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KSC SHUTTLE GROUND TURNAROUND EVALUATION

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KSC SHUTTLE GROUND TURNAROUND EVALUATION
KSC PAYLOAD ENVIRONMENTS

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KSC (CP-SPO)
OCTOBER 5, 1982

AGENDA

- INTRODUCTION
- PAYLOAD PROCESSING FLOWS
- PAYLOAD FACILITIES/SYSTEMS CAPABILITIES/STATUS
- OPERATIONAL CONSIDERATIONS
- ORBITER INTERNAL ENVIRONMENT (PRELAUNCH - POSTLANDING)
- CONCLUSIONS

FOLLOWING THIS INTRODUCTION THE TOPICS TO BE DISCUSSED ARE:

1. THE VARIOUS GENERIC LAUNCH SITE PROCESSING SEQUENCES AND THE KSC FACILITIES INVOLVED IN EACH.
2. THE ENVIRONMENTAL CONTROL CAPABILITIES OF KSC FACILITIES AND SYSTEMS.
3. IMPORTANT OPERATIONAL CONSIDERATIONS.
4. THE INTERNAL ORBITER ENVIRONMENT DURING PRE-LAUNCH AND LANDING OPERATIONS.
5. AND FINALLY, SOME CONCLUSIONS.

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INTRODUCTION

- PURPOSE OF PRESENTATION
- BACKGROUND
- PHYSICAL FACTORS TO BE CONSIDERED
- MULTIPLICITY OF REQUIREMENTS
 - SOURCES
 - STANDARDS

PURPOSE OF PRESENTATION

- TO DESCRIBE FOR PAYLOAD/MISSION DEVELOPMENT, KSC PROCESSING FLOWS, FACILITIES/SYSTEMS, AND THE VARIOUS ENVIRONMENTS TO WHICH A PAYLOAD WILL BE EXPOSED DURING GROUND PROCESSING AT KSC AND SECONDARY/CONTINGENCY LANDING SITES
 - THESE CONSIDERATIONS WILL BE IMPORTANT FOR:
 1. PAYLOAD DESIGN
 2. GROUND PROCESSING REQUIREMENTS DEVELOPMENT
- TO MAKE IT CLEAR THAT KSC CAPABILITIES HAVE BEEN DESIGNED TO MEET THE BASIC NEEDS OF MOST PAYLOADS, AND MAY NOT SATISFY THE VERY STRINGENT NEEDS OF SOME.

THE PURPOSE OF THIS PRESENTATION IS TO ADVISE PAYLOAD INVESTIGATORS OF THE VARIOUS ENVIRONMENTS THAT MAY BE ENCOUNTERED WHILE AT KSC/CCAFA'S AND OTHER LOCATIONS. THIS INFORMATION SHOULD BE CONSIDERED DURING THE PAYLOAD DESIGN PHASE TO ACCOMMODATE OR MINIMIZE SPECIAL NEEDS THAT COULD BE REQUIRED DURING THE GROUND PROCESSING OF PAYLOADS.

IT SHOULD BE NOTED THAT PRESENT AND PLANNED KSC ENVIRONMENTAL CAPABILITIES MAY NOT MEET ALL PAYLOAD REQUIREMENTS.

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BACKGROUND

- HISTORY OF PAYLOAD ENVIRONMENTAL CONTROL AT KSC
 - VIKING
 - RANGER/SURVEYOR
 - APOLLO
- ALTERNATIVE APPROACHES
 - ENCAPSULATE PAYLOAD
 - ENVIRONMENTAL CONTROL
 - CLEANING AND/OR STERILIZATION
 - COMBINATION

ENVIRONMENTAL CONTROL HAS BEEN IMPORTANT THROUGHOUT THE SPACE EXPLORATION EFFORTS OF THE UNITED STATES. THE PRIMARY PURPOSE OF ENVIRONMENTAL CONTROL IS TO REDUCE CONTAMINATION THAT COULD LEAD TO THE FAILURE OF A SYSTEM OR ENDANGER THE MISSION.

THE EXPLORATION OF OTHER CELESTIAL BODIES REQUIRED THE PLANETARY QUARANTINE PROGRAM TO PREVENT POTENTIAL INFECTION WITH EARTH DISEASES.

THESE OBJECTIVES WERE ACHIEVED BY A VARIETY OF METHODS INCLUDING: ENCAPSULATION, ENVIRONMENTAL CONTROL, CLEANING AND STERILIZATION, OR A COMBINATION OF THESE METHODS.

PHYSICAL FACTORS TO BE CONSIDERED

- PARTICULATES
 - AIRBORNE
 - FALLOUT
- TOTAL HYDROCARBONS (THC)
- NON-VOLATILE RESIDUES (NVR)
- HUMIDITY
- TEMPERATURE

THE PHYSICAL FACTORS THAT MAKE UP THE ENVIRONMENT WHICH MUST BE CONTROLLED ARE: PARTICULATES, HYDROCARBONS, NON-VOLATILE RESIDUES, AS WELL AS HUMIDITY AND TEMPERATURE. THESE FACTORS CAN DAMAGE OR DEGRADE A CAPABILITY BY: CORROSION, OBSCURATION OF OPTICAL SURFACES, DEGRADATION OF ELECTRONICS, AND JAMMING MECHANICAL SYSTEMS.

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MULTIPLICITY OF REQUIREMENTS

- SOURCES
 - JSC-07700 SPACE SHUTTLE PROGRAM LEVEL II PROGRAM DEFINITION AND REQUIREMENTS
 - VOL. X FLIGHT AND GROUND SPECIFICATIONS
 - OUTLINES THE FLIGHT AND GROUND SPECIFICATIONS THAT IDENTIFY THE SHUTTLE PROCESSING ENVIRONMENT
 - VOL. XIV SPACE SHUTTLE PAYLOAD ACCOMMODATIONS
 - IDENTIFIES THE PAYLOAD TO ORBITER ENVIRONMENTAL INTERFACES DURING PROCESSING AT KSC
 - JSL-SH-C-0005A SPECIFICATION CONTAMINATION CONTROL REQUIREMENTS FOR THE SPACE SHUTTLE PROGRAM
 - ESTABLISHES COMMON, DEFINITIVE RESPONSIBILITIES AND REQUIREMENTS FOR CONTAMINATION CONTROL FOR THE SPACE SHUTTLE PROGRAM
 - K-STSM-09.7A KSC SIS INTEGRATION AND GROUND TURNAROUND CONTAMINATION CONTROL PLAN
 - OUTLINES THE REQUIREMENTS FOR IMPLEMENTATION OF CONTAMINATION CONTROL FOR FACILITY SYSTEMS AND GROUND SUPPORT EQUIPMENT INVOLVED WITH PAYLOAD INTEGRATION AND ORBITER TURNAROUND

THE REQUIREMENTS FOR ENVIRONMENTAL CONTROL AT KSC COME FROM A VARIETY OF SOURCES. THE JSC-07700 DOCUMENTS SPECIFY THE ENVIRONMENT FOR ORBITER HARDWARE AND SHUTTLE FACILITIES. JSC-SH-C-0005A ALSO SPECIFIES REQUIREMENTS FOR THE ORBITER/CANISTER AND ASSOCIATED PAYLOAD INTERFACE REQUIREMENTS. K-STSM-09.7A DESCRIBES FACILITY AND SYSTEM REQUIREMENTS FOR VARIOUS KSC PROCESSING AREAS.

MULTIPLICITY OF REQUIREMENTS

- STANDARDS
 - VARIOUSLY ADDRESSED
 - INLET AIR (I.E., PARTICULATE/THC CONTENT)
 - AMBIENT CONDITIONS/PROPERTIES (I.E., TEMPERATURE, RELATIVE HUMIDITY, THC)
 - SURFACE DEPOSITS (I.E., VISIBLY CLEAN)
 - MAY/MAY NOT BE TIME DEPENDENT (I.E., VISIBLY CLEAN)
 - MAY/MAY NOT BE INTERRELATED (I.E., RELATIVE HUMIDITY)
 - ARE IMPACTED BY ON-GOING OPERATIONS (I.E., DOOR OPENINGS, INDUSTRIAL ACTIVITIES)
- SUMMARY/IMPACT
 - REGARDLESS OF HOW STRINGENT INLET OR AMBIENT AIR REQUIREMENTS MAY BE, IF A PAYLOAD REMAINS EXPOSED LONG ENOUGH, SURFACE DEPOSITS WILL OCCUR AND/OR MOISTURE WILL BE ABSORBED

IN ADDITION TO THE VARIOUS REQUIREMENTS SOURCES THAT AFFECT KSC, ENVIRONMENTAL CONTROL PARAMETERS COME FROM SEVERAL STANDARDS. THESE STANDARDS VARIOUSLY ADDRESS THE CONDITIONS THAT THE PROCESSING FACILITIES SHOULD MEET. IN SOME CASES THE AIR FOR A FACILITY IS EXPRESSED IN TERMS OF INLET AIR PARTICLE CONTENT; IN OTHER CASES IT IS DEFINED IN TERMS OF SUSPENDED PARTICLES IN THE FACILITY AIR AND IN STILL OTHERS, IN TERMS OF THE CLEANLINESS OF THE EXPOSED SURFACES.

THESE CONDITIONS MAY OR MAY NOT BE TIME DEPENDENT. FOR EXAMPLE, A SURFACE THAT STARTS AS VISIBLY CLEAN MAY NOT REMAIN THAT WAY WITHOUT PERIODIC CLEANING AS THE SUSPENDED PARTICLES FALL OUT.

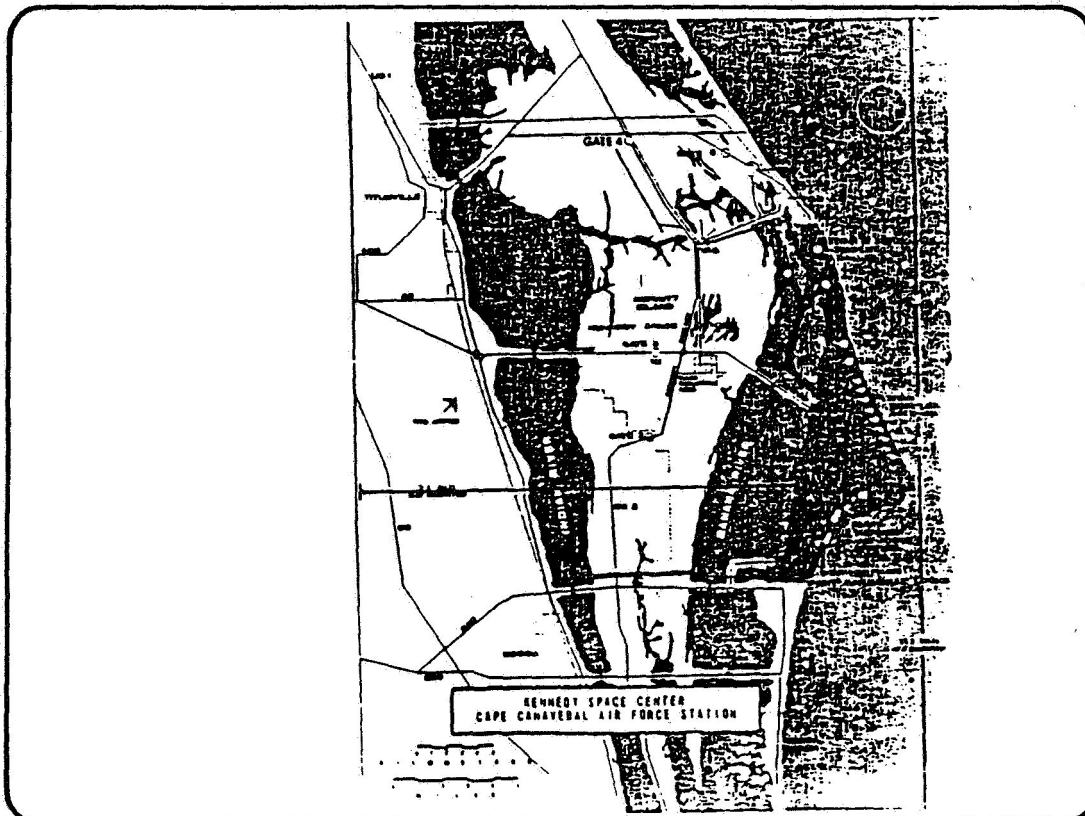
OTHER PROPERTIES MAY ALSO BE INTERRELATED SUCH AS TEMPERATURE AND RELATIVE HUMIDITY. FINALLY, OPERATIONS SUCH AS DOOR OPENINGS OR CRANE MOVEMENTS MAY IMPACT THE CONDITIONS INSIDE THE FACILITY.

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PAYLOAD PROCESSING FLOWS

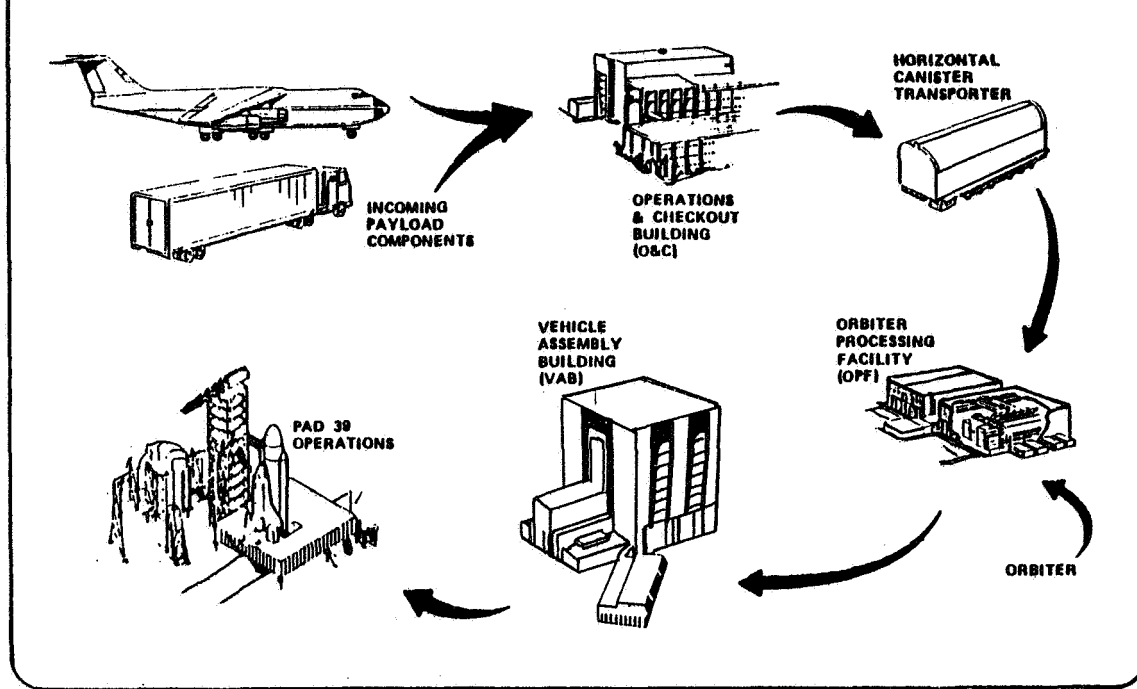
- HORIZONTAL
- VERTICAL
- MIXED
- SPECIAL
 - LIFE SCIENCES
 - GETAWAY SPECIAL (GAS)

PAYLOADS ARE GENERALLY CLASSIFIED AS HORIZONTAL (E.G., SPACELAB) AND VERTICAL (E.G., SATELLITES). THIS REFERS TO THE PAYLOAD COMPONENT ORIENTATION DURING CARGO INTEGRATION. MIXED PAYLOADS MAY HAVE BOTH HORIZONTAL AND VERTICAL COMPONENTS. PAYLOADS REQUIRING SPECIAL PROCESSING ARE THE LIFE SCIENCES EXPERIMENTS (LIVING SPECIMENS) AND GETAWAY SPECIAL (GAS) EXPERIMENTS, WHICH ARE SELF-CONTAINED AND HAVE A MINIMUM NUMBER OF ORBITER INTERFACES. OTHER SPECIAL PROCESSING FLOWS ARE, OF COURSE, POSSIBLE.



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HORIZONTAL PAYLOAD PROCESSING FLOW



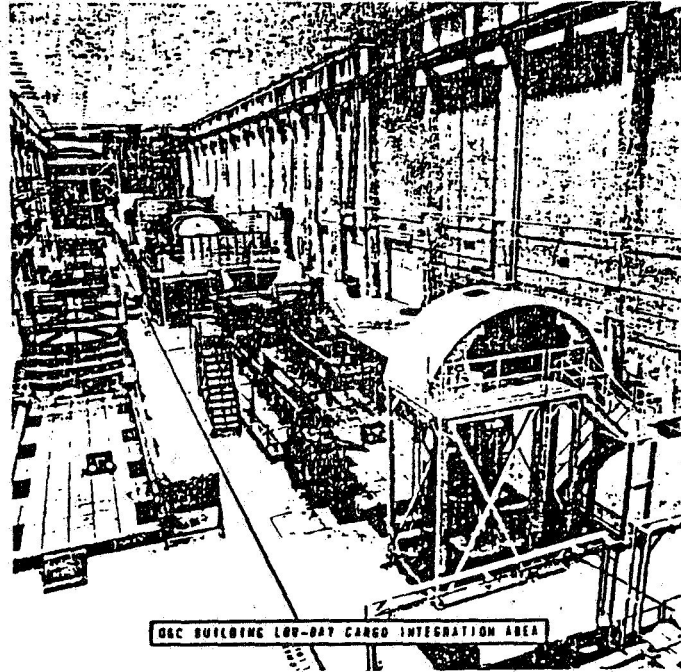
HORIZONTALLY PROCESSED PAYLOADS USUALLY CONTAIN MANY EXPERIMENTS INTEGRATED TOGETHER TO FORM A PAYLOAD THAT USES THE SPACELAB MODULE/PALLET(S) AS A CARRIER.

THE EXPERIMENTS ARE SHIPPED TO KENNEDY SPACE CENTER AND TRANSPORTED TO THE OPERATIONS AND CHECKOUT (O&C) BUILDING TO START THE INTEGRATION PROCESS. THE EXPERIMENTS ARE THEN INSTALLED INTO PREVIOUSLY STAGED SPACELAB RACKS AND ON FLOORS AND PALLET(S) AFTER VERIFICATION OF PAYLOAD ELEMENT COMPATIBILITY, RACKS/FLOORS ARE INSTALLED IN THE MODULE AND POSITIONED WITH THE PALLET(S), A STEP CALLED SPACELAB INTEGRATION. THIS WILL BE THE FINAL O&C BUILDING ACTIVITY UNLESS CARGO INTEGRATION TEST EQUIPMENT (CITE) TESTING IS REQUIRED. CITE SERVES AS AN ORBITER SIMULATOR TO MINIMIZE ANY ELECTRICAL/MECHANICAL PROBLEMS BETWEEN THE CARGO AND THE ORBITER.

THE FULL CARGO IS TRANSPORTED TO THE ORBITER PROCESSING FACILITY (OPF) IN THE PAYLOAD CANISTER AND THEN INSTALLED INTO A PRECLEANED AND PREPARED ORBITER PAYLOAD BAY. FINAL INTERFACE VERIFICATION AND PAYLOAD SERVICING/CLOSEOUT WILL OCCUR PRIOR TO PAYLOAD BAY DOOR CLOSURE WHICH IS THE FINAL PLANNED ACCESS TO THE PAYLOAD BAY PRIOR TO LAUNCH.

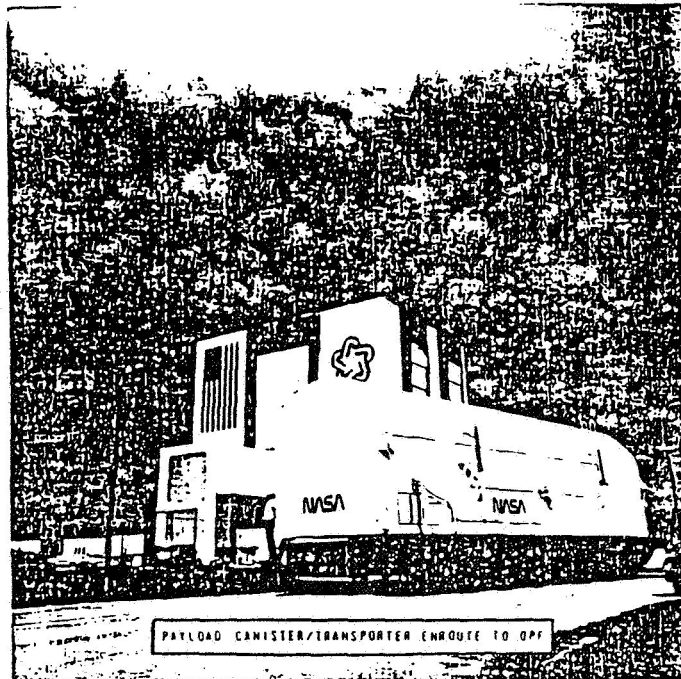
THE INTEGRATED ORBITER IS TOWED TO THE VEHICLE ASSEMBLY BUILDING (VAB), MATED TO THE EXTERNAL TANK/SOLID ROCKET BOOSTERS/MOBILE LAUNCHER AND THEN MOVED TO THE LAUNCH PAD BY THE CRAWLER TRANSPORTER FOR FINAL TESTING AND LAUNCH.

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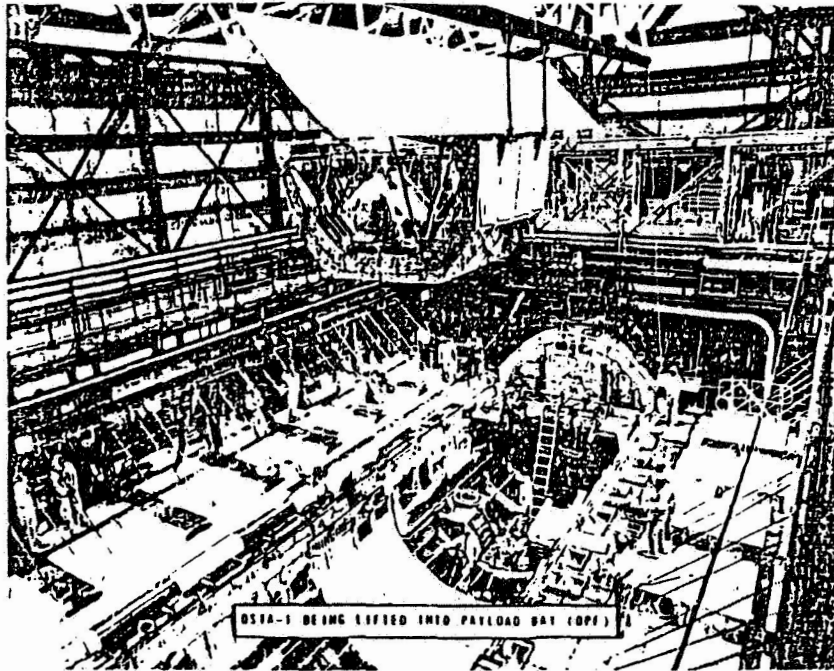
O&C BUILDING LOW-BAY CARGO INTEGRATION AREA

A PICTORIAL VIEW OF THE OPERATIONS AND CHECKOUT (O&C) BUILDING INTEGRATION AREA IS SHOWN. THE CARGO INTEGRATION TEST EQUIPMENT AREA (CITE) TEST STAND APPEARS IN THE BACKGROUND. THE TWO SPACELAB INTEGRATION STANDS (TEST STAND #2 AND #3) ARE SHOWN IN THE MIDDLE, AND IN THE FOREGROUND ARE THE EXPERIMENT INTEGRATION SOUTH AND NORTH STANDS.



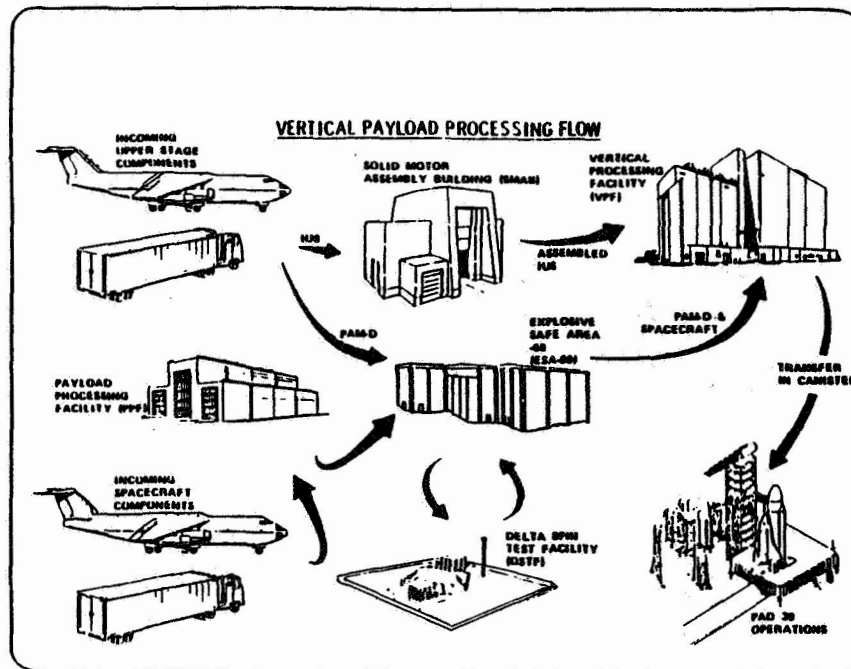
PAYLOAD CANISTER/TRANSPORTER ENROUTE TO OPF

THE PAYLOAD CANISTER IS MOVING AN INTEGRATED CARGO TOWARD THE ORBITER PROCESSING FACILITY (OPF). THE VEHICLE ASSEMBLY BUILDING (VAB) IS IN THE BACKGROUND.



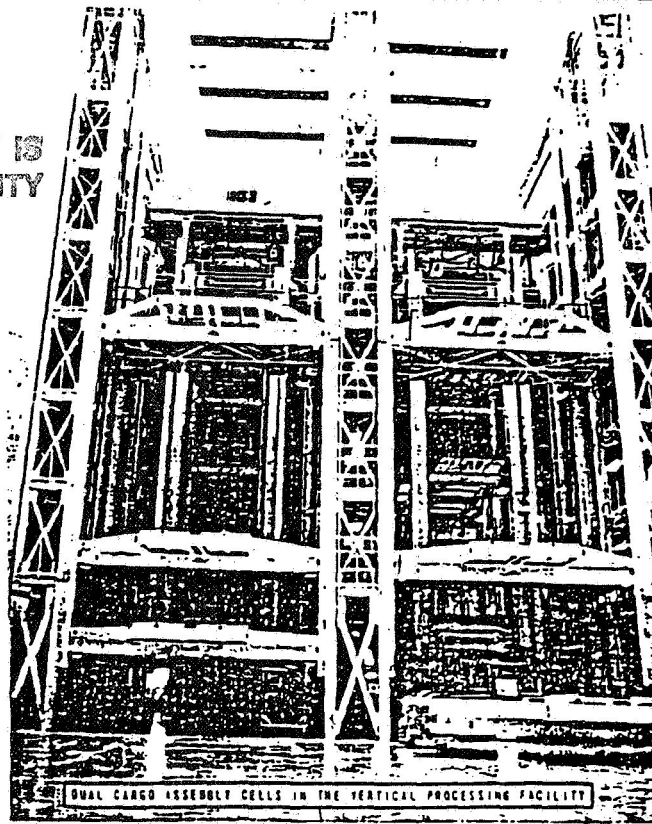
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OSTA-1, OUR FIRST MAJOR PAYLOAD IS SHOWN BEING LOWERED INTO THE ORBITER CARGO BAY IN THE ORBITER PROCESSING FACILITY (OPF).

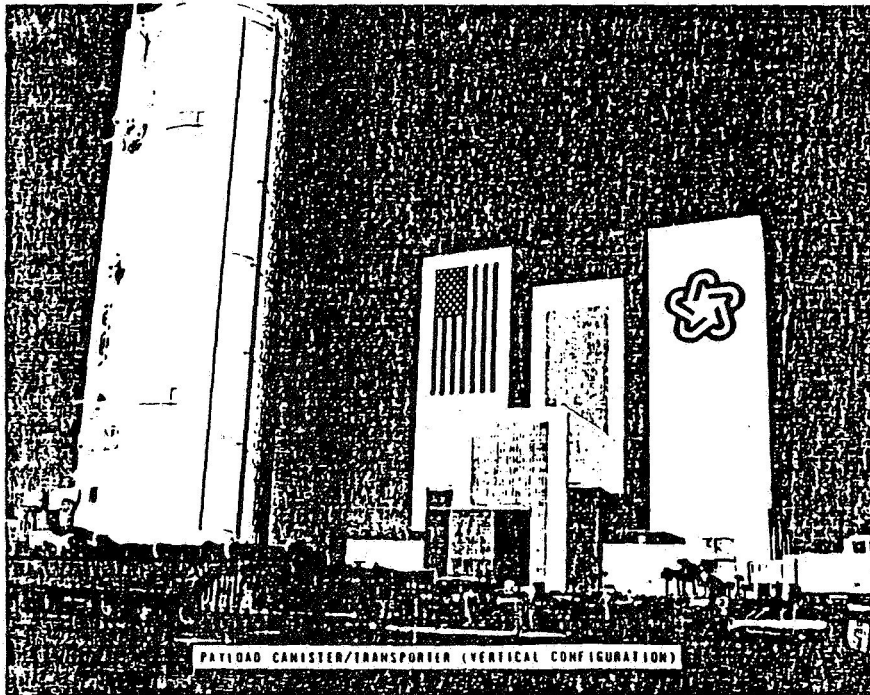


VERTICALLY PROCESSED PAYLOADS, INCLUDING COMMUNICATION SATELLITES WHICH REQUIRE UPPER STAGES, CAN FOLLOW SEVERAL DIFFERENT, YET SIMILAR PATHS. THE SPACECRAFT (S/C) ARRIVES AT ONE OF THE PAYLOAD PROCESSING FACILITIES (PPFs) AT THE CAPE CANAVERAL AIR FORCE STATION (CCAFS). AFTER ASSEMBLY/CHECKOUT, IT IS TAKEN TO THE EXPLOSIVE SAFE AREA (ESA-60A) FOR FUELING AND ORDNANCE INSTALLATION (AND INTEGRATION WITH A PAM-D). AFTER THIS, THE SPACECRAFT IS TAKEN TO THE VERTICAL PROCESSING FACILITY (VPF), INTEGRATED WITH A CARRIER, IF NECESSARY, AND SUBJECT TO CARGO INTEGRATION TEST EQUIPMENT (CITE) OPERATIONS. OTHER UPPER STAGE AND SPACECRAFT COMPONENTS ARE PROCESSED THROUGH THE SOLID MOTOR ASSEMBLY BUILDING (SMAB) AND DELTA SPIN TEST FACILITY (DSTF), RESPECTIVELY. FOLLOWING THIS CHECKOUT, THE INTEGRATED CARGO IS PLACED INTO THE CARRIER AND TRANSPORTED TO THE PAD. THERE IT IS RAISED TO THE PAYLOAD CHANGEOUT ROOM (PCR) FOR INSTALLATION INTO THE ORBITER, FINAL VERIFICATION, AND LAUNCH.

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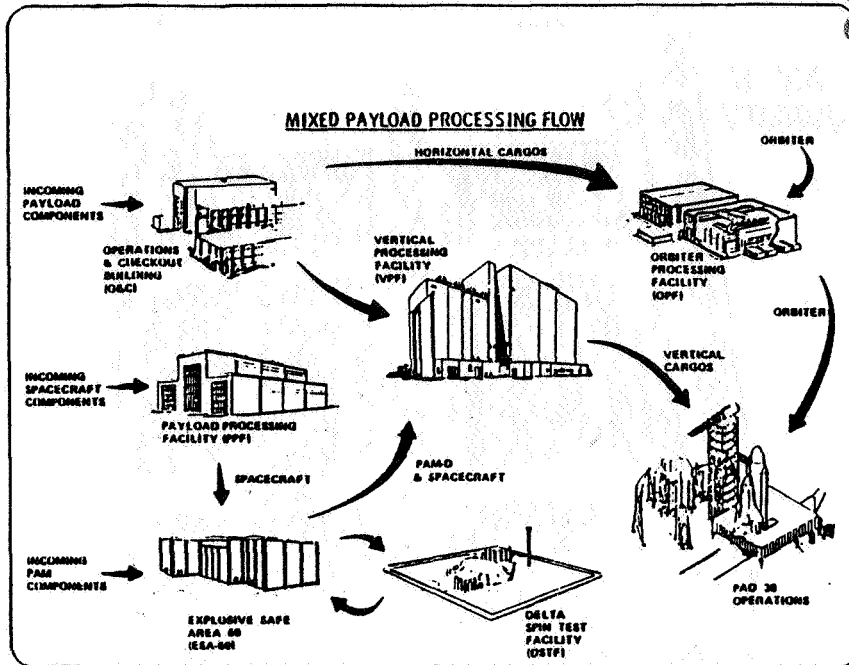


A PICTORIAL VIEW OF THE TWO CELLS IN THE VERTICAL PROCESSING FACILITY (VPF) IS SHOWN. HERE TWO CARGOS CAN BE PROCESSED SIMULTANEOUSLY.

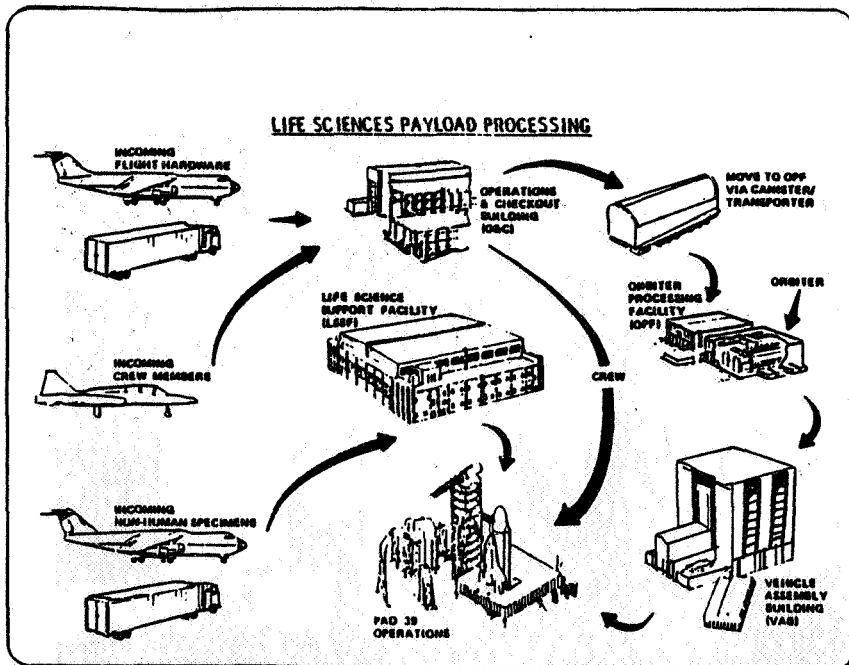


THE PAYLOAD CANISTER IS SHOWN TRANSPORTING A VERTICALLY PROCESSED CARGO ON ITS WAY TO THE LAUNCH PAD.

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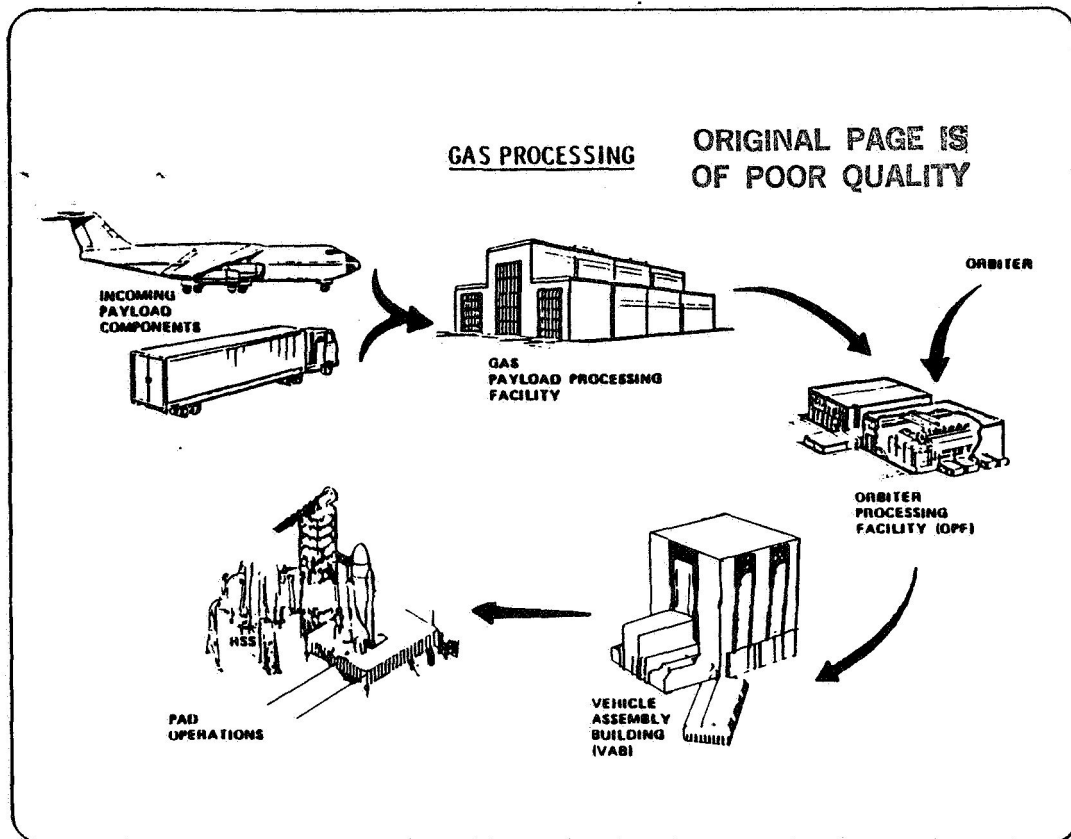


MIXED PAYLOADS (HORIZONTAL AND VERTICAL COMPONENTS) CAN FOLLOW VARIOUS INTEGRATION PATHS. THE MAJORITY OF THE PAYLOADS UNDERGO FINAL CARGO INTEGRATION IN THE VERTICAL PROCESSING FACILITY (VPF). IN THIS FLOW, THE HORIZONTAL COMPONENTS (E.G., PALLETS) ARE BUILT UP IN THE OPERATIONS & CHECKOUT (O&C) BUILDING AND TRANSFERRED TO THE VERTICAL PROCESSING FACILITY (VPF) FOR INTEGRATION WITH THE VERTICAL COMPONENTS. THE ENTIRE CARGO IS THEN TAKEN TO THE PAD AND INTEGRATED WITH THE ORBITER FOR LAUNCH.

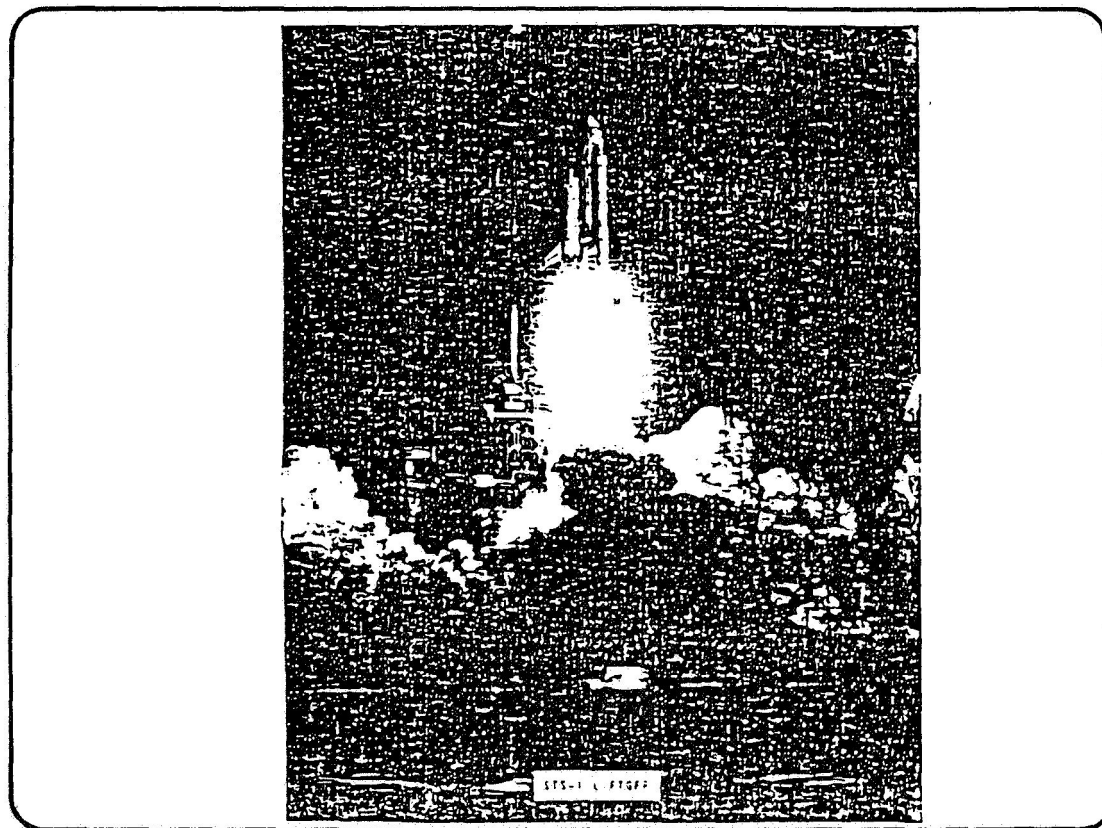


LIFE SCIENCES PAYLOADS FOLLOW THE SAME BASIC FLOW AS THE HORIZONTAL CARGOES. THE PRIMARY DIFFERENCE IS THE ADDITION OF THE LIVING TEST SUBJECTS (E.G., PLANTS, ANIMALS, ETC.). THESE NON-HUMAN SPECIMENS ARE TAKEN TO THE LIFE SCIENCES SUPPORT FACILITY (LSSF) FOR PREPARATION AND PRE-FLIGHT ISOLATION. AFTER THE FLIGHT HARDWARE HAS BEEN INTEGRATED AND THE ORBITER IS READY FOR LAUNCH, THE FLIGHT SPECIMENS ARE TAKEN TO THE PAD FOR LATE INSTALLATION INTO THE ORBITER.

ADDITIONALLY, ACTIVITIES INVOLVING HUMAN SUBJECTS WILL BE CONDUCTED IN THE O&C BUILDING BASELINE DATA COLLECTION FACILITY (BCDF) OR IN EXISTING MEDICAL FACILITIES.



GETAWAY SPECIAL (GAS) PAYLOADS HAVE MINIMUM INTERFACES WITH THE ORBITER, THIS PERMITTING A SIMPLIFIED FLOW. UPON ARRIVAL THE ELEMENTS ARE PACKAGED INTO THE GAS CAN(S) AT THE DESIGNATED PAYLOAD PROCESSING FACILITY (PPF), USUALLY HANGAR 5, OR IN THE OPERATIONS AND CHECKOUT (O&C) BUILDING. THE INSTALLATION OF THE GAS CAN(S) WILL OCCUR IN THE ORBITER PROCESSING FACILITY (OPF) FREQUENTLY AS LATE AS POSSIBLE BECAUSE OF THE LIMITED LIFE OF INTERNAL BATTERIES.



A PICTORIAL VIEW OF THE FIRST SHUTTLE LAUNCH.

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PAYLOAD FACILITIES/SYSTEMS CAPABILITIES/STATUS

- PAYLOAD TO FACILITY/SYSTEMS INTERFACES
- KSC FACILITIES/SYSTEMS CAPABILITIES
- OPERATIONS AND CHECKOUT (O&C) BUILDING STATUS
- ORBITER PROCESSING FACILITY (OPF) STATUS
- OPERATIONAL CONSIDERATIONS
- KSC AMBIENT ENVIRONMENT
- ATMOSPHERIC STABILITY

PAYLOAD TO FACILITY/SYSTEMS INTERFACES

● FACILITIES/SYSTEMS*

HORIZONTAL PROCESSING

- OFF-LINE LABS
- O&C BLDG, ASSEMBLY & TEST (A&T) AREA
- CANISTER/TRANSPORTER
- ORBITER PROCESSING FACILITY (OPF)**
- PAYLOAD ENVIRONMENTAL TRANSPORTATION SYSTEM (PETS)

VERTICAL PROCESSING

- PAYLOAD PROCESSING FACILITIES
- EXPLOSIVE SAFE AREA-60A (ESA-60A)
- VERTICAL PROCESSING FACILITY
- CANISTER/TRANSPORTER
- PAYLOAD CHANGEOUT ROOM (ON PAD)

OTHER

- LIFE SCIENCE SUPPORT FACILITY (LSSF)
- BASELINE DATA COLLECTION FACILITY (BDCF)

● PROBLEM AREAS

- OPERATIONAL IMPACTS (DOOR OPENINGS, ETC.)
- CAPABILITIES MATCH THOSE STATED; OPERATIONAL LIMITATIONS MAY BE REQUIRED FOR SOME OPERATIONS AND UNDER SOME AMBIENT CONDITIONS
- ** CAPABILITIES WILL MATCH THOSE STATED ON COMPLETION OF MODIFICATIONS IN WORK

THIS LIST SUMMARIZES THE FACILITIES AND GSE THAT TYPICAL PAYLOADS WILL INTERFACE WITH DURING PROCESSING AT KSC. THE GENERAL ENVIRONMENTAL PARAMETERS FOR THE PROCESSING FACILITIES ARE LISTED ON THE FOLLOWING PAGE.

THE BASELINE DATA COLLECTION FACILITY (BDCF) IS A PART OF THE HUMAN LIFE SCIENCES EXPERIMENT SUPPORT EFFORT AT KSC, AND IS LOCATED IN THE OPERATIONS AND CHECKOUT (O&C) BUILDING.

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KSC FACILITIES/SYSTEMS CAPABILITIES:

- TEMPERATURE: 65° TO 78° F
- RELATIVE HUMIDITY
 - HORIZONTAL PROCESSING ≤ 50%
 - VERTICAL PROCESSING ≤ 50%
 - LIFE SCIENCE SUPPORT FACILITY ≤ 60%
- AIR INPUT CLASS** ≤ 100 K
- NON-VOLATILE RESIDUES (NVR)*** ≤ 1 mg/0.1M²/24 HOUR
- TOTAL HYDROCARBONS (THC)*** ≤ 15 ppm
- CLEANLINESS OBJECTIVE VISIBLY CLEAN 1 IN PAYLOAD BAY & CANISTER ONLY
 - * INCLUDES ALL FACILITIES/SYSTEMS LISTED ON PRIOR PAGE
 - ** IN THE VERTICAL PROCESSING FACILITY (VPF), PAYLOAD CHANGEOUT ROOM (PCR), AND BUILDING AE (UPF IS BEING MODIFIED TO PROVIDE) CLASS 5000 GUARANTEED INPUT AIR (HEPA FILTERED)
 - *** NORMALLY ACHIEVED DUE TO KSC AMBIENT ENVIRONMENT

THE PARAMETERS LISTED ARE THE OUTSIDE LIMITS OF ALL PAYLOAD FACILITIES AND SYSTEMS THAT HAVE AN ENVIRONMENTAL CONTROL CAPABILITY. THE VEHICLE ASSEMBLY BUILDING (VAB) DOES NOT HAVE ENVIRONMENTAL CONTROL AND TOTAL HYDROCARBONS (THC), AND NON-VOLATILE RESIDUE REQUIREMENTS (NVR) ARE NOT IMPOSED ON ALL FACILITIES.

OPERATIONS AND CHECKOUT (O&C) BUILDING STATUS

- MODIFICATIONS IN WORK:
 - ALL UNUSED OPENINGS AND PENETRATIONS INTO THE ASSEMBLY AND TEST AREA ARE BEING SEALED
- MODIFICATIONS PENDING FUNDING APPROVAL
 - MODIFY HVAC SYSTEM TO IMPROVE CONTROL PERFORMANCE AND RELIABILITY
 - ESTIMATED COMPLETION DATE OCTOBER 1, 1983
- OFF-LINE LABS ARE OPERATIONAL

TO IMPROVE THE RELIABILITY OF THE OPERATIONS AND CHECKOUT (O&C) BUILDING ENVIRONMENTAL CONTROL SYSTEM, THE FOLLOWING MODIFICATIONS ARE BEING PURSUED. SEALING UNUSED OPENINGS AND PENETRATIONS WILL ALLOW A POSITIVE PRESSURE TO BE MAINTAINED IN THE OPERATIONS AND CHECKOUT (O&C) ASSEMBLY AND TEST (A&T) AREA. THIS WILL HELP REDUCE PARTICULATE CONTAMINATION IN THE HIGH BAY, AND ALLOW BETTER CONTROL OVER INTERNAL RELATIVE HUMIDITY AND TEMPERATURE.

A PENDING MODIFICATION TO THE HVAC SYSTEM WILL IMPROVE THE RELIABILITY OF THE SYSTEM, AND ALSO IMPROVE ITS OPERATIONAL EFFICIENCY FROM AN ENERGY POINT OF VIEW.

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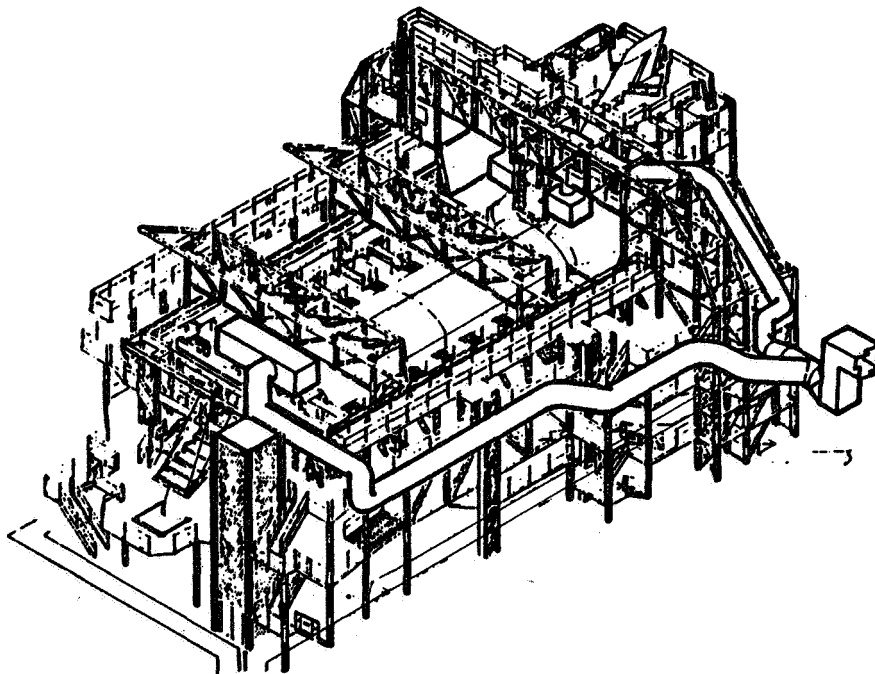
ORBITER PROCESSING FACILITY (OPF) STATUS

- MODIFICATIONS IN WORK TO IMPROVE ECS CAPABILITY:
 - INSTALL CONTINUOUS PAYLOAD BAY CLASS 5000 AIR PURGE WHEN PAYLOAD BAY IS OPEN
 - OTHER PHYSICAL MODIFICATIONS WHICH WILL REDUCE PARTICULATES INCLUDE:
 - ADDED EXTERIOR PAVING
 - ADDED SMOKE SCRUBBERS
 - IMPROVED CLEAN UP CAPABILITY
 - IMPROVED HVAC SYSTEM INCORPORATING HEPA FILTERS
 - OPERATIONAL
 - IMPROVED SCHEDULING OF OPERATIONS
 - IMPROVED PERSONNEL CONTROL

- ESTIMATED COMPLETION DATE
 - PAYLOAD BAY PURGE
 - HI-BAY 2 FEBRUARY 1983
 - HI-BAY 1 JULY 1983

THE ORBITER PROCESSING FACILITY (OPF) WILL BE MODIFIED TO IMPROVE PAYLOAD CLEANLINESS. MODIFICATIONS WILL ENABLE THE ENVIRONMENTAL CONDITIONING SYSTEM TO MAINTAIN A CONTINUOUS CLEAN AIR PURGE INTO THE PAYLOAD BAY. ADDITIONAL ORBITER PROCESSING FACILITY (OPF) PHYSICAL MODIFICATIONS TO REDUCE PARTICULATE CONTAMINATION ARE LISTED. OPERATIONAL MODIFICATIONS SUCH AS SCHEDULING AND PERSONNEL CONTROL WILL ALSO BE USED TO HELP REDUCE CONTAMINANT LEVELS NEAR THE ORBITER PAYLOAD BAY.

OPF PURGE DUCT ARRANGEMENT



THIS SKETCH SHOWS THE PLANNED ARRANGEMENT OF THE PURGE AIR DUCTS IN THE OPF WORKSTANDS AS THE SYSTEM IS BEING DESIGNED.

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OPERATIONAL CONSIDERATIONS

- AMBIENT WEATHER
- DOOR OPENINGS
- ACCESSING OF PAYLOAD
- INDUSTRIAL TYPE OPERATIONS
- ENERGY CONSERVATION CONSISTENT WITH ACHIEVING ACCEPTABLE ENVIRONMENTAL CONTROL

SEVERAL FACTORS INFLUENCE THE PAYLOAD ENVIRONMENT AT KSC. THE AMBIENT CONDITIONS CAN HAVE AN IMPACT ON TEMPERATURE AND RELATIVE HUMIDITY. THIS CAN ALSO AFFECT ENVIRONMENTAL CONTROL SYSTEM OPERATING REQUIREMENTS, CONDITIONS AND TIMES. OPENING DOORS INTO THE PROCESSING AREAS CAN LEAD TO A DEGRADATION OF THE INTERNAL ENVIRONMENT AND MAY ALSO ALLOW DUST AND OTHER PARTICULATES TO ENTER THE AREA. PAYLOAD ACCESS PRESENTS CONTAMINATION PROBLEMS AS THE ACCESS EQUIPMENT AND PERSONNEL MAY CARRY CONTAMINANTS INTO CLOSE PROXIMITY OF EXPERIMENTS.

INDUSTRIAL OPERATIONS, SUCH AS CRANE OPERATIONS, ARE ALSO POTENTIAL CONTAMINATORS OF PAYLOAD PROCESSING AREAS.

KSC AMBIENT ENVIRONMENT

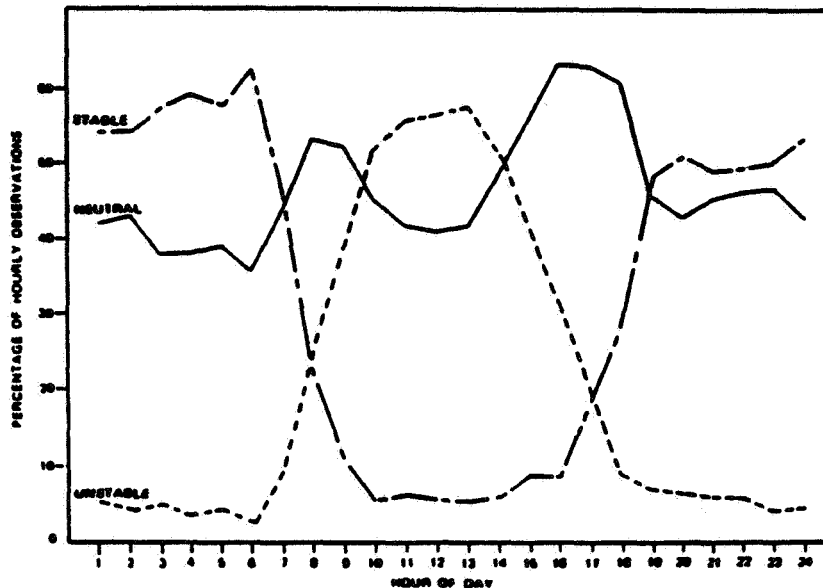
MONTH	J	F	M	A	M	J	J	A	S	O	N	D	ANNUAL
TEMPERATURE (°F) MEAN DAILY MAXIMUM	69.8	69.8	73.4	77.0	82.4	86.0	87.0	87.8	86.0	80.6	75.2	69.8	78.8
TEMPERATURE (°F) MEAN DAILY MINIMUM	51.8	53.6	57.2	62.6	66.2	71.6	73.4	73.4	73.4	69.8	60.8	53.6	64.4
(%) MEAN RELATIVE HUMIDITY	80	80	78	75	77	81	83	84	82	79	79	79	80
(INCHES) MEAN PRECIPITATION	2.95	3.40	4.13	2.01	1.80	4.23	5.70	5.97	8.85	5.10	3.45	1.58	49.17 CUM.

SOURCE: KSC-FINAL ENVIRONMENTAL IMPACT STATEMENT-1979; BASED ON A 14 YEAR DATA BASE.

THIS TABLE SHOWS THE AVERAGE WEATHER AT KSC DURING EACH MONTH. AS IT SHOWS, THE WEATHER AT KSC IS GENERALLY HOT, HUMID AND WET, WHICH CAN IMPACT THE INTERNAL ENVIRONMENT OF THE PROCESSING FACILITIES, TRANSPORTATION GSE AND THE ORBITER PAYLOAD BAY.

ATMOSPHERIC STABILITY

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SOURCE: KSC-FINAL ENVIRONMENTAL IMPACT STATEMENT - 1979

THIS GRAPH INDICATES THAT THE ATMOSPHERE IS MOST STABLE (IMPLYING LITTLE OR NO WIND) DURING EARLY MORNING AND NIGHTTIME HOURS. THIS WOULD SUGGEST THAT THE BEST TIME FOR OPERATIONS REQUIRING DOOR OPENINGS OR PAYLOAD MOVEMENT EXTERNAL TO FACILITIES IS DURING THESE HOURS.

ORBITER INTERNAL ENVIRONMENT (PRELAUNCH - POSTLANDING)

- PRE-LAUNCH
 - CLOSURE OF PAYLOAD BAY DOOR IN ORBITER PROCESSING FACILITY (OPF) UNTIL LAUNCH

- POST-LANDING
 - PURGE HOOKUP UNTIL PAYLOAD BAY DOOR OPENING IN ORBITER PROCESSING FACILITY (OPF)

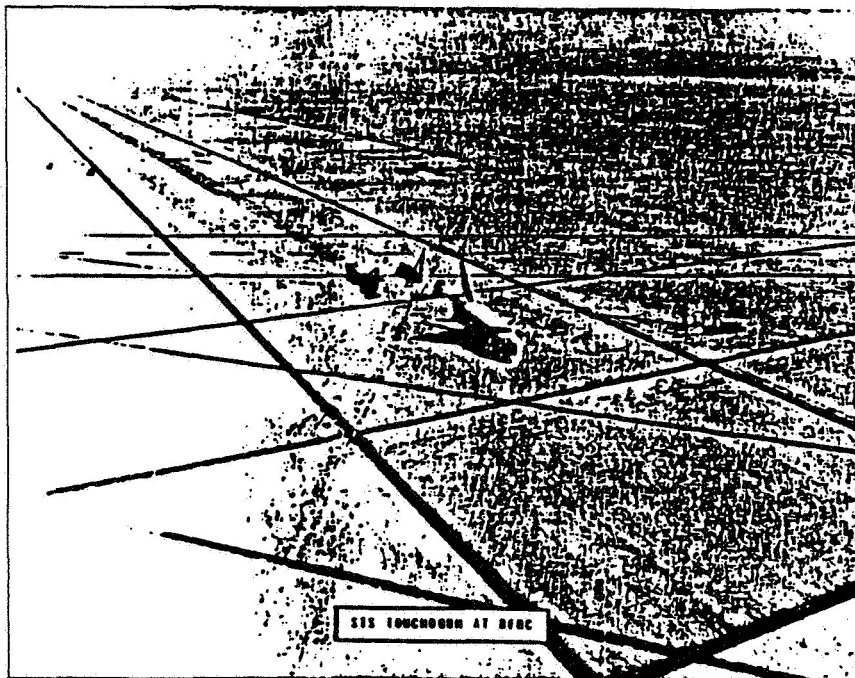
- SECONDARY/CONTINGENCY LANDING SITES

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SECONDARY/CONTINGENCY LANDING SITES

- SHUTTLE TRANSPORTATION SYSTEM (STS) PRIORITY AFTER LANDING AT CONTINGENCY SITE
 - CREW SAFETY
 - ORBITER SAFETY
- EXISTENCE OF PAYLOAD BAY PURGE IS DEPENDENT UPON WHICH LANDING SITE IS USED
 - SECONDARY LANDING SITE SAME AS PRIMARY SITE
 - CONTINGENCY LANDING SITE HAS NO PLANNED PURGE CAPABILITY
- PAYLOAD BAY ENVIRONMENT COULD VARY FROM MAXIMUM PLANNED CAPABILITY TO NO PAYLOAD BAY PURGE

SHOULD THE ORBITER LAND AT ANY SITE OTHER THAN THE PRIME OR SECONDARY LANDING SITES (KENNEDY SPACE CENTER [KSC] OR EDWARDS AIR FORCE BASE [EAFB]) THE PRIMARY CONCERNS OF THE GROUND TEAMS ARE CREW HEALTH AND SAFETY AND THEN THE SAFETY OF THE ORBITER. NO SPECIAL PAYLOAD ENVIRONMENTAL SUPPORT IS PLANNED AT A CONTINGENCY LANDING SITE. THE EXTENT OF PAYLOAD SUPPORT IS DEPENDENT UPON THE LANDING SITE USED AND MAY VARY FROM NO PAYLOAD PURGE OR SUPPORT TO FULL PAYLOAD SUPPORT AND PURGE.



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PRE-LAUNCH

- POST PAYLOAD BAY (PLB) CLOSEOUT
 - TOW TO VAB* NO PURGE PROVIDED (1/2 HOUR)①
 - OTHER VAB PROCESSING NO PURGE PROVIDED UNLESS REQUIRED①
 - HOISTING & ET MATE* NO PURGE PROVIDED (30 HOURS)①
 - TRANSFER TO PAD PURGE PROVIDED②
 - PAD DWELL TIME** PURGE PROVIDED②
 - CRYOGENIC LOADING PURGE PROVIDED④
- SIS-3 EXPERIENCE - NO HUMIDITY PROBLEMS PER DATA
- ** VERTICAL AND HORIZONTAL PROCESSING - BAY WILL REACH AMBIENT IN ABOUT 20 HOURS

NOTES

- ① PAYLOAD BAY TEMP MAX 83° F, 31% MAX RELATIVE HUMIDITY (STS-2 AUG. 10-16 1981)
MAX 74.5° F, 34% MAX RELATIVE HUMIDITY (STS-3 FEB. 3-4, 1982)
- ② 70° ± 5° F NOMINAL; 36% MAX RELATIVE HUMIDITY; 15 PPM MAXIMUM HYDROCARBONS;
NOMINAL AIR CLASS 100, GUARANTEED 5000
- ③ 70° ± 5° F NOMINAL; 31% MAX RELATIVE HUMIDITY; 15 PPM MAXIMUM HYDROCARBONS;
NOMINAL AIR CLASS 100, GUARANTEED 5000
- ④ DURING FUEL CELL LOADING (L-52 TO L-44.5 HRS) PAYLOAD BAY PURGE SWITCHED TO GN₂,
70° ± 5° F NOMINAL; 0% RELATIVE HUMIDITY; 15 PPM MAXIMUM HYDROCARBONS; NOMINAL CLASS
100 GUARANTEED CLASS 5000. ALSO, GN₂ PURGE 3 HOURS PRIOR TO START OF CRYO LOADING
(L-10 HR 30 MIN) THROUGH LAUNCH.

THERE ARE TWO TIME PERIODS OF NO PAYLOAD BAY PURGE AFTER THE PAYLOAD DOORS ARE CLOSED, THE FIRST BEING THE TIME TO TOW THE ORBITER FROM THE ORBITER PROCESSING FACILITY TO THE VEHICLE ASSEMBLY BUILDING (VAB) TRANSFER AISLE AND THE SECOND TIME OCCURRING AS THE ORBITER IS LIFTED FROM THE TRANSFER AISLE FLOOR AND MATED WITH THE EXTERNAL TANK/SOLID ROCKET BOOSTERS/MOBILE LAUNCH PLATFORM.

PAYLOAD DEVELOPERS SHOULD NOTE THAT THE PAYLOAD BAY PURGE IS CHANGED FROM AIR TO GN₂ DURING PERIODS OF FUEL CELL AND EXTERNAL TANK CRYOGENICS LOADING. PAYLOADS MOUNTED ON PALLETS/SPECIAL STRUCTURES WOULD BE EXPOSED TO A GN₂ ENVIRONMENT FOR THE SPECIFIED TIME PERIODS.

POST-LANDING (PRIMARY SITE)

- AFTER SAFING AT THE SHUTTLE LANDING FACILITY, AN AIR PURGE IS CONNECTED APPROXIMATELY 45 MINUTES AFTER LANDING TO CONDITION THE PAYLOAD BAY UNTIL THE ORBITER IS IN THE ORBITER PROCESSING FACILITY (OPF)*
- NO ECS CAPABILITY DURING FERRY FLIGHT TO KSC
- 70 ± 5° F NOMINAL; 36% MAX RELATIVE HUMIDITY; 15 PPM MAXIMUM HYDROCARBON; AIR CLASS 100, GUARANTEED 5000

LANDING SITES OTHER THAN THE KENNEDY SPACE CENTER MAY BE THE DESIGNATED PRIMARY LANDING SITE.

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CONCLUSIONS

- EXPERIMENT SPONSORS SHOULD CONSIDER DESIGNING FOR SUPPLEMENTAL PROTECTIVE MEASURES FOR CRITICAL OR ENVIRONMENTALLY SENSITIVE PAYLOAD ELEMENTS (TO BACKUP AND/OR AUGMENT FACILITY CAPABILITIES)
- MISSION UNIQUE PAYLOAD LAUNCH/LANDING SITE ENVIRONMENTAL CONTROL REQUIREMENTS SHOULD:
 - BE DETERMINED EARLY IN PLANNING CYCLE
 - NOT NECESSITATE FACILITY MODIFICATIONS IF POSSIBLE
 - BE IDENTIFIED EARLY TO PAYLOAD MISSION MANAGEMENT FOR TRANSMISSION TO KSC/JSC
 - KSC - IF FACILITY MODIFICATIONS, GROUND OPERATIONS CONSTRAINTS OR SCHEDULE IMPACTS ARE INVOLVED
 - JSC - IF USE OF PAYLOAD BAY LINER KIT IS PLANNED OR PAYLOAD BAY CLEANING TO BETTER THAN "VISIBLELY CLEAN 1" IS REQUIRED
- ANY INTEGRATION FLOW SERIAL IMPACTS OR FACILITY MODIFICATIONS WILL BE AN OPTIONAL SERVICE

SUMMARY

- IT SHOULD BE REMEMBERED THAT KSC'S ENVIRONMENTAL CAPABILITIES WERE DESIGNED TO MEET THE BASIC NEEDS OF MOST PAYLOADS AND NOT THE VERY STRINGENT NEEDS OF A FEW EXPERIMENTS

THE MAJORITY OF LAUNCH/LANDING SITE ENVIRONMENTAL CONTROL REQUIREMENTS FOR PAYLOAD PROCESSING CAN BE MET BY EXISTING AND/OR PLANNED CAPABILITIES. THE GOAL FOR PAYLOAD DEVELOPERS IS TO INVESTIGATE AND UNDERSTAND OUR CAPABILITIES AND USE THIS INFORMATION IN THE EARLY STAGES OF PLANNING/DEVELOPMENT OF THE PAYLOAD ITEM(S). ADDITIONALLY, ANY SPECIAL OR UNIQUE PROCESSING REQUIREMENTS SHOULD BE IDENTIFIED EARLY TO PERMIT TIMELY CONSIDERATION OF THIS CAPABILITY, ASSUMING APPROVAL.