NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
MARSHALL SPACE FLIGHT CENTER, ALABAMA 35812

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

APR [illegible] 1975

REPLY TO
ATTN OF: SA42-92-75

TO: NASA Headquarters
Attn: MHE/Richard W. Williams

FROM: SA41/William C. Rice

SUBJECT: Thiokol Environmental Impact Statement

The subject document has been generated to describe the environmental impact during the manufacturing and test operations planned during the DDT&E phase at the Thiokol/Wasatch Division. Submittal of this document was previously discussed with Bill Saavedra, NASA Headquarters, as being a part of the environmental impact documentation required for the Space Shuttle Program. Enclosed for your information is a copy. One has been furnished to General Curtin in relation to the facilities contract at Wasatch. If you have any questions, please contact C. M. Mitchell, 453-4783. Additional copies can be made available to you if required.

W. C. Rice
William C. Rice
Deputy Manager
SRB Project Office

Enclosure

cc:
SA42/Mr. Mitchell
SA49/Mr. Burks
TC/HSV/Mr. Parker

TWR-10462

ENVIRONMENTAL IMPACT STATEMENT FOR SPACE SHUTTLE SOLID ROCKET MOTOR PROJECT MANUFACTURING AND TEST OPERATIONS AT THE WASATCH DIVISION

31 March 1975

DR 3-5

PREPARED FOR

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Thiokol / WASATCH DIVISION

A DIVISION OF THIOKOL CORPORATION

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ENVIRONMENTAL IMPACT STATEMENT FOR SPACE SHUTTLE SOLID ROCKET MOTOR PROJECT MANUFACTURING AND TEST OPERATIONS AT THE WASATCH DIVISION

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FOREWORD

This document presents the "Environmental Impact Statement" for the Solid Rocket Motor Project manufacturing and test operations that will be conducted at Thiokol Corporation, Wasatch Division, Promontory, Utah. This document fulfills the requirements of Technical Directive 15, dated 11 December 1974, as authorized by Letter Contract No. NAS8-30490, dated 26 June 1974.

The guidelines given in Attachment A to NMI 8800.7C, Council on Environmental Quality, Preparation of Environmental Impact Statements, Part II of the Federal Register, dated Wednesday, 1 August 1973, Volume 38, Number 147, were used in the preparation of this statement.

The requirement for use of International System of Units has been waived for this document.

SUMMARY

The manufacturing and testing activities for the Space Shuttle Solid Rocket Motor will be conducted at the Wasatch Division in northern Utah. Situated among low hills east of the Promontory Mountains, the plantsite is in a remote, almost uninhabited desert area. The nearest small town, Corinne, is 19 miles to the southeast; consequently, the area is free of the pollution problems attending more congested areas. Operations at the Wasatch Division commenced in late 1956. From that initial beginning until the present time, plant activity has encompassed a wide range of programs requiring the processing of solid propellants, rocket motor testing, and the industrial support necessary to achieve program goals. Rocket motors manufactured and tested during this 18 year period vary from 5 in. CP motors containing 7-9 lb of propellant to 156 in. Space Booster motors containing 700,000 lb of solid propellant. During this time period, no incidents of annoyance or injury to the general public have been experienced, nor have reports been received of damage to agricultural crops or animal life. The living habits of people in the vicinity of the plantsite have not been altered or changed, nor have there been any discernible population shifts in nearby ranches or communities.

The SRM project effort is essentially a continuing activity of the manufacturing and testing operations conducted at the Wasatch Division over the past 15 years. The most significant difference in comparison to other programs is the size of selected processing and handling equipment, volume of raw materials and processes and quantity production of solid propellant. It is therefore concluded that the manufacturing and test processes at the Wasatch Division plant will have no discernible impact on the local environment and ecology.

1.0 INTRODUCTION

In recent years there has been an increasing awareness by the general public of the need for protecting and improving the quality of the environment in which we live. Adverse environmental conditions which could endanger water and air quality, or cause pollution, damage to life systems, threats to health, or other adverse consequences to our environment, have always been of the utmost concern to Thiokol Corporation. With the award of the Solid Rocket Motor Project to Thiokol, this concern was increased by the realization that large quantities of raw materials and components will be received, stored, processed, tested and shipped at the Wasatch Division. The two major areas of environmental concern are the noise and exhaust products generated during the SRM static firings. It is Thiokol's goal to assure that quality of the total environment at, and surrounding, the Wasatch Division plant remains within acceptable limits and that any changes to this environment will not become offensive to the general public.

1.1 PURPOSE

The purpose of this document is to present information and data concerning the environmental impact incident to manufacture and test of the Space Shuttle Solid Rocket Motor at the Wasatch Division, Promontory, Utah. Preparation of this document also provided the means for review of existing policies and procedures to assure that they contain adequate controls to (1) insure that all SRM decision making processes include careful consideration of potential environmental effects, (2) actions are taken to protect our environmental quality, and (3) activities are continued to maintain constant awareness of Federal, State and local government requirements.

1.2 SCOPE

All environmental conditions induced by the manufacture and test of the SRM at the Wasatch facilities were systematically determined and their potential impact on the surrounding environment evaluated. The analysis utilized all currently available data and information from internal and external sources. Existing control measures were reviewed and found to be adequate to eliminate or significantly minimize any adverse effects on the existing environment which may result from SRM activity. This document specifically covers the effects of exhaust emissions and waste burning on air quality, noise generation from SRM static firings, water pollution, and industrial/sanitary waste disposal.

2.0 PROJECT DESCRIPTION

The Space Shuttle flight system (Figure 1) is composed of an Orbiter, an external tank (ET) that contains the ascent liquid propellant to be used by the Orbiter main engines, and two solid rocket boosters (SRBs). The Orbiter and SRBs are reusable; the external tank is expended on each launch. The SRBs and the Orbiter main engines will fire in parallel at liftoff. The two SRBs are separated from the Orbiter/external tank after burnout at an altitude of approximately 27 nautical miles and are recovered by means of a parachute system. After SRB separation, the Orbiter main propulsion system continues to burn until the Orbiter is injected into the required ascent trajectory. The external tank then separates and falls into the ocean. The Orbiter Maneuvering System (OMS) completes insertion of the Orbiter into the desired orbit. The primary elements of the SRB are the Solid Rocket Motor (SRM) including case, propellant, ignition system and nozzle; forward and aft structures; separation and recovery avionics; and thrust vector control subsystems.

The Solid Rocket Motor Project entails all activities necessary to design, develop, manufacture, test, and deliver segmented SRMs (Figure 2) for the Space Shuttle flight system. Each SRM will provide 2,900,000 lb of initial sea level thrust and deliver 290.6 x 10^6 lb-sec (vacuum) total impulse over 122.0 sec of action time. The maximum expected operating pressure (MEOP) is 936 psig. The current configuration is 146 in. diameter, 1,503 in. in overall length, contains 1,108,300 lb of propellant and has a total weight of 1,254,210 lb. The nozzle utilizes an expansion ratio of 7.16:1 and a flexible seal bearing capable of ± 8 deg deflection. Each motor consists of 11 weldfree D6AC case segments that are assembled into four casting segments prior to propellant loading. The casting segments consist of two interchangeable center segments, a forward segment and an aft segment. There are four deliverable segments per SRM. The material used for the internal insulation systems is an asbestos silica filled nitrile butadiene rubber (NBR). The SRM propellant is a polybutadiene acrylic acid acrylonitrile terpolymer binder (PBAN), ammonium perchlorate (AP), aluminum powder formulation. A small amount of

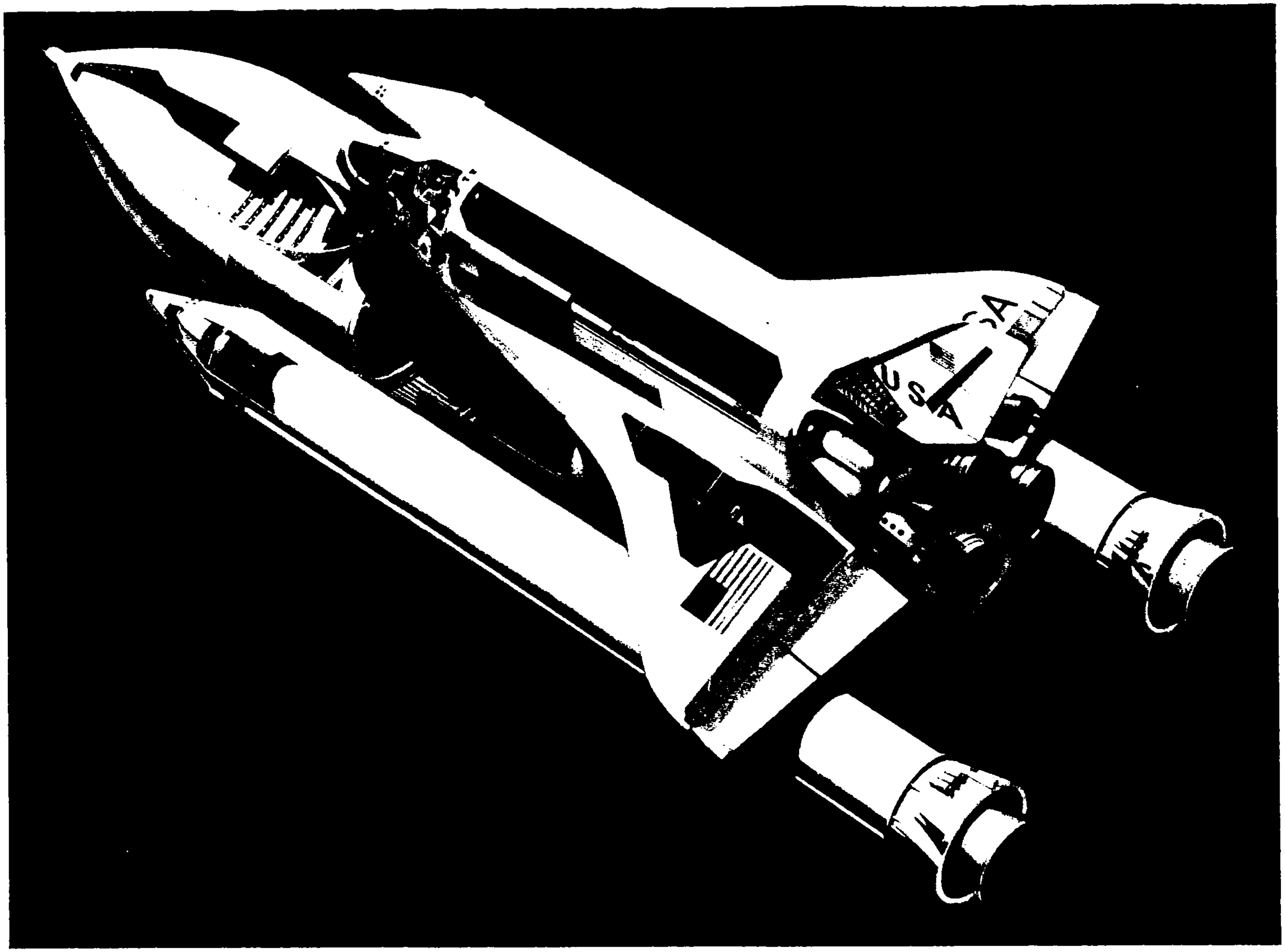

Figure 1. Space Shuttle Vehicle

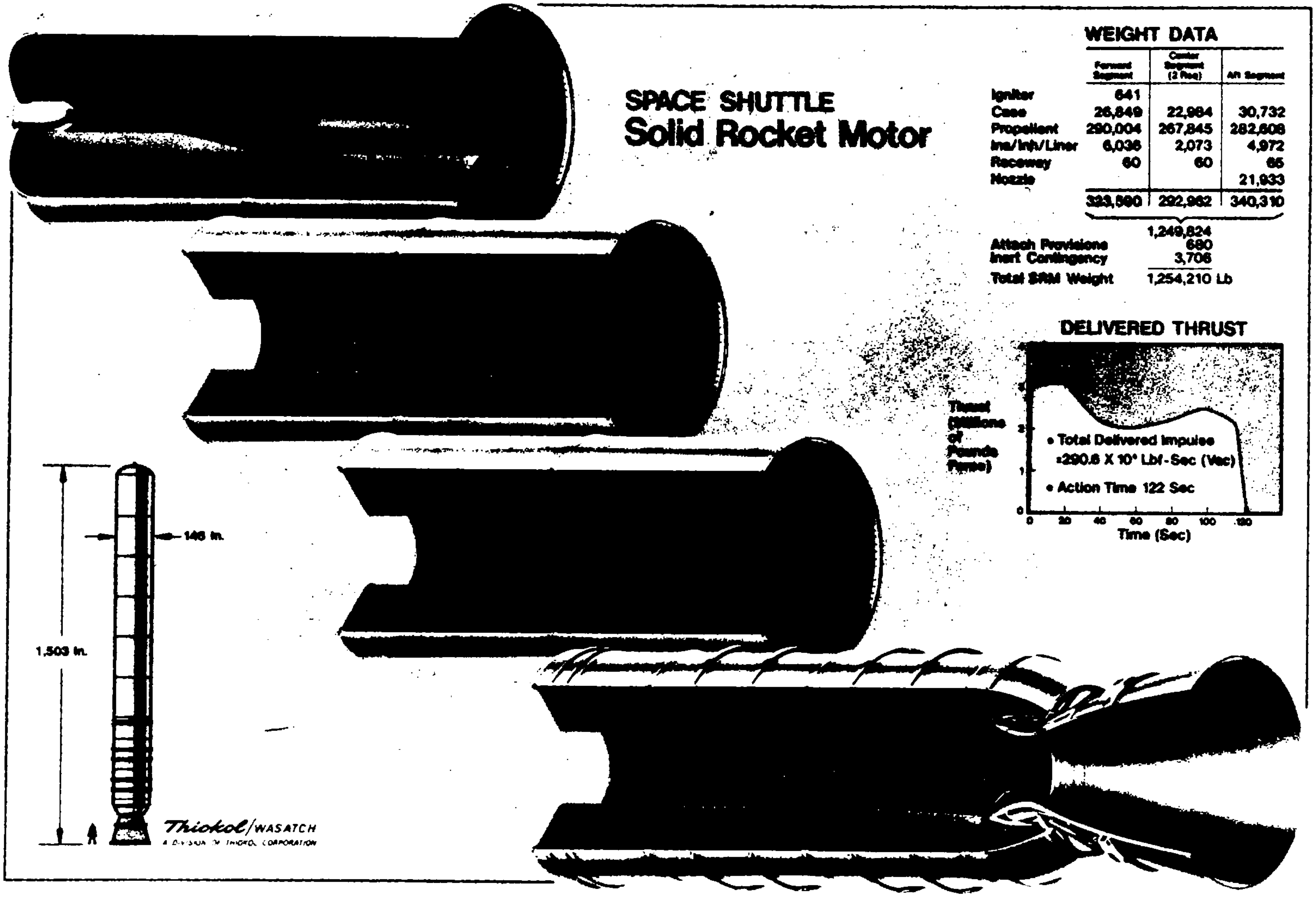

Figure 2. Solid Rocket Motor (SRM)

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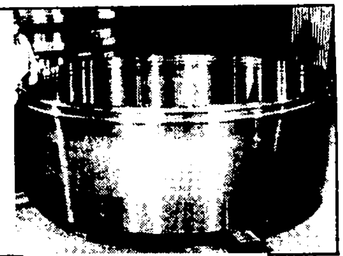
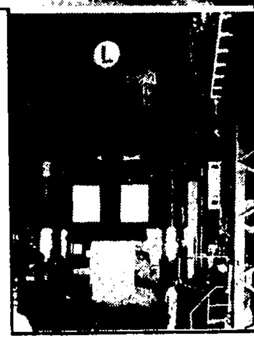
burning rate catalyst (iron oxide) has been added to achieve the desired propellant burning rate. The liner material is an asbestos filled HC polymer (carboxyl terminated polybutadiene) system. The SRM ignition system consists of a safety and arming (S&A) device; an igniter adapter; a small multinozzle, steel cased, solid propellant pyrogen initiator; and a single nozzle, steel cased, solid propellant main pyrogen igniter. The SRM propellant grain is of a conventional design, with a star-configured perforation in the forward casting segment and a truncated cone perforation in each of the center and aft casting segments.

The major processing activities associated with SRM manufacturing are case cleaning, protective coating, insulating, liner application, propellant manufacturing and loading, and nozzle, flex bearing and ignition system fabrication. An overview representation of the process flow is shown in Figure 3.

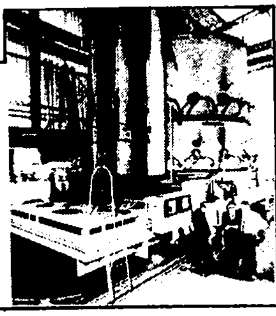
CASE SEGMENT FABRICATION

- FORGE AND ROUGH MACHINE

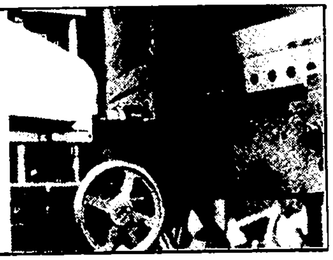




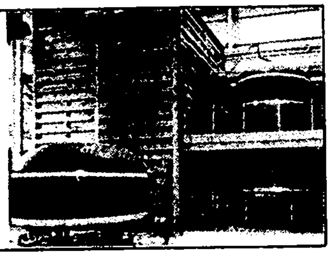
- HEAT TREAT



- FINAL MACHINE

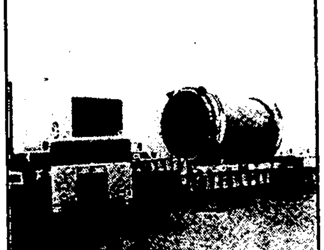


- PROOF TEST
- FINAL INSPECTION
- SHIP TO WASATCH DIVISION

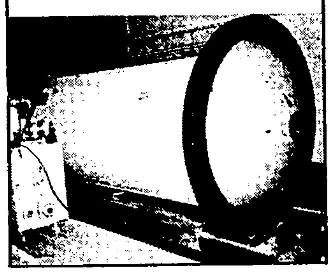


- RECEIVE AT WASATCH DIVISION
- VISUALLY INSPECT
- STORE

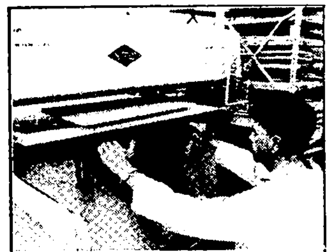
- TRANSPORT TO INERT PARTS PREPARATION COMPLEX
- VAPOR DEGREASE
- ASSEMBLE CASE SEGMENTS
- LEAK TEST JOINTS



- INSTALL CASTING SEGMENT IN PAINTING PIT
- PAINT AND CURE
- INSPECT

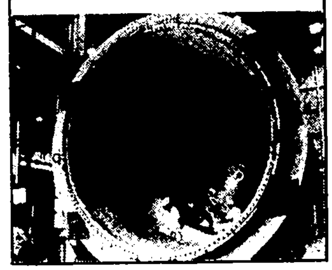


INSULATION PREPARATION

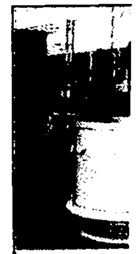


- RECEIVE AND STORE NBR PRECUT SECTIONS
- INSPECT

- APPLY CHEMLOK PRIMER
- CURE
- INSTALL MOLD RINGS
- LAY-UP INSULATION
- AUTOCLAVE
- CURE
- INSPECT



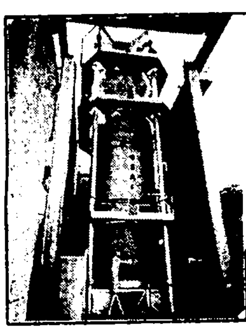
LINE



- RECEIVE LI
- INSPECT
- STORE
- MIX LINER
- INSPECT

- SOLVENT
- INSTALL C
- SLING LIN
- CURE LINE
- INSPECT

- VAPOR DEGREASE
- GRIT BLAST
- VAPOR DEGREASE
- MAGNETIC PARTICAL INSPECT
- VAPOR DEGREASE
- PRESERVE
- STORE

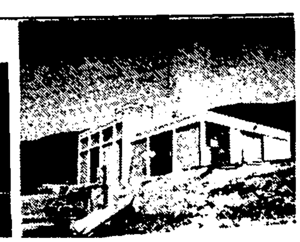


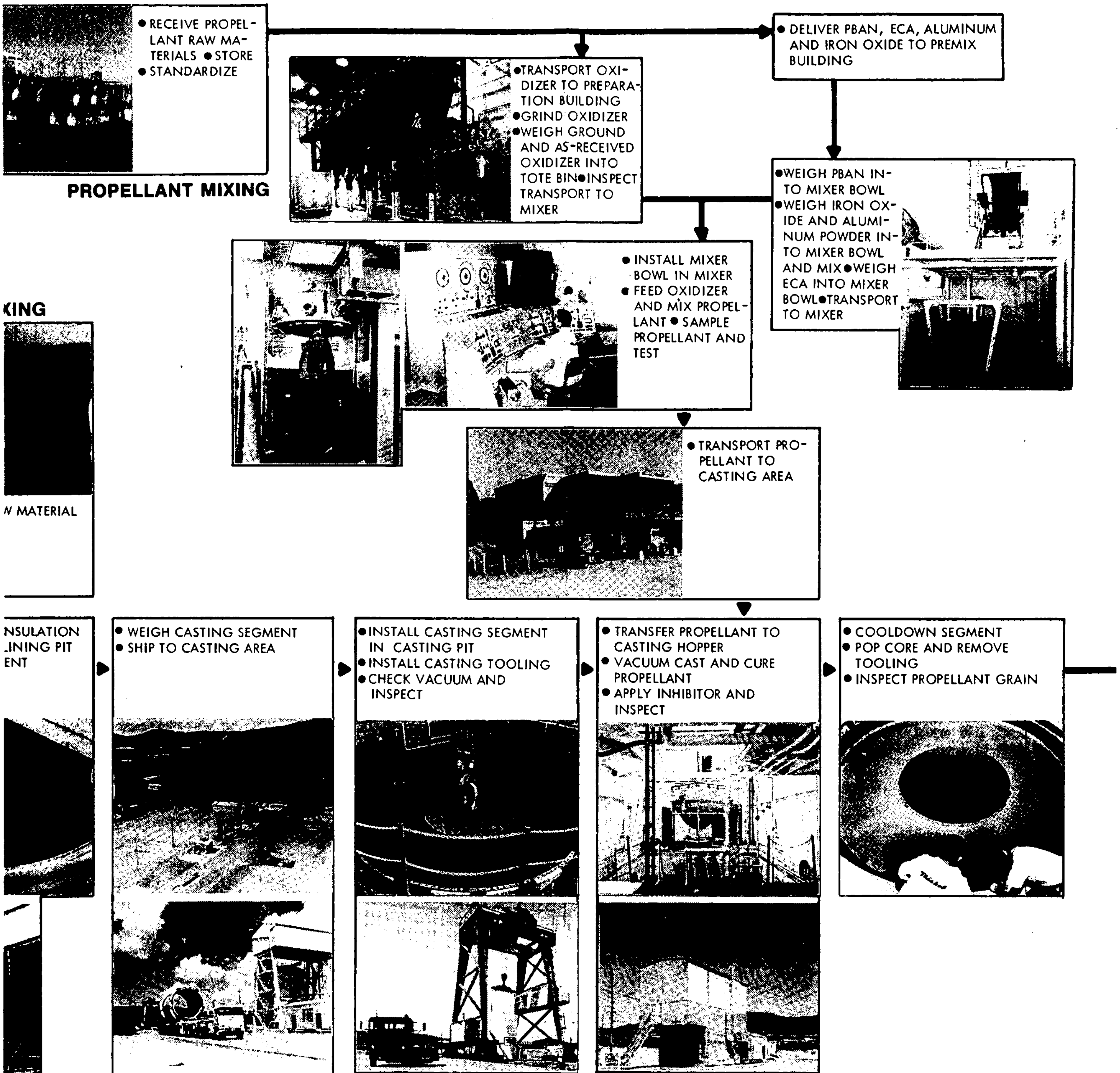
- TRANSPORT SEGMENT TO PROOF TEST BAY
- LEAK TEST SEGMENT JOINTS
- PROOF TEST
- DISASSEMBLE SEGMENTS
- DIMENSIONALLY INSPECT

- DISASSEMBLE SEGMENTS
- VAPOR DEGREASE
- GRIT BLAST
- MAGNETIC PARTICLE INSPECT
- VAPOR DEGREASE

CASTING SEGMENT REFURBISHMENT

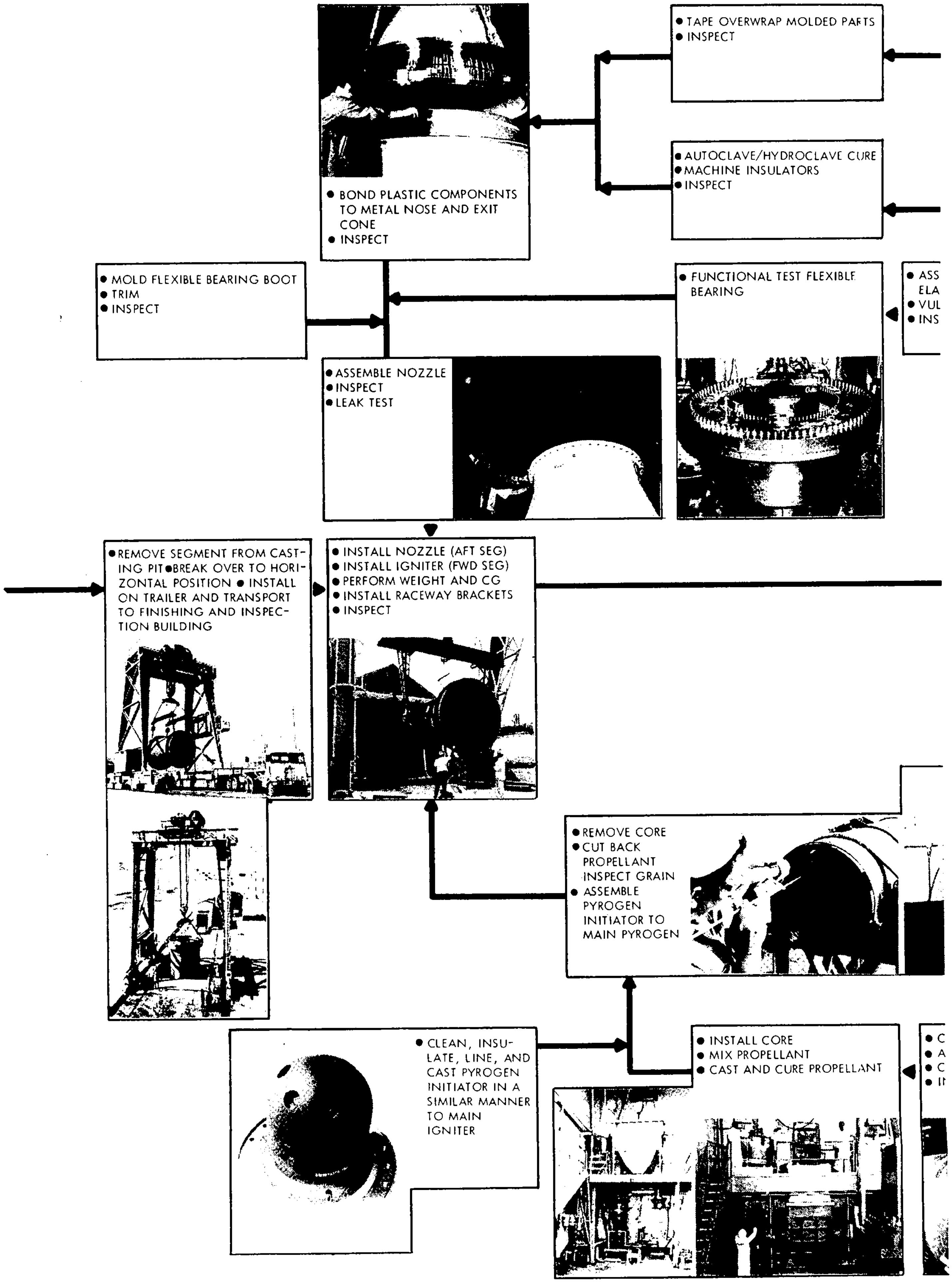
- RECEIVE RECOVERED SEGMENTS
- VISUALLY INSPECT
- STORE
- TRANSPORT TO WASHOUT FACILITY
- WASHOUT INSULATION





WASATCH DIVISION OPERATIONS

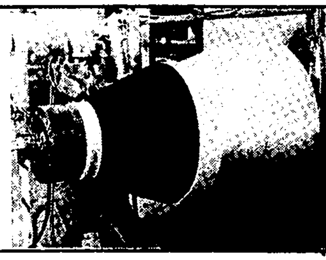
Figure 3. SRM Manufacturing Flow (Sheet 1 of 2)



● TAPE OVERWRAP MOLDED PARTS
● INSPECT
● AUTOCLAVE/HYDROCLAVE CURE
● MACHINE INSULATORS
● INSPECT
● BOND PLASTIC COMPONENTS TO METAL NOSE AND EXIT CONE
● INSPECT
● MOLD FLEXIBLE BEARING BOOT
● TRIM
● INSPECT
● FUNCTIONAL TEST FLEXIBLE BEARING
● ASS
ELA
● VUL
● INS
● ASSEMBLE NOZZLE
● INSPECT
● LEAK TEST
● REMOVE SEGMENT FROM CASTING PIT ● BREAK OVER TO HORIZONTAL POSITION ● INSTALL ON TRAILER AND TRANSPORT TO FINISHING AND INSPECTION BUILDING
● INSTALL NOZZLE (AFT SEG)
● INSTALL IGNITER (FWD SEG)
● PERFORM WEIGHT AND CG
● INSTALL RACEWAY BRACKETS
● INSPECT
● REMOVE CORE
● CUT BACK PROPELLANT
INSPECT GRAIN
● ASSEMBLE PYROGEN INITIATOR TO MAIN PYROGEN
● CLEAN, INSULATE, LINE, AND CAST PYROGEN INITIATOR IN A SIMILAR MANNER TO MAIN IGNITER
● INSTALL CORE
● MIX PROPELLANT
● CAST AND CURE PROPELLANT

- PREPARE AND LOAD MOLDS
- PRESS CURE MOLDED PARTS

- PREPARE MANDRELS
- TAPE WRAP INSULATORS



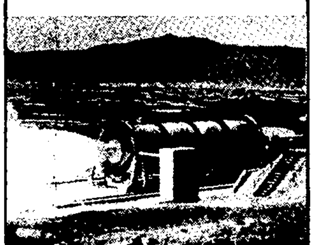
NOZZLE FABRICATION

- RECEIVE FORGINGS, MACHINED METAL PARTS, PLASTIC, AND ELASTOMERIC MATERIALS

RINGS, SHIMS, AND
R STOCK IN PRESS
E ASSEMBLY

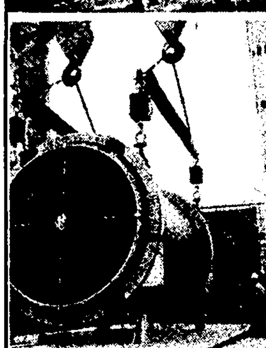
- MACHINE FLEXIBLE BEARING END RINGS
- INSPECT

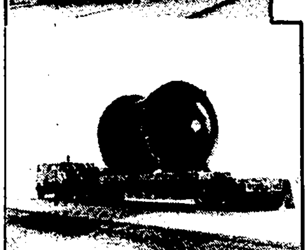
- TRANSPORT TO TEST BAY (DDT&E)
- ASSEMBLE SRM FOR STATIC TEST
- STATIC TEST



- TRANSPORT CASTING SEGMENTS TO LAUNCH SITE

STATIC TEST (DDT&E)





MAIN PYROGEN & PYROGEN INITIATOR FABRICATION

NSULATION
INER
NER

- RECEIVE, STORE MAIN IGNITER CASE
- INSPECT, DEGREASE, GRIT BLAST
- APPLY, CURE INSULATION
- INSPECT

Figure 3. SRM Manufacturing Flow (Sheet 2 of 2)

3.0 FACILITIES DESCRIPTION

The Solid Rocket Motor Project will be conducted utilizing existing facilities located at the Wasatch Division plantsite, Promontory, Utah. These facilities are contained on a 19,000 acre site adjacent to the north end of the Great Salt Lake (Figures 4 thru 9). The site is remote from any significant population center and also reasonably isolated from ranches located at varying distances from the area boundaries. Topography of the area further aids in providing protection to ranch tenants located in near proximity to the plant area. The SRM processing will be largely centralized in three R&D plant locations: the inert processing complex, the propellant mixing/casting area, and the assembly area.

The traveling public will not be exposed to environmental changes which may be generated either by manufacturing processes or static testing of motors. With the exception of a secondary state highway leading to the "Golden Spike" historic site several miles west of the plant, there is no other road or highway identified as a main artery for the traveling public. A short section of this highway is also part of a plant periphery road, south and west of the plant area, and serves essentially as an access means for plant personnel and is used by ranchers as an access means to established market roads. The SRM static test site is two miles north of this southwest plant periphery road.

During the past 18 years this facility has been used for the manufacture and test of missile and space solid rocket motors. The SRM Project effort is essentially a continuing activity of similar nature and scope. The most significant difference in comparison to other programs is the size of selected processing and handling equipment, volume of raw materials and processes, and quantity production of solid propellant.

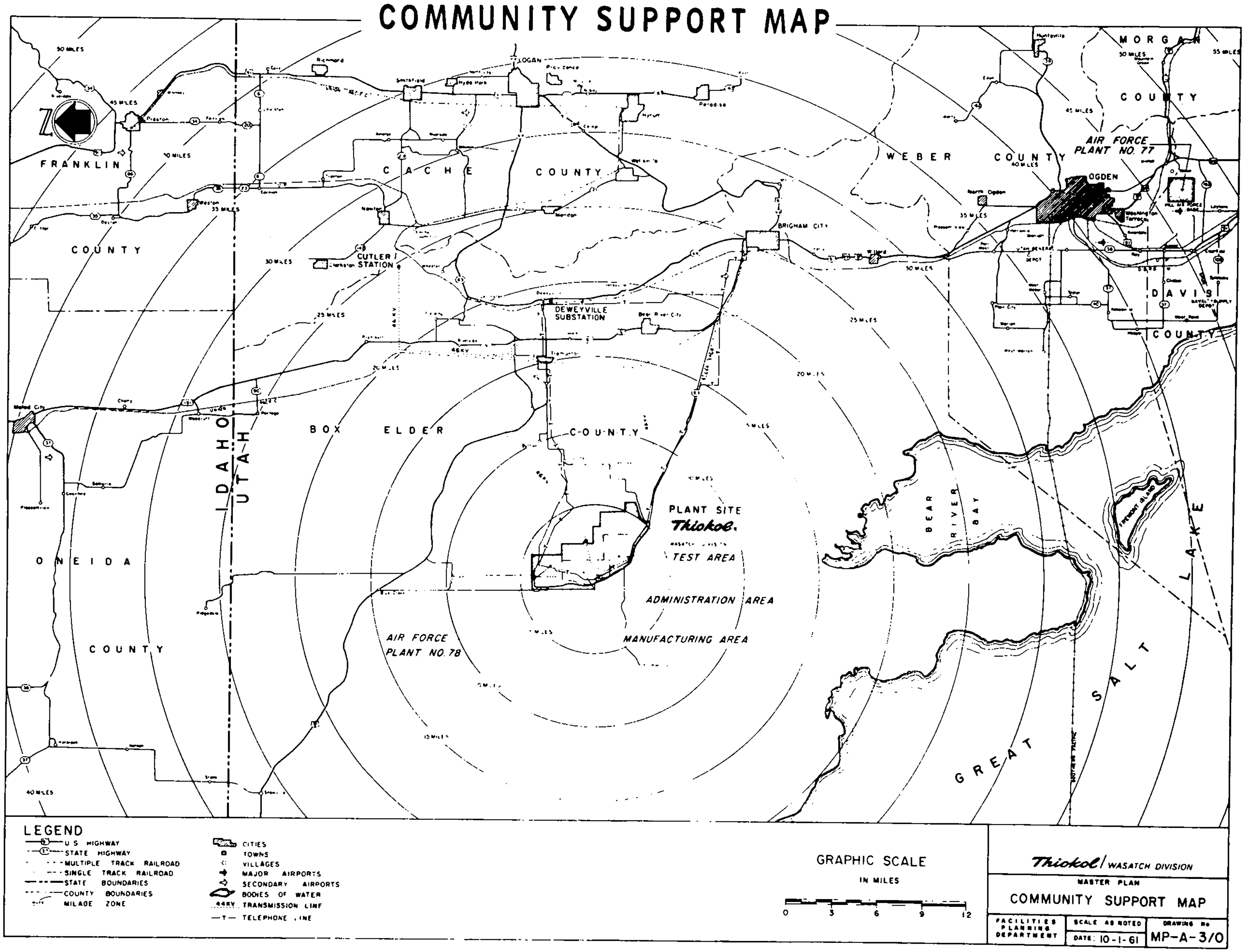


Figure 4. Community Support Map

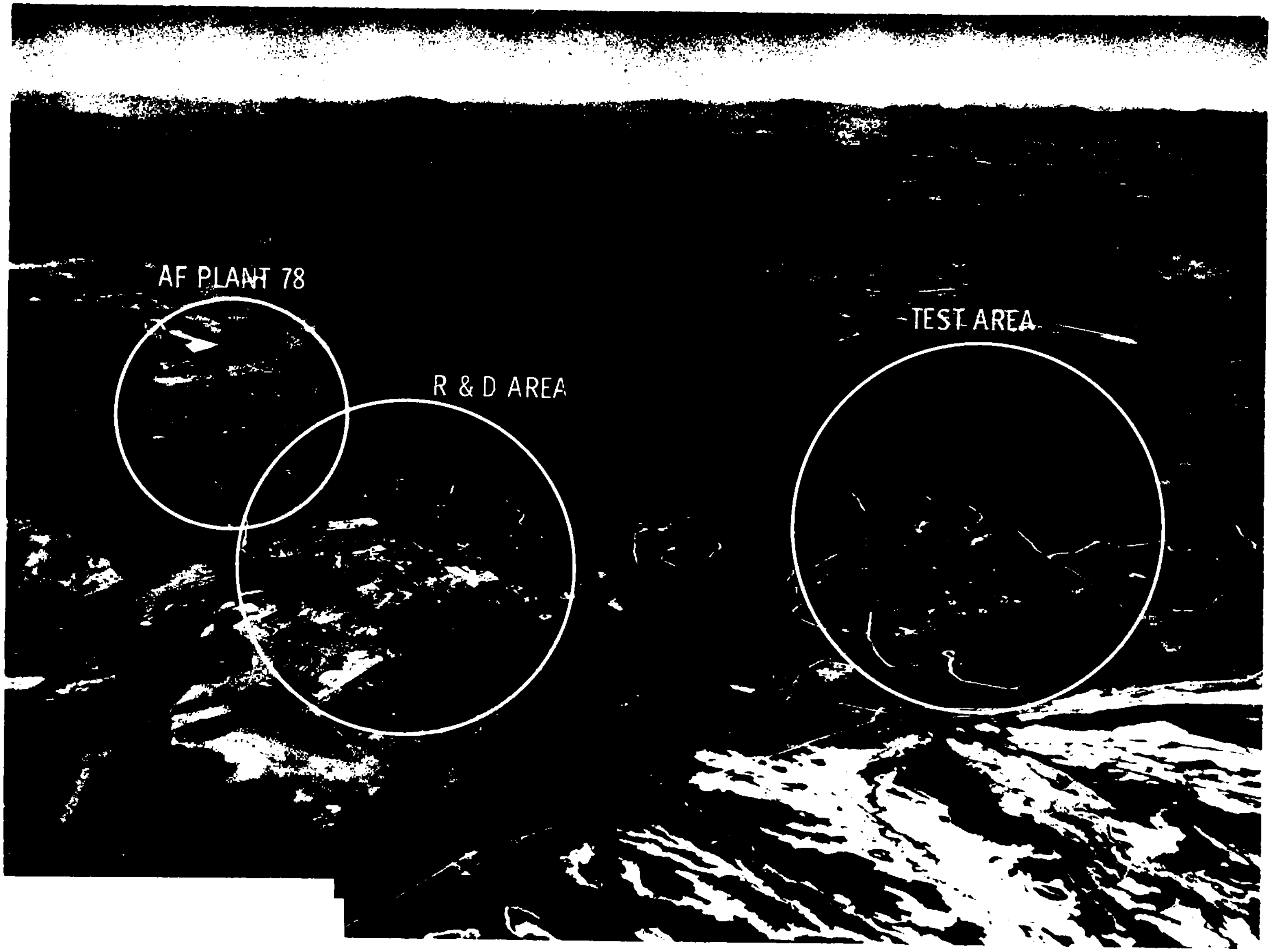


Figure 5. Principal Wasatch Division Areas

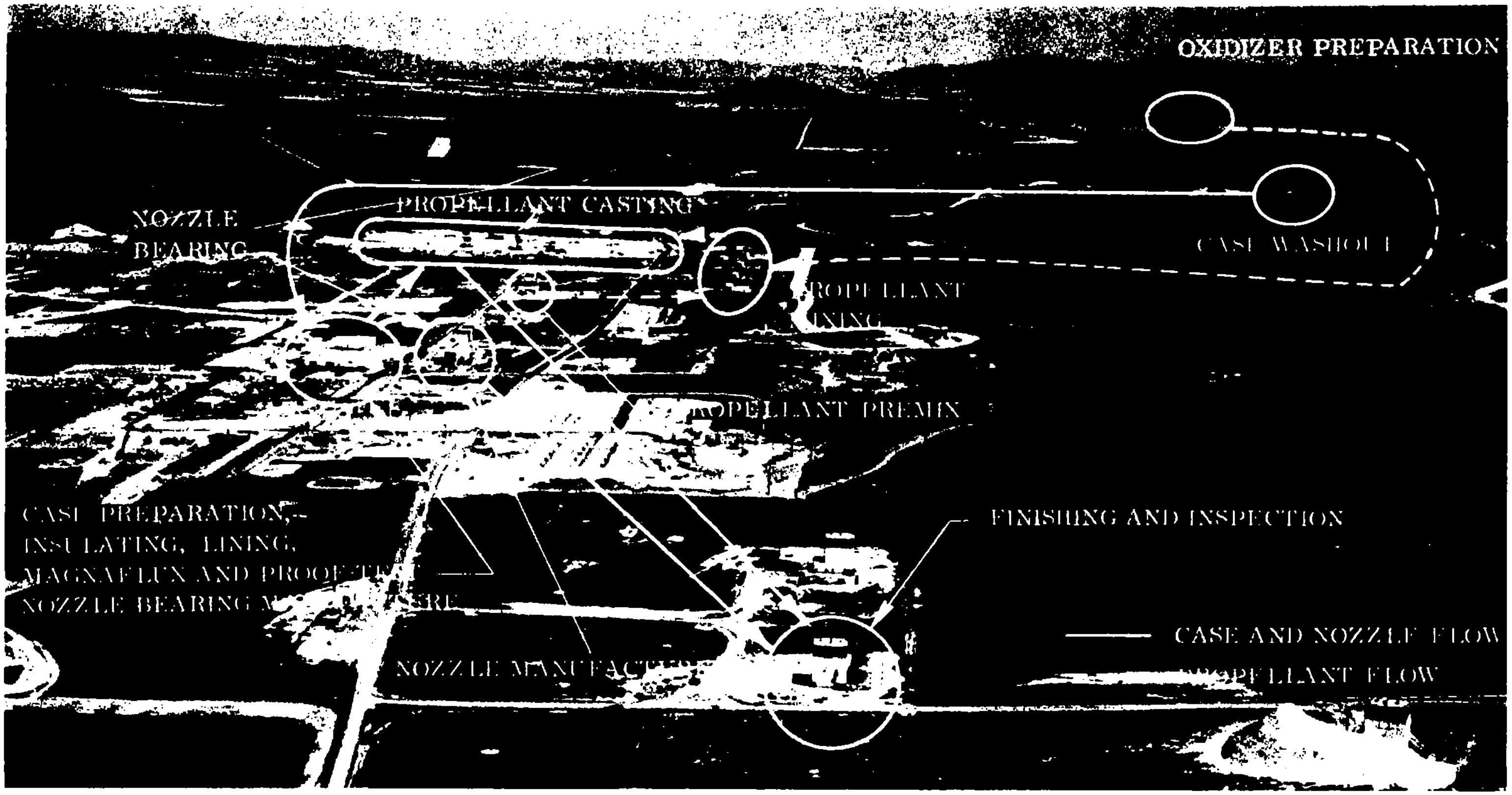


Figure 6. Aerial View of Manufacturing Area

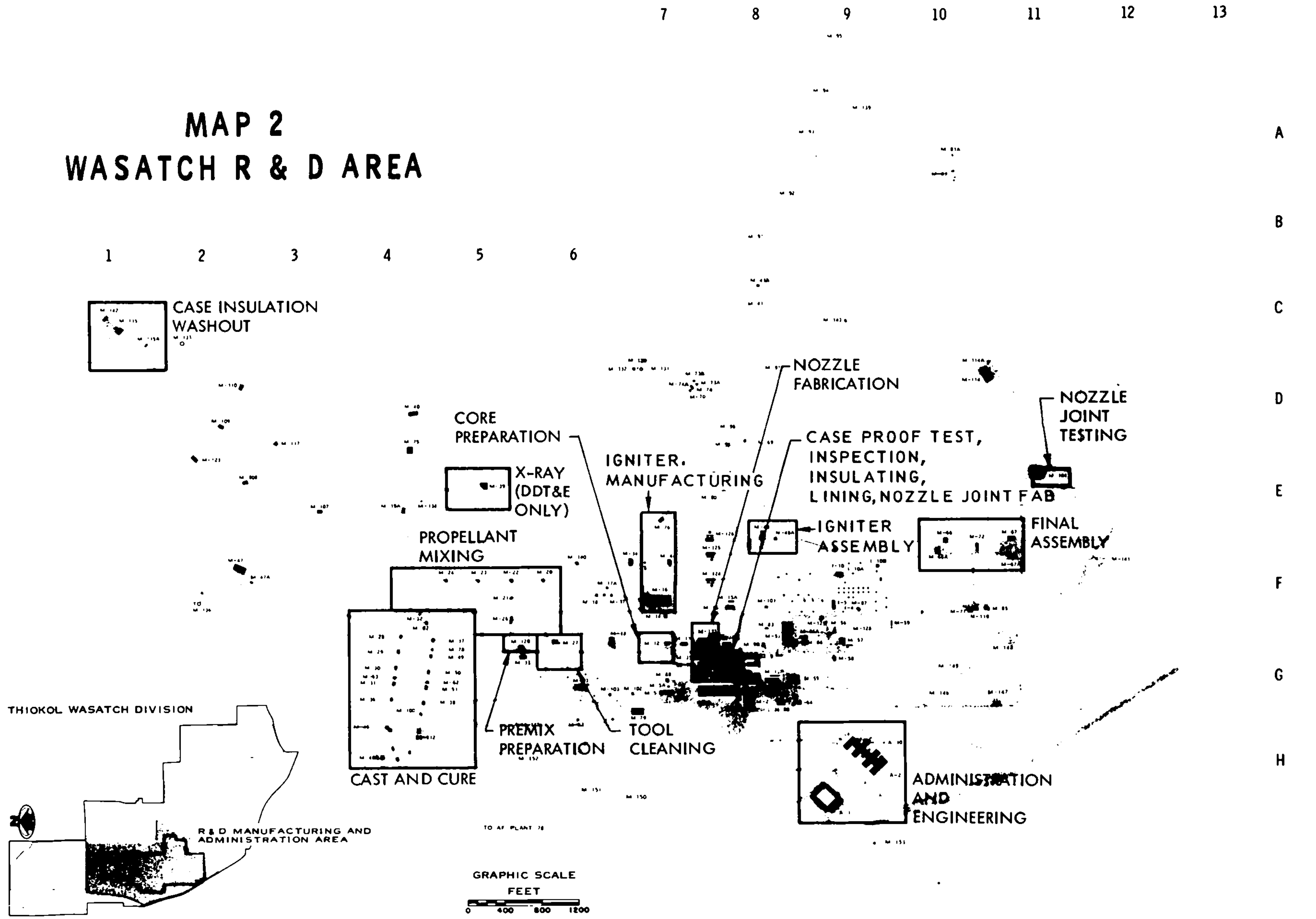


Figure 7. Wasatch R&D Area

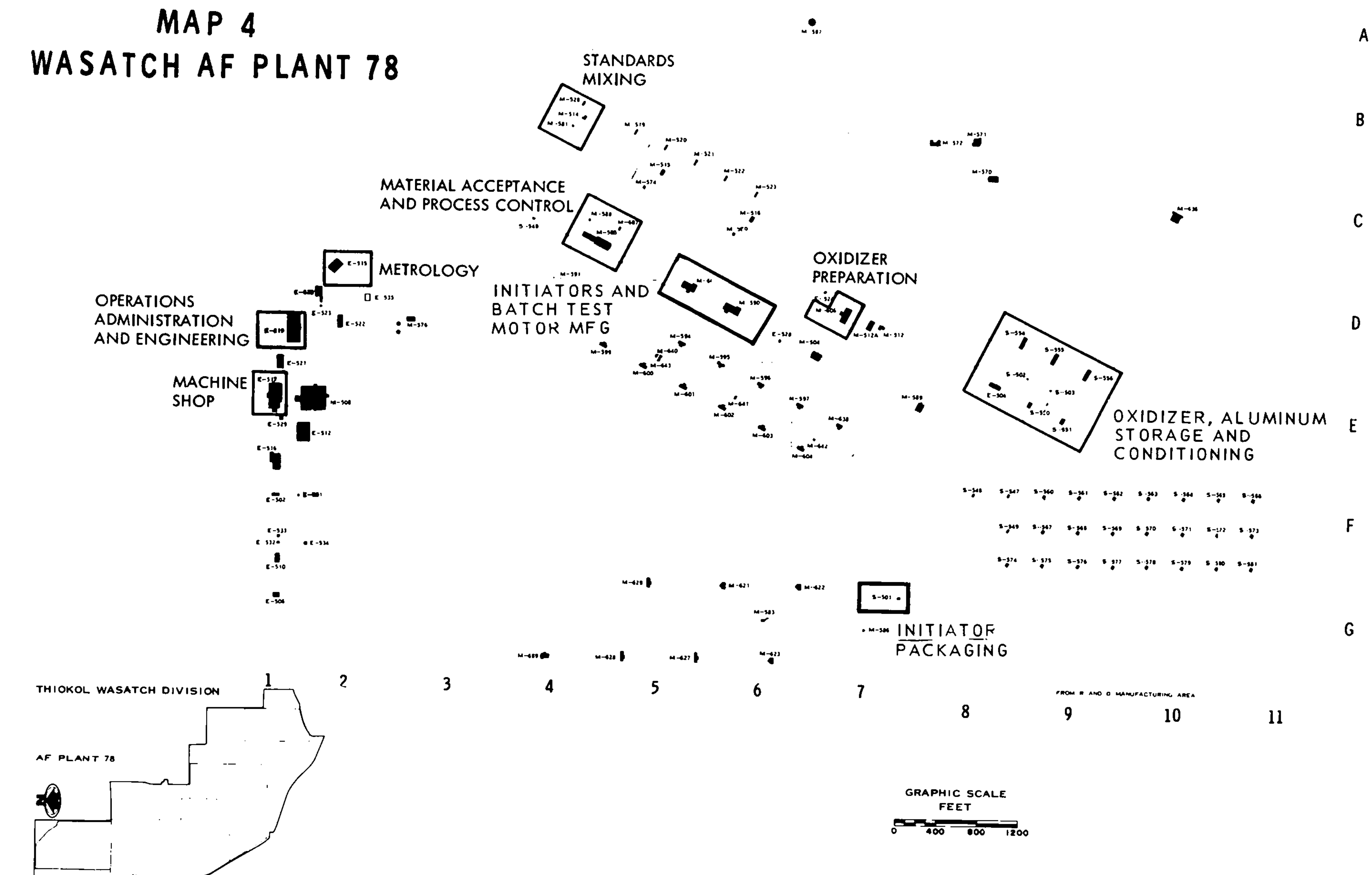


Figure 8. Air Force Plant 78

MAP 3
WASATCH TEST AREA

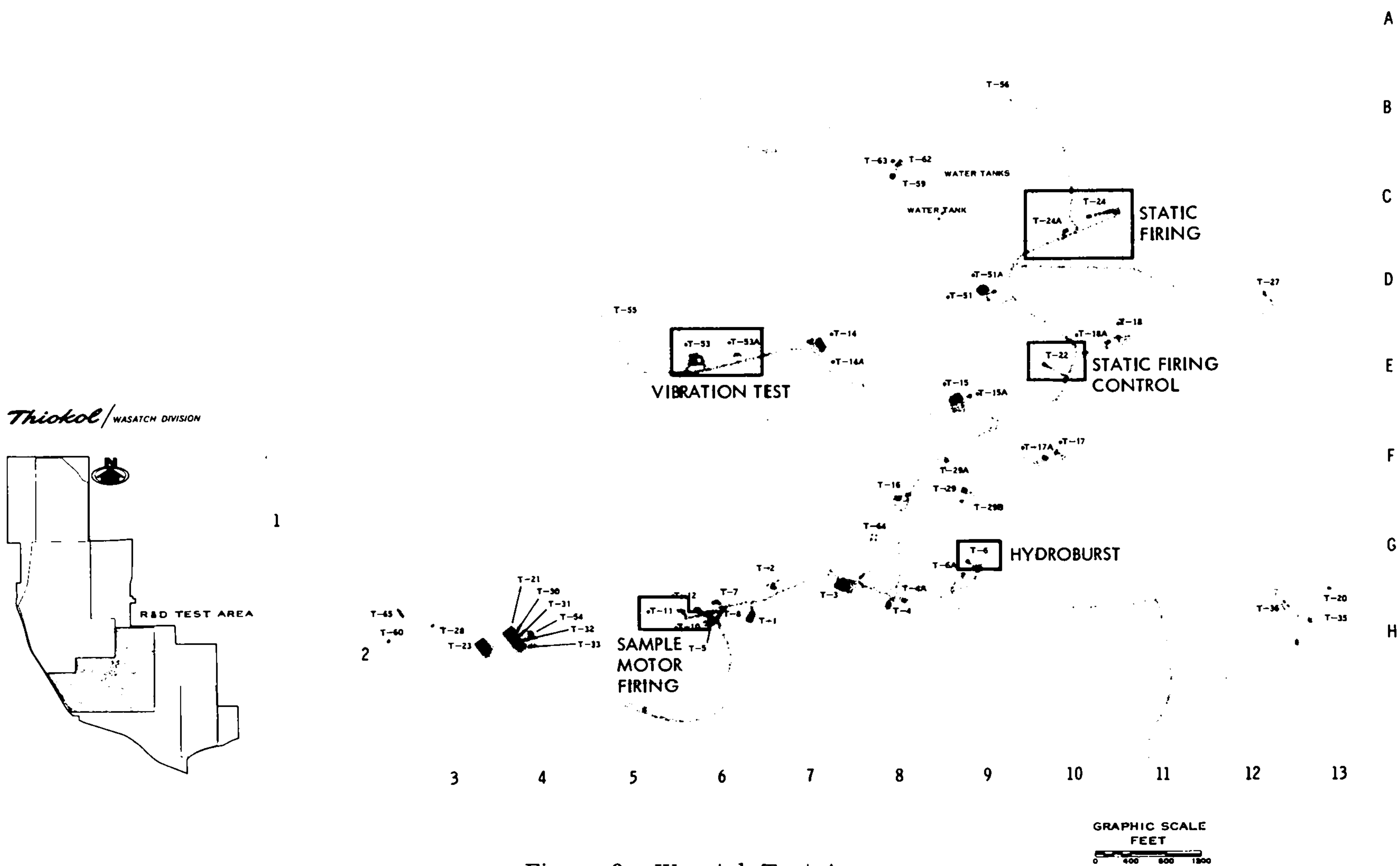


Figure 9. Wasatch Test Area

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Associated effort pertinent to the development, manufacture, testing and delivery of SRMs will be the modification of some existing facilities. Expansion of these facilities will have negligible impact on the immediate area. The projected construction with its attendant installation of utilities, soil movement, relocation and/or new road construction, destruction of plant life, etc. will not result in a significant environmental impact or nuisance to the general public. A summary description of the facility/equipment modifications which have a potential of environmental impact is presented in Table I. All existing facilities, where required, are equipped with adequate control devices to prevent deleterious discharges to the atmosphere or to the ground water table. All facility/equipment modifications will also include new/modified process discharge control devices that will meet the requirements of State and Federal agencies having jurisdiction.

TABLE I

FACILITY AND EQUIPMENT MODIFICATION SUMMARY

Bldg	Function	Description of Modifications
M-10	Hydrotest and inspect recycled SRM cases	Relocate the current Minuteman hydrotest system. Add a new SRM hydrotest system and rotary table for case inspection.
M-12	Clean and wax casting cores	Relocate equipment. Enlarge paint booth and building turnaround apron.
M-27	Clean casting fixtures and mix bowls	Add new high pressure water cleaning system, table, bowl dumper and hoist.
M-52	Case degrease, grit blast, Magnaflux, insulation preparation and flex bearing fabrication	Consolidate insulation preparation station. Relocate paint booth. Add insulation storage area, Magnaflux machines, vapor degreaser, vacuum cleaner for grit blast, and 2,500 ton press.
M-111	Paint, insulate and line case	Building additions. Add 30-ton bridge crane, autoclave, exhaust system, painting station, and high pressure air compressor.
M-113	Nozzle fabrication	Add 120 in. and 168 in. VBM, hydroclave, dust collector exhaust system, and tape wrapper attachments.
M-115	Wash insulation from fired SRM cases	Deepen washout system pit. Add longer boom and 2-ton hoist. Alter splash shield and associated tooling.
M-116	Nozzle refurbishment	Add oven and minor equipment.
M-606	Oxidizer grind and blend	Alter grinding system. Add tote bins and storage shed.
T-24	Static fire SRMs	Add larger thrust blocks, protection building and instrumentation.

4.0 ENVIRONMENTAL EFFECTS

The Solid Rocket Motor Project encompasses all manufacturing and test efforts. Included within the scope of this activity are propellant manufacturing, insulation and liner application, casting and curing of propellant, processing of metal parts, and fabrication of assorted nonmetallic fiber parts.

The production of the SRM involves high volume processing of chemical ingredients. The processes in themselves are not conducive to the generation of contaminants causing environmental degradation; however, the processes do result in minimum quantities of wastes and the supporting activities generate waste products which, if inadequately disposed of, or otherwise uncontrolled, would pollute the atmosphere and ground water sources. In a like manner, static testing of SRMs could have minor effects on the local environment and ecology if not adequately controlled.

4.1 AIR QUALITY

The plant complex is located in northern Utah, 20 miles south of the Idaho border and approximately midway between the borders of Nevada and Wyoming. Elevation of the site is approximately 4,250 ft above mean sea level in a valley between two ridges reaching 6,000 feet in elevation. Salt flats are located to the south, with range and farm lands situated to the north. With the plant geographic location between the ridges noted, two definitive wind patterns dominate - northwesterly in the winter and southeasterly in the summer. Figure 10 illustrates the predominant wind patterns experienced and percent of occurrence.

The area is classified as semiarid, with an annual precipitation of 13 in., the majority in the form of snow. Storm activity is experienced approximately 20 percent of the winter days and 5 percent of the summer days. Since start of plant operations in 1957 there has been no incident on record of having to cease normal operations because of climatic conditions.

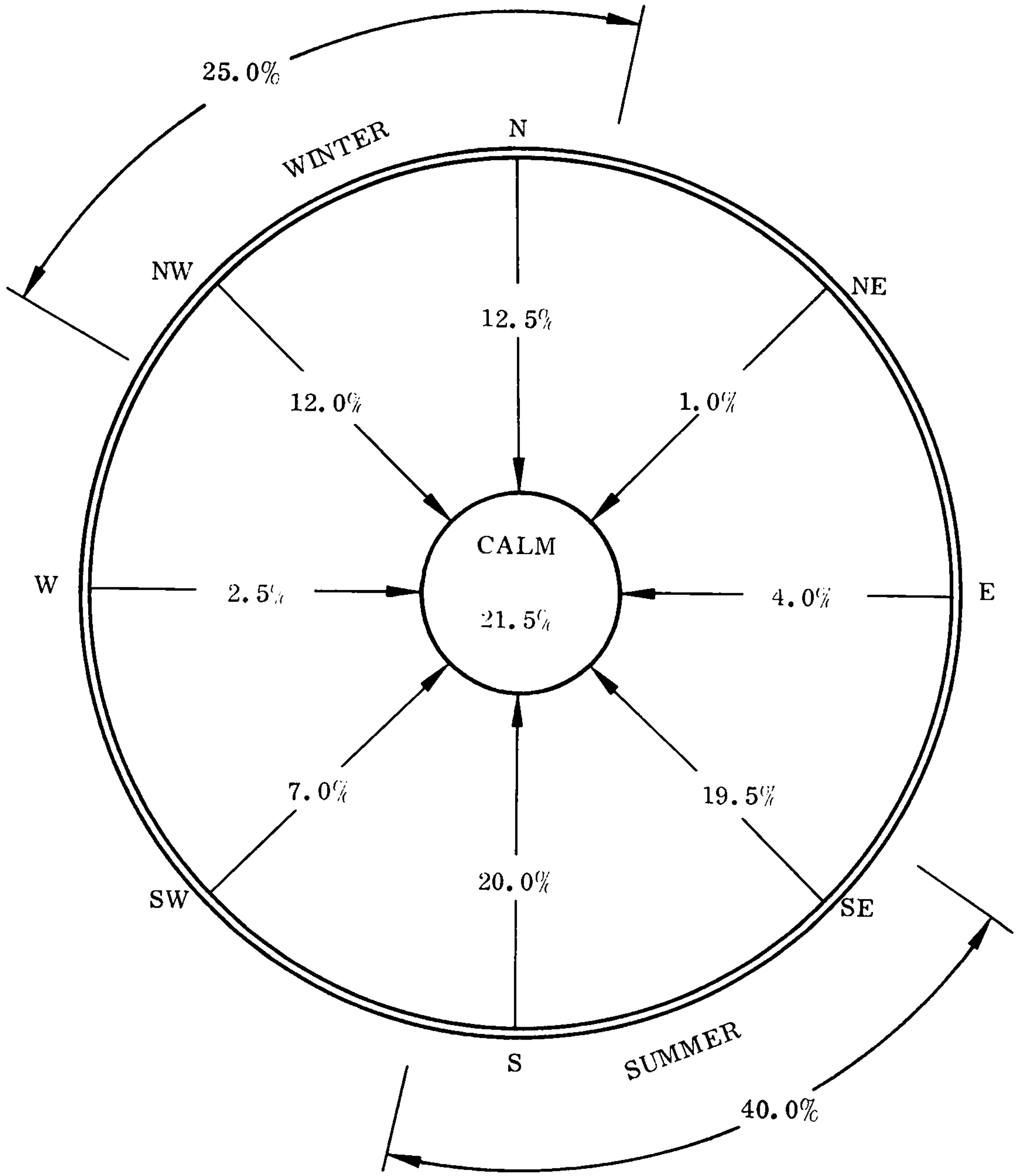


Figure 10. Wind Rose (Wasatch R&D, 4 PM, 1974)

4.1.1 Static Test Firings

The orographic configuration at the test area is highly conducive to the development of a wind system in which the surface wind blows up-slope during the day and down-slope at night, with a mean southerly flow over the area every month of the year. The test area terrain and circulation aloft apparently favor the development of unusual vertical wind structures in which the increase of wind velocities at identical heights is less than that observed in many other regions of the state (Figure 11). This wind profile contributes to the observed rise of motor exhaust clouds in the test area (Figure 12). Thiokol has reviewed the SRM Project with Utah's Air Conservation Committee of the Division of Health. They concur that testing the large SRM motors under suitable conditions of the Clearing Index would not violate Utah's Air Quality Regulations. The Clearing Index is an indication of the predicted clearance of ground level pollutants in a given area based on measured temperature lapse rate and wind speeds. Data compiled by the Air Conservation Committee for the Salt Lake Valley, including the Wasatch Division area, show that favorable Clearing Index conditions have prevailed for static testing more than 85% of the time over the past seven years. Therefore, a primary objective of the operational procedure is to insure that a favorable "Clearing Index" prevails for the SRM static tests.

Static test firings will expel large volumes of hot gases containing various concentrations of inorganic compounds and insignificant amounts of organic off-gases. One SRM firing will release the following:

HCl	237,000 lb
Al_2O_3	330,000 lb
CO	263,000 lb
CO_2	41,500 lb
N_2	96,000 lb

The test pad is located at an elevation of 4,600 feet above mean sea level. Wind patterns will produce a general ascending motion over the area during the day. These conditions will minimize the probability of surface fumigation and encourage a dominant plume rise with resultant vertical mixing of exhaust products. Tempera-

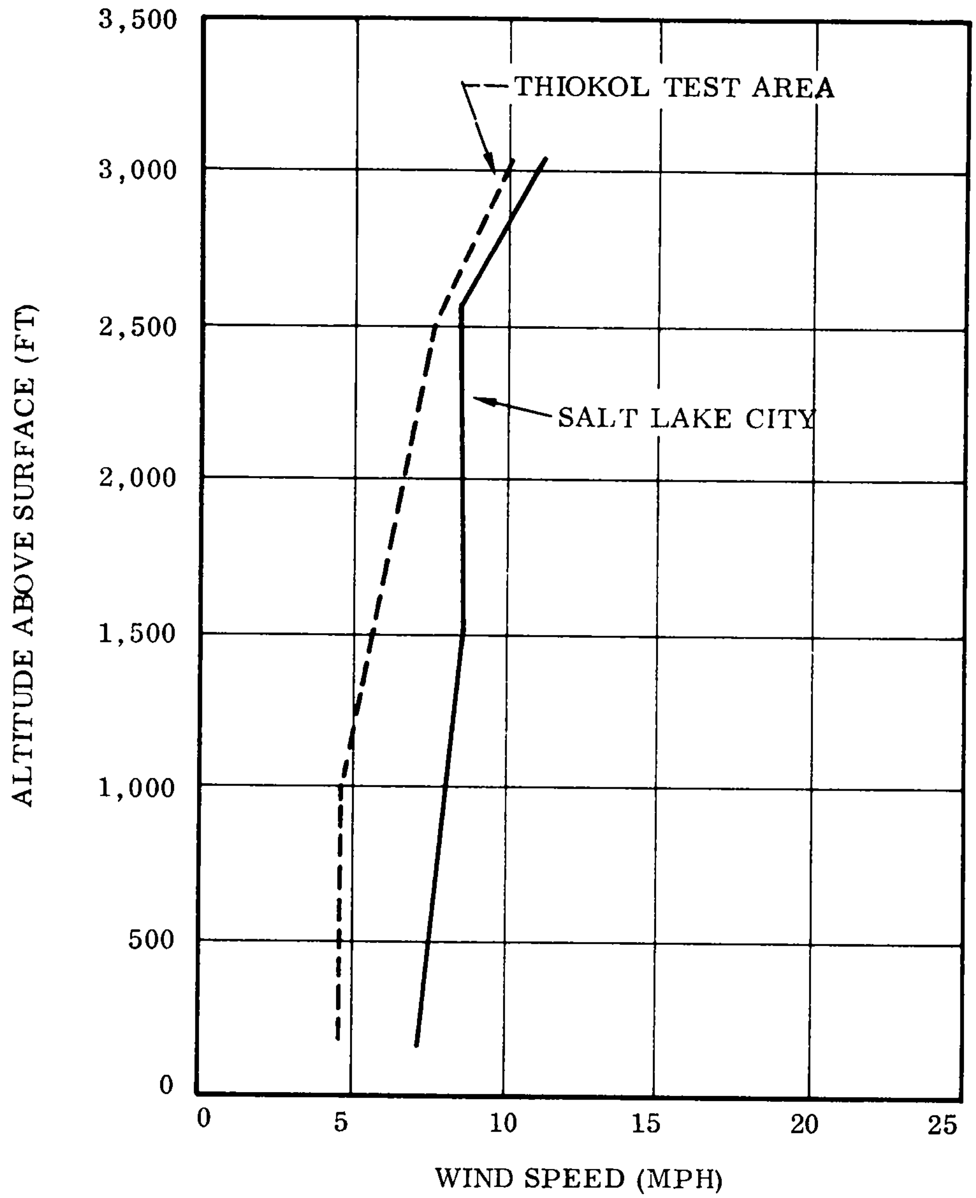


Figure 11. Typical Wind Profiles

Figure 12. Exhaust Cloud Rise Over Test Area

As shown in Figure 13, nine previous tests using toxic and nontoxic propellants have demonstrated cloud rise characteristics under various wind and temperature regimes.

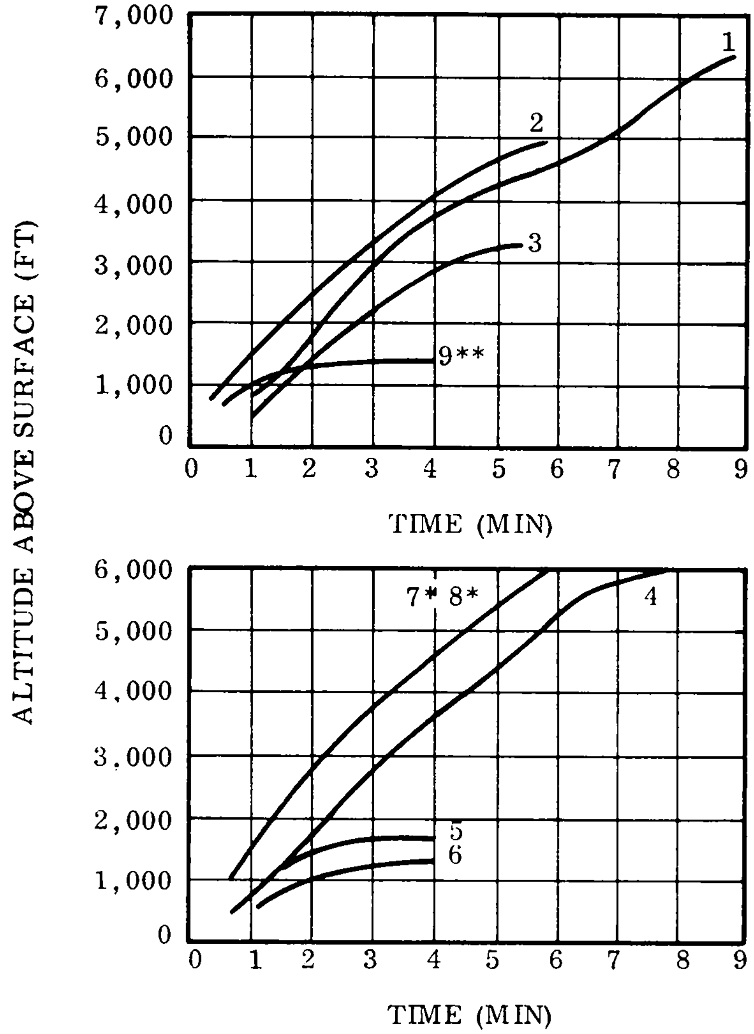
Approximately five miles east of the test area are isolated ranch sites; however, wind patterns minimize the ranch site exposures to the generated exhaust clouds. Furthermore, cloud dispersal and dilution precludes "exhaust mass" enveloping or otherwise exposing ranch tenants to toxic concentrations of gases. More populous areas, towns or clusters of rural homes, are further removed from possible exposure to exhaust products by the prevailing meteorological conditions and distance from the source.

The Bear River Migratory Bird Refuge is located approximately 20 miles south and east of the test area, within the downwind pattern of air flow during the winter months; however, mixing and dilution of the rocket motor exhaust within the radius noted would tend to negate any hazard to the waterfowl habitat.

No specific information relative to the receptor effects of very dilute HCl solutions has been found in the literature. Authorities have estimated that a HCl concentration injurious to plants is 10 parts per million for a few hours. No information was found in the literature on the acid concentration required to produce vegetation spotting. Information was also lacking on the effects of dilute acid solutions on other types of surfaces. Thiokol has received no reports of vegetation damaged from inhabitants in the immediate vicinity of plant boundaries or inhabitants further removed from the plant periphery.

During three launches of the Titan III C in which wind speeds ranged from 8 to 12 mph, five air samples showed average HCl concentrations of 115 to 400 parts per million for a period of 45 sec after launch. No HCl concentrations were measured at ground level distances from 0.5 to 1 mile downwind from the launch site in any of the nine launches included in the study. However, the odor of HCl was detected at a distance 4,000 feet downwind from the launch 5 min after a launch in which the mean wind speed exceeded 8 mph.

Precipitation scavenging of HCl (acid mist formation in stratus clouds, rain or snow) is a possibility; however, this is not foreseen as a problem. Test firings



Test No.	Propellant Weight (lb)	Total Heat Released (x 10^{10} cal)	Ref Wind (mps)	Observed Rise (ft)	Predicted Rise (ft)
1	45,000	5.40	5.0	2,000	2,460
2	6,000	0.82	3.0	2,000	2,220
3	5,032	0.74	7.5	1,300	874
4	45,000	5.40	1.5	6,500	8,700
5	3,000	0.41	13.4	600	400
6	1,125	0.15	8.9	200	450
7	128,000	17.4	15.0	*	12,200
8	127,000	17.3	19.0	*	9,600
9**	1,200	0.16	4.2	656	793

*Unable to follow cloud. Curve represents aircraft's maximum rate of climb.
**Beryllium propellant.

Figure 13. Measured Cloud Rise and Test Data

will not be conducted under these conditions. All tests will be conducted within parameters established by Thiokol for rocket motor firings and within the climatologic criteria of the Utah Air Conservation Committee. Furthermore, annual precipitation is low and in most instances occurs in the form of storm fronts moving in a predictable pattern. This permits the scheduling of tests with minimum impact on projected schedules.

Test firings will not contaminate ground water sources with HCl. There is no means of "water scrubbing" the exhaust gases nor is there a means to water cool the pad surface during the firing. Providing a means to "water scrub" the exhaust gas would be of little or no effect. Data from Titan III C launches show that deluge water does not trap a significant amount of HCl.

Aluminum oxide (Al_2O_3) fallout has been observed on occasion within the plant boundaries. However, concentrations were not measured. High volume air sampler collections taken at Coyote, California, during and after Titan III C test firings did not reveal Al_2O_3 concentrations above background levels. Samples were located downwind from the test pad at several distances up to 2,000 and 3,000 feet. Being an inert material, Al_2O_3 particulate is not considered as presenting a problem.

Although CO is a harmful constituent of the exhaust products, HCl is the more predominant due to the nature of its toxicity and potential impact on ambient air and water quality as compared to CO. Little is known about the atmospheric chemistry of CO. There are possible reactions with NO_2, OH and H_2O, but no definitive observational or theoretical evidence exists as to their effectiveness. No gaseous reactions have been shown to be important scavengers of CO in the atmosphere. CO_2 and N_2 are of considerably less concentration and fall below ambient levels as soon as the exhaust cloud attains horizontal dimensions of a few hundred meters within a few minutes of rocket motor burnout.

Based on the threshold limit values (TLV) regarding airborne concentration of contaminants to which a person may be exposed without adverse effect, HCl at 5 ppm is a significantly more critical hazard than the other compounds.

Furthermore, HCl is absorbed by water in the atmosphere and may settle out as a mist or rain having a potential effect on vegetation and ground water quality. As HCl is a readily measured constituent of the exhaust and its chemistry in the atmosphere is known, it is a reasonable method to determine the environmental effects of solid rocket motor exhaust products.

Although not anticipated, catastrophic events can occur during motor static testing, especially during development motor firings. In event of an SRM case rupture subsequent to ignition resulting in a mass deflagration of the SRM, a "fire ball" would mushroom, discharging a large cloud of propellant gases to the atmosphere. Due to the temperature generated it is expected that there would be a rapid ascent of a cloud in a relatively stable mass. Dispersal and dilution is projected to be consummated at a higher altitude than during a normal firing.

Shrapnel and burning propellant fragments also would be dispersed for several hundred feet; however, all such dispersal would be within plant boundaries. Limited plant life, such as range grass and sagebrush would be destroyed. However, no impact is forecasted on the limited animal wildlife in the area.

4.1.2 Manufacturing Operations

Thiokol manufacturing operations are in compliance with Utah State restrictions on the emission or discharge of pollutants to the atmosphere. Required sampling of stack discharges are conducted by plant analytical specialists and records maintained for review. On a selected basis, recovery equipment necessary to certain operations involving organic solvents, etc, is monitored and evaluated for efficiency. Installations of selected atmospheric discharge equipment require approval by State and Federal agencies. All equipment in this category is designed to the agency specification and approved by them prior to use.

Hazardous vapors or particulates generated by plant processes and emitted to the atmosphere are minimal, and the ambient air quality is not degraded to a level which may be detrimental to the local ecology.

4.1.3 Waste Propellant Disposal

Presently the only economical and safe method to dispose of waste propellant resulting from manufacturing operations is by burning in large open pits. The Wasatch Division has utilized this method for 18 years. The burning pit area currently used (Figure 14) is rigidly controlled to insure that waste propellant burning operations are not conducted during adverse weather conditions. The waste propellant burning process results in the discharge to the atmosphere of large volumes of HCl, Al_2O_3, CO, CO_2 and N_2 as in the case of SRM static firings. However, the State of Utah Air Conservation Committee permits this method of disposal by issuance of a variance on an annual basis (Figure 15).

The manufacture of 19 SRMs will result in the requirement to dispose of 152,000 lb of waste propellant during the tenure of the DDT&E program. This volume represents less than 10 percent of that amount burned during 1974 in support of the Minuteman motor reclamation and other current programs.

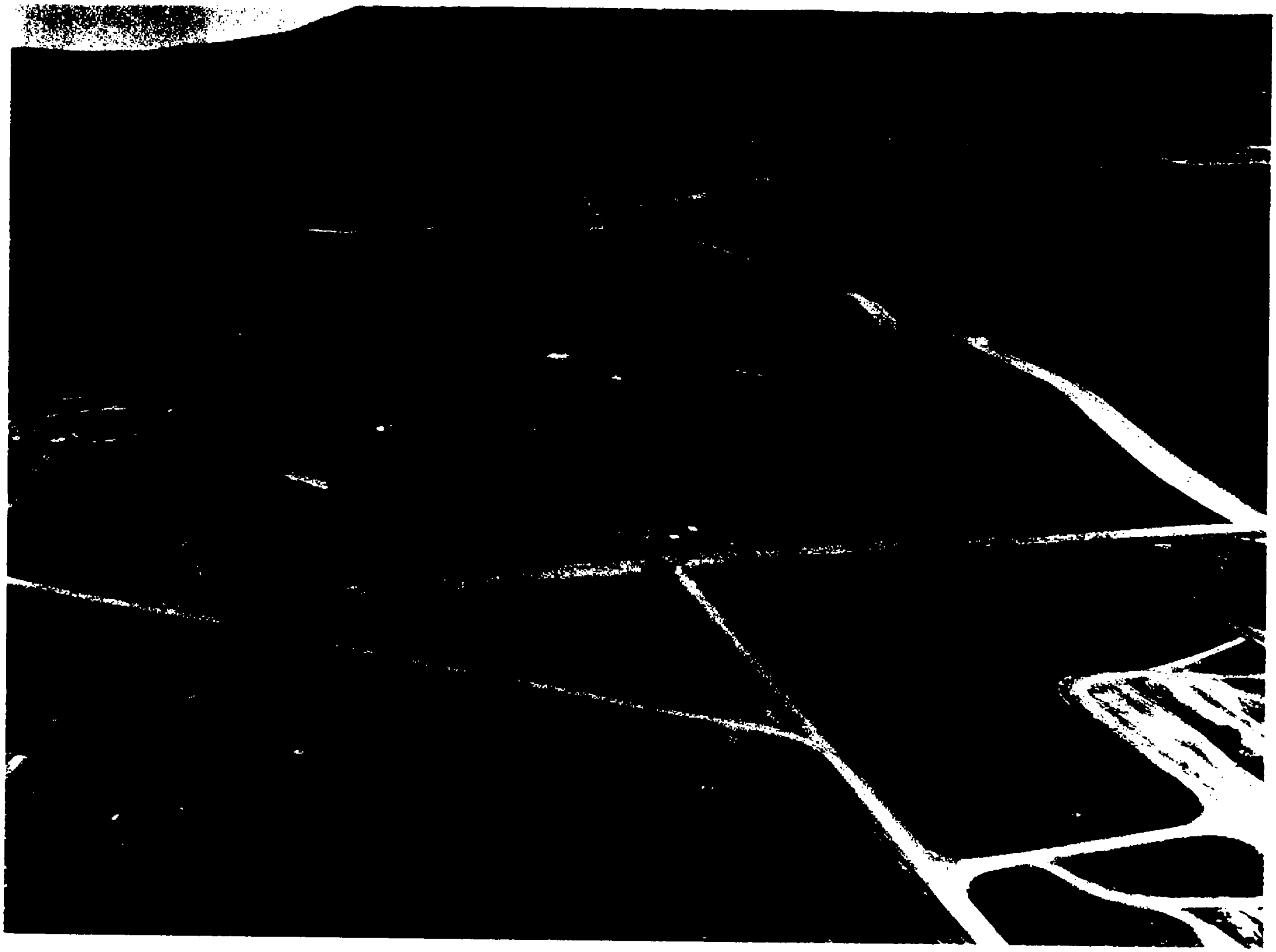


Figure 14. Aerial View of Waste Propellant Burning Area

STATE OF UTAH—DEPARTMENT OF SOCIAL SERVICES

CALVIN L. RAMPTON
Governor

PAUL S. ROSE
Executive Director

DIVISION OF HEALTH
44 MEDICAL DRIVE
SALT LAKE CITY, UTAH 84113
AREA CODE 801

Board of Health
Air Conservation Committee
Health Facilities Council
Medical Examiner Committee
Nursing Home Advisory Council
Water Pollution Committee

LYMAN J. OLSEN, M.D., M.P.H.
Director of Health

BUREAU OF ENVIRONMENTAL HEALTH
72 East 4th South
Salt Lake City, Utah

328-6108
January 24, 1975

JAN 2 '75

Mr. J. E. Madsen
Director of Operations
Thiokol Chemical Corporation
P.O. Box 524
Brigham City, Utah 84302

Dear Mr. Madsen:

The Utah Air Conservation Committee, at its regular meeting of January 23, 1975, granted the Thiokol request for extension of the Company's variance from the provisions of Section 3.1.4 d, Code of Air Conservation Regulations.

This variance will terminate on January 31, 1976 and is subject to the following stipulations:

1. This variance is for the open burning of explosive material and is limited to that material which cannot be safely stored long enough to await favorable meteorological conditions as defined under the clearing index system.

2. This variance does not allow the open burning of any waste containing Beryllium or other highly toxic materials except when meteorological conditions are such that the resulting products of combustion will traverse over unoccupied areas only. A description and evaluation of the quantities of highly toxic material to be emitted to the atmosphere must be submitted to the Executive Secretary prior to each burning.

3. Records must be kept of the date, time, place and quantity of each burn and the type of material burned during the period of this variance; these records must be submitted to the Utah Air Conservation Committee at the end of the variance period.

4. A report of investigative efforts to eliminate open burning of hazardous materials of this type must be submitted to the Committee at the end of the variance period.

Figure 15. Variance on Open Burning From State of Utah
(Sheet 1 of 2)

page 2
letter to Mr. Madsen
1/24/75

You are reminded that any request for variance extension must be submitted at least sixty days prior to the expiration of the existing variance.

Sincerely,

Grant S. Winn, Ph.D.
Executive Secretary
Utah Air Conservation Committee

BCB:jw

Figure 15. Variance on Open Burning From State of Utah
(Sheet 2 of 2)

4.2 WATER QUALITY

The plant water supply originates from two deep wells located on the plantsite and four deep wells located between 2 and 10 miles to the southwest. The wells are replenished by an underground aquifier, geologically situated over a salt water aquifier. Heavy usage of the well water will result in infiltration of salt water into the fresh water supply; therefore, the wells are routinely sampled each month for any baseline change in chemical content. Bacterial samples are also taken to verify that no organic contamination is introduced from plant sources, particularly from sanitary waste treatment facilities.

There is one small stream within the environs of the plantsite which flows along the west boundary. At times during the summer the stream is dry; however, it is sampled during the seasons of flow and tested for bacterial and chemical content for possible contamination from plant sources. All tests are performed within the criteria and standards promulgated by cognizant State and Federal governmental agencies. To date, no change in baseline data has been observed for these water sources.

Since the plantsite is remote from the general public and relatively uninhabited land area is available, disposal of industrial and sanitary wastes is conducted at the plantsite. Contaminated waterborne wastes are collected in portable catch tanks and transported to evaporation/percolation beds located at the solid propellant waste burning grounds. These facilities are situated at an elevation of 4,600 feet and are well removed from operating areas and buildings to permit open burning of the contaminated dry residue. Upon completion of the percolation/evaporation process, the residue is burned under the same control parameters established for waste propellant.

Disposal of other waterborne wastes, such as photographic and chemical materials, is accomplished through discharging the material to below ground catch basins and distributing to clay tile fields to permit evaporation and soil percolation. These facilities are separate from sanitary waste treatment units.

Sanitary wastes are discharged to septic tanks, the effluent of which is also discharged to tile fields in selected isolated areas. Any sludge accumulation affecting efficient septic tank operation is removed and deposited in remotely located drying beds. All facilities within this category are approved by the Utah State Board of Health. Their sanitary engineers periodically evaluate the facilities for adequacy and safety of operation in the interest of public health.

4.3 ACOUSTICS

Sound levels which will be generated during SRM static tests are not expected to be great enough to impose a hazard or nuisance factor to inhabitants of the surrounding area. The nearest incorporated township is 15 miles from the test site. Furthermore, topography of the test site area and meteorological conditions generally common to this area are conducive to minimizing the sound levels.

Analytical computations for a 156 in. SRM test firing predicted that the overall sound levels generated would be 135 db at 1,000 feet and 100 db at 7,000 feet. This test firing was conducted in June 1968 under favorable meteorological conditions. At a right angle distance of 9,000 feet to the exhaust line an acoustic level of 88 db was recorded. The spectator zone for SRM static firings will be located between 6,000 and 10,000 feet from the test stand. At this distance there should be no unpleasant sensations due to body organ response and no anticipated problems concerning auditory response.

Periodically, low air temperature inversions are experienced at the Wasatch Division. These low temperature inversions ($\approx \Delta 8°$ F/1,000 ft) generally exist between sunset and noon. When afternoon inversions occur they are at an increased altitude, and wind patterns are developed which are favorable to reducing noise levels. However, SRM test firings will only be conducted under favorable conditions of no inversion or high inversion to minimize the effect of high noise levels.

4.4 SOLID WASTES

Solid wastes resulting from plant operations which are nonsalvageable for recycle or reuse are disposed of by either burning or burial. Noncontaminated solid wastes such as paper, metal containers, wood, plastics, etc, are buried in a sanitary landfill approved by the Utah State Board of Health. Classified waste is pulverized and buried as required by security regulations which are customer imposed. Contaminated solid wastes such as propellant or MEK impregnated rags, plastics, etc, are disposed of by burning in the same manner as solid propellant wastes (Ref Para 4.1.3.).

4.5 ECOLOGICAL SYSTEMS

The effect of SRM manufacturing and test operations on the ecosystem is expected to be insignificant. There has been no change in the plant life within the past 18 years, during which manufacturing activity has been similar to that which is projected for the SRM Project. That is, vegetative species present heretofore have not been succeeded by species of a different type, nor is there evidence of any species becoming extinct. Agricultural grain crops, most of which are cultivated at some distance from the plantsite, also have shown no effect from exposure to the environment "generated" by division operations. There are no wooded or forested areas in the vicinity and the area is void of any deciduous or evergreen shrubs or trees.

Existing animal life on the site consists of grazing cattle and a small deer herd. Upon purchase of the land by Thiokol, the seller was granted grazing rights which he has always exercised. The deer herd has found refuge within the plant boundaries and forages on existing vegetation. The latter population has shown no signs of diminishing.

4.6 HAZARDOUS MATERIAL STORAGE

Hazardous material such as ammonium perchlorate and cured propellant are stored in facilities or in open peripheral areas at quantity distances from each other and adjacent processing buildings and structures. Lightning protection is provided and adequate fire control measures have been effected by control of vegetation and firebreaks. No contaminants are discharged to the atmosphere or ground surface from long periods of storage.

4.7 FUEL STORAGE

Presently, the Wasatch Division has an above ground fuel oil storage capacity of approximately 450,000 gallons. Below ground fuel oil storage capacity is 150,000 gallons. All gasoline is stored below ground level. All fuel supplies, below and above ground, are monitored by monthly inventory versus delivery records check to verify there is no loss which may constitute contamination of the soil.

5.0 ECONOMIC IMPACT

The SRM Project will enhance the economy of the area which includes selected communities in southern Idaho and to a greater degree, northern Utah. The rocket propellant industry has been a steady economic force in the areas identified for a period exceeding 18 years. Ranching and farming are the main impetus to the economy in this area with the rocket motor industry a secondary factor. Implementation of this program will not significantly impact the economy of other areas within the state of Utah. However, it will assure the economic stability in an area subject to the problems associated with the raising and marketing of agricultural products.

6.0 UNAVOIDABLE ENVIRONMENTAL EFFECTS

It is acknowledged that in operations associated with production of the SRM, the quality of the environment suffers a degree of degradation. This premise holds true for most industries, particularly those engaged in chemical processing. However, by judicious control of processes, implementation of control measures and the establishment of operational criteria within realistic guidelines, much can be accomplished to minimize impact on the environment and its effect on people. The activities identified within this text are not considered to be of a magnitude having more than a minimal effect on the environment, particularly when compared to other sources of environmental contaminants.

7.0 ALTERNATIVES TO PROPOSED ACTIONS

Inasmuch as the facilities projected for the SRM effort have been used for a number of years on previous similar programs, and will become available on a timely basis as present programs phase out, no consideration was given to providing alternate facilities at another location.

8.0 PROGRAM EFFECT ON LONG-TERM PRODUCTIVITY

The Thiokol effort in the Space Shuttle Program will have no adverse long-term effects on environmental productivity. The quality of Utah's environment has not been affected by Thiokol rocket motor operations in the 18 years prior to this program. Space Shuttle SRM activities, as scheduled, will not increase the "burden" on the environment, as phasing in of SRM activity is timed with the phaseout of existing programs. The Space Shuttle system will enhance long-term productivity of the earth's environment and Thiokol's effort in the overall program is an integral part necessary to the fulfillment of that projection.

9.0 IRREVERSIBLE AND IRRETRIEVABLE NATURAL RESOURCES

All solid propellant used to manufacture the SRMs is irretrievable. This is approximately 1,108,000 lb per SRM. The resources required to produce the propellant are also irretrievable. There will be no significant irreversible commitments of natural resources.