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Summary

TITAN II-A IN TITAN I SILOS (U)

TECHNICAL OBJECTIVE DOCUMENT

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Summary

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CONTENTS

	Page
I. Introduction	3
II. Summary	4
III. Airborne Vehicle	5
IV. Criteria for Titan I Squadron Operations and Conversion .	6
A. Launch Mode	8
B. Subsystem Definition Criteria and Ground Rules. . .	9
1. Command and Control	12
2. Launch Control and Checkout	14
3. Power System Changes	18
4. Mechanical Subsystems	21
a. Propellant Transfer and Pressurization Systems (PTPS)	21
b. Water System	25
c. Air Conditioning (A/C)	25
d. Hydraulics	25
5. Structural Subsystems	27
a. Titan I Complex General Layout	27
b. Silo Size Criteria	27
c. Blast Hazard Criteria	30
d. Launch Silo Door	30
e. Silo Structural Modifications	33
f. Shock Isolation System	36
g. Acoustic Considerations for Titan IIA in a Titan I Silo	37
6. Logistics	40
a. Organization Maintenance of Titan IIA on the Titan I Complex	40
b. Titan I MAMS Conversions to Maintain the Titan IIA	42
c. Spare Parts for Titan IIA	42
d. Personnel Training for Titan IIA	45
e. Technical Manuals for Titan IIA	45
V. Program Plan	49
VI. Program Cost	54

Figures

		Page
IV-B-1-1	OGE and Communications Complex Layout	13
IV-B-1-2	Control Center Modifications	17
IV-B-3-1	Power System Diagram	19
IV-B-3-2	Power Demands	20
IV-B-4-1	Propellant Transfer System	24
IV-B-4-2	Missile Silo A/C and Water Systems	26
IV-B-5-1	Titan I Complex General Layout With Typical Launcher Plan. . .	28
IV-B-5-2	Launch Silo Door	32
IV-B-5-3	Launch Silo	35
IV-B-5-4	Predicted Titan IIA Acoustic Environmental Levels. .	38
IV-B-6-1	Organizational Maintenance of Titan IIA in Titan I . Complex	41
IV-B-6-2	Titan I MAMS Conversion to Maintain Titan IIA	43
IV-B-6-3	Spare Parts for Titan IIA	44
IV-B-6-4	Personnel Training for Titan IIA.	46
IV-B-6-5	Technical Manuals for Titan IIA	48
V-1	Titan IIA Accommodated in Titan I Complexes - Schedules (4 Sheets)	
	Summary Schedule (Sheet 1 of 4).	50
V-2	PMR - TF-1 Activation (Sheet 2 of 4)	51
V-3	Base Modifications (Sheet 3 of 4)	52
V-4	Base Modifications (Sheet 4 of 4)	53
VI-1	Estimate for Entire Program Plan	55

I. Introduction

The retaliatory effectiveness of a weapons system will decrease as the enemy anti-ICBM capability, target hardness and dispersion increase. Methods for upgrading the effectiveness of the weapons system must be constantly evaluated to strike a balance between the advantages of achieving greater retaliatory deterrence and the expenditures necessary to achieve that deterrence. The Martin Company, recognizing the need for constant advancement, has invested considerable in-house and funded contract study efforts to realize optimum effectiveness for cost. One Martin Company study scopes the feasibility of upgrading Titan I bases with Titan II vehicles; another is a Titan IIA feasibility study. Both have become criteria for this study.

A method that upgrades the effectiveness of the arsenal and still makes maximum use of existing facilities is to modify operational Titan I complexes, replacing the Titan I missiles with advanced Titan vehicles. This proposal, in reaction to recent A/F-BSD and SAC request, proposes to directly advance Titan I, SM-68 operational basing to accommodate the advanced Titan IIA as an ICBM. This basing conversion and booster replacement program saves the USAF from further investments in new launch facilities and eliminates further investment in development, operations of the Logistics Command, expansion of base support, relocation of SAC operating personnel, and cost-significant expansion of the SAC communications system.

Completed studies, computer and test programs, and proven experience determined the ready feasibility, cost, program schedules, and logistics criteria projected herein. This study directly adapts the Titan IIA vehicle study design but presents a complete program and cost plan including booster development, which allows equitable comparison to other applications. The details required to convert Titan I squadrons to in-silo Titan IIA launch capability that will yield reaction times equivalent to Titan II, SM-68B specifications and minimum Weapons System downtime (conversion as well as for operations) is presented.

II. <u>Summary</u> - The Titan IIA booster, an uprated Titan II having the same accuracy, overpressure resistance and reaction time as Titan II but twice the payload carrying capabilities, is analyzed in this study for adaptability to the Titan I operational base. Total program and cost plans are projected for vehicle development and production as well as squadron conversion to present equitable comparison to other weapons system's "increased effectiveness" studies. The presented activation plan, requiring 50% force ineffectiveness for 6 months, could be extended to take advantage of the launch complex increment approach which allows for a long range conversion plan where the operations ineffectiveness would be 16.7%.

Ground rules are established that yield a minimization of operational ineffectiveness, operations personnel and maintenance costs. Increased survivability is balanced against activation and operational costs. Hardness is assumed to remain the same as Titan I; but reaction time and Command and Control communications were advanced to the latest state-of-the-art. No concept was allowed that would reduce reliability below the Titan II specified level. This study stresses prefabricated facility construction and equipment installation techniques. Maximum use of existing installation is stressed; no construction is required beyond existing structual boundaries. Existing Titan I equipment used and not interfering remains in place. After examining all subsystems, feasibility is considered sufficiently investigated to allow a direct criteria document development, with the singular exception of a model vehicle engine exhaust and entrainment ratio test which will be required if the funded Titan IIA tests prove inadequate.

III. Airborne Vehicle - This presentation, "Titan I Launch Complex Accommodation for Titan IIA", utilizes the Titan IIA booster. It is primarily concerned with the peculiarities of adapting Titan IIA to the Titan I base system. Another section presents the Titan IIA design, system integration, program development plan, and integration into the Titan II, SM-68B operational hard site squadrons. The entire booster design is adaptable, without exception, to this section's presentation.

IV. <u>Criteria for Titan I Squadron Operations and Conversion</u> - This presentation examines and gives recommendation for upgrading the existing Titan I weapon system by installing storable and fast reaction capability vehicle into the Titan I hard base squadron(s). In addition to the vehicle aspects that improve weapon system capability through vehicle performance that yields range and payload improvement, the launch operations and base considerations yield numerous bonus features that add to weapon system capability. This presentation aims at providing fast reaction time, continued and inexpensive readiness, improved survivability, and considerably less maintenance and service expenditure of resource relative to the existing Titan I operation. The following ground rules were evolved to carry out the general intent of weapon system improvement attendant to cost effectiveness:

- No state-of-the-art beyond mid-1967.
- Titan IIA booster vehicle identical to that already evolved by Martin Company study contract.
- Reaction Time equal to Titan II.
- In-silo, non-guided launch (elevated "soft" launch eliminated because of survivability and reaction time considerations).
- Give the Squadron and Wing Commands the option of launching the three complex vehicles either in salvo or individual sequence modes.
- Survivability equivalent to existing facility (includes aspects of command, control, and communications; hardness; minimum silo "soft" time; and improved system reliability).
- Operational squadrons to be designed for a single launch capability i.e., the silo and/or any of its components are expendable during launch if there is no degradation to vehicle performance.
- Minimum down time of a silo and complex is mandatory; prefabricated,

mobile and/or portable facility and subsystem equipment components are preferred;

- Use existing facility and subsystem installation as much as possible. Existing equipment and facility, not required for Titan IIA, is not specified for removal unless it interferes with activities or operation;

- Reduction of maintenance and service is stressed from the outset as a ground rule for systems design concept;

- Operations costs are carefully weighed against the short-term activation cost;

- Improvement of survivability and operations simplicity yield improved reliability, operations cost reduction, and operations personnel.

The entire approach to improving the weapons system effectiveness entails a balance of the short-term activation costs against the long term operations and maintenance costs. This approach is imposed as subsystem design criteria.

A. Launch Mode - The present Titan I weapon system, due to power loads imposed by elevator systems allows for only one launch at a time per complex. Installation of Titan II type of AGE, e.g., LCC and CMG in the Complex Control Center for each silo allows the A/F Command the option of either sequence or salvo launch capability. Powerloads become insignificant relative to existing powerhouse capability to the extent that diesel units can be reduced.

The Titan II type of equipment has proven its high reliability. A switching capability through additions of interconnecting cabling has been carefully considered and eliminated as a design possibility due to complications of engineering change, cost, and reduced reliability. If the minutely remote possibility exists that a launch from a silo malfunctioned due to AGE, the redundant AGE already utilized to launch a vehicle could be "cannibalized" in a relatively short time (measured in seconds if the malfunction is identified in the control center; minus fifteen minutes if the malfunction is identified in the equipment terminal).

The sketches clearly illustrate the adequacy of the present Control Center. Existing interconnection cabling is adaptable. Titan II AGE is less complex than existing Titan I equipment and, therefore, more reliable.

The operational mode of the Titan IIA weapon system is continued vehicle readiness that yields short term reaction time identically equivalent to the requirements of the SM-68B contracts specifications.

B. SUBSYSTEMS DEFINITION AND CRITERIA

Subsystems	Criteria for Modification	Problem Area	General Resolution
Command and control.	Increased survivability of launch complex through introduction of advanced state-of-the-art and communication media.	Maximum utilization of existing installations and circuits.	UHF radio capability added. Antenna exposure to "soft" condition lessened through antenna modifications.
Launch control and checkout.	Adapt Titan II OGE proven state-of-the-art. Salvo or individual silo launch control capability.	Switch-over capability from one silo set to a second silo set to effect operational reliability and possibly reduce maintenance and service operations costs.	Separate control sets for each silo.
Facility power.	Compute maximum power requirements attendant to removal of elevator launch requirement. Eliminate unnecessary existing equipment.	Activation time and cost required to introduce commercial power as a means of maintaining continued readiness for lessened operations and maintenance.	Eliminate the unnecessary diesel generators.
PTPS (Propellant transfer and Pressurization Systems).	Titan II operational state-of-the-art. Minimum installation which will result in mobile or portable transfer system for vehicle loading after installation into the silo.	Safety attendant to propellant loading from equipment adjacent to the open silo. Loading Hazards. Time sequence of fuel and oxidizer loading require to be minimized to yield minimum "soft" time.	Utilization of mobile condition and transfer system.

SUBSYSTEMS DEFINITION AND CRITERIA (cont.)

Subsystems	Criteria for Modification	Problem Area	General Resolution
Air Conditioning (A/C)	Maximum utilization of the existing Titan I installation. Utilization of Titan II design for environmental control.	Silo sensors to detect storable propellant toxicity.	Examination of the existing silo A/C for adaptability.
Water System.	Adapt existing Titan I water system to combat the hazards attendant to the Titan IIA storable propellant.	Titan IIA hazard protection requirement is greater than that required for existing Titan I.	Added larger capacity for water storage. Feeder lines examined and found adequate.
Shock Isolation System.	Make use of existing Titan I system or other Titan design that is already tooled, tested and proven.	Entire Titan I shock isolation system must be improved; The Titan I system is inadequate due to the increased mass of the Titan IIA. Adapting Titan II silo isolation system to this configuration.	Careful examination of the system as installed at TF-II indicates adequate load carrying capability and installation adaptability.
Structural Facility.	Maintain existing Titan I complex hardness, in-silo launch, confine exhaust duct within existing silo, minimize the silo modification downtime by utilizing prefabricated techniques.	Ratio of air intake to engine exhaust. Modify the door system to accommodate the silo conversion as well as placement of launch duct for balanced air and entrainment.	Existing computer program has proven the ability of the silo to accommodate air entrainment and exhaust balance for a non-guided in-silo launch. Steel prefabricated forms for duct structure concrete has been adapted as an integral part of the wall design remaining in place.

SUBSYSTEMS DEFINITION AND CRITERIA (cont.)

Subsystems	Criteria for Modification	Problem Area	General Resolution
Logistics Systems (operational supply, service and maintenance).	Reduce to the extent of eliminating operations personnel, maintenance requirements, and components re-cycle without compromise to readiness.	Logistics reduction aims are complicated when a vehicle system of greater capability is introduced.	Apply the Titan equipment systems development learning curve. Replace obsolete Titan I facility and equipment with more reliable Titan II developed equipment.

1. Command and Control (Communications) - The existing Titan I operational communications will be modified and supplemented by a new intrasite radio maintenance system and a new intersite hard radio system to increase the integrity and survivability of communications. The intersite hard radio can be installed at the MAB (Missile Assembly Building) command post. Existing telephone, P.A. (Public Address), and wire communications systems will be modified only to the extent necessary to comply with Titan IIA operational requirements.

New radio type maintenance net (RTMN) antennas will be installed in the modified silos, equipment terminals and propellant terminal decontamination areas. RTMN antennas will be installed in the control center, antenna terminal, powerhouse, tunnel junctions, and above ground on three new VSS (Voice Signaling System) poles.

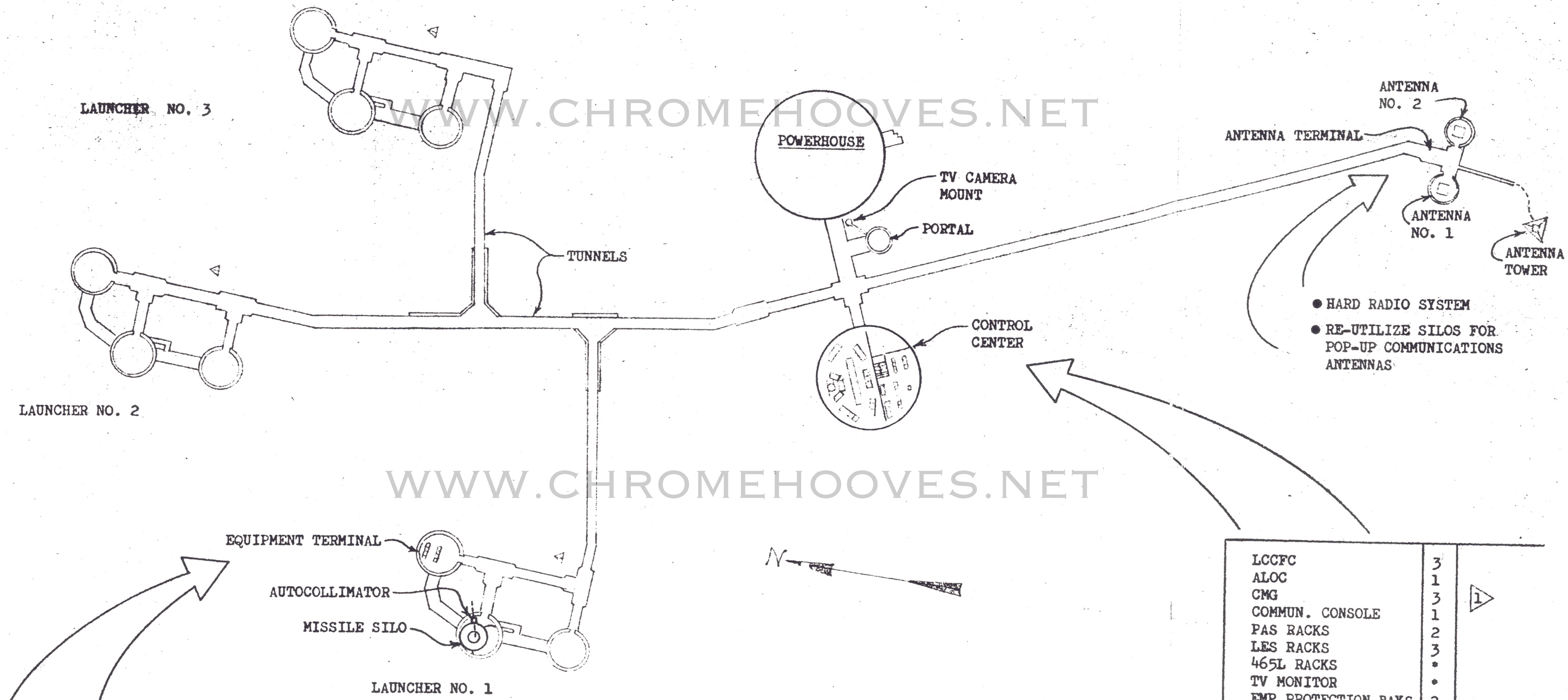
The new intersite hard radio will be installed in the existing BTL antenna terminal; one above ground soft antenna tower will be installed, and the two BTL (Bell Telephone Laboratory) antenna silos will be modified to accommodate "pop-up" type hard radio antennas.

The existing wire communications will be modified to include the new collimator rooms, above ground propellant hardstands and the modified silos. All communications speakers and outlets in the silos, propellant terminals, and hardstand areas will be selected compatible with Titan IIA propellants.

The SAC 465L equipment will be interfaced with the new intersite hard radio system as well as the hardened wire system. PAS (Primary Alerting System) and LES (Launch Enable System) equipment will have slight modification. Communication panels would be added to the PDC, (Power Distribution Control) MFL (Missile Fault Location) and MGACG (Missile Guidance and Alignment Checkout Group).

Titan I line protective equipment, now considered inadequate for EMP, will be upgraded per recommendations of Martin funded study AF04(647) - 576, CCN 571.

TITAN I LAUNCH COMPLEX AC MMODATIONS FOR TITAN IIA
OGE & COMMUN CATIONS
COMPLEX LAYOU



- HARD RADIO SYSTEM
- RE-UTILIZE SILOS FOR POP-UP COMMUNICATIONS ANTENNAS

LCCFC	3	1▷
ALOC	1	
CMG	3	
COMMUN. CONSOLE	1	
PAS RACKS	2	
LES RACKS	3	
465L RACKS	*	
TV MONITOR	*	
EMP PROTECTION BAYS	2	
INTRA-SITE RADIO	1	
TELEPHONE BAYS	*	
P.A. SYSTEM	2	

MGACG	1	(4 Racks)
MFL	1	
PDC	1	1▷
MG Set	1	
PWR SUPPLY	2	
BATTERY	2	
TV CAMERA	*	
FPCB	1	1▷

1▷ PDC-3 CONTROL PANEL & RADIATION MONITOR RELOCATED TO CMG

* QTY. TO BE DETERMINED

- CAPABILITY OF SALVO OR SEQUENCE LAUNCH
- COMMUNICATIONS SURVIVABILITY IMPROVEMENT

Figure IV-B-1-1

Additional equipment for protection against electromagnetic pulse (EMP) damage to communications circuits will be added in the main frame area on the upper level of the control center.

The Titan I waveguide system between each equipment terminal and silo can be removed.

2. Launch Control and Checkout.

a. Operational Ground Equipment (OGE)

The Titan I launch control and checkout equipment will require extensive modification and additions to meet new requirements of Titan IIA. A complete set of OGE, power supplies, and power distribution control will be provided for each Titan IIA missile. This would be done to provide salvo and sequence launch capability as well as improved reliability. Since the distances between silos and control center are much greater than for Titan II, the DC power equipment, the checkout equipment, and part of the launch control equipment will be located in the equipment terminal due to its proximity to the silo, yielding shorter cable runs.

The PDC, the MG Set, Batteries, MFL, MGACG, facility power control board and T.V. camera will be located in the equipment terminal.

A new autocollimator room, sight tube, and theodolite stand will be added for each silo.

The LCC, CMG, T.V. Monitors, alternate Launch Officer's Console (ALOC), Communications Console, and communications racks will be located on the upper level of the control center. The PDC-3 control panel and radiation monitor will be relocated in the CMG's; and the CMG re-entry vehicle monitor chassis will be modified to interface with the new re-entry vehicle. The control center common circuits, hazard warning circuits and complex damage control circuits will be packaged in new chassis and located in one CMG. T.V. monitor controls will be provided in the control center.

b. Maintenance Ground Equipment (MGE) - The requirements for maintenance ground equipment for Titan IIA will be similar to Titan II. The Titan II electronic test bench will be modified to accommodate the new chassis. The battery test set and battery truck will be required. The hydraulic control can be used. The missile monitor simulator and the facility monitor simulator will be modified to be compatible with the new missile and facility. New guidance test bench equipment and modified facility - IGS simulator will be provided.

c. Interconnecting Cabling - Whenever possible, existing cables will be left in place and re-utilized, such as tunnel, control center and communications cabling. The silo cabling and umbilicals will be new. Prefabricated OGE cabling will be used to the maximum extent possible.

d. Titan I Control Center Changes - The existing motor generators on the lower level will be removed and surplused. The existing battery rack required for emergency lighting will be retained. A new battery rack required for DC circuits will be installed in the area made available by the removal of the motor generators. All other equipment, beds, eating facilities and storage will remain.

On the upper level in the control area all Bell Telephone Guidance and RRU (Remington Rand - Univac) equipment will be removed. T.V. monitors and T.V. control console will be retained and relocated with additional T.V. monitors. All Titan I checkout equipment, and consoles will be removed and surplused.

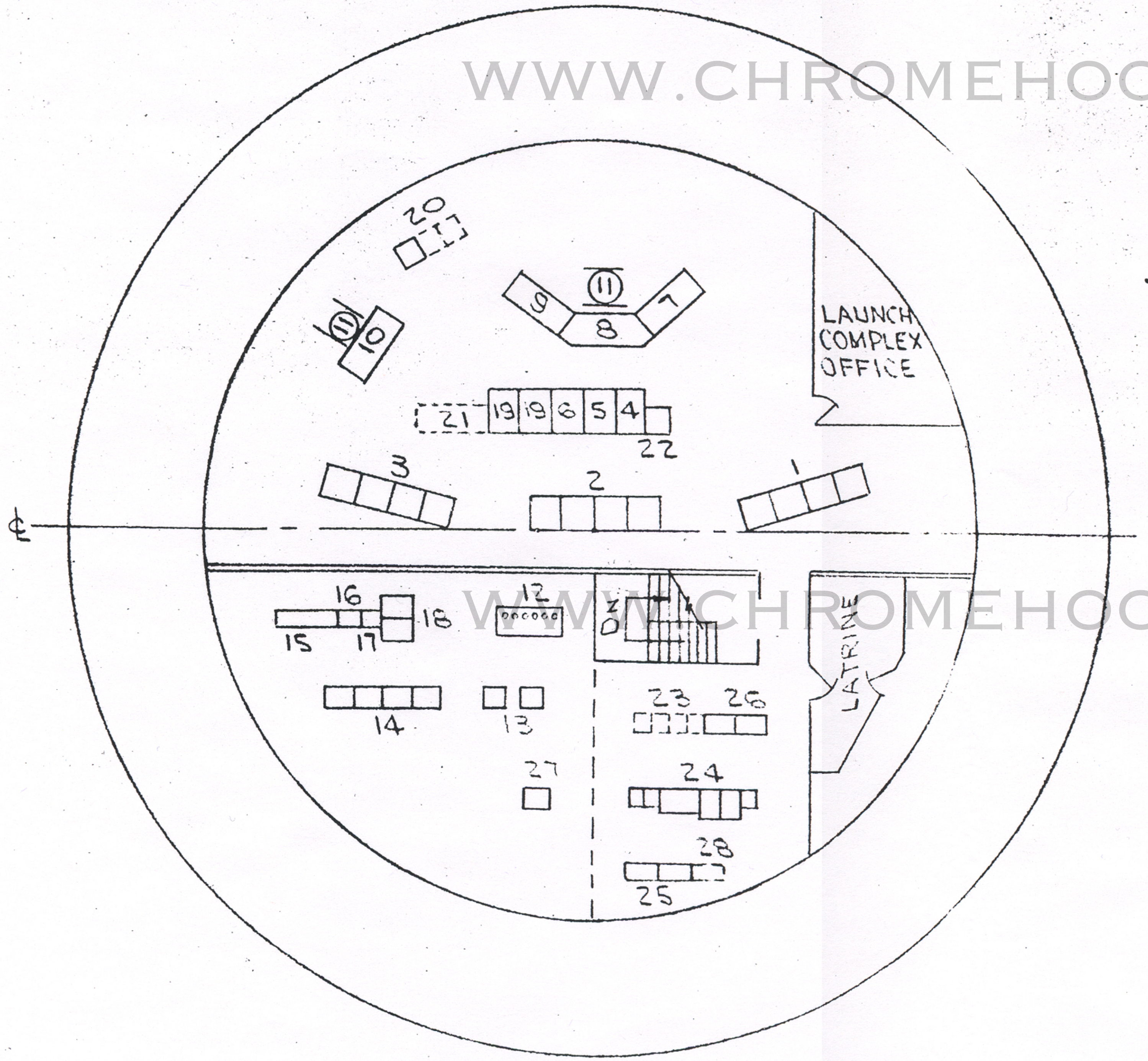
Three new Titan II consoles would be installed in a close group arrangement. (see sketch) The consoles will be observed and controled by the one launch control officer. His chair will be located for ready access to the console control buttons. Each console will service and control one silo. Cross switching is not economically feasible without sacrifice of reliability levels now attained by Titan II equipment.

T.V. monitors can be suspended at the correct elevation to allow constant surveillance by the launch control officer. Each set will monitor a single silo. The T.V. monitor control console will be located to allow viewing of the monitors.

Three Titan II Control Monitor Groups will be installed under the T.V. cameras. One drawer, the voltmeter control drawer, of each Power Distribution and Control rack would be installed in corresponding Control Monitor Groups. The balance of the PDC cabinet will be installed in the equipment terminal. Each Control Monitor Group will service and monitor one silo.

An additional console second chair accommodates the alternate launch officer's position.

TITAN I COM[illegible]LEX ACCOMMODATIONS FOR TITAN IIA
CON[illegible]ROL CENTER MODIFICATIONS



CONTROL CENTER UPPER LEVEL

Item No.	Qty.	Description
1	4	TV MONITORS, LAUNCHER #1
2	4	TV MONITORS, LAUNCHER #2
3	4	TV MONITORS, LAUNCHER #3
4	1	CMG, LAUNCHER #1 } ▷1
5	1	CMG, LAUNCHER #2 } ▷1
6	1	CMG, LAUNCHER #3 } ▷1
7	1	LAUNCH CONTROL CONSOLE #1
8	1	LAUNCH CONTROL CONSOLE #2
9	1	LAUNCH CONTROL CONSOLE #3
10	1	ALTERNATE LAUNCH OFFICER'S CONSOLE
11	2	SHOCK ISOLATED CHAIRS
12	1	MAIN DISTRIBUTION FRAME
13	2	P.A. GROUP
14	4	COMMUNICATIONS BAY FRAMES
15	1	BATTERY RACK
16	1	BATTERY CHARGER
17	1	POWER & SUPERVISORY FRAME
18	1	TEST DESK
19	2	465L SUB C RACKS
20	3 *	LES RACKS
21	1 *	LES DISPLAY
22	1	PAS RACK
23	4 *	465L RACKS
24	6	HARD RADIO & MULTIPLEX
25	2	EMP PROTECTION BAYS
26	2	WCT BAYS
27	1	INTRA-SITE RADIO RACK
28	1 *	PAS CABINET

▷1 PDC-3 CONTROL PANEL & RADIATION MONITOR RELOCATED TO CMG

* ACP ONLY

FIGURE IV-B.1-2

3. <u>Power System Changes</u>

<u>Initial Change</u> - Add Commercial Power System substation; shut diesel engines down, place two units in standby readiness. This will reduce facility base load from 1280 KW to 850 KW and reduce operation requirements.

<u>System Update</u> - After engineering studies are made, several major changes in equipment will reduce the complexity of the present Titan I power house; such as:

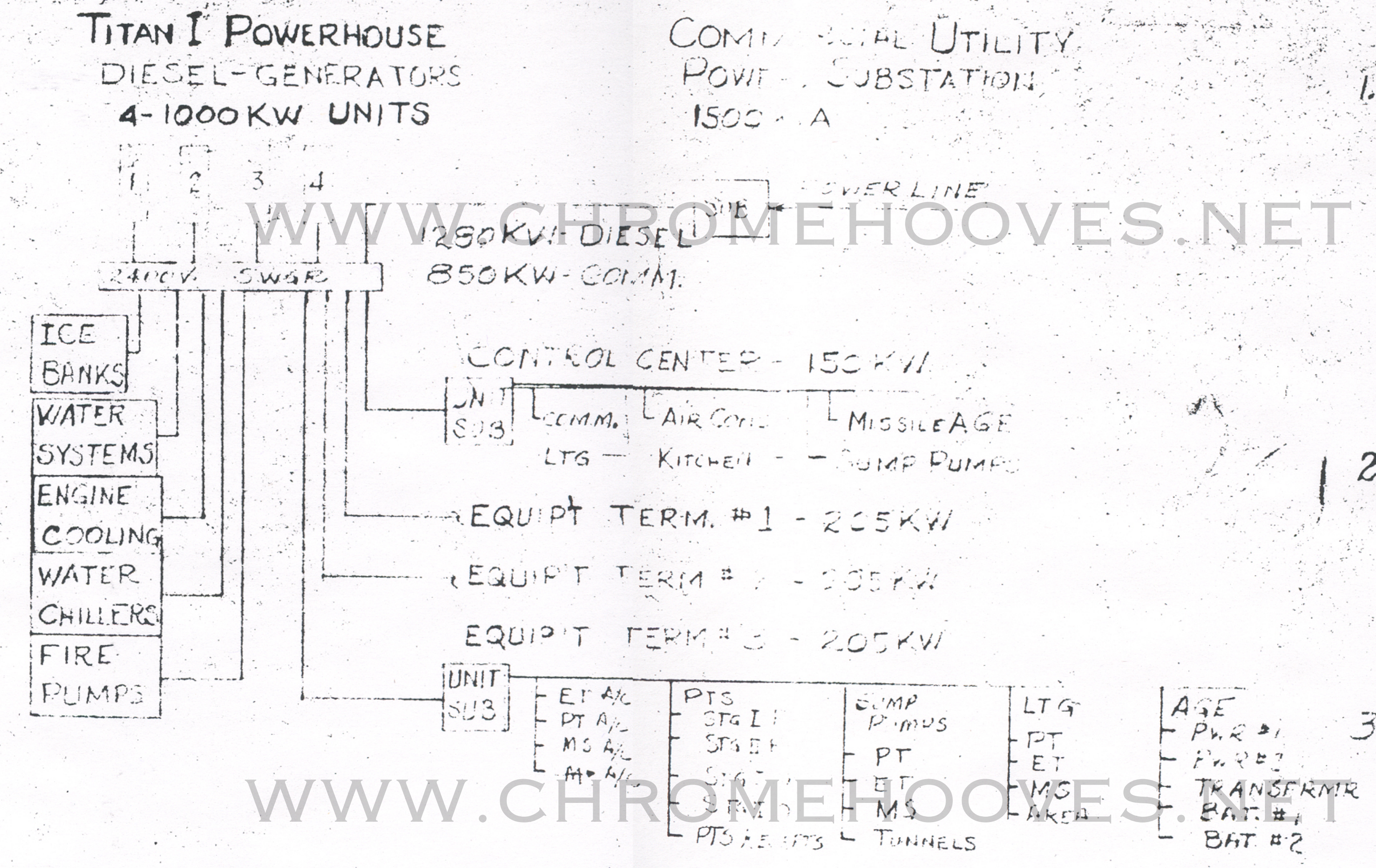
a. Elimination of Ice Bank System with associated Refrigeration Systems, pumps, etc. 200 H.P.

b. Revision of Air Conditioning System requirements to the E.T.'s, P.T.'s and powerhouse with possible reduction in water chiller horsepower requirements. Present two units are 850 horsepower each; Titan II System's are 25 horsepower each and are in each silo area--total 75 horsepower plus possible 25 horsepower unit for the Control Center.

c. Revision of water treating systems based upon recent operating experience to reduce complexity and number of pumps required.

d. Revision of Diesel Engine auxiliaries to make the units more nearly self-contained; such as: lube oil circulation-filtration-cooling and jacket coolant circulation-filtration-cooling.

These System Updating programs may permit base load reduction to about 500 KW, permit removal of two of the diesel engine generators, and reduce manpower operation and maintenance requirements.



POWER SYSTEM DIAGRAM
TITAN I MODIFIED FOR TITAN IIA

MAJOR AREAS

1. POWERHOUSE – Add Commercial Utility Co. Power Connection; shut Diesel Engines down; moth ball 2 units, maintain 2 units in operational stand by. Unitize 2 Diesel Units for self contained operation of lube, fuel & cooling systems. This will reduce facility base load from 1280KW to 850 KW.

2. WATER CHILLER SYSTEM – Present Units are 850 HP each. The requirements of the modified silos & vehicles should be studied in view of replacing these units with possible 100-150 HP units.

3. ICE BANK SYSTEM – Present Ice Bank System should be modified or removed entirely based upon reduced power requirements for launching.

4. WATER TREATMENT SYSTEM – Restudy water treating system based upon reduced requirements of modified [illegible], normally shutdown Diesels, & better experience to reduce complexity and maintenance.

5. LIGHTING SYSTEM CONTROL – Present operations allow all lights in all areas to be left on continuously. Remote control to turn off unneeded lights can reduce power requirements by 250 KW and reduce lighting replacements.

Total Complex Load can be reduced to 500KW or less from the present 1280KW. Launch Power for TITAN I totalled 3020 KW. Launch power for TITAN IIA (Dry launch) would total about 500KW.

MARTIN

BY ERS DATE 9/26/63 SUBJECT POWER DEMANDS TITAN I & TITAN II IN TITAN I SILOS

CHKD. BY DATE

SHEET NO. OF

JOB NO.