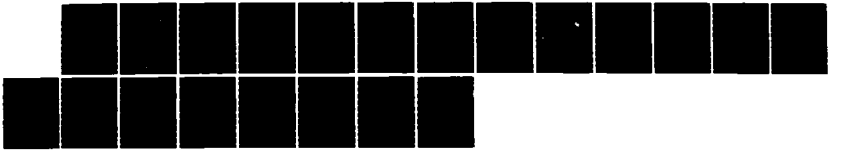
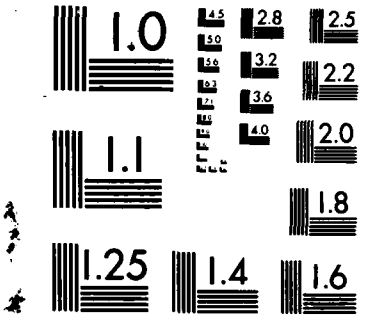
AD-A173 686 FEASIBILITY STUDY OF COAL GASIFICATION/FUEL CELL/COGENERATION PROJECT FOR..(U) EBASCO SERVICES INC NEW YORK C TRAPP ET AL. JUN 85 DAAG29-85-C-0007 1/1

UNCLASSIFIED F/G 10/2 NL





FEASIBILITY STUDY OF

COAL GASIFICATION / FUEL CELL / COGENERATION

FORT HOOD, TEXAS SITE
PRELIMINARY SURVEY

REPORT CLIN 000203

PREPARED FOR

DEPARTMENT OF THE ARMY
AND
GEORGETOWN UNIVERSITY

JUNE, 1985

EBASCO

EBASCO SERVICES INCORPORATED

Two World Trade Center,
New York, N.Y. 10048

FEASIBILITY STUDY OF

COAL GASIFICATION / FUEL CELL / COGENERATION

FORT HOOD, TEXAS SITE
PRELIMINARY SURVEY

REPORT CLIN 000203

PREPARED FOR

DEPARTMENT OF THE ARMY
AND
GEORGETOWN UNIVERSITY

JUNE, 1985

EBASCO

EBASCO SERVICES INCORPORATED

Two World Trade Center,

New York, N.Y. 10048

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER CLIN 000203	2. GOVT ACCESSION NO. AD-A173686	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* Feasibility Study of Coal Gasification/ Fuel Cell Cogeneration Preliminary Site Survey-Fort Hood Texas		5. TYPE OF REPORT & PERIOD COVERED Preliminary Site Survey 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) C Trapp, P Estreich		8. CONTRACT OR GRANT NUMBER(s) DAAG-29-85-C-0007
9. PERFORMING ORGANIZATION NAME AND ADDRESS Ebasco Services 2 World Trade Center New York, New York 10048		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 611102-BH57-09
11. CONTROLLING OFFICE NAME AND ADDRESS U S Army Research Office Post Office Box 12211 Research Triangle Park 27709		12. REPORT DATE June 1985 13. NUMBER OF PAGES 16
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release: distribution unlimited

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

Prepared in cooperation with Georgetown University. The views, opinions and/or findings contained in this report are those of the author(s) and should not be constructed as an official Department of the Army position, policy or decision, unless so designated by other documentation.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Fuel Cell/Coal Gasification/Cogeneration Exemplar Study

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Report describes site characteristics that could affect the feasibility of a Coal Gas/Fuel Cell/Cogeneration project and describes existing sources of thermal and electric energy.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

TABLE OF CONTENTS

		Page
1.0	Introduction	1-1
2.0	Summary	2-1
3.0	Site Description	3-1
4.0	Site Peculiarities	4-1
5.0	Existing Thermal Energy Sources and Distribution	5-1
6.0	Existing Electrical Energy Sources and Distribution	6-1
7.0	Fuel Supply	7-1
8.0	References	8-1

LIST OF FIGURES

		Page
TX 3-1	Site Diagram	2-2

PRELIMINARY SITE SURVEY REPORT

1.0 Introduction

The purpose of this report is to present the results of the preliminary survey of the Fort Hood, Texas site proposed for a Coal Gasification/Fuel Cell/Cogeneration (GFC) system.

The site characteristics that could affect the feasibility of a GFC installation are discussed as well as existing methods for generating and distributing thermal and electric energy.

2.0 Summary

The proposed site at Fort Hood provides adequate space for the GFC system and a potential chilled water refrigeration plant (not included in this study) with room for additional GFC modules, if required at a later date (See Figure TX 3-1).

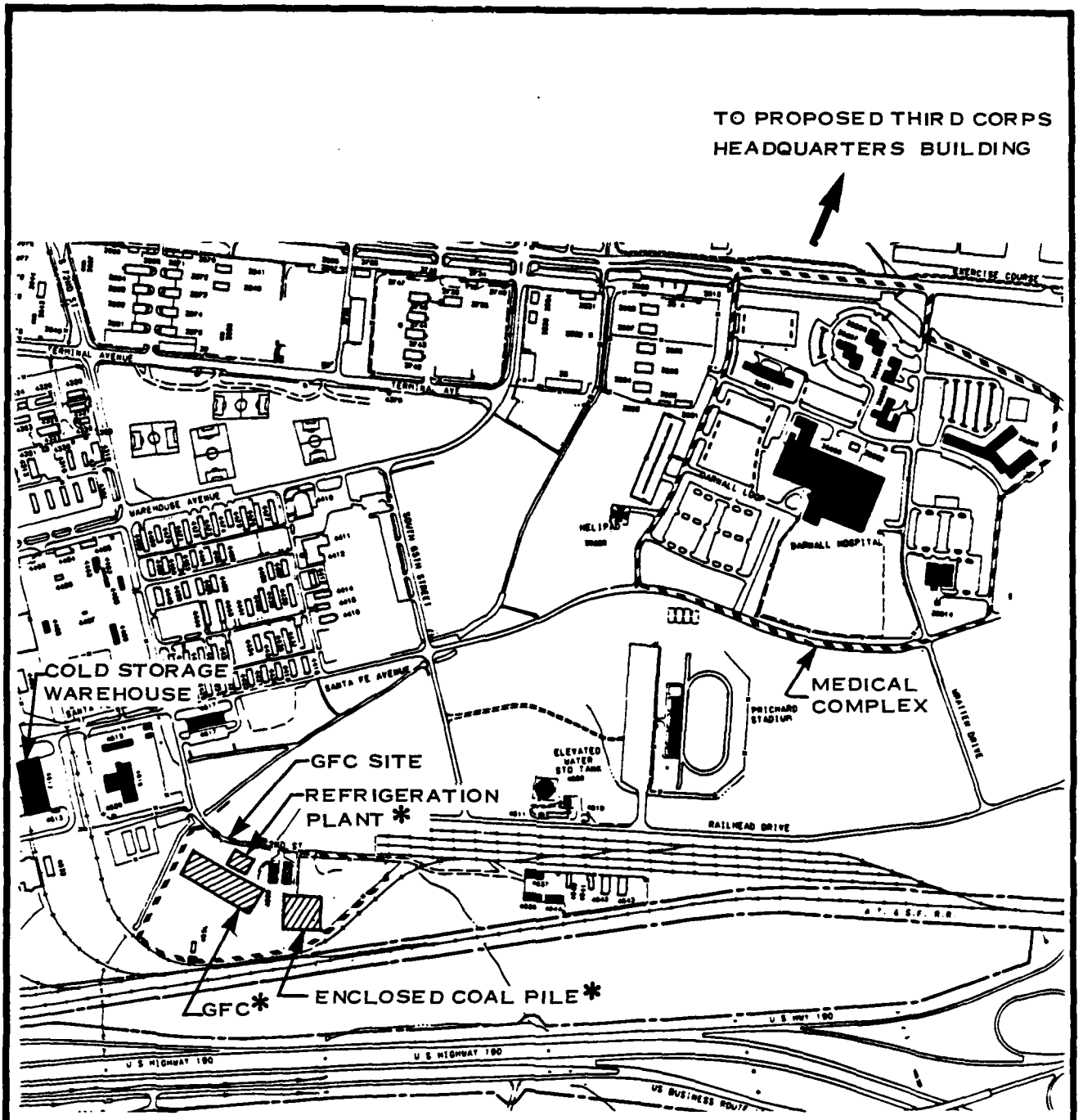
The GFC is located approximately 4000 feet from the medical complex, requiring the burial of connecting services which include chilled water or dual temperature chilled and hot water mains (approximately 10 inch supply and return pipe for one GFC module output). The buried mains from the GFC must be extended as a system with branch connections to all buildings served.

Because of the corrosive nature of the soil (see par. 3.0), careful selection and design of the underground piping system is required, with consideration given to materials, provisions for leak testing, leak location and cathodic protection. The effect of this piping distribution system on GFC economics will be reviewed.

Buried electric feeder cables from the GFC to the substation located approximately 2,400 feet beyond the medical complex are also required.

Fuel cell net output of 11,000 kW is well below the minimum usage at Fort Hood currently about 20,000 kW. Economic analysis will determine if all the electric power should be supplied to Fort Hood directly or sold to Texas Power & Light (TP&L) at avoided cost rates.

Emissions are controlled by system design and operating practice to stay within federal and local environmental limits. For example, fugitive dust emissions will be controlled by enclosures for coal storage and material handling equipment, and by dust suppression sprays and dust collectors; sulfur pit emissions will be controlled by recycling vapor to the oxidizer tanks; the occasional excess of gasifier output due to fuel



*NOT TO SCALE

DOA / GEORGETOWN UNIVERSITY
COAL GAS / FUEL CELL / COGENERATION
FORT HOOD, TEXAS SITE PLOT PLAN FIGURE TX 3-1
EBASCO SERVICES INCORPORATED

cell demand reduction will be handled by flaring; noise emissions of coal delivery and coal handling as well as rotating equipment can be reduced by enclosures and/or direct acoustic treatment.

The poor quality of soil (caliche) merits review following receipt of geotechnical information, of its possible effect on construction costs.

The Fort Hood site has no peculiarities that would affect the technical risks identified in the Basic System Description (CLIN 0001) and, none that would eliminate this site from consideration to accommodate a GFC system.

3.0 Site Description

The Fort Hood Military Reservation is one of four sites proposed for the Gasification/Fuel Cell/Cogeneration (GFC) system and is located adjacent to Kileen, Texas, occupying a part of Bell County and of Coryell County in North Central Texas.

Of the three areas which constitute this installation - West, North and South Fort Hood - the latter includes the site selected for the GFC system. This site will initially include a covered coal pile, gasifier and gas processing, fuel cells, thermal management system, cooling towers and a central refrigeration plant.

The proposed GFC site in South Fort Hood is approximately 12 acres at an elevation of approximately 950 ft above mean sea level. Referring to Figure TX 3-1, it is 1,000 feet west of the Fort Hood railhead and unloading docks and is bordered on the south by the Atchison Topeka and Santo Fe (AT&SF) main line tracks. Parallel to and adjacent to these tracks is US Highway 190 assuring both truck, via the clear creek entrance to Fort Hood and rail access to the GFC site during construction and for coal delivery and ash removal.

On the west and north of the GFC site are, respectively, a drainage canal and 72nd Street. The nearest private residences are approximately one mile south of the GFC site at the reservation boundary.

The GFC is located 2000 feet from the elevated water storage tank No. 4655 at Railhead Drive and 65th Street. According to one system analysis, it was recommended to the Corps of Engineers[3] that this 1,500,000 gallon tank supply water during peak hours at the rate of 1.18 million gallon/day (MGD). The GFC system, requiring 0.05 MGD would add 4 percent to this recommended flow which is negligible for a tank of this size.

The average waste water flow from area No. 10 which includes the GFC site was 0.124 MGD with a peak flow of 0.469 MGD[4]. The 12-inch exit line

from the area has a capacity of 7 MGD. The GFC contribution of approximately 0.015 MGD would be easily handled by the system.

The following soil characteristics are typical for the Fort Hood area and will be confirmed upon receipt of test borings(1).

1. A caliche type soil exists at the site and the approximate depth will have to be determined for foundation design. Due to the concentration of calcium carbonate which builds up with capillary movement of moisture to the surface, this material when dry, is difficult to excavate and when wet, is extremely unstable.

   With this soil, it is expected that the GFC system will have a mat foundation.

2. There is little if any rock to be found in the site area.

3. The water table is expected to be below any excavation point. However, the soil has a high moisture content with resistivities in various locations of the cantonment ranging from 610 ohms/cm^3 to 3800 ohms/cm^3(2). Soil resistivities from zero to 2000 ohm/cm^3 are termed "severely, corrosive" in the National Association of Corrosion Engineers Handbook.(6)

The buildings considered for service by the GFC are in three locations. Representing the largest electrical and thermal load, the medical complex is in the first location and is approximately 4000 feet northeast of the GFC. It is bordered by Santa Fe Avenue on the south, Tank Destroyer Boulevard on the north, Wratten Drive on the east and includes the following buildings:

Building No.	Name	Floor Area (ft^2)
36000	Darnall Hospital	458,971
36001	Clinic	44,626

Building No.	Name	Floor Area (ft^2)
36003	Barracks/Administration	18,526
36006	Bachelor Officer Quarters	152,737
36007	Barracks	25,550
36008	Barracks	21,900
36009	Mess Hall	7,995
36014	Dental Clinic	36,725

Darnall Hospital which is the major structure in this group was built in 1966 with a total floor area of 214,525 ft^2. The five story addition completed in July 1984 more than doubled its floor area to the above listed value.

In the second location is the proposed Third Corps Headquarters Building which would have a gross floor area of 312,000 ft^2. This would be located an additional 2,400 feet north-northeast of and beyond Darnall Hospital at the north end of Sandowski Field Parade Ground.

In the final location is Building No. 4612 which is the cold storage warehouse, 820 feet northwest of the GFC site and on the far side of both the drainage ditch and a north-south railroad spur track.

4.0 Site Peculiarities

1. With the exception of the Cold Storage Warehouse, the GFC is located remotely from the thermal loads. Specifically, the GFC is 4000 feet from the Medical Complex, and 6400 feet from the proposed Third Corp Headquarters Building.

2. The buildings that make up the medical complex each have their own thermal energy sources for heating and cooling. To serve the entire medical complex, from the GFC would require the addition of an underground thermal distribution system.

3. One of the preferences expressed by Fort Hood personnel[1] is to provide a central chilled water refrigeration plant to serve the medical complex. This plant would be located at the GFC and be powered by GFC thermal output. An underground chilled water piping distribution would be required to link the GFC and the medical complex or other buildings.

4. A caliche type soil exists at the Fort Hood site which is a poor type of soil, meriting review following receipt of detailed geotechnical information of its possible effect on construction costs.

5.0 Existing Thermal Energy Sources and Distribution

Unlike the other three sites, the Fort Hood buildings considered for service by the GFC are, with the minor exception of Building Nos. 36007, 36008 and 36009, served by their respective thermal energy sources and not by a central heating or cooling plant.

Information available on thermal energy sources for each of the existing buildings to be considered is summarized as follows:(1)

Building No. 36000 - Darnall Hospital
Served by three gas fired boilers of 7000 lb/hr capacity generating 100 psig steam. Steam is reduced to pressures required for sterilizers, bedpan washers, humidifiers and kitchen equipment. Steam to water heat exchangers provide hot water to air handling unit heating coils and perimeter fan coil units.

Flat plate solar collectors in conjunction with two 3750 gallon storage tanks contribute about half the annual domestic hot water heating requirement.

Three electric drive centrifugal chillers totaling 1300 tons with cooling towers provide chilled water to the air handling unit cooling coils. However, to permit seasonal shutdown of mechanical refrigeration, the Computer Room and CAT Scan Room have been provided with their respective self-contained air conditioning units.

Building No. 36001 - Clinic
Served by one 1,800,000 Btu/hr output gas fired hot water generator and a 60 ton reciprocating chiller with cooling tower.

Building No. 36003 - Barracks
Served by one 2,310,000 Btu/hr input gas fired hot water generator and a 50 ton reciprocating chiller with air cooled condenser.

Building No. 36009 - Central Plant and Mess Hall
A 6,312,000 Btu/hr output hot water generator supplies hot water to Building Nos. 36007, 36008 and 36009.
Domestic hot water in 36009 by separate gas fired heater.
A 105 ton reciprocating chiller with air cooled condenser provides chilled water to Building No. 36007, 36008 and 36009.

Building Nos. 36007 and 36008 - Barracks
Served by heating and chilled water plant of Building No. 36009.
Domestic hot water by water to water heat exchangers.

Building No. 36014 - Dental Clinic
Served by a gas fired hot water generator of 837500 Btu/hr output with a 75 ton reciprocating chiller and 100 ton absorption chiller. Part of the heating and cooling load is carried by a solar collector system.

Building No. 36006 - Bachelor Officer Quarters
Served by two gas fired boilers totalling, 8,887,000 Btu/hr output capacity and generating 15 psig steam for space heating, domestic hot water and kitchen use. Air conditioning is provided by a 180 ton centrifugal chiller with cooling tower.

Building No. 4612 - Cold Storage Warehouse
This building is said to have a negligible space heating requirement and is provided with 220 tons of refrigerating capacity.

6.0 Existing Electrical Energy Sources and Distribution

The electrical requirements for Fort Hood are supplied by Texas Power & Light Company (TP&L). Electric power is transmitted to the fort via two 138 Kilovolt (KV) transmission lines, each connected to separate transmission networks at the main substation. This substation, located at the corner of Tank Destroyer Blvd and Hood Road, houses four transformers, three rated at 25 MVA and one rated at 20 MVA. They are each equipped with load tap changers and step down the 138 KV transmission line voltage to the 12.5 KV distribution voltage. Switched capacitor banks are connected to the transformer secondaries for power improvement. This substation currently supplies all of Fort Hood's electrical power at a power factor of approximately 87%.(5)

The four bus sections in the substation supply 16 Fort Hood feeder circuits. Adjacent bus sections are connected by motor operated air break switches. This allows disconnecting a transformer for inspection, servicing or for any other reason that requires it to be out of service. Each bus is also backed up by an inspection bus. The feeder circuits are connected to both the source bus and its corresponding inspection bus.

The 16 feeder circuits to Fort Hood are of overhead construction with two circuits per pole line. However, buried feeders have been used in newer residential areas or other congested areas.

Operation and maintenance of the Fort Hood electrical system which is reported to be in good condition is the responsibility of government personnel assigned to Fort Hood.

Local records were reviewed during a recent site visit and they showed that during the fiscal year of 1984 the monthly usage of electricity reached a high of 36,311,000 KWH during the month of August, and a low of

14,185,000 kWH during the month of February. The summer peak during this same period was approximately 63 MW and the low was approximately 20 MW.

It was also pointed out, during the site visit, that a second substation will be installed near the new army facility being constructed at New Montague village on West Foot Hood. This new substation will be tied into the existing Fort Hood electrical system.

7.0 Fuel Supply

Most of the active lignite mines in Texas are captive to utility companies. The nearest lignite reserves expected to be in production during the life of this installation are located in the vicinity of Malakoff, Texas.

Malakoff lies about 125 to 150 highway miles northeast of Fort Hood. In the East, trucks are restricted to maximum loads of about 20-tons. In Texas, depending upn conditions along the route (bridges, etc.) it may be possible to use trucks with 25-ton capacity. For an annual burn of about 55,000 tons per year, 9 to 10 trucks per day of 25 ton capacity, operating on a 5 day basis would be required. For 20-ton loads, about 11 to 12 trucks per day would be required on a 5 day basis. These deliveries could be scheduled for evenings or nights.

The railroad serving Fort Drum is the Atchison, Topeka & Santa Fe and the railroad surving the Malakoff area is the St Louis Southwestern (Cotton Belt). This would involve a joint haul as two separate carriers are involved. No joint rates are currently published for a lignite movement from Malakoff to Fort Hood and a study by the respective railroads would have to be made to determine routing interchange points and joint rates.

8.0 References

8-1 Personal communication with Director of Engineering and Housing, Fort Hood, on January 23 and 24, 1985.

8-2 Freese & Nichols Utility Survey, Volume 2, March 1978, p. 3-5, 6, 7.

8-3 Freese & Nichols Utility Survey, Volume 1, March 1978, p. 4-3.

8-4 Ibid, p. 2-15.

8-5 Black & Veatch, Basewide Energy Conservation Study and System Plan, Fort Hood, Texas, Final Report, Volume 1, Chapter 7.

8-6 National Association of Corrosion Engineers Hand Book

END

12-86

DTIC