ONE HUNDRED FIFTH CONGRESS
Presented to the
COMMITTEE ON GOVERNMENT REFORM AND OVERSIGHT
Subcommittee on
National Security,
International Affairs and Criminal Justice
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NASA Oversight and Vision for Space Exploration Hearings

INTEGRATED SPACE PLAN

Version 4.0 May 1997

Produced by Ronald M. Jones

The Integrated Space Plan (ISP) is a very long range perspective of what could be humanity's future in space. Its 100-year plus vision is driven by a goal to permanently expand human presence into the frontier of space and tap the unlimited energy and resource wealth of our solar system. The ISP is not a definitive plan. It is a compilation of evolutionary opportunities for near term and long-range space activities, many of which will be required to open the space frontier. The ISP was created from the integration of numerous long-range studies, including NASA's Human Exploration and Development of Space Enterprise, the previous Project Pathfinder case studies, recommendations from the Solar System Exploration Committee, the National Commission on Space, the Ride Report, the 1988 and 1996 National Space Policy Directives, the Augustine Commission, the Stafford Synthesis Group and recent NASA Outer Planets Science Working Group findings. Special initiatives, such as those described in the Ride Report or the four Stafford Synthesis Group architectures, (i.e., Mars Exploration, Science Emphasis for the Moon and Mars, The Moon To Stay and Mars Exploration, and Space Resource Utilization) are integral parts of the ISP. These scenarios, as well as the agenda described by the National Commission on Space, can be graphically depicted by shading the appropriate boxes involved. Although all programs could not be depicted due to the limited area available, the ISP illustrates the systematic interrelationships of the wide spectrum of international space projects that will be required if we are to expand human presence into the solar system. To accentuate the international nature of space activities, performance data on all launch vehicles in current operation or under production, as well as data on all of the world's principle launch sites, have been included in the ISP. Mir space station data has also been included.

The ISP can be read from top to bottom or left to right. From top to bottom, vertical column elements are phased in chronologically to support centerline milestones. Reading across the columns from left to right will yield the total scope of required activity within a given time span in support of the total "integrated" architecture. The centerline of the ISP, it's critical path, reflects current policy and future milestones required to establish a permanent human occupation on the Moon, Mars and industrial-related facilities. Arrowed lines between boxes depict evolutionary, supporting or synergistic relationships. Double-arrowed lines between boxes are communications or data links. Bold lines are trunk lines with numerous (2 or more) branches stemming from along their path. Boxes with bold lines are either long-range (centerline) objectives or key "enabling" programs important because their development affects the development of many other programs. Boxes with double lines are in-space transportation nodes. The ISP is chronologically depicted in five year time intervals because this is a practical segment of time to portray the implementation of such a major long-range integrated effort. The dates shown have an uncertainty that increases with time, but the element chronologies are intended to be specific. Finally, the large bubbles represent the collective synergism of those elements contained within the time span bounded by a bubble. These highest level goals represent future plateaus of human achievement. They manifest themselves from the emergent technical capability developed as we progressively explore and expand into our solar neighborhood. They are attainable through the selective execution of the proper ISP elements.

The producer of the Integrated Space Plan welcomes comments and inputs. Those individuals who have contributed ideas or suggestions that have been utilized are listed on the ISP. Future updates will be made as time and need permits. Send your comments, ideas, suggestions, or changes to:

ISP Comments-
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ABUNDANT NEAR-EARTH-EXTRATERRESTRIAL RESOURCES					
RESOURCE	MOON	PHOBOS/ DEIMOS	ASTEROIDS	COMETS	ELEMENT NAME
Al	X				ALUMINUM
C		X	C	X	CARBON
Ca	X				CALCIUM
Fe	X		M		IRON
H		X	C	X	HYDROGEN
He3	X				HELIUM 3
Mg	X				MAGNESIUM
N		X	C	X	NITROGEN
Ni	X		M		NICKEL
O	X	X	C	X	OXYGEN
Si	X				SILICON
Ti	X				TITANIUM
H2O	?	X	C	X	WATER

* METALLIC=M, CARBONACEOUS=C

AMERICAN LAUNCH VEHICLES					
VEHICLE	PERFORMANCE IN POUNDS LEO	PERFORMANCE IN POUNDS GTO	1st FLT	PAYLOAD FAIRING DIA	APPROXIMATE LAUNCH COSTS IN 1990$
SPACE SHUTTLE	53,700	13,000	1981	15 FT	$245M
TITAN IV	39,000	10,000	1989	16.7 FT	$154M^^
TITAN III	32,000	11,000	1989	10 AND 13.1 FT	$160M^
TITAN II	4,200	POLAR	1988	10 FT	$43M**
ATLAS II AS	18,500	7,700	1993	10.8 AND	$110M*
ATLAS II A	14,900	6,200	1991	13.75 FT	$90M*
ATLAS II	14,100	5,900	1991		$80M*
ATLAS I	12,300	4,950	1990	10.8 AND	$70M*
ATLAS E	1,800	POLAR	1974	13.75 FT	$45M
DELTA II - 7925	11,100	4,010	1990	8,	$50M
DELTA II - 6925	8,780	3,190	1989	9.5 AND 10 FT	$44M
TAURUS	3,200	830	1992	4.2 FT	$16M
PEGASUS	1,000	275	1990	3.8 FT	$7-12M
SCOUT	600	120	1979	2.9 AND 3.5 FT	$11M

* WITH CENTAUR
** NO STRAP-ONS
^ NO UPPER STAGE
^^ NO UPPER STAGE, $214M WITH IUS, $227M WITH CENTAUR

RUSSIAN LAUNCH VEHICLES			
VEHICLE	PERFORMANCE IN POUNDS LEO	PERFORMANCE IN POUNDS GTO	1st FLT
BURAN / SL-17	66,000		1988
ENERGIA/SL-17	194,000	40,000	1987
PROTON / SL-13	44,100		1968
PROTON / SL-12		12,100	1967
ZENIT-3 / SL-16		9,480	1993
ZENIT-2 / SL-16	30,300		1985
SOYUZ / SL-4	15,400		1963
MOLNIYA/SL-6		3,300	1961
VOSTOK / SL-3	10,400		1959
TSYKLON/SL-14	8,800		1977
SL-11			1967
KOSMOS / SL-8	3,000		1964

EUROPEAN LAUNCH VEHICLES			
VEHICLE	PERFORMANCE IN POUNDS LEO	PERFORMANCE IN POUNDS GTO	1st FLT
HERMES	6,600		2002
ARIANE 5	39,600	15,000	1996
ARIANE 44L	21,100	9,260	1989
ARIANE 44P	18,300	8,160	1988
ARIANE 42L	16,300	7,050	
ARIANE 44P	15,200	6,610	
ARIANE 42P	13,400	5,730	1990
ARIANE 40	10,800	4,190	1990

JAPANESE LAUNCH VEHICLES			
VEHICLE	PERFORMANCE IN POUNDS LEO	PERFORMANCE IN POUNDS GTO	1st FLT
H-2	23,000	8,800	1994
H-1	7,000	2,400	1986
M-V	4,300	2,680	1995
M-3S-II	1,720	1,140	1985

CHINESE LAUNCH VEHICLES		
LONG MARCH VEHICLES	PERFORMANCE IN POUNDS LEO	PERFORMANCE IN POUNDS GTO
LM-2E/HO*	29,900	9,900
LM-2E	20,430	7,430
LM-3A	15,800	5,500
LM-3	11,000	3,300
LM-4	8,800	2,430
LM-2C	7,040	2,200
LM-1D	1,650	440

* 1995 FIRST LAUNCH

INDIAN & ISRAELI LAUNCH VEHICLES		
VEHICLES	PERFORMANCE IN POUNDS LEO	PERFORMANCE IN POUNDS GTO
GSLV*	17,600	5,500
PSLV	6,600	990
ASLV	330	
SLV-3	90	
SHAVIT	350	

* 1995 FIRST LAUNCH

LEO ET RESOURCE BASE		
ELEMENT	LBS PER TANK	ELEMENT NAME
Al	56,490	
C	2,760	
Cr	188	CHROMIUM
Cu	3,450	COPPER
Fe	415	
H	466	
Mg	268	
N	246	
Ni	200	
O	1,725	
Si	690	
Ti	220	
Zn	173	ZINC

SPACE STATION MIR				
ELEMENT	LENGTH IN FT	VOLUME IN CU FT	MASS IN LBS	PWR IN kW
CORE MODULE	43	3,180	46,300	9
KVANT-1	19.7	1,410	24,250	3
KVANT-2	45	2,120	43,210	9
KVANT-3	39	3,180	42,990	9
KVANT-4	42	2,650	43,100	0
KVANT-5	42	2,650	43,100	0
SOYUZ-TM	23	350	15,210	1.5
PROGRESS	23	210	15,870	1.5
MIR TOTAL	**108.7**	**15,750**	**274,030**	**33**

PRINCIPLE GLOBAL LAUNCH SITES		
SITE	LATITUDE	OPERATOR
BARKING SANDS*	22.1N	AMERICA
POKER FLATS*	65.2N	AMERICA
VANDENBERG	34.7N	AMERICA
WHITE SANDS*	32.1N	AMERICA
CHURCHILL*	58.7N	CANADA
CANAVERAL	28.5N	AMERICA
WALLOPS*	37.9N	AMERICA
ANDOYA*	69.3N	NORWAY
KOUROU	5.2N	FRANCE
KIRUNA*	67.5N	SWEDEN
NEGEV	31.0N	ISRAEL
SAN MARCO	2.9S	ITALY
KAPUSTIN YAR	48.4N	RUSSIA
PLESETSK	62.8N	RUSSIA
TYURATAM	45.6N	KAZAKSTAN
SRIHARIKOTA	13.9N	INDIA
JIUQUAN	40.7N	CHINA
XICHANG	28.2N	CHINA
TAIYUAN	37.6N	CHINA
TANEGASHIMA	30.2N	JAPAN
KAGOSHIMA	31.2N	JAPAN
WOOMERA*	31.1S	AUSTRALIA

* SOUNDING ROCKET RANGE

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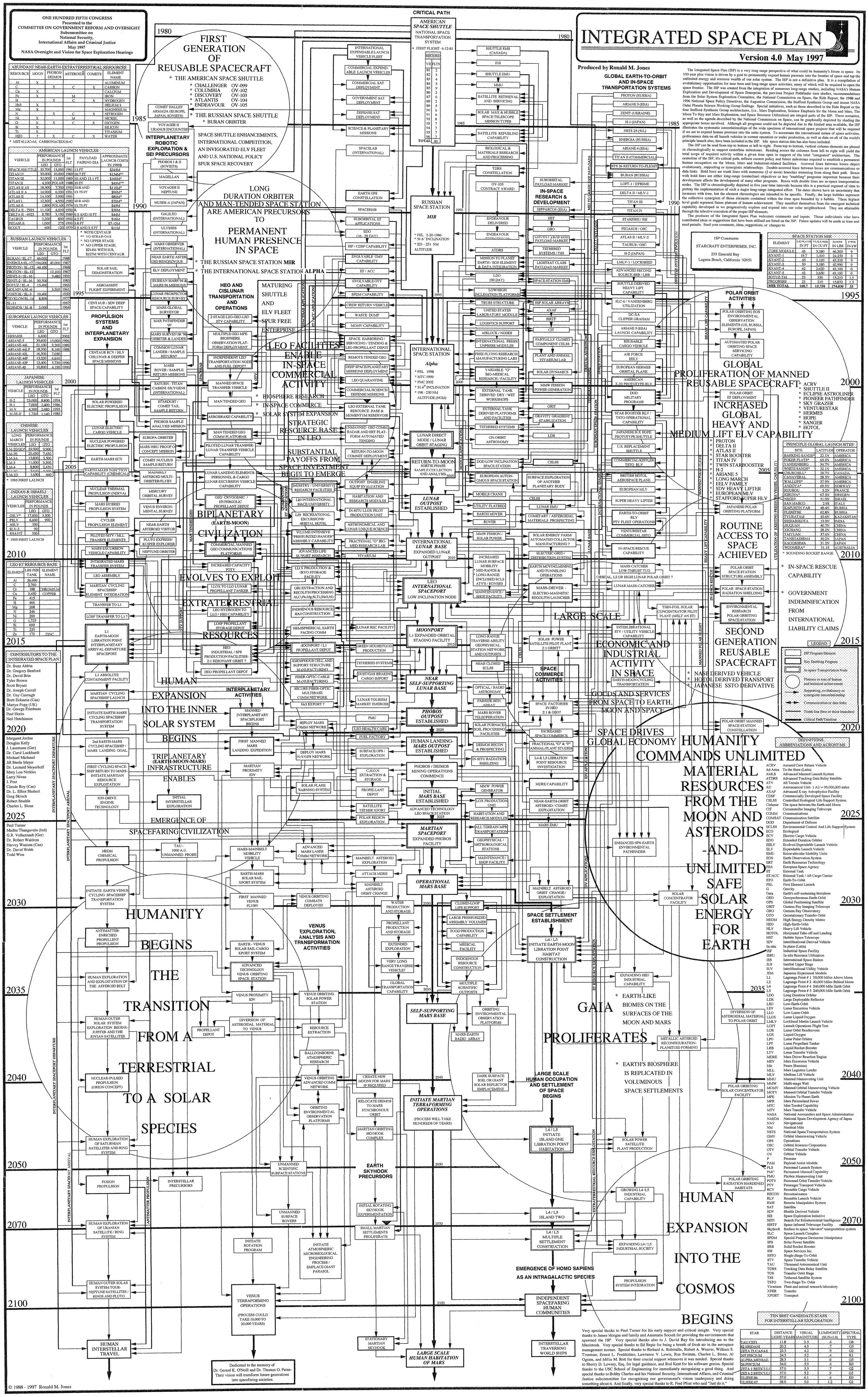
CRITICAL PATH
AMERICAN SPACE SHUTTLE
NATIONAL SPACE TRANSPORTATION SYSTEM
* FIRST FLIGHT: 4-12-81
RECORD
YR FLTS
81 2
82 3
83 4
84 5
85 9
86 2
87 0
88 2
89 5
90 6
91 6
92 8
93 7
94 7
95 7
96 7
TOTAL 80
1980
FIRST GENERATION OF REUSABLE SPACECRAFT
* THE AMERICAN SPACE SHUTTLE
* CHALLENGER OV-099
* COLUMBIA OV-102
* DISCOVERY OV-103
* ATLANTIS OV-104
* ENDEAVOUR OV-105
* THE RUSSIAN SPACE SHUTTLE
* BURAN ORBITER
SPACE SHUTTLE ENHANCEMENTS, INTERNATIONAL COMPETITION, AN INVIGORATED ELV FLEET AND U.S. NATIONAL POLICY SPUR SPACE RECOVERY
1985
COMET HALLEY ARMADA (EUROPE, JAPAN, SOVIETS)
VOYAGER II URANUS ENCOUNTER
INTERPLANETARY ROBOTIC EXPLORATION & SEI PRECURSORS
PHOBOS I & II (SOVIETS)
MAGELLAN
VOYAGER II NEPTUNE
MUSES-A (JAPAN)
1990
GALILEO (INTERNATIONAL)
ULYSSES (INTERNATIONAL)
MARS OBSERVER (INTERNATIONAL)
NEAR EARTH ASTEROID RENDEZVOUS
ELV DEPLOYMENT
RUSSIAN MARS 94 & MARS 96 MISSIONS
LUNAR PROSPECTOR RESOURCE SURVEY
MARS GLOBAL SURVEYOR
MAR PATHFINDER '97
MARS SURVEYOR '98 ORBITER & LANDER
COMMON LUNAR LANDER / SAMPLE RETURN?
MARS ROVER / SAMPLE RETURN MISSIONS
SATURN - TITAN CASSINI /HUYGENS (INTERNATIONAL)
STARDUST / COMET TAIL SAMPLE RETURN
PHOBOS SAMPLE ANALYSIS MISSION
EUROPA ORBITER
MARS ISRU PROOF OF CONCEPT MISSION
COMET NUCLEUS SAMPLE RETURN
MAINBELT ASTEROID MULTI-ORBITER/FLYBY
MERCURY ORBITAL SURVEY
VENUS ENVIRONMENTAL SURVEY
NEAR-EARTH ASTEROID VISITOR
PLUTO EXPRESS/ KUIPER EXPLORER
NEPTUNE ORBITER
SOLAR SAIL DEMONSTRATION
AEROASSIST FLIGHT EXPERIMENT
CENTAUR / SDV DEEP SPACE CAPABILITY
PROPULSION SYSTEMS AND INTERPLANETARY EXPANSION
CENTAUR RCV / HLV CISLUNAR & DEEPER SPACE MISSIONS
SOLAR POWERED ELECTRIC PROPULSION
LUNAR ELECTRIC CARGO VEHICLE
NUCLEAR POWERED ELECTRIC PROPULSION
EARTH-MARS ECV
EARTH-MARS INJECTION CAPABILITY (CHEMICAL)
NUCLEAR THERMAL PROPULSION (NERVA)
MARS HYBRID PROPULSION SYSTEM
CYCLER PROPULSION ELEMENT
PILOTED MTV / MLL TRANSFER ELEMENTS
MARS EXCURSION VEHICLE CAPABILITY
INTEGRATED MARS TRANSFER SYSTEM
LEO ASSEMBLY
MARTIAN CYCLING SPACESHIP ELEMENT INTEGRATION
TRANSFER TO L1
LOSF TRANSFER TO L1 ?
L1 EARTH-MOON LIBRATION POINT INTERPLANETARY ARRIVAL-DEPARTURE SPACEPORT
L1 ABSOLUTE CONTAINMENT FACILITY
MARTIAN CYCLING SPACESHIP LAUNCH
INITIATE EARTH-MARS CYCLING SPACESHIP TRANSPORTATION SYSTEM
2nd EARTH-MARS CYCLING SPACESHIP / MARS LANDING GOAL
FIRST CYCLING SPACESHIP RETURN TO MARS- INITIATE MARTIAN RESOURCE EXPLOITATION
ION-DRIVE ENGINE TECHNOLOGY
INITIATE EARTH-VENUS CYCLING SPACESHIP TRANSPORTATION SYSTEM
HEDM CHEMICAL PROPULSION
ANTIMATTER-ENRICHED PROPELLENT PROPULSION
HUMAN EXPLORATION AND EXPLOITATION OF THE ASTEROID BELT
HUMAN OUTER SOLAR SYSTEM EXPLORATION BEGINS- JUPITER AND THE JOVIAN SATELLITES
NUCLEAR-PULSED PROPULSION (ORION CONCEPT)
HUMAN EXPLORATION OF SATURNIAN SATELLITES AND RING SYSTEM
FUSION PROPULSION
HUMAN EXPLORATION OF URANIAN SATELLITE / RING SYSTEM
HUMAN OUTER SOLAR SYSTEM TOUR- NEPTUNE SATELLITES / RINGS AND PLUTO
HUMAN INTERSTELLAR TRAVEL
INTERPLANETARY SPACEPORT DEPARTURE
INTERPLANETARY SPACEPORT ARRIVAL
ANTIMATTER PROPULSION
LONG DURATION ORBITER AND MAN-TENDED SPACE STATION ARE AMERICAN PRECURSORS TO
PERMANENT HUMAN PRESENCE IN SPACE
* THE RUSSIAN SPACE STATION MIR
* THE INTERNATIONAL SPACE STATION ALPHA
HEO AND CISLUNAR TRANSPORTATION AND OPERATIONS
2 STAGE LEO-GEO-LEO STV CAPABILITY
MULTIPLE GEO MPE BIOSPHERE OBSERVATION PLAT-FORM DEPLOYMENT
INDEPENDENT LEO TRANSPORTATION NODE AND FUEL DEPOT?
MANNED SPACE TRANSFER VEHICLE
MAN TENDED GEO
AEROBRAKE CAPABILITY
MAN TENDED GEO COMM PLATFORMS
PILOTED LUNAR TRANSFER-LUNAR TRANSFER VEHICLE CAPABILITY
LUNAR LANDING ELEMENTS- PERSONNEL & CARGO LUNAR EXCURSION VEHICLE CAPABILITY
GEO CRYOGENIC / HYPERGOLIC PROPELLANT DEPOT
BIPLANETARY (EARTH-MOON) CIVILIZATION
COMMERCIAL MANNED GEO COMMUNICATIONS PLATFORMS
INCREASED CAPACITY POTV
EVOLVES TO EXPLOIT
LLOX TO LLO LUNAR PROPELLANT TANKER
EXTRATERRESTRIAL
LEO HYDROGEN TO LLO / HEO CAPABILITY
LOSF PROPELLANT STORAGE DEPOT
RESOURCES
HEO INDUSTRIAL / SPS PRODUCTION FACILITIES- 2:1 RESONANT ORBIT ?
HEO PROPELLANT DEPOT
HUMAN EXPANSION INTO THE INNER SOLAR SYSTEM BEGINS
INTERPLANETARY ACTIVITIES
MANNED INTERPLANETARY SPACEFLIGHT BEGINS
FIRST MANNED MARS LANDING EXPEDITION
MARTIAN PROXIMITY IDV
TRIPLANETARY (EARTH-MOON-MARS) INFRASTRUCTURE ENABLES
INITIAL INTERSTELLAR EXPLORATION
EMERGENCE OF SPACEFARING CIVILIZATION
TAU - 1000 A.U. UNMANNED PROBE
MARS-MAINBELT MOBILITY VEHICLE
EARTH-MARS SOLAR SAIL XPORT SYSTEM
FIRST MANNED VENUS FLYBY
VENUS ORBITING COMSATS DEPLOYED
HUMANITY BEGINS THE TRANSITION FROM A TERRESTRIAL TO A SOLAR SPECIES
EARTH - VENUS SOLAR SAIL CARGO XPORT SYSTEM
ADVANCED TECHNOLOGY VENUS ORBITING SPACE STATION
VENUS PROXIMITY IDV
VENUS ORBITING SOLAR POWER STATION
DIVERSION OF ASTEROIDAL MATERIAL TO VENUS
PROPELLANT DEPOT
RESOURCE EXTRACTION
BALLOONBORNE ATMOSPHERIC RESEARCH
VENUS ORBITING ADVANCED COMM NETWORK
ORBITING ENVIRONMENTAL OBSERVATION PLATFORMS
UNMANNED SCIENTIFIC SURFACE STATIONS
UNMANNED SURFACE ROVERS
INITIATE ROTATION PROGRAM
INITIATE ATMOSPHERIC MICROBIOLOGICAL ENGINEERING PROCESS / EMPLACE GIANT PARASOL
VENUS TERRAFORMING OPERATIONS
(PROCESS COULD TAKE 10,000 TO 20,000 YEARS)
INTERSTELLAR PRECURSORS
VENUS EXPLORATION, ANALYSIS AND TRANSFORMATION ACTIVITIES
MATURING SHUTTLE AND ELV FLEET SPUR FREE ENTERPRISE
LEO FACILITIES ENABLE IN-SPACE COMMERCIAL ACTIVITY
* BIOSPHERE RESEARCH
* IN-SPACE COMMERCE
* SOLAR SYSTEM EXPANSION
STRATEGIC RESOURCE BASE IN LEO
SUBSTANTIAL PAYOFFS FROM SPACE INVESTMENT BEGIN TO EMERGE
INDUSTRY / UNIVERSITY RESEARCH FACILITIES
LEO INTERNATIONAL SPACE UNIVERSITY
LEO RECREATIONAL EXCURSIONS/ ORBITAL HOTEL
VOLUME INTENSIVE "PRESURIZED HANGER" ASSEMBLY CAPABILITY
ADVANCED LIFE SUPPORT RESEARCH
LLOX PRODUCTION & CRYO STORAGE FACILITY
ORE EXTRACTION AND REGOLITH PROCESSING Al,O,Fe,Mg,Si,Ti,(He3,Ni)
INDIGENOUS RESOURCE HA3 CONSTRUCTION
HEMISPHERICAL EARTH FACING COMM
MOONPORT / L1 PROPELLANT DEPOT
AMORPHOUS CELL AND SUPPORT STRUCTURE MANUFACTURING
FIBER-OPTIC CABLE MANUFACTURING
SECURE FIBER-OPTIC MULTIBASE COMM NETWORK
He3 EXPORT ?
DEPLOY MARS COMM NETWORK
DEPLOY MARS N/A V/GPS NETWORK
SOLAR FLARE WARNING SYSTEM
INTERNATIONAL EXPENDABLE LAUNCH VEHICLE FLEET
COMMERCIAL EXPENDABLE LAUNCH VEHICLES
COMMERCIAL SAT DEPLOYMENT
GOVERNMENT SAT DEPLOYMENT
DEFENSE SAT DEPLOYMENT
SCIENCE & PLANETARY MISSIONS
SPACELAB (INTERNATIONAL)
EARTH GPS CONSTELLATION
SPACEHAB
SUBORBITAL ET APPLICATIONS
EDO (16 - 28 DAY)
ISF / CDSF CAPABILITY
EVOLVABLE OMV CAPABILITY
ET / ACC
EVOLVABLE OTV CAPABILITY
SPDM CAPABILITY
CREW RETURN VEHICLE
WASTE DUMP
MOMV CAPABILITY
SPACE HARBORING / SERVICING / TENDING & LEO PROPELLANT DEPOT
REMOTE TENDED GEO
DEEP SPACE/PLANETARY MISSIONS DEPLOYMENT
LEO QUARANTINE
COMMERCIAL/SCIENCE/ DEFENSE MISSIONS
LEO EXTERNAL TANK RESOURCE BASE & MOMENTUM RESERVOIR
UNMANNED GEO COMM, RADAR AND ERT PLAT-FORM AUTOMATED TENDING
RETURN-TO-MOON COMNET DEPLOYMENT
OUTPOST ENABLING EQUIP EVALUATION
HABITATION AND RESEARCH MODULES
IN-SITU LLOX PILOT PRODUCTION UNIT
ASTRONOMICAL AND LUNAR UNIQUE SCIENCE
FRACTIONAL "G" BIO-MED RESEARCH LAB
VIVARIUM
LUNAR REC FACILITY
GREEN HOUSE/FOOD PRODUCTION
TETHERED SYSTEMS
DUST/GAS BRAKING CARGO IMPORT
LUNAR TOURISM MARKET EMERGES
PMU
LEO HEALTH CARE
FUEL FACTORY
SURFACE OPS / EXPLORATION
C,H,O,N EXTRACTION & STORAGE
PROPELLANT DEPOT
SATELLITE TETHER XPORT
POLAR REGION EXPLORATION
CREATE NEW MOONS FOR MARS IF REQUIRED
RELOCATE DEIMOS TO MARS SYNCHRONOUS ORBIT
MARTIAN ORBITING SKYHOOK COMPLEX
EARTH SKYHOOK PRECURSORS
INITIAL ROTATING SKYHOOK EXPERIMENTATION
SMALL MARTIAN SETTLEMENTS PROLIFERATE
STATIONARY MARTIAN SKYHOOK
LARGE SCALE HUMAN HABITATION OF MARS
INITIATE MARTIAN TERRAFORMING OPERATIONS
(PROCESS WILL TAKE HUNDREDS OF YEARS)
INTERNATIONAL SPACE STATION Alpha
* FEL 1998
* MTC 1999
* PMC 2002
* 51.6° INCLINATION
* 190 - 250 NM ALTITUDE (NOM)
LUNAR DIRECT MODE / LUNAR ORBIT STAGING
RETURN-TO-MOON SORTIE PHASE SAMPLE COLLECTION AND ANALYSIS
RUSSIAN SPACE STATION MIR
* FEL 2-20-1986
* 51.6° INCLINATION
* 221 - 221 NM ALTITUDE
LUNAR OUTPOST ESTABLISHED
INTERNATIONAL LUNAR BASE EXPANDED LUNAR OUTPOST
LEO INTERNATIONAL SPACEPORT LOW INCLINATION NODE
MOONPORT L1 EXPANDED ORBITAL STAGING FACILITY
NEAR SELF-SUPPORTING LUNAR BASE
PHOBOS OUTPOST ESTABLISHED
HUMAN LANDING- MARS OUTPOST ESTABLISHED
PHOBOS / DEIMOS MINING OPERATIONS COMMENCE
INITIAL MARS BASE ESTABLISHED
ADVANCED TECHNOLOGY LEO SPACE STATION 2025
MARTIAN SPACEPORT EXPANDED PHOBOS FACILITY
OPERATIONAL MARS BASE
WATER PRODUCTION AND STORAGE
PROPELLANT PRODUCTION AND STORAGE
EXTENDED EXPLORATION
VERY LONG RANGE TRAVERSE VEHICLE?
GLOBAL TRANSPORTATION CAPABILITY
SELF-SUPPORTING MARS BASE
LARGE SCALE HUMAN OCCUPATION AND SETTLEMENT OF SPACE BEGINS
INITIATE ISLAND ONE LIBRATION POINT HABITATION
ISLAND TWO
MULTIPLE SETTLEMENT CONSTRUCTION
EMERGENCE OF HOMO SAPIENS AS AN INTRAGALACTIC SPECIES
INDEPENDENT SPACEFARING HUMAN COMMUNITIES
INTERSTELLAR TRAVERSING WORLD SHIPS
SHUTTLE RMS (CANADA)
IUS
SHUTTLE EMU
MMU
SATELLITE RETRIEVAL AND SERVICING
SOLAR MAX & HUBBLE SPACE TELESCOPE MISSION TYPES
SATELLITE REFUELING CAPABILITY
BIOLOGICAL & MATERIALS RESEARCH AND PROCESSING
TDRS CONSTELLATION
OV-105 CONTRACT AWARD
ENDEAVOUR DELIVERED
ENDEAVOUR OPERATIONAL
ATDRS
MISSION TO PLANET EARTH / EOS ELEMENT & DATA INTEGRATION
LDO (90 DAY)
LOW/HIGH INCLINATION PLATFORMS
TRUSS STRUCTURE
UNITED STATES LABORATORY MODULE
LOGISTICS SUPPORT
AIRLOCK / NODES
INTERNATIONAL PRESS/ UNPRESS MODULES
FREE FLYING RESEARCH/ MANUFACTURING LABS
VARIABLE "G" BIO-MEDICAL RESEARCH / FACILITY
EXTERNAL TANK DERIVED DRY / WET WORKSHOPS
EXTERNAL TANK DERIVED PLATFORMS AND FACILITIES
TETHERED SYSTEMS
ON-ORBIT ASTRONOMY
DOD LOW INCLINATION SPACE STATION
EUROPEAN AUTONOMOUS SPACE STATION
MOBILE CRANE
UTILITY FLATBED
EARTH MOVER
ROVER
MMW FISSION / SOLAR POWER
INCREASED LUNAR SURFACE MOBILITY
* MID-RANGE &
* LONG-RANGE ENCLOSED ECLS ATV'S / ROVERS
MAINTENANCE / SHOP FACILITY
LONG-RANGE TRAVERSE ABILITY GEOPHYSICAL STATION NETWORK AND OUTPOSTS
NEAR CLOSED ECLSS
OPTICAL / RADIO ASTRONOMY
FARSIDE SETI ARRAY
MARS ROVER TELEOPERATION
SOLAR FURNACE/ SOIL PROCESSING FACILITIES
DEIMOS RECON & PROSPECTING
IN-SITU RADIATION SHIELDING
MMW POWER GENERATOR
LOX PRODUCTION UNIT
HABITATION AND RESEARCH MODULES
ALL TERRAIN MPR TRANSPORTATION
GEOPHYSICAL / METEOROLOGICAL STATIONS
MAINTENANCE / SHOP FACILITY
MAINBELT ASTEROID EXPLORATION
ATTACH MDRE
MAINBELT ASTEROID ORBIT CHANGE
CLOSED-LOOP LIFE SUPPORT
LARGE PRESSURIZED ASSEMBLY VOLUMES
FOOD PRODUCTION CAPABILITY
MEDICAL FACILITY
INDIGENOUS RESOURCE CONSTRUCTION
MULTIPLE SCIENTIFIC OUTPOSTS
ORBITING ENVIRONMENTAL OBSERVATION PLATFORMS
MARS-EARTH RADIO ARRAY
DARK SURFACE SOIL OR GIANT SOLAR REFLECTOR EMPLACEMENT
SPACE SETTLEMENT ESTABLISHMENT
L4 / L5 INITIATE EARTH-MOON LIBRATION POINT HABITAT CONSTRUCTION
SPACE COMMERCE ACTIVITIES
SUBORBITAL PAYLOAD MARKET
IN-SPACE RESEARCH & DEVELOPMENT
HIPPARCOS (ESA)
HST
GRO
MID TO LARGE SIZE PAYLOAD MARKET
TETHERED SYSTEMS / TSS
LIGHTSAT CLASS PAYLOAD MARKET
SPACE STATION EMU
SSF SOLAR ARRAYS
AXAF
SIRTF
CIT
PARTIALLY CLOSED COMPONENT CELSS
PLANT AND ANIMAL VIVARIUM LAB
SOLAR DYNAMICS
MMW FISSION POWER GENERATION
GRIT
GRAVITY GRADIENT STABILIZATION
LDR
CELSS
SURFACE EXPLORATION OF ANOTHER PLANETARY BODY
LUNAR EMU
COMETARY / ASTEROIDAL MATERIALS PROSPECTING
SOLAR ENERGY FARM/ AUTOMATED COLLECTOR MANUFACTURING ?
ELECTRIC GRID / DISTRIBUTION SYSTEM
EARTH MOVING,MINING AND TUNNELING OPERATIONS
MASS-DRIVER - ELECTRO-MAGNETIC REGOLITH LAUNCHER
SOLAR POWER SATELLITE PILOT PLANT 2:1 ORBIT?
SPACE FACTORIES IN HEO 2:1 & GEO?
INCREASED SPACE COMMERCE
FRACTIONAL "G" & "P" ANIMAL/PLANT STUDIES
L4 & L5 LIBRATION POINT RESOURCE INVESTIGATION
MDRE CAPABILITY
NEAR-EARTH-ORBIT ASTEROID / COMET EXPLOITATION
MARS EMU
MAINBELT ASTEROID ORBIT CHANGE / EXPLOITATION
ORBITAL ASTRONOMY
SPACE STATION
TETHERED SYSTEMS
EUROPEAN SPACE STATION
INTERNATIONAL SPACE STATION
LUNAR BASE
MANNED POLAR FLIGHT
IDV APPLICATIONS
ET RESOURCE EXPLOITATION
EXTRATERRESTRIAL RESOURCE EXPLOITATION
ENHANCED SPS-EARTH ENVIRONMENTAL PATHFINDER
SOLAR CONCENTRATOR FACILITY
EXPANDING HEO INDUSTRIAL CAPABILITY
* EARTH-LIKE BIOMES ON THE SURFACES OF THE MOON AND MARS
GAIA PROLIFERATES
METALLIC ASTEROID RECONFIGURATION- PLANETOID FORMING
* EARTH'S BIOSPHERE IS REPLICATED IN VOLUMINOUS SPACE SETTLEMENTS
SOLAR POWER SATELLITE PLANT PRODUCTION
GROWING L4 / L5 INDUSTRIAL CAPABILITY
EXPANDING L4 / L5 INDUSTRIAL SOCIETY
PROPULSION SYSTEM INTEGRATION
GLOBAL EARTH-TO-ORBIT AND IN-SPACE TRANSPORTATION SYSTEMS
PROTON (RUSSIA)
ARIANE 3 (ESA)
ZENIT (UKRAINE)
H-1 (JAPAN)
NSTS 25 (51L)
ENERGIA (RUSSIA)
ARIANE 4 (ESA)
TITAN II (COMMERCIAL)
STS 26 RETURN-TO-FLIGHT
BURAN (RUSSIA)
LOFT-1 / E'PRIME
DELTA II / MLV-1
TITAN III
TITAN IV
STARFIRE / SSI
PEGASUS / OSC
ATLAS II / MLV-2
TAURUS / OSC
H-2 (JAPAN)
LMLV-1 / LOCKHEED
ADVANCED SECOND SOURCE SRB / LRB
SHUTTLE DERIVED HEAVY LIFT CAPABILITY
SLC-6 / VANDENBERG UTILIZATION
DC-XA CLIPPER GRAHAM
ARIANE 5 (ESA) LAUNCH CAPABILITY
REUSABLE CARGO VEHICLE
AIR FORCE EELV
EUROPEAN HERMES ORBITAL PLANE
AMERICAN X-33 PROTOTYPE RLV
DOD MILITARY PROGRAMS
STAR BOOSTER RLV / TSTO OPERATIONAL CAPABILITY
JAPANESE H-X HOPE PROTOTYPE SHUTTLE
U.S. REPLACEMENT SHUTTLE
COMMERCIAL/KISTLER TSTO RLV
BRITISH HOTOL AEROSPACE PLANE
EUROPEAN MLV
SUPER HEAVY LIFTER
EARTH-TO-ORBIT RLV/ PTV FLEET OPERATIONS
VENTURESTAR COMMERCIAL SSTO
IN-SPACE RESCUE CAPABILITY
MASS-CATCHER LOW-THRUST TUG
ORBITAL, L2 OR HIGH LUNAR POLAR ORBIT ?
LUNAR MASS-CATCHER
THIN-FOIL SOLAR CONCENTRATOR PILOT PLANT (MELT AN ET)
INTERLIBRATIONAL STV / UTILITY VEHICLE CAPABILITY
EARTH-MOON CYCLING TRANSPORTATION
SHUTTLE SYSTEMS EVOLUTION
HEAVY LIFT CAPABILITY
IN-SPACE RESCUE
POLAR ORBIT ACTIVITIES
POLAR ORBITING EOS ENVIRONMENTAL OBSERVATION ELEMENTS (US, RUSSIA, EUROPE, JAPAN)
AUTOMATED POLAR ORBITING SPACE SERVICING CAPABILITY
GLOBAL PROLIFERATION OF MANNED REUSABLE SPACECRAFT
POLAR ORBIT ET DEPLOYMENT
INCREASED GLOBAL HEAVY AND MEDIUM LIFT ELV CAPABILITY
* PROTON
* DELTA II
* ATLAS II
* STAR BOOSTER
* TITAN IV
* TWIN STARBOOSTER
* H-2
* ARIANE 5
* LONG MARCH
* EELV FAMILY
* SDV HEAVY LIFTER
* EUROPEAN MLV
* STAFFORD SUPER HLV
JAPANESE POLAR ORBITING PLATFORM
ROUTINE ACCESS TO SPACE ACHIEVED
POLAR ORBIT SPACE STATION STRUCTURE ASSEMBLY
POLAR SPACE STATION RADIATION SHIELDING
ENVIRONMENTAL RESEARCH POLAR ORBITING SPACE STATION
SECOND GENERATION REUSABLE SPACECRAFT
* NASP DERIVED VEHICLE
* HOTOL DERIVED TRANSPORT
* JAPANESE SSTO D