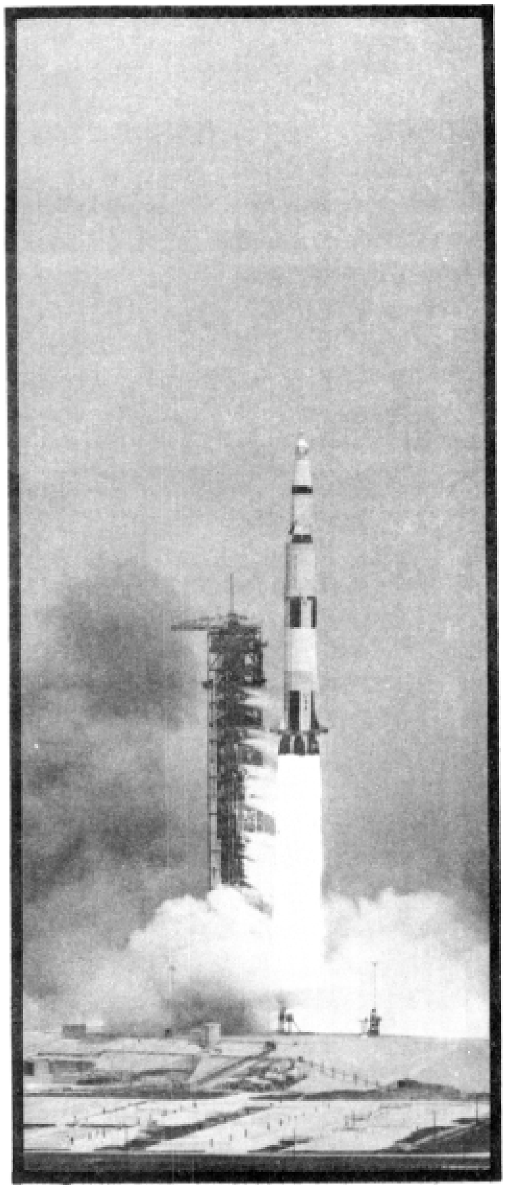
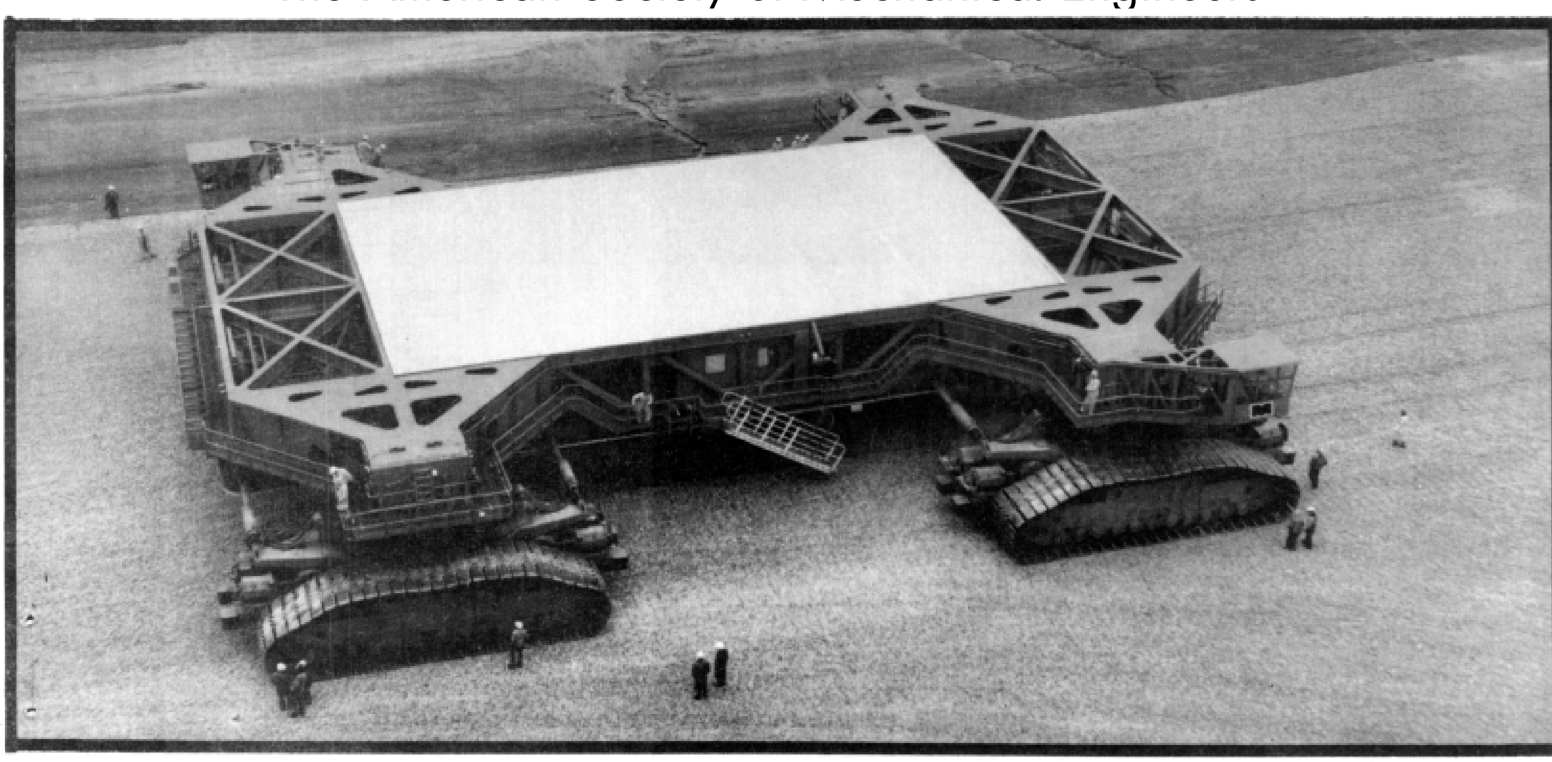


National Historic Mechanical Engineering Landmark

Crawler Transporters of Launch Complex 39, Kennedy Space Center

February 3, 1977

The American Society of Mechanical Engineers



INTRODUCTION

The two Crawler Transporters of Kennedy Space Center's Launch Complex 39 are the largest ground vehicles ever built. Each six-million-pound transporter can carry a twelve-million-pound Saturn V rocket and mobile launcher combination several miles to the launch pads. So versatile are the transporters that they will also be used to carry Space Shuttle vehicles, with the only modifications needed being adaptors to fit different vehicles.

To date, ASME's Engineering Landmarks Program has focused on technical achievements of the less-recent past. The Crawler Transporters were built in the mid-sixties, and are still in active use. Like all of their counter-part Landmarks, though, they represent high technical achievement, and played a significant role in the development of the nation. ASME is proud to dedicate the Crawler Transporters as National Historic Mechanical Engineering Landmarks.

DEDICATION CEREMONY

Crawler Transporters of Launch Complex 39

2:00 p.m., February 3, 1977

Welcome and Introduction of Honored Guests	James S. Roy, Vice President, Region XI, ASME
ASME Landmark Program	Dr. J. Paul Hartman, Member, ASME National History and Heritage Committee
History of the Crawler Transporters	D D Buchanan 3 Feb '77 D. D. Buchanan, Chief Engineer for the Crawler Transporters
Presentation of Plaque	Dr. Stothe P. Kezios, President-elect, ASME
Acceptance	Lee R. Scherer, Director, NASA, John F. Kennedy Space Center

A tour of a Crawler Transporter will be conducted shortly after the ceremony.

ACKNOWLEDGEMENTS

KENNEDY SPACE CENTER

Lee R. Scherer, Director
D. D. Buchanan, Chief Engineer, the Crawler Transporters

ASME CANAVERAL SECTION

Dr. Thomas E. Bowman, Chairman
Vincent Cassisi, Secretary
Dr. Armand Dil Pare, Chairman, History and Heritage Committee
Hudson C. Haile, Former Chairman, History and Heritage Committee

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Earle C. Miller, President
Dr. Rogers B. Finch, Executive Director and Secretary
James S. Roy, Vice President, Region XI
James A. Henly, Jr., History and Heritage Chairman, Region XI

THE ASME NATIONAL HISTORY AND HERITAGE COMMITTEE

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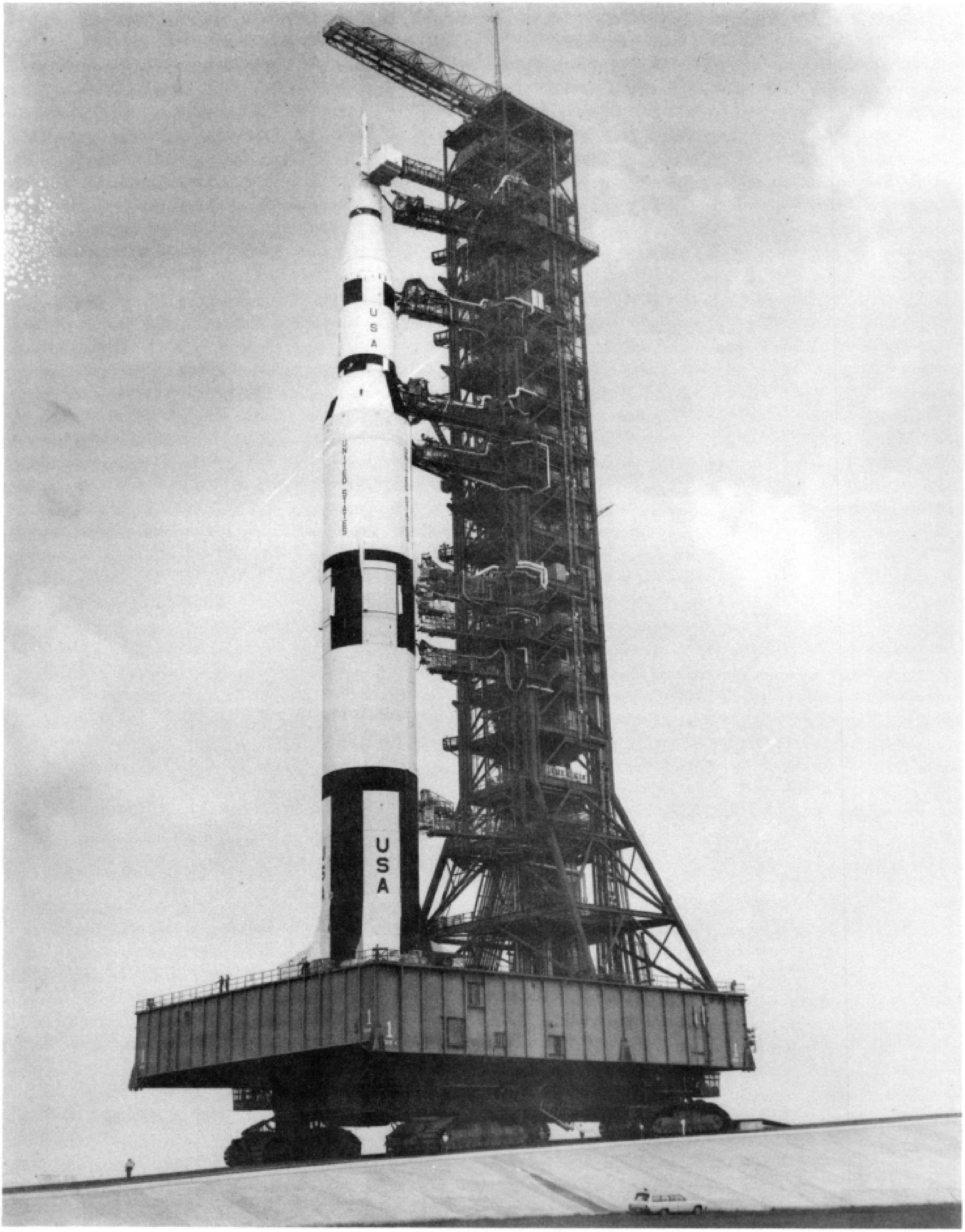
Professor R. S. Hartenberg	
Dr. J. Paul Hartman	
Dr. Otto Mayr (Ex-officio)	Smithsonian Institution
Maurice Jones	ASME Staff Liaison

Brochure author: Hudson C. Haile, Former Chairman, History and Heritage Committee, Canaveral Section
Brochure design: Peter Serratore, ASME Public Relations Staff



TRANSPORTER WITH MOBILE LAUNCHER & SATURN V

EARLY CONCEPTS

In 1961, President Kennedy set a national goal of making a manned landing on the moon before the end of the decade. The National Aeronautics and Space Administration was assigned the responsibility of accomplishing this awesome feat. At the time, neither the huge and extremely sophisticated flight hardware nor the supporting launch facilities existed.

While other NASA facilities tackled the job of designing and developing the Saturn V launch vehicle and Apollo spacecraft for transporting three men to the moon, Kennedy Space Center began the design of the launch complex.

Heading the team at KSC was Dr. Kurt H. Debus, KSC Director and rocketry pioneer with launch experience dating from the 1930's.

Because of the size and complications of handling the huge Saturn V rocket and the adverse environmental factors of wind, rain, highly corrosive salt air, electrical storms, and hurricanes that exist at KSC, Dr. Debus' team departed from the conventional methods of assembly and checkout at the launch pad, and decided that the Saturn V would be assembled and checked out in a vehicle assembly building, and then transported to the launch pad on a mobile launch tower.

Conveyance of the mobile launcher and Saturn V to the pad posed no small problem in 1961. The rocket and launcher would weigh 12 million pounds, and the distance would be 3.5 miles to Pad A and 5 miles to Pad B. In addition, a portable service tower would be required to be transported to the launch pads for servicing the Saturn V.

There were three concepts of transporting the vehicle and launcher -- a barge and canal system, a rail system, and a land transporter. The task of selecting one of these three and then transforming a concept into reality fell to Mr. D. D. Buchanan, then Chief of the Launcher Systems and Umbilical Tower Design Section, now Associate Director for Design.

After a year of study, it was decided in 1962 that the cross-land tracked vehicle, or transporter, would be the most feasible conveyance.

Early concepts of the transporter showed the transporter integral with the mobile launcher, but exposure to launch damage and possible long repair periods influenced the selection of a transporter that would be completely self-powered and separate from the structures. The transporter would be the largest land vehicle ever constructed, would weigh six million pounds by itself, and would be capable of transporting either the mobile launcher with assembled Saturn V, or the mobile service structure.

In July 1962, NASA Headquarters in Washington, D.C., approved the crawler transporter concept and in March 1963, a contract was awarded to Marion Power Shovel Co., Marion, Ohio, for construction of two transporters.

THE TRANSPORTERS

Construction

Although the Marion Power Shovel Co. had years of experience building large self-propelled strip mining shovels, the largest in existence in 1963 had only a 48-foot square chassis. The KSC transporters by comparison are 131 feet long and 114 feet wide. The pieces were built in Marion, Ohio, and assembled at KSC. The first transporter was completed and made its first unloaded run in 1965. By 1967, both transporters were in service. Although the transporters travel at maximum speeds of only 1 MPH loaded and 2 MPH unloaded, each one had traveled 350 miles by 1970. The cost of these giants was $14,000,000.

Each transporter is equipped with four trucks, each with two tracks 41 feet 3 inches long and 7 feet 6 inches wide. Each track, or belt, consists of 57 individual treads, or shoes, weighing one ton each. The size of each track is roughly the same as a Greyhound bus.

Propulsion Machinery

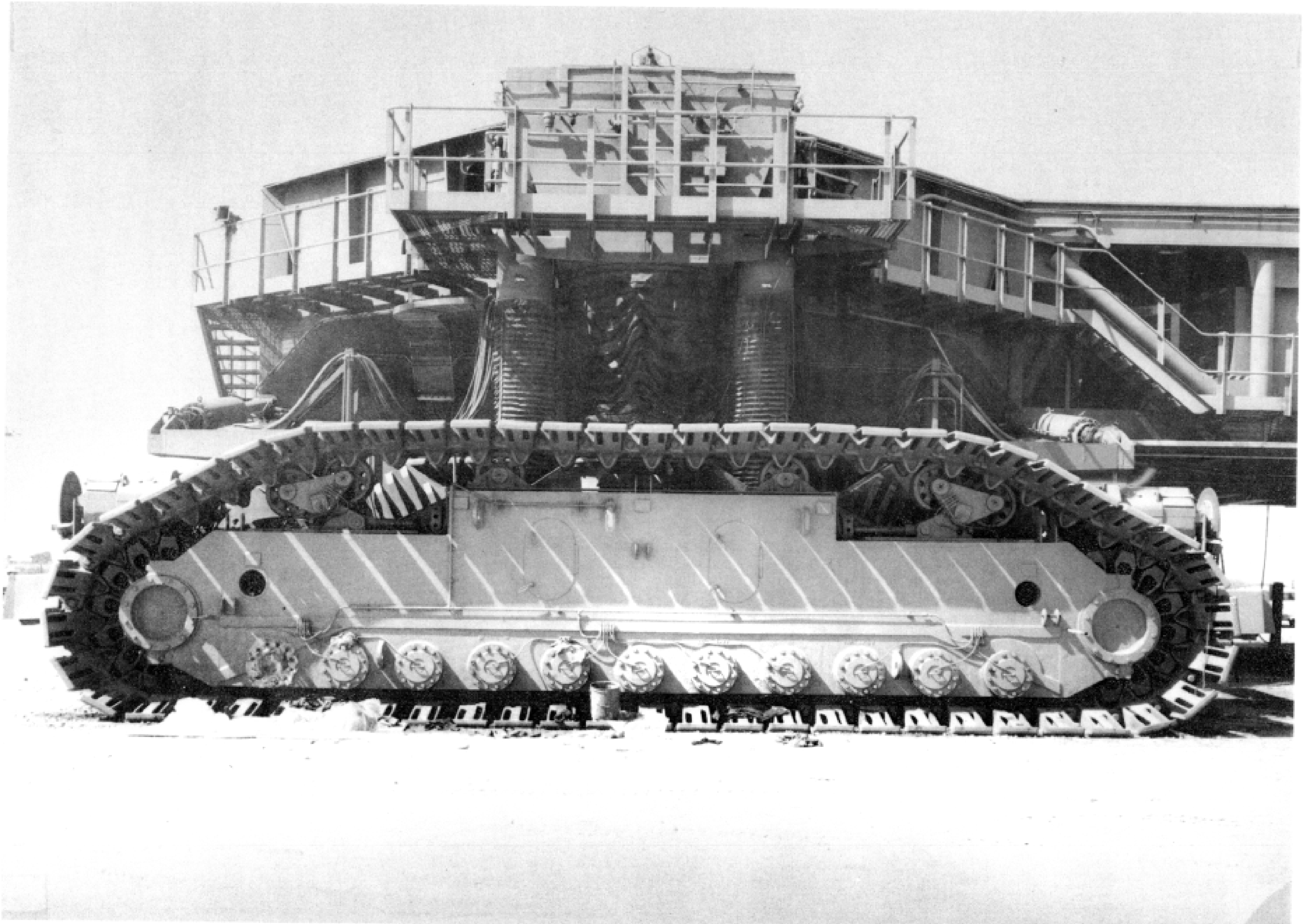
Sixteen traction motors mounted on the trucks are fed by four 1000 kilowatt DC generators driven by two 2,750 horsepower diesel engines. An additional two 750 kilowatt AC generators driven by two 1065 horsepower diesels provide power for leveling, jacking, and steering systems. Five thousand gallons of fuel are carried on board in order to supply the 150 gallon-per-mile fuel consumption rate. The diesel engines are cooled by six 500 gallon radiators, and lubricating pumps grease automatically into 176 bearings in the trucks.

Leveling System

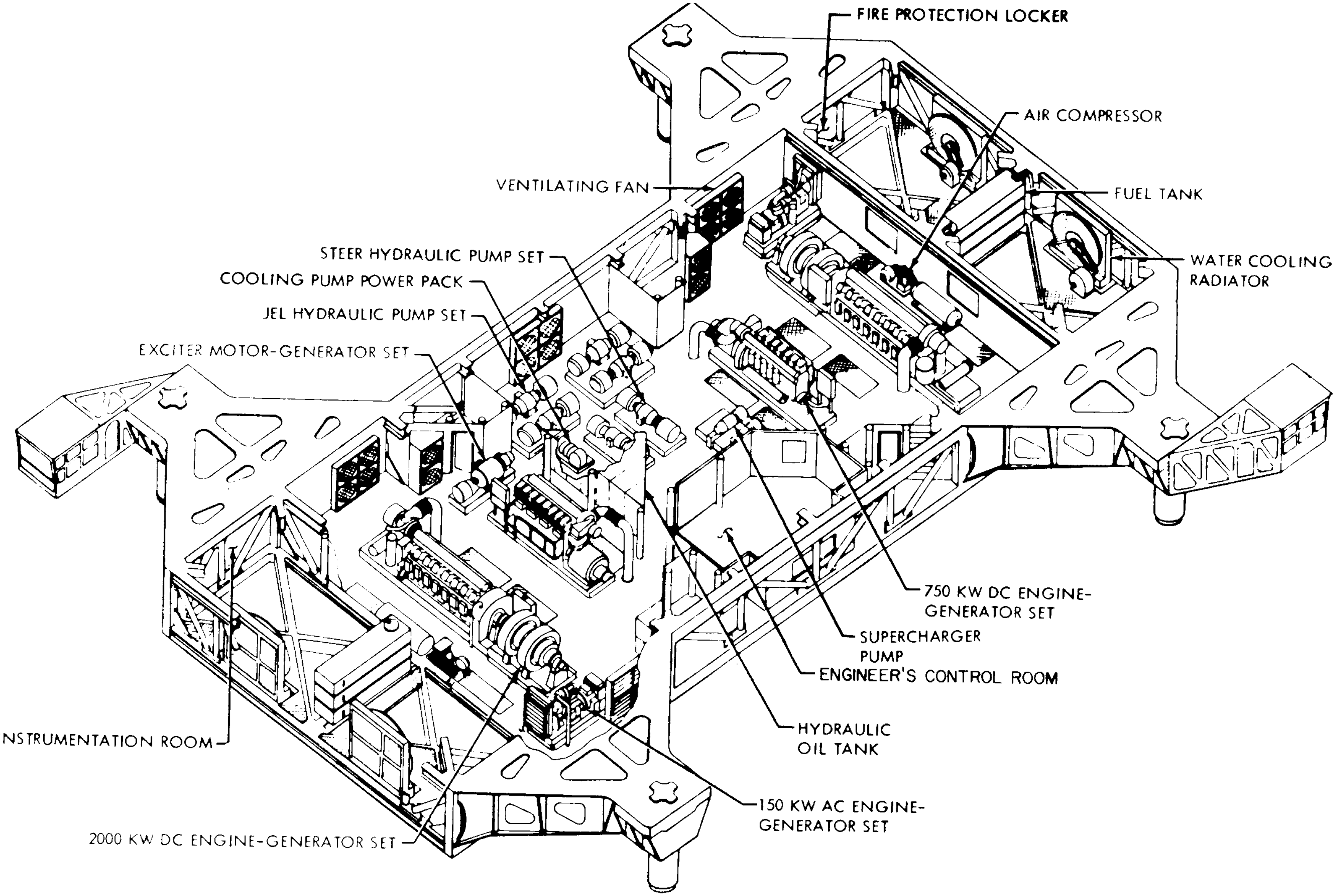
Leveling of the transporter is accomplished with two independent, but identical, hydraulic servo-systems. Two manometers located just under the deck with horizontal mercury-filled tubes 135 feet long cross diagonally at the middle to form an X and sense and control leveling. Transducers sense errors in leveling and transmit signals to a servo-system which operates four variable control pumps, two for each diagonal axis. The pumps operate four hydraulic cylinders at each corner of the transporter to support the load and maintain it in a level condition. Stabilizing systems are required to counteract variations in roadway level, wind, and weight of load being transported.

Controls

Control cabs are mounted on each end of the transporter at opposite corners. Glass enclosed, the cab houses the control console and positions for the cab engineer or operator and an observer. Communications includes two-way radio, and the normal launch operations radio network. Since the operator cannot see the rear or opposite side, three observers walk with the transporter and communicate with the operator via two-way radio. The crew for operating the transporter systems consists of eleven personnel.



CRAWLER TRANSPORTER TRUCK



CRAWLER TRANSPORTER EQUIPMENT LOCATION

Operation

In operation, the transporter is driven under the mobile launcher in the VAB (vehicle assembly building) and accurately positioned. The hydraulic jacking system with 16 hydraulic jacks (four at each corner) is then activated to raise the transporter structure up for contact with the mobile launcher. The launcher is then lifted clear of its ground support pedestals and transporting begins. In route to the launch pad, the transporter senses any unevenness in the roadway and the leveling system automatically maintains the mobile launcher and launch vehicle in a vertical position within ± 10 minutes of arc. In other words, the top of a 363 foot launch vehicle does not deviate from the vertical by more than one foot. On the pad ramp during approach to the top of the pad, the same system compensates for the 5% grade of the ramp and maintains vertical alignment.

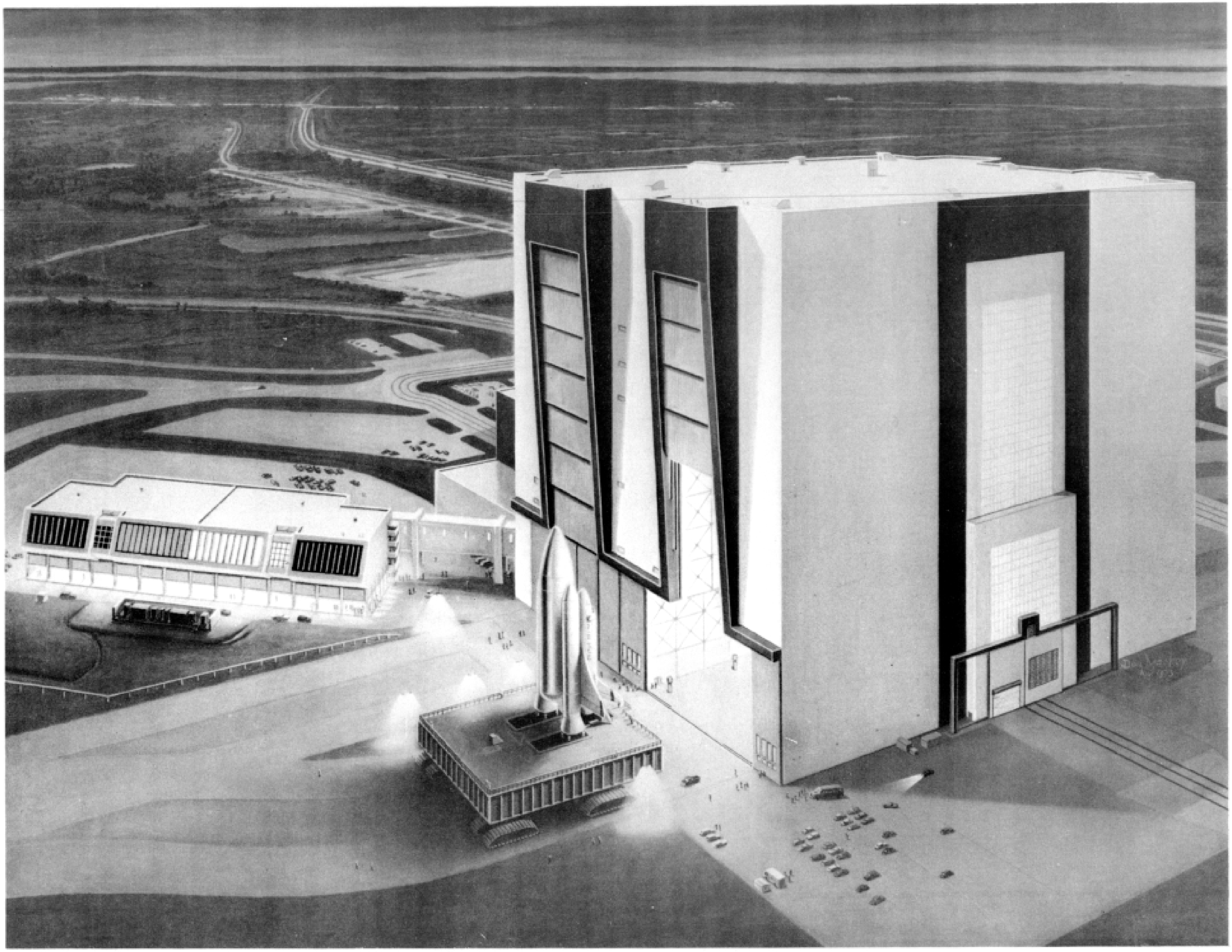
Once the launcher and vehicle are set down and bolted to the pad pedestals, the transporter withdraws a safe distance from the pad for launch. After launch, the operation is reversed and the mobile launcher is returned to the VAB.

The task of operating such a machine as the Transporter with all of the associated responsibility does not fall to one man. The Transporter is operated by a highly trained team of engineers and technicians, which is necessitated by the many complex electronic, electrical, and mechanical systems aboard. The team is headed by an Operations Director, who receives communications from various locations on the complex and gives the orders. The Control Room Engineer is second in command and coordinates the efforts of the other members of the team. The JEL engineer operates the JEL (jacking, equalization, and leveling) system from the JEL console in the control room to maintain the chassis and its cargo in a horizontal plane. The Cab Engineer sits in the driver's seat in the forward cab and actually initiates the signals for go,stop, turn, etc. He receives his orders by radio and regulates speed to ensure that the Transporter reaches its destination at the prescribed time.

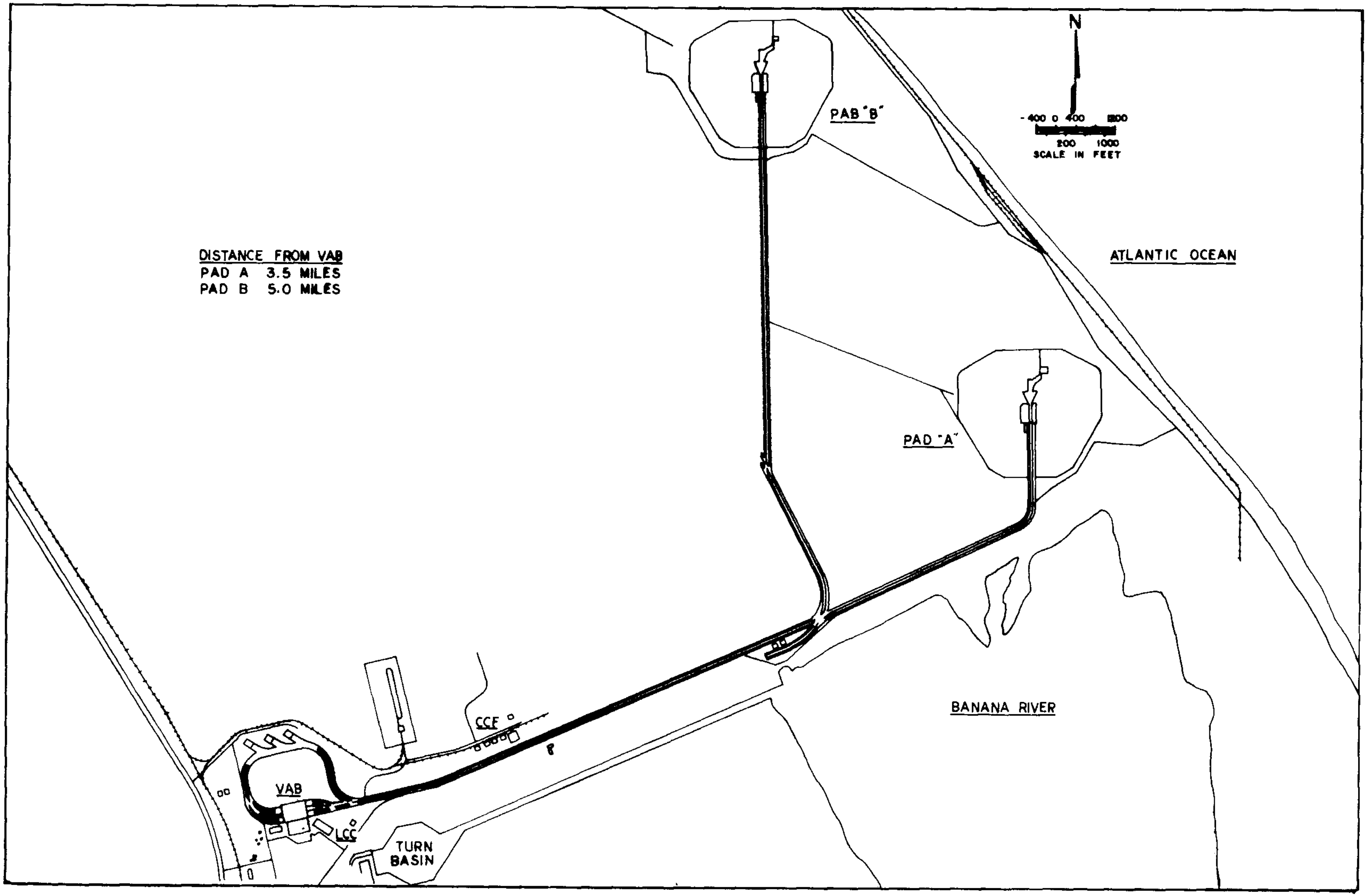
APPLICATION TO THE SHUTTLE PROGRAM

Of credit to the individual who designed the KSC Transporters is the fact they did not embark on exotic schemes that might have taken years to develop and would have cost many times more. Instead they used existing and proven concepts that were modified and ingeniously applied to the Apollo Program requirements.

The exceptional foresight that was exercised in making the Transporters separate and independent of the transported structures is obvious. Although the launch structures were modified to support the Apollo Skylab Program, no modification of the Transporters was necessary. In the Shuttle era, when launches may reach as many as 40 per year, the Transporters will truly be the workhorses of Complex 39 at KSC, and will continue to function into the 1990's as they exist today -- the same basic design initiated in 1962.



TRANSPORTER WITH SHUTTLE



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200 1000
SCALE IN FEET
PAB "B"
ATLANTIC OCEAN
DISTANCE FROM VAB
PAD A 3.5 MILES
PAD B 5.0 MILES
PAD "A"
BANANA RIVER
CCF
VAB
LCC
TURN BASIN

COMPLEX 39

NATIONAL HISTORIC MECHANICAL ENGINEERING LANDMARK PROGRAM

In September 1971 the ASME Council reactivated the Society's History and Heritage program with the formation of a National History and Heritage Committee. The overall objective of the Committee is to promote a general awareness of our technological heritage among both engineers and the general public. A charge given the Committee is to gather data on all works and artifacts with a mechanical engineering connection which are historically significant to the profession. An ambitious goal, and one achieved largely through the volunteer efforts of the Section History and Heritage Committees and interested ASME members.

Accordingly, two major programs are carried out by the Sections under the direction of the National Committee: (1) a listing of industrial operations and related mechanical engineering artifacts in local Historic Engineering Records; and (2) a National Historic Mechanical Engineering Landmark program. The former is a record of detailed studies of sites in each local area; the latter is a demarcation of local sites which are of national significance -- people or events which have contributed to the general development of mankind.

In addition, the Society cooperates with the Smithsonian Institution on a joint project which provides contributions of historical material to the U.S. National Museum of History and Technology in Washington, D.C. The Institution's permanent exhibition of mechanical engineering memorabilia is under the direction of a curator, who also serves as an ex-officio member of the ASME National History and Heritage Committee.

The Crawler Transporters of Launch Complex 39 are the eighteenth landmark to be designated since the program began in 1973. The others are:

Ferries and Cliff House Cable Railway Power House, San Francisco, CA - 1973
Leavitt Pumping Engine, Chestnut Hill Pumping Station, Brookline, MA - 1973
A. B. Wood Low-Head High-Volume Screw Pump, New Orleans, LA - 1974
Portsmouth-Kittery Naval Shipbuilding Activity, Portsmouth, NH - 1975
102-inch Boyden Hydraulic Turbines, Cohoes, NY - 1975
5000 KW Vertical Curtis Steam Turbine-Generator, Schenectady, NY - 1975
Saugus Iron Works, Saugus, MA - 1975
Pioneer Oil Refinery, Newhall, CA - 1975
Chesapeake & Delaware Canal, Scoop Wheel and Engines, Chesapeake City, MD - 1975
U.S.S. Texas, Reciprocating Steam Engines, Houston, TX - 1975
Childs-Irving Hydro Plant, Irving, AZ - 1976
Hanford B-Nuclear Reactor, Hanford, WA - 1976
Underground Air Conditioning, Magma Copper Mine, Superior, AZ - 1976
Manitou and Pike's Peak Cog Railway, Colorado Springs, CO - 1976
Edgar Steam-Electric Station, Weymouth, MA - 1976
Mt. Washington Cog Railway, Mt. Washington, NH - 1976
Folsom Power House #1, Folsom, CA - 1976