTEM AT A MINIMUM WEIGHT OF 300 LB. THAT PAYLOAD VOLUME AND WEIGHT COULD INCLUDE SEVERAL EXPERIMENTS OR JUST ONE DEPENDING ON USER NEEDS.

THE CURRENT PRELIMINARY DESIGN FOR THE SERVICE MODULE WILL ALLOW US TO FLY AT LEAST 3 FT^3 AT ABOUT 150 LBS. PAYLOAD WEIGHT. THE SERVICE MODULE, TOO, COULD ACCOMMODATE MULTI OR SINGLE EXPERIMENTS - HOWEVER THEY WILL NOT BE RECOVERED FROM ORBIT.

IN ADDITION TO 400W OF PEAK POWER, PRESSURIZED AND UNPRESSURIZED ENVIRONMENTS, AND VIDEO DOWNLINK, A CONTROLLED LOADING ON PAYLOADS FROM LAUNCH TO TOUCHDOWN WILL BE PROVIDED.

(SLIDE #4)

YOU CAN SEE IN THIS SERVICE MODULE CONCEPT THAT THE GENERAL DIMENSIONS ARE _____.

SALIENT FEATURES INCLUDE, SOLAR ARRAYS, DEPLOYABLE RADIATOR, AND A PAYLOAD DECK SEPARATE FROM THE SYSTEMS DECK. THE WEIGHT OF THE SERVICE MODULE WILL BE 800#.

(SLIDE #5)

AN EXPANDED VIEW OF THE RECOVERY CAPSULE REVEALS SOME UPPER LEVEL DETAIL OF ITS MERCURY CONCEPTUAL DESIGN.

THE PRESSURIZED COMPARTMENT AND ABLATIVE SHIELD ARE VISIBLE. THE WEIGHT OF THE RE-ENTRY VEHICLE WILL BE 1000#. AFTER RECOVERY, CERTAIN KEY COMPONENTS WILL BE RE-USED TO HELP MINIMIZE COST.

(SLIDE #6)

FINALLY, THE COMBINED SERVICE MODULE AND RECOVERY SYSTEM IS ILLUSTRATED HERE AS THE FREE-FLYER IN ITS CONCEPTUAL FORM. OVERALL BASIC DIMENSIONS ARE APPROXIMATELY X FT. LONG BY 40" TO 48" IN DIAMETER.

YOU CAN SEE THE DEPLOYABLE SOLAR ARRAYS AND RADIATORS. THE 4TH STAGE OF THE LV IS KEPT WITH THE SM.

(SLIDE #7)

THE COMET CONTRACT IS FOR 3 MISSIONS PLUS 2 OPTIONS. THE FIRST MISSION LAUNCH TARGET DATE IS SEPTEMBER 9, 1992.

#2 IS 23 MONTHS LATER (APPROX. AUG. 94)
#3 IS 10 MONTHS AFTER THAT (APPROX. JUNE 95)

OPTIONS, IF DESIRED, WILL BE EXERCISED WHEN IT MAKES SENSE IN TERMS OF THE CCDS PAYLOAD FLIGHT NEEDS, FUNDING AVAILABILITY, ETC. CURRENT LAUNCH SCHEDULE FOR THESE TWO OPTIONS CALLS FOR JUNE 96 AND JUNE 97.

(SHUT OFF PROJECTOR)

THE STATED GOAL OF THE COMET PROGRAM IS "TO DEVELOP THE MEANS FOR THE U.S. INDUSTRY TO SERVICE THE NEEDS OF COMMERCIAL USERS OF SPACE" BY GROWING COMET INTO A FULLY INTEGRATED, INDUSTRIALLY CONTROLLED, AFFORDABLE SPACE SERVICE FOR LAUNCH, CONTROL AND RECOVERY OF COMMERCIAL PAYLOADS.

IT WAS THIS COMET GOAL THAT MATCHED OUR GOALS AT W AND RAISED OUR ANTENNA. SINCE THE EARLY 80'S WE

RECOGNIZED THE NEED TO ACCESS SPACE FOR COMMERCIAL APPLICATIONS. WE SAW AN EMERGING MARKET OF USERS SEEKING TO EXPLOIT THE UNIQUE FEATURES OF THE SPACE ENVIRONMENT WANTING MICROGRAVITY AND ULTRAHIGH VACUUM NOT ACHIEVABLE HERE ON EARTH. THE BIGGEST IMPEDIMENTS THE POTENTIAL USERS FACED WERE ACCESS AND COST.

AT THAT TIME, WE PUT IN PLACE A PLAN TO CREATE THE INFRASTRUCTURE THAT WOULD ULTIMATELY PROVIDE A ONE-STOP-SHOP FROM PAYLOAD ENGINEERING AND INTEGRATION THROUGH LAUNCH, OPERATIONS IN SPACE PLATFORMS AND, FINALLY, RETURN OF THE PAYLOAD PRODUCT TO THE USER. OUR BY-WORD FOR THE PLAN IS "LOW-COST SPACE-IN-SPACE". OUR PLAN LED US TO

- ISF
- ASTROTECH

AND CONTINUES WITH OUR PARTICIPATION IN THE COMET PROGRAM.

WE, AT WESTINGHOUSE, ARE PARTICIPATING AS A TEAM PLAYER WORKING IN CLOSE COLLABORATION WITH SPACE INDUSTRIES AND EER SPACE SYSTEMS AND THE CCDS'S ASSIGNED TO THE PROJECT. THE BUDGET IS TIGHT AND, SINCE WE AND OUR INDUSTRIAL TEAM MEMBERS RECOGNIZE THE TRUE COMMERCIAL POTENTIAL OF THE COMET CONCEPT, WE HAVE TAKEN A TRUE COMMERCIAL APPROACH TO MEET THE BUDGET PROFILE -- WE HAVE ASSUMED FINANCIAL RISK FOR FUTURE PROFIT.

IN ACCORDANCE WITH NASA AND THE CCDS'S WISHES AND OUR DESIRE, WESTINGHOUSE WILL BEGIN MARKETING AT HOME AND ABROAD, THE UNITED STATES' FIRST COMPLETE COMMERCIAL SPACE LAUNCH, OPERATIONS AND RECOVERY SERVICE.

JIM ROSE TESTIFIED, ON THE 5TH OF APRIL THIS YEAR, BEFORE THE HOUSE SUBCOMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY. IN THAT TESTIMONY, JIM DESCRIBED PART OF OCP'S MISSION IS TO "MAKE COMMERCE IN SPACE A REALITY BY

ENCOURAGING PRIVATE INVESTMENT IN COMMERCIAL SPACE VENTURES --- "THE COMET PROGRAM IS A GREAT EXAMPLE OF THE FULFILLMENT OF THIS MISSION. THROUGH THIS INITIATIVE, INDUSTRY --- SPACE INDUSTRIES, EER, AND WE AT WESTINGHOUSE --- ARE INVESTING IN BUILDING THE INFRASTRUCTURE SYSTEMS FOR COMMERCIAL RESEARCH AND MANUFACTURING IN SPACE. WE ARE USING THIS PROGRAM TO DEVELOP AN INTEGRATED COMMERCIAL SPACE SERVICE INFRASTRUCTURE GIVING THE UNITED STATES A LEADING ROLE IN THIS NEW INDUSTRY.

PARAMETER	
MISSION DURATION	30 TO 100 DAYS OR LONGER
NOMINAL ORBIT	300 NMI ±50 AT 40° ±2° INCL.
MICROGRAVITY LEVEL	< 10^{-5}G; DISTURBANCES HELD TO ABSOLUTE MINIMUM
ATTITUDE POINTING	SOLAR INERTIAL ±5°
ATTITUDE CONTROL	3 AXIS ACTIVE CONTROL USING REACTION WHEELS AND MAG TORQUERS
POWER	
- HOUSEKEEPING	115 W
- PAYLOAD	400 W

PAYLOAD ACCOMMODATION PARAMETERS 3

Space Division

PARAMETER	SERVICE MODULE	RECOVERY SYSTEM
Total Payload Weight	150 lb. minimum	300 lb minimum
Total Payload Volume	3 cubic feet	6 cubic feet
Power Available to Payloads*		
- Continuous	200 W	200W
- Peak	400W for 200 hrs.	400W for 200 hrs.
- Voltage	28V ± 4V dc	28V ± 4V dc
Heat Rejection	400 W	400W
Internal Environment		
- Pressure	Vacuum	1 ATM
- Atmosphere	0 ATM	Dry Air
- Temperature	72 ±5°F at Baseplate	72 ± 5°F at Baseplate
Telemetry*		
- Command Uplink	4Kb/sec	4Kb/sec
- Real-time Data Downlink	32Kb/sec	32Kb/sec
- Video Downlink	Compressed NTSC - 256Kb/sec	Compressed NTSC - 256Kb/sec
- Freq. of Transmissions	5 passes/day, 40 minutes contact time per day	5 Passes/day, 40 minutes contact time per day
Loads of Payloads		
- Powered Flight Loads	< Less than 12g	<12g
- Reentry Loads	NA	<10g
Late Access	NA	Within 6 hrs. of launch

* Free-Flyer

COMET Service Module

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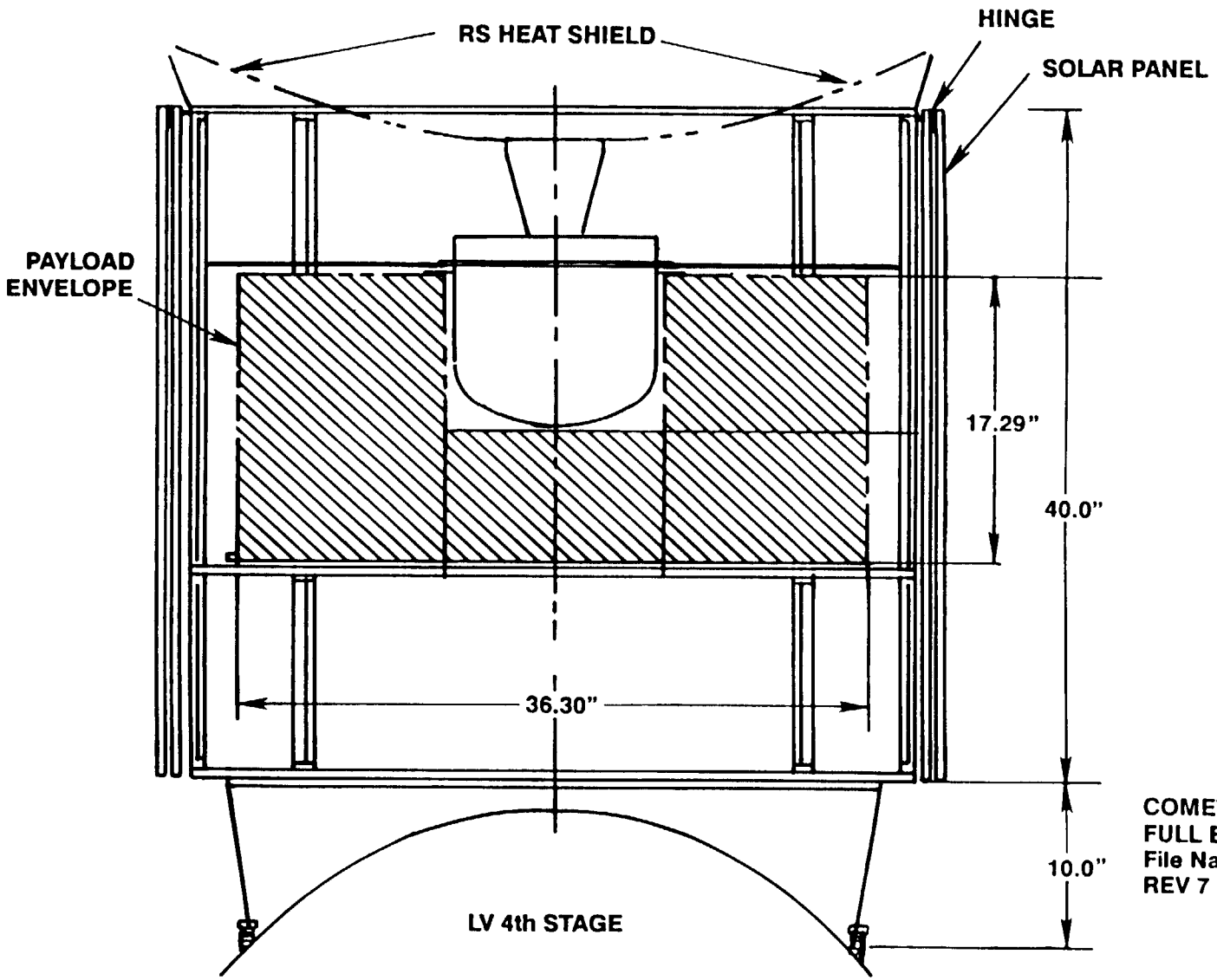

COMET
FULL ELEVATION
File Name: COMET 1
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COMET Re-entry Vehicle

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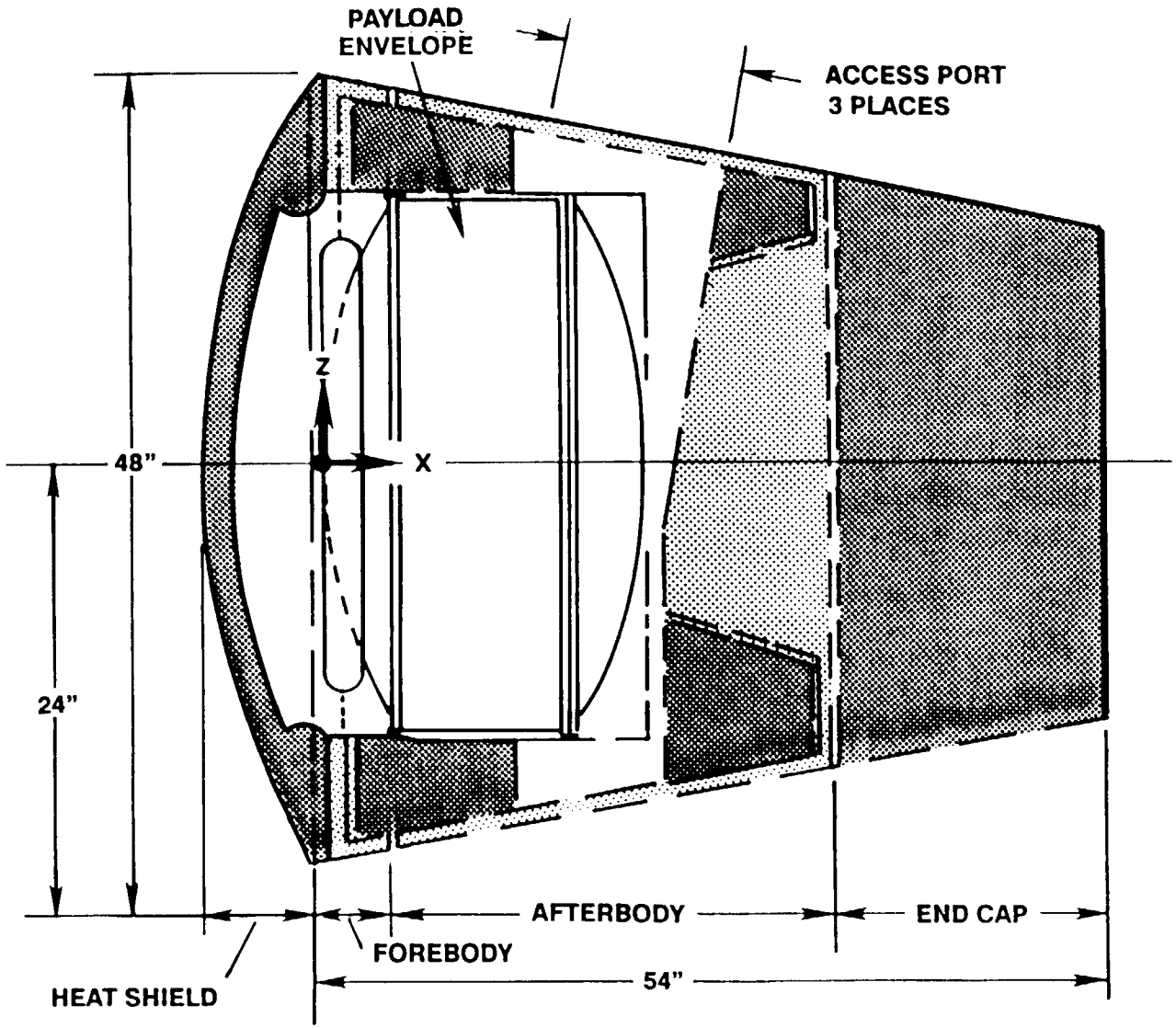

COMET Free Flyer

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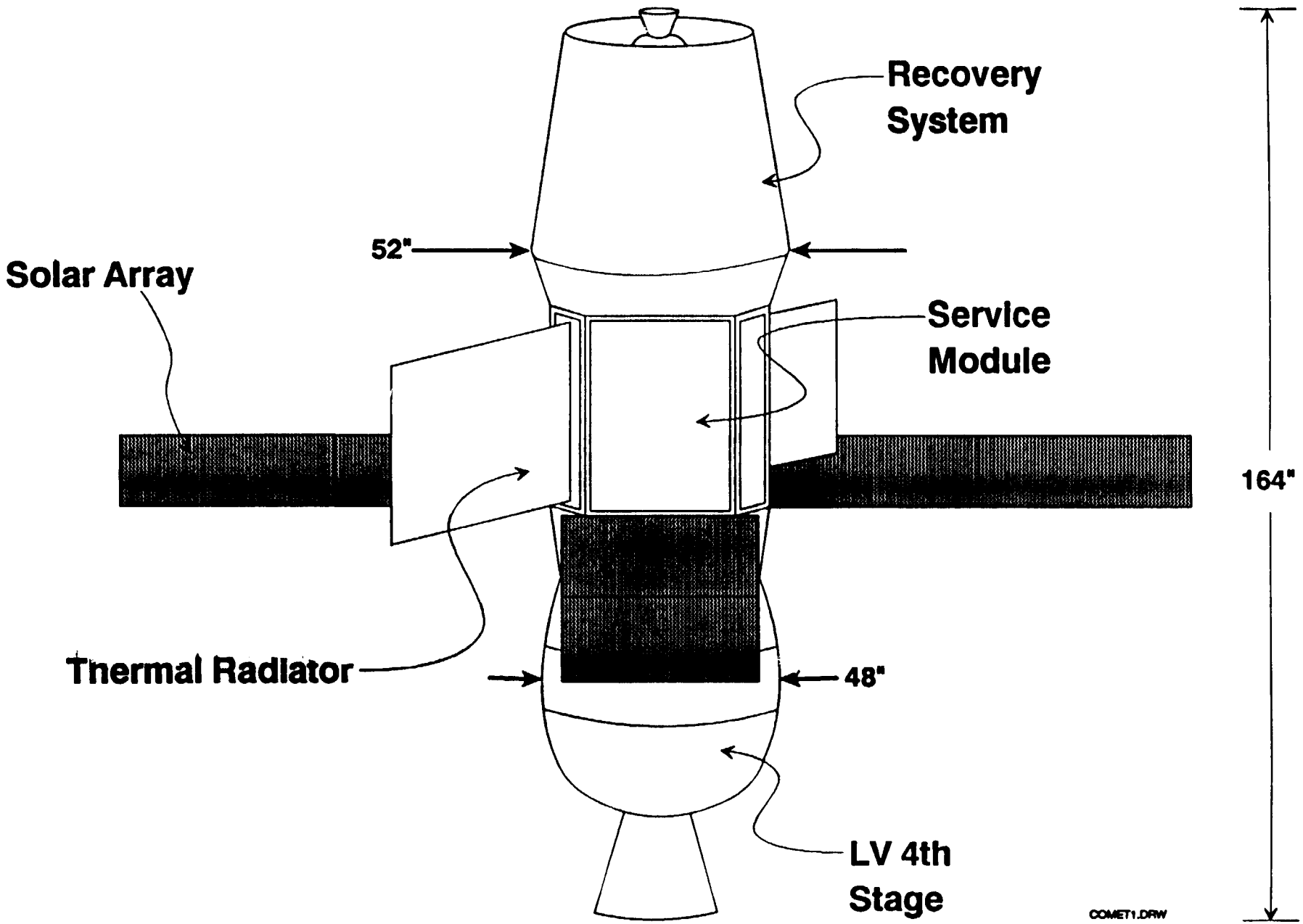

COMET SCHEDULE

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