

**50th Anniversary Celebration
1947 - 1997**

The Apollo Era at the Space Division: 1960 to 1975

by Ken Elchert

The Apollo Era at the Space Division: 1960 to 1975

The decade of the sixties brought new leadership and great changes and challenges to both the nation and North American Aviation. In 1960, Lee Atwood was appointed president of NAA and in December the Missile Development Division in Downey was renamed the Space and Information Systems Division (S&ID). Harrison Storms, the chief engineer of the Los Angeles Division, was named president and Dale Myers became the vice president of S&ID.

Less than five months later, the former Soviet Union orbited the first man around the earth challenging the technological leadership of the United States. On May 25, 1961, to regain that leadership, the nation's newly-elected president, John F. Kennedy, made the landing of a man on the moon and his safe return to the earth a national goal. S&ID would play a key role.

In June, S&ID announced its intention to submit a proposal for the spacecraft for Project Apollo which NASA created to accomplish the moon landing. On July 28, 1961, NASA issued a request for proposal for development of the Apollo spacecraft. NAA's proposal was submitted to NASA's Space Task Group at Langley Field on October 9. A team of twelve men from S&ID led by Lee Atwood and Harrison Storms presented an oral briefing to the NASA Group on the proposal. On November 28, NASA announced that S&ID was awarded contract NAS9-150 to produce the command (CM) and service modules (SM) and the launch escape subsystem (LES). Earlier, on September 11, NASA had awarded S&ID contract NAS7-200 to produce the S-II stage which at the time was to be the second stage of the Apollo Saturn C-3 launch vehicle. Thus, within six weeks, S&ID became NASA's principal contractor for Project Apollo.

The Saturn C-3 was subsequently canceled but on November 6, 1961, MSFC directed NAA to design the S-II with five Rocketdyne J-2 engines as the second stage of the Saturn C-5, the vehicle which would launch the Apollo spacecraft carrying the astronauts to the moon. The S-II was the largest hydrogen-fueled rocket stage built up to that time – 81 ft. 7 in. long, 33 ft. in diameter and weighing up to 1,075,000 pounds fully fueled. Because of its great size, the S-II would be constructed vertically and shipped through the Panama Canal to KSC by barge. To facilitate this, the stage was built in Seal Beach. Approximately 10,800 NAA personnel worked on the S-II project.

On April 19, 1962, Buildings 3 and 6 were transferred to S&ID from the Autonetics Division adding 700,000 square feet of office and manufacturing area. A year later, Buildings 2, 4, and 5 were acquired by S&ID when Autonetics moved to Anaheim and in April, 1964, Buildings 302, 303, and 305 were leased.

The Apollo spacecraft contract called for the development and fabrication of 49 manned or test CM's and SM's, 30 boilerplate vehicles, 23 full-scale mockups, accompanying spacecraft-LM adapters (SLA), 5 test fixtures, 4 mission simulators, 3 evaluators, 5 trainers, 2 miscellaneous SLA, and tracking and ground support equipment. The CM weighed 13,000 pounds and contained over two million functional parts and 15,000 wires but used only two kilowatts of electrical power. The SM had a total length of 24 ft. 2 in., a diameter of 12 ft. 10 in. and a fueled weight of up to 54,000 pounds. The SM supplied the electricity, water, oxygen and primary

propulsion for the CM. With the launch escape system (LES), the combined spacecraft was 65 feet long, weighed 75,000 pounds, and had a total of 32 rocket engines.

Testing constituted nearly 50% of the development of the Apollo spacecraft. Tests included 7 escape motor tests, 40 parachute drop tests, 48 CM land-impact tests, 52 CM water-impact tests, 15.5 hours of CSM acoustic/vibration tests, 277.6 hours of CSM modal survey testing, 773 hours of CSM thermal vacuum tests, and 1474.5 minutes of SM propulsion system tests. Wooden mock-ups were built to provide configuration information and to develop manufacturing methods and metal boilerplates were used for engineering tests.

The first drawing was received on January 15, 1962, and fabrication began on February 9. The first mock-up was completed on June 11, and the first completed CM boilerplate, BP-25, began recovery tests near the entrance to the Los Angeles Harbor on August 7. One month later, the first boilerplate CM accepted by NASA, BP-1, was delivered to the Space Division Engineering Development Laboratory for land and water impact tests. The Apollo impact test facility was completed in Downey the following February and impact testing began on March 11, 1963. On March 12, the first flight-rated boilerplate, BP-13 was completed and shipped to MSFC. In November, the first launch test (PA-1) of the LES took place at White Sands Missile Range, New Mexico, using BP-6.

On April 15, 1964, Dale Myers was named program manager for Apollo, succeeding vice president John Paup who was named assistant to president Harrison Storms. On May 28, BP-13 became the first Apollo spacecraft put into orbit. On July 1, NASA took over the Industrial Facilities in Downey, formerly known as Air Force Plant 16.

During February 1965 the first Block II CM mock-ups (M-26 and M-27) were completed and in October, the first actual Apollo spacecraft, CSM-009, was completed and accepted by NASA. By the end of the year, employment at S&ID peaked at 35,385 about $\frac{3}{4}$ of whom worked in Downey. On January 20, 1966, the first launch of a Block I command module, CM-002, took place on a Little Joe II booster at White Sands and the LES became the first Apollo spacecraft subsystem to be qualified for manned flights. Five weeks later, CSM-009 became the first fully-configured Apollo spacecraft to be launched into space and recovered.

On January 27, 1967, tragedy struck Project Apollo when Gus Grissom, Ed White and Roger Chaffee died in a fire in CM-012 at Pad 34 while preparing for the first manned Apollo flight. The subsequent investigation resulted in extensive modification to the command module, incorporating more than 1800 changes to systems and procedures. In April, Bill Bergen, former president of Martin Aircraft, replaced Harrison Storms as president and in May, Buz Hello became vice president of S&ID for launch operations. In September, Rockwell-Standard Corporation merged with NAA to become North American Rockwell and Willard Rockwell replaced Lee Atwood as chairman of the board. S&ID was renamed the Space Division.

On November 9, the Apollo project began its recovery with the maiden flight of the Saturn V on Apollo 4 and the first orbital flight of an Apollo spacecraft, CM-017/SM-020, which qualified the heat shield for lunar missions. In 1968, the first manned flight of the Apollo spacecraft, CSM-101, took place on Apollo 7 and on the very next flight, astronauts Borman, Lovell and Anders traveled aboard CSM-103 to become the first men to orbit the moon during the Christmas flight of Apollo 8. Eight months later, CSM-107 code-named "Columbia" took the Apollo 11 astronauts to the moon and Armstrong and Aldrin became the first men to land on the lunar surface.

During the Apollo 13 mission, the number 2 oxygen tank in the SM exploded causing the mission to be aborted and the crew to use the Lunar Module "Aquarius" as a lifeboat. As a result of the mishap, further modifications to the CSM were made including additional cryogenic oxygen in the SM. The final manned lunar mission took place on Apollo 17 which returned safely on December 19, 1972.

The next manned U.S. space project was Skylab, America's first experimental space station, which made extensive use of Apollo hardware. Three crews consisting of nine astronauts spent 171 days aboard Skylab from May 25, 1973 to February 8, 1974. The final use of Apollo flight hardware took place in July 1975 on the joint U.S.-Soviet Apollo-Soyuz Test Project (ASTP). In addition to the CSM, the docking module was built at the Space Division and served as an airlock and transfer tunnel between Apollo and Soyuz.

Fifteen crews rode in Apollo spacecraft on six earth orbital and nine lunar missions totaling nearly 285 days. The Space Division-built command modules were the only Apollo flight hardware to survive the missions intact. They are now the responsibility of the Smithsonian Institution.

APOLLO COMMAND MODULE RECORD
- Mock-ups -

ID No.	Utilization	Completed	Site	Disposition*
Block I				
M-1/E-1	CM Evaluator 1.	Early 62	Downey	?
M-1/E-2	CM Evaluator 2.	March 62	MSC	?
M-2/E-3	Engineering design evaluation studies.	12/62	KSC	?
M-2/E-4	Engineering design evaluation studies.	12/62	KSC	?
M-3	Engineering design evaluation studies.	6/62	KSC	KSC
M-4	Partial SM and adapter only.-----			
M-5	Official configuration control mockup.	6/62	Downey	?
M-6	SM only. Requirement deleted 4/62.-----			
-				
M-7	SM only.-----			
-				
M-8	-----Requirement deleted 4/62-----			
-				
M-9	Size, weight and cg evaluation.	12/62	Tulsa	?
M-10/E-5	Req't deleted 3/26/62--structural shell became Evaluator 5-----			
M-11	Size, weight and cg evaluation.	12/62	KSC	KSC
M-12	Crew support systems.	12/62	Downey	?
M-13	-----Requirement deleted 3/26/62-----			
-				
M-14	-----Requirement deleted 3/26/62-----			
-				
M-15	-----Requirement deleted 3/26/62-----			
-				
M-16	Partial SM only. Requirement deleted 3/26/62-----			
-				
M-17	Partial SM only. Requirement deleted-----			
-				
M-18	Simulation of complete spacecraft.	12/31/62	Downey	?
M-19	-----Requirement deleted-----			
-				
M-20	-----Requirement deleted-----			
-				
M-21	Adapter only. Requirement deleted-----			
-				
M-22	Evaluate interior and exterior arrangement.	8/63	MSC	?
M-23	Partial CSM. Umbilical tests.	11/64	MSFC	?
Block II				
M-24	Wiring and tubing mockup.	12/65	Downey	?

M-25	SM only.-----			
-				
M-26	Tooling mockup. Lower equipment bay.	2/65	Downey	?
M-27	Tooling mockup. Forward deck.	2/65	Downey	?
M-28	Mockup for astronaut's review.	4/30/65	Downey	?
M-29	SM only. House test model.-----			
-				

*There is a command module mockup on display at the Planes of Fame Museum in Chino, CA.

APOLLO COMMAND MODULE RECORD
- Boilerplates -

ID No.	Utilization	Completed	Site	Disposition
BP-1	Land and water impact tests.	9/7/62	Dny/MSC	?
BP-2	Land and water impact tests.	12/62	Dny/MSC	?
BP-3	Showed cabin interior arrangement.	9/10/62	El Centro	Destroyed.
BP-4	-----Requirement deleted-----			
-				
BP-5	-----Requirement deleted 8/62-----			
-				
BP-6	First launch test (PA-1) 11/7/63.	3/8/63	WSMR	?
BP-7	-----Requirement deleted-----			
-				
BP-8	-----Requirement deleted-----			
-				
BP-9A	Launched on SA-10 7/30/65.	3/6/63	MSFC/KSC	NR
BP-10	-----Requirement deleted-----			
-				
BP-11	-----Requirement deleted-----			
-				
BP-12	A-001 test 5/13/64.	12/63	WSMR	Lancaster
BP-13	Launched on SA-6 (A-101) 5/28/64.	12/17/64	KSC	NR
BP-14	NAA house Block I spacecraft #1.	9/64	Downey	?
BP-15	Launched on SA-7 (A-102) 9/18/64.	6/64	KSC	NR
BP-16	Launched on SA-9 (A-103) 2/16/65.	8/64	KSC	NR
BP-17	-----Requirement deleted-----			
-				
BP-18	-----Requirement deleted-----			
-				
BP-19	Parachute recovery tests.	2/63	El Centro	LACMNH
BP-20	-----Requirement deleted-----			
-				
BP-21	-----Requirement deleted 8/62-----			
-				
BP-22	High altitude abort test (A-003) 5/19/65.	3/17/65	WSMR	JSC
BP-23	Abort tests A-002 and PA-2.	9/64	WSMR	WSMR
BP-24	-----Requirement deleted-----			
-				
BP-25	Water recovery and handling tests.	8/62	MSC	Ft. Worth
BP-26	Launched on SA-8 (A-104) 5/25/65.	8/64	KSC	NR
BP-27	Dynamic tests.	10/64	MSFC	MSFC
BP-28	Water and land impact tests.	7/64	Downey	?
BP-29	Flotation tests.	4/65	MSC	Meteor
Crater				
BP-30	Backup for CM-020.	9/30/66	KSC	KSC

BP-213	Helicopter drop tests	?	?	River Grove, IL
BP-1101A	?	?	?	Wheat Ridge, CO
BP-1102A	?	?	?	Louisville, KY
BP-1206	?	?	?	Suffolk, UK
BP-1207	?	?	?	Howie-in-Hills, FL
BP-1210	?	?	?	Enid, OK
BP-1220	?	?	?	Durham, NC
BP-1224-1	Flammability tests.	?	MSC	Webster, TX
BP-1227	?	?	?	Grand Rapids
BP-1250-C	Flammability and cabin vent tests.	?	?	?

APOLLO COMMAND MODULE RECORD
- Block I -

ID No.	Utilization	Site	Disposition
CM-001	-----SM only-----		
CM-002	Power-on abort test (A-004) 1/20/66.	WSMR/Dny	Cradle of Aviation, Garden City, NY
CM-003	-----Requirement deleted-----		
-			
CM-004	Structural tests.	Downey	Scrapped
CM-005	-----Requirement deleted-----		
-			
CM-006	Block II ECS tests.	Downey	Scrapped
CM-007	Post landing tests.	Downey/MSC	Museum of Flight, Seattle, WA
CM-008	Thermal vacuum tests.	MSC	Scrapped
CM-009	Launched on AS-201 (Apollo 1A) 2/26/66.	KSC	Municipal Airport, Lincoln, NE
CM-010	Backup for CM-002.	WSMR	Space & Rocket Ctr., Huntsville, AL
CM-011	Launched on AS-202 ("Apollo 2") 8/25/66.	KSC	Dulles Int'l Airport, Washington, DC
CM-012	Damaged in Apollo 1 fire 1/27/67.	KSC	NASA LaRC, VA
CM-013	-----Requirement deleted-----		
-			
CM-014	Land test.	KSC	Scrapped
CM-015	Same as BP-18.	KSC	N/A
CM-016	-----Requirement deleted-----		
-			
CM-017	Launched on AS-501 (Apollo 4) 11/9/67.	KSC	Stennis Space Ctr, MS
CM-018	-----Requirement deleted-----		
-			
CM-019	-----Requirement deleted-----		
-			
CM-020	Launched on AS-502 (Apollo 6) 4/4/68.	KSC	Fernbank Science Center, Atlanta, GA
CM-098	?	?	Academy of Science, Moscow, Russia
CM-099	?	?	Scrapped

APOLLO COMMAND MODULE RECORD
- Block II -

ID No.	Utilization	Site	Disposition
CM 2S-1	Ground and water tests.	Downey	?
CM 2S-2	Static structural tests.	Downey	?
CM 2TV-1	Thermal vacuum tests.	MSC	?
CM 2TV-2	Assigned to Skylab tests.	MSC	?
CM-100	?	?	?
CM 101	Launched on AS-205 (Apollo 7) 10/11/68.	KSC	Nat'l. Museum of Science & Tech., Ottawa, Canada
CM 102	Pad 34 checkout.	KSC	Scrapped
CM 103	Launched on AS-503 (Apollo 8) 12/21/68.	KSC	Chicago Museum of Science & Tech., IL
CM 104	Launched on AS-504 (Apollo 9) 3/3/69.	KSC	MI Space & Science Center, Jackson, MI
CM 105	ASTP demonstration.	?	NASM, Wash., DC
CM 106	Launched on AS-505 (Apollo 10) 5/18/69.	KSC	Science Museum, London, UK
CM 107	Launched on AS-506 (Apollo 11) 7/16/69.	KSC	NASM, Wash., DC
CM 108	Launched on AS-507 (Apollo 12) 11/14/69.	KSC	VA Air & Space Center, Hampton, VA
CM 109	Launched on AS-508 (Apollo 13) 4/11/70.	KSC	KS Cosmosphere & Space Ctr., KS
CM 110	Launched on AS-509 (Apollo 14) 1/31/71.	KSC	US Astronaut Hall of Fame, Titusville, FL
CM 111	Launched on AS-210 (Apollo 18) 7/15/75.	KSC	KSC, FL
CM 112	Launched on AS-510 (Apollo 15) 7/26/71.	KSC	USAF Museum, Dayton, OH
CM 113	Launched on AS-511 (Apollo 16) 4/16/72.	KSC	US Space & Rocket Ctr., Huntsville, AL
CM 114	Launched on AS-512 (Apollo 17) 12/7/72.	KSC	Space Ctr Houston
CM 115	-----Requirement deleted-----		JSC, Houston, TX
CM 116	Launched on AS-206 (Skylab 2) 5/25/73.	KSC	Naval Av. Museum, Pensacola, FL
CM 117	Launched on AS-207 (Skylab 3) 7/28/73.	KSC	LeRC, Cleveland, OH
CM 118	Launched on AS-208 (Skylab 4) 11/16/73.	KSC	NASM, Wash., DC
CM 119	AS-210 backup and AS-208 rescue.	KSC	Apollo/Saturn V Center, KSC, FL

APOLLO COMMAND and SERVICE MODULE FLIGHTS

<u>Date</u>	<u>Mission</u>	<u>CM/SM</u>	<u>Code Name</u>	<u>Launch Vehicle</u>	
Unmanned Test Flights					
<u>Boilerplate</u>					
11/7/63	PA-1	BP-6	-----	LES	
5/13/64	A-001	BP-12	-----	Little Joe II	LJII #2
5/28/64	A-101	BP-13	-----	Saturn I	SA-6
9/18/64	A-102	BP-15	-----	Saturn I	SA-7
12/8/64	A-002	BP-23	-----	Little Joe II	LJII #3
2/16/65	A-103	BP-16	-----	Saturn I	SA-9
5/19/65	A-003	BP-22	-----	Little Joe II	LJII #4
5/25/65	A-104	BP-26	-----	Saturn I	SA-8
6/29/65	PA-2	BP-23A	-----	LES	
7/30/65	A-105	BP-9A	-----	Saturn I	SA-10
<u>Block I</u>					
1/20/66	A-004	CM-002	-----	Little Joe II	LJII #5
2/26/66	“Apollo 1A”	CSM-009	-----	Saturn IB	AS201
8/25/66	“Apollo 2”	CSM-011	-----	Saturn IB	AS202
11/9/67	Apollo 4	CM017/SM020	-----	Saturn V	AS501
4/4/68	Apollo 6	CM020/SM014	-----	Saturn V	AS502
Manned Flights (Block II)					
10/11-22/68	Apollo 7	CSM-101	-----	Saturn IB	AS205
12/21-27/68	Apollo 8	CSM-103	-----	Saturn V	AS503
3/3-13/69	Apollo 9	CSM-104	Gumdrop	Saturn V	AS504
5/18-26/69	Apollo 10	CSM-106	Charlie Brown	Saturn V	AS505
7/16-23/69	Apollo 11	CSM-107	Columbia	Saturn V	AS506
11/14-24/69	Apollo 12	CSM-108	Yankee Clipper	Saturn V	AS507
4/11-17/70	Apollo 13	CSM-109	Odyssey	Saturn V	AS508
1/31-2/9/71	Apollo 14	CSM-110	Kitty Hawk	Saturn V	AS509
7/26-8/7/71	Apollo 15	CSM-112	Endeavor	Saturn V	AS510
4/16-27/72	Apollo 16	CSM-113	Casper	Saturn V	AS511
12/7-19/72	Apollo 17	CSM-114	America	Saturn V	AS512
5/25-6/22/73	Skylab 2	CSM-116	-----	Saturn IB	AS206
7/28-9/25/73	Skylab 3	CSM-117	-----	Saturn IB	AS207
11/16/73-2/8/74	Skylab 4	CSM-118	-----	Saturn IB	AS208
7/15-24/75	ASTP	CSM-111	Apollo	Saturn IB	AS210

SATURN S-II STAGE RECORD

<u>ID No.</u>	<u>Utilization</u>	<u>Disposition</u>
S-II-S/D	Structural / dynamic test stage.	Destroyed on test stand 9/29/65.
S-II-T	All systems test stage.	Destroyed on test stand 5/28/66.
S-II-F/D	Facilities integration / dynamic test stage.	On display at the US Space & Rocket Center, Huntsville, AL
S-II-1	Flight stage.	Flown: SA-501, Apollo 4, 11/9/67.
S-II-2	Flight stage.	Flown: SA-502, Apollo 6, 4/4/68.
S-II-3	Flight stage.	Flown: SA-503, Apollo 8, 12/21/68.
S-II-4	Flight stage.	Flown: SA-504, Apollo 9, 3/3/69.
S-II-5	Flight stage.	Flown: SA-505, Apollo 10, 5/18/69.
S-II-6	Flight stage.	Flown: SA-506, Apollo 11, 7/16/69.
S-II-7	Flight stage.	Flown: SA-507, Apollo 12, 11/14/69.
S-II-8	Flight stage.	Flown: SA-508, Apollo 13, 4/11/70.
S-II-9	Flight stage.	Flown: SA-509, Apollo 14, 1/31/71.
S-II-10	Flight stage.	Flown: SA-510, Apollo 15, 7/26/71.
S-II-11	Flight stage.	Flown: SA-511, Apollo 16, 4/16/72.
S-II-12	Flight stage.	Flown: SA-512, Apollo 17, 12/7/72.
S-II-13	Flight stage assigned to Apollo 18*/Skylab.	Flown: SA-513, Skylab 1, 5/14/73.
S-II-14	Flight stage assigned to Apollo 19*.	On display at KSC, FL.
S-II-15	Flight stage assigned to Apollo 20*.	On display at JSC, TX.

*mission canceled.

CHRONOLOGY OF EVENTS DURING PROJECT APOLLO

1960

- 1960 **Dutch Kindelberger retires as Chief Executive Officer.**
- 1960 **Lee Atwood becomes CEO and president of NAA.**
- 3/17/60 8th Lunar and Planetary Exploration Colloquium held at the NAA Recreation Center in Downey.
- 7/28-29/60 The first NASA-Industry Program Plans Conference is held to acquaint industry with the agency's plans for advanced spacecraft and circumlunar missions.
- 7/29/60 **NASA announces the Apollo program & objective to land men on the moon.**
- 9/13/60 NASA briefs prospective bidders on the Apollo project study contract.
- 12/5/60 **Harrison Storms, chief engineer of the Los Angeles Division, named president of the Missile Division in Downey.**
- 12/16/60 **Space and Information Systems Division (S&ID) established to consolidate NAA space system programs; renamed from Missile Development Division. Dale Myers becomes Vice President of S&ID.**

1961

- 4/18/61 Representatives from 30 aerospace firms, including NAA, attend a bidders conference on the S-II stage at MSFC.
- 5/15/61 Initial design and development bids for the S-II stage are submitted by seven companies, including NAA.
- 5/25/61 **President Kennedy sets landing a man on the moon by end of decade as national goal.**
- 6/15/61 NASA asks four of the companies, including NAA, bidding for the S-II stage to submit detailed proposals.
- 6/61 S&ID announces its intention to submit a proposal for the Apollo spacecraft.
- 7/18/61 A NASA-Industry Apollo Technical Conference is held for representatives of potential Apollo contractors.
- 7/28/61 **NASA issues a request for proposal to 12 companies including NAA for the Apollo spacecraft prime contract.**
- 8/1/61 NASA presents a briefing to potential Apollo spacecraft contractors.
- 9/11/61 **NASA announces that S&ID is awarded contract NAS7-200 to develop and build the S-II stage.**
- 10/9/61 **The proposal for the Apollo program is submitted to NASA's Space Task Group at the Chamberlain Hotel, Old Point Comfort, VA.**
- 10/11/61 **A team of 12 men, including Lee Atwood, Harrison Storms, and J. W. Paup present an oral briefing to the NASA Space Task Group on NASA's proposal for the Apollo spacecraft.**
- 10/27/61 First Saturn I launch.
- 11/6/61 MSFC directs NAA to design the S-II with five J-2 engines for use as the second stage of the Saturn C-5.
- 11/28/61 **NASA announces that contract NAS9-150 for Apollo CSM spacecraft -- command and service modules and the launch escape subsystem -- is**

awarded to S&ID of NAA – effectively making the division NASA’s principal contractor in the Apollo program.

- 12/5/61 Negotiations for the Apollo contract are held. Boilerplate program is added.
- 12/12/61 **NAA’s letter contract for the Apollo spacecraft is signed.**
- 12/21/61 **The first four major Apollo subcontractors announced by S&ID. Letter contract No. NAS9-150, authorizing work on the Apollo program beginning January 1 is signed by NASA and NAA.**

1962

- 1/15/62 **First mockup drawing received.**
- 1/22/62 **The first Apollo engineering order is issued for fabrication of the first mockups of the Apollo command and service modules.**
- 1/27/62 Preliminary master plan for manufacturing the Apollo spacecraft is released.
- 2/62 Steel construction is changed to welded aluminum.
S&ID sends pilot staff to Tulsa, Oklahoma, for Apollo and Saturn overload operation.
- 2/9/62 **Fabrication effort begins on mock-ups. Preliminary contract awarded to NAA to design and fabricate the S-II stage.**
- 2/14/62 **NAA announces that S&ID will take over part of the USAF plant at Tulsa for work on Apollo.**
- 3/62 **CM Evaluator 1 (M-1) is completed.**
- 3/62 CM Evaluator 2 (M-2) is completed.
- 3/62 Buildings in Torrance are leased.
- 3/26/62 Requirement for mock-ups M-13, M-14, M-15, and M-16 deleted.
- 4/62 Requirement for mock-ups M-6 and M-8 deleted.
- 4/4/62 **Mockup of the Apollo command module, prepared by S&ID in support of the Apollo proposal, is shown to the public for the first time.**
- 4/19/62 **Harrison Storms announces that 700,000 square feet of office and manufacturing area (Buildings 3 and 6) in the Downey complex will be transferred to S&ID from the Autonetics Division.**
- 5/62 S-II stage lengthened from 75.1 ft. to 81.3 ft.
- 6/11/62 First mockup, for cabin exterior equipment, is completed.
- 6/62 Mock-ups M-3, M-4, M-5, M-7 are completed.
- 6/20/62 A temporary water pool, 20 by 20 ft and 10 ft deep is completed for interim flotation and water-impact tests of the Apollo CM.
- 7/5/62 **The first spacecraft parachute drop test is conducted at El Centro.**
- 7/13/62 NASA officially informs S&ID of the selection of the LOR mode for lunar missions.
- 7/23/62 **S&ID’s first employee for the Apollo Program arrives at Cape Canaveral, Florida.**
- 8/2/62 The heat shield for Apollo BP-1 is completed.
- 8/7/62 **First completed CM boilerplate (BP-25) of the Apollo command module begins water recovery & handling tests near the entrance to the Los Angeles Harbor.**
- 8/62 **Dutch Kindleberger dies. Lee Atwood succeeds him as NAA’s chairman of the board.**

- 8/62 The first test incorporating data acquisition in the Apollo test program is completed at El Centro.
- 8/62 Requirement for boilerplates BP-5 and BP-21 deleted.
- 8/62 S&ID begins move into AF Plant 3 in Tulsa Oklahoma.
- 9/6/62 NASA deletes five Apollo mock-ups, three boilerplate articles, and several GSE items from the contract.
- 9/7/62 **First boilerplate CM (BP-1) is accepted by NASA and delivered to the Space Division Engineering Development Laboratory for land and water impact tests.**
- 9/10/62 Boilerplate BP-3 is completed and shipped to MSC in Houston.
- 10/31/62 The firm-cost proposal for the definitive Apollo program is completed and submitted to NASA.
- 12/62 BP-2 is completed for land and water impact tests at Downey.
- 12/62 Block I CM mockups M-2, M-9, M-11, M-12, M-18 are completed.

1963

- 1963 Buildings in El Segundo are leased.
S&ID becomes the largest U.S. industrial space center with 22,800 employees.
- 1/63 Cold-flow testing of both CM and SM RCS are initiated at Downey.
- 1/14/63 **The first meeting between S&ID and Grumman engineers on the Apollo LM is held in Downey.**
- 2/15/63 **The Apollo impact-test facility is completed.**
- 2/63 BP-19 is completed for parachute recovery tests at El Centro.
- 2/28/63 **Complete mating and alignment of BP-9 CM, SM, adapter, and LES are accomplished in the Navajo test tower. First mating of a major Apollo vehicle structure.**
- 3/6/63 BP-9 is completed for dynamic tests at MSFC.
- 3/8/63 BP-6 is completed for pad abort tests at White Sands.
- 3/11/63 **Land and water impact tests at the impact-test facility with BP-2 start.**
- 3/12/63 **BP-13, the first flight-rated boilerplate to be completed, is accepted by NASA and shipped to MSFC.**
- 4/63 **Buildings 2, 4, and 5 acquired by S&ID when Autonetics moves to Anaheim.**
- 5/63 SM subassembly operations begin.
- 5/63 Concept of using radioactive particle emissions to measure propellant in the RCS tanks is selected – the first application of this technique.
- 5/3/63 BP-19 parachute recovery tests of earth landing system at El Centro start.
- 5/24/63 BP-15 is completed for Saturn launch environment tests.
- 7/63 First aft bulkhead is bonded.
- 8/63 SM assembly operations begin.
- 8/63 CM subassembly operations begin.
- 8/63 Mockup M-22 is completed.
- 8/14/63 The definitive contract for the Apollo spacecraft through 5/15/65 is executed by NASA: 11 mock-ups, 15 boilerplate capsules and 11 flight-ready spacecraft for \$934.4 million (including \$50 million fixed fee)
- 8/30/63 In-house cold plate eutectic bonding operations begin.

9/6/63 Parachute recovery test of BP-3 takes place at El Centro. BP-3 is destroyed.
 10/63 CM-009 assembly begins.
 10/2/63 First cold plate is completed and delivered to MIT.
 10/19/63 Apollo CM BP-19 makes a successful parachute test at El Centro.
 11/7/63 **The first launch test (PA-1) – a pad abort test of BP-6 – is conducted at White Sands.**
 11/22/63 **President John F. Kennedy is assassinated.**
 12/63 BP-12 is completed for testing at White Sands.
 12/63 Heat shield design is changed to use open-face fiberglass honeycomb bonded to the substructure and the cells filled with ablative material.
 12/63 A concept is adopted whereby a portion of the SLA is to be split into four panels and hinged outward to expose the LM.
 12/6/63 P & W delivers the first prototype Apollo fuel cell to S&ID.

1964

1/2/64 The initial SM structural assembly, SM 001, is delivered to systems installation.
 1/23/64 The initial crew compartment weld assembly, SC 006, is completed.
 2/17/64 BP-13 is completed and shipped to KSC for booster compatibility tests.
 2/19/64 SC-006 crew compartment bonded assembly is completed.
 2/64 NASA directs S&ID to install deployable canard surfaces on the forward end of the Apollo LES motor to provide for aerodynamically orienting the CM during parachute recovery. A boost protective cover is added to the LES in order to protect the CM windows and heat shield surfaces. Water recovery is chosen as the primary mode to minimize impact-system requirements.
 2/64 CM Mockup #22 is completed.
 3/64 Site Activation organization is formed – Clear Lake Facility Site Activation commences.
 4/64 Two fuel cell modules are connected in parallel and successfully operated for the first time in the S&ID test facilities.
 4/64 **Buildings 302, 303, and 305 are leased. (303 & 305 were newly constructed)**
 4/15/64 **Dale Myers, S&ID Vice President, is named Program Manager for Apollo, succeeding Vice President John Paup, who is named assistant to President Harrison Storms.**
 4/28-30/64 **The first mockup review of the Block I Apollo CSM is held at S&ID.**
 5/64 Buildings in Compton and Building 312 in North Long Beach are leased.
 5/13/64 The second test flight (A-001) – transonic abort test -- of the Apollo program occurs at White Sands when BP-12 is launched by a Little Joe II.
 5/28/64 **Apollo CM BP-13 becomes first Apollo vehicle placed in orbit.** A-101 is launched on SA-6.
 6/64 BP-15 is completed for booster compatibility tests at KSC.
 6/64 The unmanned Block I spacecraft mission objectives are defined to enable final design of the automated controls.
 7/1/64 **NASA Industrial Facilities, Downey, formerly AF Plant 16, is taken over by NASA.**
 7/64 BP-28 is completed for water and land impact tests at Downey.

7/64 Initial hardware from major subcontractors is delivered – for use in testing with BP-14.

7/8-9/644 The second mockup review of the Block I Apollo CSM is held at S&ID.

7/18/64 The primary spacecraft heat shield assemblies (for SC-006 CM) are completed and shipped to AVCO for ablation application.

8/64 BP-16 and BP-26 are completed.

8/64 Initial activation effort at the Downey site for start of BP-14 testing is completed.

8/14/64 BP-14 testing at Downey starts.

9/64 Modifications to BP-6 are completed – redesignated BP-6A.

9/64 BP-23 is completed for max Q test at White Sands.

9/18/64 Apollo BP-15 is successfully orbited by Saturn I (SA-7) on A-102 mission.

9/30/64 **Second Block II Apollo CSM mockup review is held.**

10/64 BP-27 is completed for dynamic tests at MSFC.

10/30/64 SC 009 heat shield assemblies are completed and shipped to AVCO.

11/64 Partial CM, SM, and LES Mockup #23 is completed.

11/64 Go-ahead is given for a two-phase CSM development program – Blocks I and II.

11/64 Compatibility of the acceptance checkout equipment with spacecraft equipment and S&ID checkout facilities are confirmed by operating all equipment together for the first time using Boilerplate 14.

11/23/64 NASA gives a formal go-ahead to NAA for manufacture of Block II Apollo CSM.

12/8/64 BP-23 is launched in a high Q abort test (A-002) on Little Joe II at White Sands.

12/18/64 **The first spacecraft hardware item to be delivered, SC 001 SM, is shipped to WSMR.**

12/23/64 SC 009 CM and SM are transferred to Bldg. 290 for system installations.

12/31/64 Mock-up M-23 is completed.

1965

1965 **Robert Greer joins Space Division as Assistant to President and becomes S-II Program Director later in year.**

1/65 **First qualification tests successfully completed are of the launch escape and pitch control motors.**

2/65 **Activation of AFRM 001 for the SPS at the Propulsion System Development Facility at WSMR is completed – the SPS installed in SM-001 is first hot fired.**

2/65 **First Block II CM mockups (M-26, M-27) are completed.**

2/16/65 BP-16 is launched in a micrometeoroid test (AS-103) on SA-9.

3/17/65 BP-22 is completed for high altitude abort test at White Sands.

3/24/65 **Systems installation on SC-009 is completed.**

4/65 **Water and land impact tests with BP-28 at the S&ID Impact Test Facility.**

4/65 CM-009 arrives at test division at Downey.

4/65 BP-29 is completed for flotation tests at MSC.

4/16/65 NASA announces that future structures for Apollo SM will be built at S&ID's Tulsa plant.

4/24/65 **First test firing of the S-II stage is performed at Santa Susana.**

4/26/65 Completed SC 009 heat shield assemblies are received at S&ID from AVCO.

4/30/65 Block II CM mockups M-27A and M-28 are completed.

5/65 Buildings on Warner Road in Anaheim and Bldg. 318 at Lakewood & Bellflower Blvd. Are leased.

5/65 BP-23 is modified for pad abort test at White Sands – redesignated BP-23A.

5/65 Testing of a completely integrated environmental control system is initiated in the S&ID Downey complex.

5/7/65 **SC 009 LES – the first LES – is completed.**

5/19/65 BP-22 is launched in a planned high-altitude test (A-003) of LES on LJ-II at White Sands.

5/25/65 BP-26 is launched on SA-8 Saturn I on the AS-104 mission.

5/29/65 SC 009 crew compartment heat shield structural assembly operations are completed -- initial structural completion of an AVCO-covered crew compartment heat shield assembly.

6/65 Activation of Downey site for SC-009 is completed.

6/29/65 BP-23A is successfully launched during a pad abort test (PA-2) at White Sands.

7/65 BP-12 modifications for water impact tests at Downey are completed -- redesignated BP-12A.

7/65 CM-004 is completed for structural tests at Downey.

7/16/65 Pregnant Guppy returns heat shield for SC 009.

7/30/65 BP-9A is launched on SA-10 to place Pegasus 3 into orbit on the AS-105 mission.

8/13/65 Apollo SM SC 012 is delivered to the clean room of Bldg. 290 following completion of structural assembly.

8/19/65 ELS is given a parachute qualification drop test using BP-19 at El Centro.

8/30/65 SPS engine is fired 29 times during the week at White Sands.

9/29/65 S-II-S/D is destroyed on test stand in post-test pressurization accident.

10/1/65 Three 43” Apollo flotation bags are completed and packaged.

10/7/65 The first Apollo LM adapter ordnance separation test firings are completed at S&ID Tulsa plant.

10/8/65 CSM 002 is shipped to White Sands for power-on tumbling abort test.

10/20/65 **The first actual Apollo spacecraft, CSM-009, is accepted by NASA.**

10/24/65 CM-009 is shipped to KSC – arrives 10/25.

11/5/65 An Apollo CM equipped with a new aft heat shield and unitized couch is dropped into the water pool at Downey.

11/26/65 Modifications to CM-004 are completed for static and thermal structures tests at Downey. Redesignated CM-004A.

12/65 Block II mockups M-24 and M-25 are completed.

12/6-17/65 The critical design review of the Block II CSM (mockup M-27A) is held.

12/8/65 NAA signs Apollo Contract Supplemental Agreement No. 115 to change the Apollo contract from a CPFF to a Cost-Plus-Incentive-Fee contract.

12/17/65 **Peak of Apollo program – 35,385 people are employed by the division, about ¾ of whom work at Downey.** Command modules accepted by NASA to date include 18 mockups, 18 boilerplates, and 2 spacecraft.

12/26/65 CSM-009 is mated with the Saturn IB at KSC.

12/29/65 S-II stage is ground tested for 18 seconds.

1966

1/3/66 \$148,000 contract is awarded to NAA for 9-month study to determine impact of proposed improved J-2 engine on the S-II stage.

1/12/66 S-II is static fired at Santa Susana Field Lab for 354 seconds.

1/19/66 NASA approves Supplemental Agreement No. 115.

1/21/66 NAA's CSM contract is converted from cost-plus-fixed-fee to cost-plus-incentive fee.

1/20/66 **A power-on tumbling abort test (A-004) of the LES is conducted at White Sands with the launch of CM-002 on a Little Joe II. The LES is declared qualified. First launch of a Block I CM and last launch of a Little Joe II.**

2/3/66 **First static test firing of production version of LES rocket motor – becomes the first Apollo spacecraft subsystem to complete NASA qualification tests for manned flights.**

2/26/66 **First unmanned space flight of actual fully-configured Apollo spacecraft (CSM-009) is launched on AS-201 (“Apollo 1A”). First Apollo spacecraft recovered from flight.**

4/7/66 SM propulsion engine test phase is completed.

4/23/66 **First captive firing of Saturn V S-II stage test vehicle – 15 sec. firing.**

5/66 Modifications to BP-6A are completed – redesignated BP-6B.

5/17/66 S-II test fired for 150 seconds.

5/25/66 S-II test fired for 350 seconds.

5/25/66 SA-500F vehicle is rolled out to LC-39A. S-II-T is tested in ground firing.

5/28/66 S-II-T is destroyed when LH2 tank explodes on test stand at MTF.

6/66 Last Block II mockup (M-29) is completed.

8/25/66 Second successful test using CSM-011 on AS-202 (“Apollo 2”) – recovered in Pacific.

9/30/66 BP-30 is completed as a backup for CM-020 at KSC.

10/66 **The first Apollo Block II parachute qualification test is conducted at El Centro.**

12/3/66 The cost-plus-incentive-fee contract with NASA expires.

12/66 S-II accepted as flight-worthy.

1967

1/21/67 First S-II stage arrives at KSC.

1/27/67 **Apollo 1 disaster with CSM-012.**

4/67 A NASA task team led by astronaut Frank Borman charged with overseeing Block II CSM redefinition begins work at S&ID to provide input on detail design, overall quality and reliability testing, and scheduling.

4/67 **Bill Bergen, former president of Martin Aircraft, becomes president of NAA S&ID.**

5/67 **S&ID renamed “Space Division”.**

5/67 **Buz Hello becomes VP of Space Division for Launch Operations.**

9/22/67 **Rockwell-Standard Corporation merges with NAA, Inc. to become North American Rockwell Corporation. Willard Rockwell replaces Lee Atwood as chairman of the board.**

11/9/67 **Apollo 4 – first flight of Saturn V (AS-501) & orbital flight of a CSM (CM-017/SM-020). CM is recovered in Pacific and heat shield is qualified for lunar flight.**

1968

1/22/68 Apollo 5 launch.
2/3/68 Value of NAR Space Division contract with NASA's MSC on Apollo program reaches \$2.996 billion.
3/6-7/68 Design certification reviews of CSM-101 are held at MSC/Houston.
4/4/68 Apollo 6 – redesigned CSM (CM-020/SM-014) is tested in space launched on AS-502. Longest single burn of SPS engine in space.
5/29/68 CM-101 leaves Downey for KSC.
8/16/68 Jim Webb cables Washington authorizing preparations for a manned lunar mission.
9/7/68 SM-001 propulsion tests at WSTF are completed.
10/11/68 **Apollo 7 is launched on AS-205. First flight of Block II Apollo spacecraft (CSM-101). First manned Apollo mission.**
10/24/68 Last X-15 flight.
11/11/68 Tom Paine gives the go-ahead to launch Apollo 8 to the moon.
12/21/68 **Apollo 8 is launched on AS-503 with CSM-103. First manned flight to the moon.**

1969

3/3/69 Apollo 9 is launched on AS-504 with CSM-104 "Gumdrop".
5/18/69 Apollo 10 is launched on AS-505 with CSM-106 "Charlie Brown".
7/16/69 **Apollo 11 is launched on AS-506 with CSM 107 "Columbia". First men on the moon 7/20/69.**
11/14/69 Apollo 12 is launched on AS-507 with CSM-108 "Yankee Clipper".

1970

4/11/70 Apollo 13 is launched on AS-508 with CSM-109 "Odyssey".
7/31/70 **Value of NAR Space Division contract with NASA's MSC on Apollo program reaches \$3.3 billion.**

1971

1/31/71 Apollo 14 is launched on AS-509 with CSM-110 "Kitty Hawk".
7/26/71 Apollo 15 is launched on AS-510. First J-type Apollo spacecraft (CSM-112 "Endeavor").

1972

4/16/72 Apollo 16 is launched on AS-511 with CSM-113 "Casper".
7/26/72 **NASA announces that the Space Division is awarded the Space Shuttle Orbiter contract.**
12/7/72 Apollo 17 is launched on AS-512 with CSM-114 "America". Last Apollo mission to the moon.

1973

February North American Rockwell becomes Rockwell International.
5/14/73 Skylab is launched on AS-513.
5/25/73 Skylab 2 is launched on AS-206 with CSM-116.
7/28/73 Skylab 3 is launched on AS-207 with CSM-117.
11/16/73 Skylab 4 is launched on AS-208 with CSM-118.

1974

August Space Division completes the docking module for ASTP.

1975

7/15/75 ASTP is launched on AS-210 with CSM-111. **Final flight of Apollo spacecraft.**