PGandE GEYSERS RETROFIT PROJECT

MILESTONE REPORT NO. 3

(STRETFORD PROCESSES UNITS 1-12)

RECO Job No. S-79007

June 29, 1979

DISCLAIMER

HR

Rogers

MILESTONE REPORT NO. 3

INDEX

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MILESTONE NO. 3

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MILESTONE REPORT NO. 3

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1.0 INTRODUCTION

Milestone Report No. 3 is a progress report. Rogers Engineering Co., Inc. has investigated what sites are best suited for consolidation of power generating units 1 through 12 for processing the noncondensable gases through the Stretford Process for H_2S abatement below 10% of the mass flow.

The consolidation arrangement for the power generating units are Units 1 through 6 which produces 187 MWe power. Units 7-8 and 11 producing 212 MWe and Units 9-10 and 12 which also produces 212 MWe power. Site survey and selection for the Stretford units provided for a primary and alternative site for each consolidation. Each of these three groups of plants is associated with its Stretford Process Plant.

The gas blowers located at each power plant to push the noncondensable gases through the stainless steel pipe network to the Stretford Process have been sized. When combining the new auxiliary load requirements of these blowers and the Stretford units it was determined that additional auxiliary transformer capacity is necessary.

We are investigating additional alternatives with respect to the Stretford Process application. This data will be submitted in the Final Report, See Section 6.

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2.0 SUMMARY

A field survey was conducted to locate convenient Stretfrod sites for consolidation of power generation Units 1 through 6, 7-8 and 11, 9-10 and 12. The primary site location, verified with field measurements were at Units 3-4 illustrated by Drawing SK-006, Unit 11 illustrated by Drawing SK-0028 and Unit 12 illustrated by Drawing SK-0029.

The noncondensable gas blowers required to push the gas from the power unit sites to the Stretford site range in horsepower. Schedule 10 stainless steel pipe will convey the gas over the Geyser terrain following the routing of existing steam lines wherever possible.

Because of the cost of the noncondensable gas blowers and associated stainless steel pipe individual Stretford units are being costed out and will be reported on in the Final Report in July. At this time a recommendation will be made as to the best arrangement for the retrofit.

Alternative sites have been verified for the power unit consolidation and are addressed in the Table of Contents as Alternative No. 2.

The total GM estimate cost for the Stretford located at Unit 3-4 for consolidation of Units 1-6 = $9,970,500.

For consolidation of Units 7-8 and 11, $10,073,900.

For consolidation of Units 9-10 and 12, $7,563,400.

Other power unit combinations were examined. Such as combining Units 1-6 with 7 and 8. This was rejected because the consolidated power block was nearing 300 MWe which was concluded to be too large to lose in the event we lost the Stretford. Other reasons; such as using an individual Stretford for Unit 11 would then become necessary thus producing an unbalanced power block in our consolidation arrangement.

Another combination being studied but not ready for this report is the routing of noncondensable gas from Units 9-10 and 12, to Unit 14 now under construction. This will require the Stretford supplier to expand the process facilities at the Unit 14 site. Field verification of the expanded Stretford Process on the Unit 14 site has yet to be accomplished.

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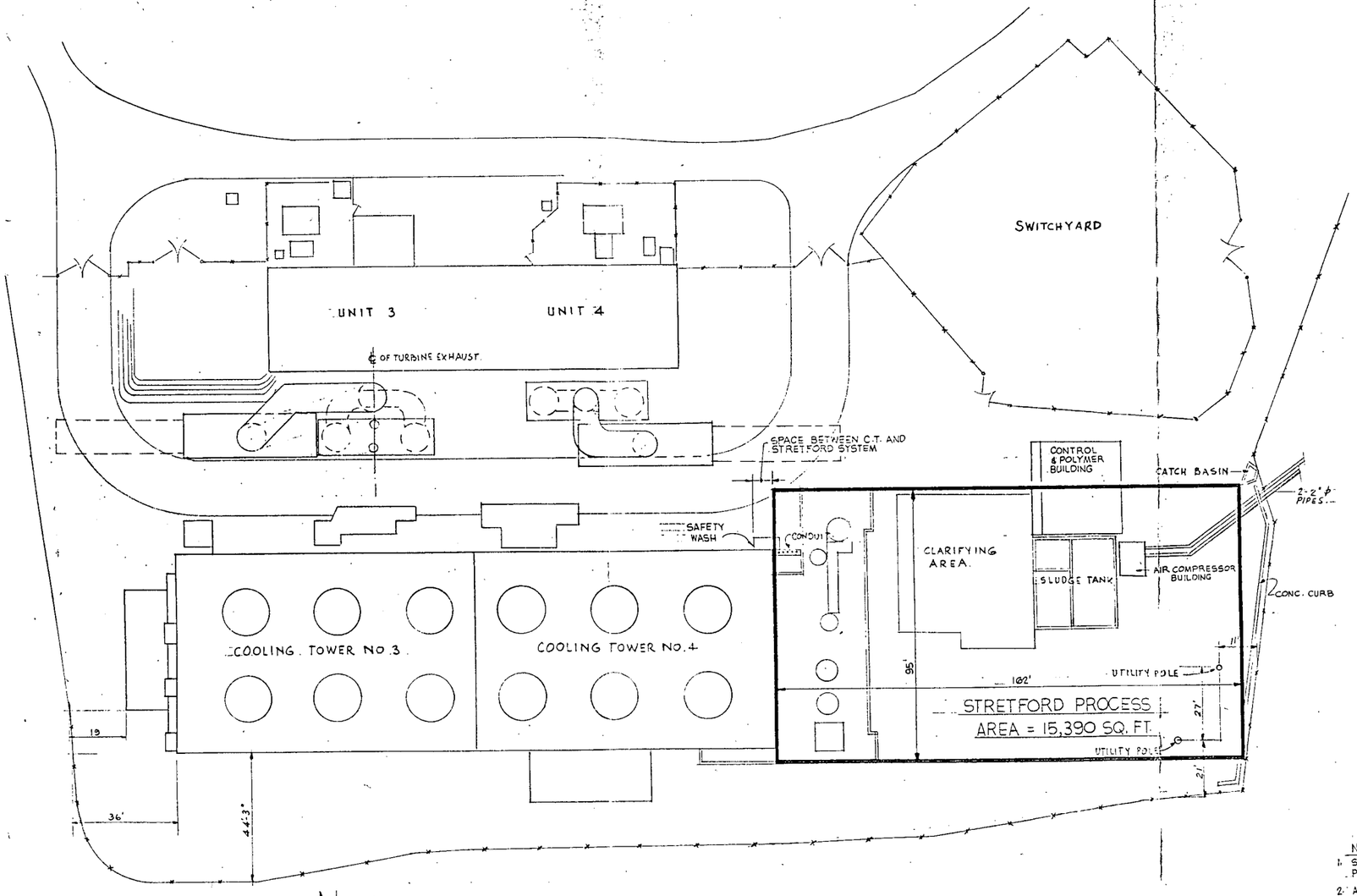
3.1 Proposed Site at Units 3 and 4
Drawing SK-006 (Alternative No. 1)

The two sites examined for Stretford location were both capable of accepting a 95' x 162' Process unit. Locating the process unit inside the existing fence line is desirable from the standpoint of no clearances required from other organizations for land rights as would be the case for Alternative No. 2. (SK-005A & B)

The auxiliary transformer required to accommodate the 1,065 kW of additional power for the Stretford can be located in the existing switchyard. Room to pull Unit 4 condenser tube bundle without interference has also been considered in placement of the Stretford.

The water purification equipment now existing and servicing Units 3-4, 5-6 must all be removed from the site. However its removal has an impact on operation of units 5 and 6, which will be taken into account when planning the retrofit construction schedule for each unit.



UNIT 3 & UNIT 4 SITE PLAN WITH PROPOSED STRETFORD UNIT AREA

NOTES:
1. STRETFORD UNIT TO BE PLACED IN INDICATED AREA.
2. AREA 15,390 SQ. FT RESULTS FROM DIMENSIONS 95' x 162' AS REPORTED BY PARSONS FOR STRETFORD EQUIPMENT.
3. REMOVE EXISTING EQUIPMENT.

REV.	ZONE	DATE	REVISION	DR.	CHK.	APP'D RECO	APPR.
1		9/19/79	ISSUED FOR MILESTONE REPORT #3	E.A.	LFW		
0		5/31/79	ISSUED FOR MILESTONE REPORT #2				

REFERENCE DRAWINGS

ROGERS ENGINEERING CO., INC.
ENGINEERS - ARCHITECTS
111 PINE STREET, SAN FRANCISCO, CALIFORNIA 94111

SCALE 1" = 20'-0" DATE 5-25-79
DR. E.A. CHK. LFW ENG. EJM APPROVED

APPROVALS
DATE
DATE

P G and E RETROFIT STUDY
UNITS 1 THRU 6
SITE PLAN - STRETFORD ALTERNATIVE No. 1
CONSOLIDATION OF UNITS 1 THRU 6

JOB NO. S 79007 | SK-006 | 1

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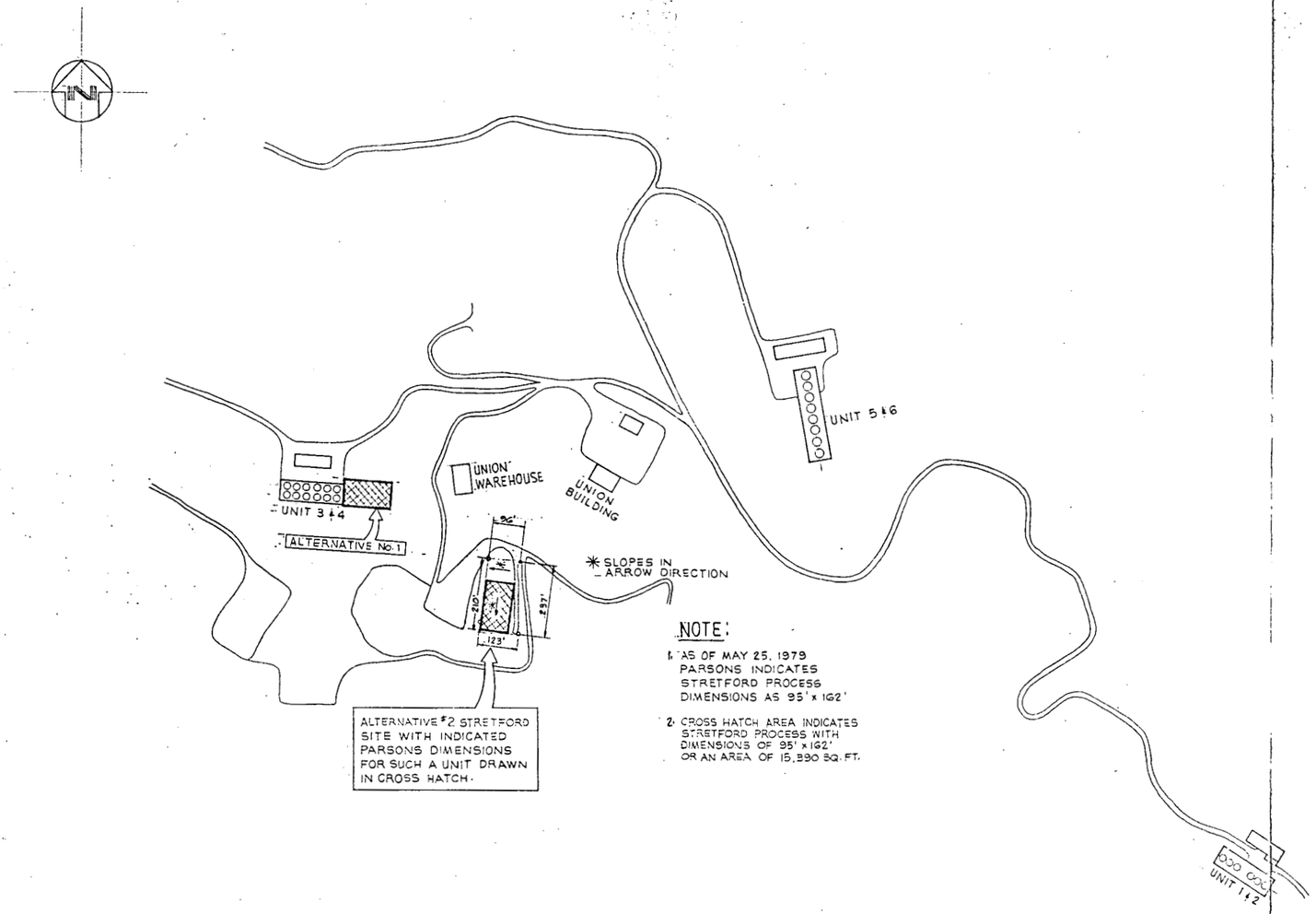
3.2 Alternative Site (UOC)
SK-005A & B (Alternative No. 2)

The land rights to clear the Union Oil Corp. junkyard of the procedural requirements necessary to make it available for the Stretford Process which consolidates Units 1 through 6 make it the second choice.

Another disadvantage the site has is the additional stainless steel piping required from Units 3-4. Not only do the piping costs increase, but so does the vulnerability of the noncondensable gas piping network, because of the additional pipe length.



NOTE:

1. AS OF MAY 25, 1979 PARSONS INDICATES STRETFORD PROCESS DIMENSIONS AS 95' x 162'
2. CROSS HATCH AREA INDICATES STRETFORD PROCESS WITH DIMENSIONS OF 95' x 162' OR AN AREA OF 15,390 SQ. FT.

REFERENCE DRAWINGS	REV.	ZONE	DATE	REVISION	DR.	CHK.	APPR. RECO	APPR.
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	◇		6/14/79	ISSUED FOR MILESTONE REPORT #3	GO	LFW	EJM	

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DR. GO. CHK. LFW ENG. EJM APPROVED

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PG and E RETROFIT STUDY
UNITS 1 THRU 6
SITE PLAN - STRETFORD PLANT LOCATIONS ALTERNATIVE No. 1 & 2
CONSOLIDATION OF UNITS 1 THRU 6

JOB NO. S 79007 | SK-005A | 0

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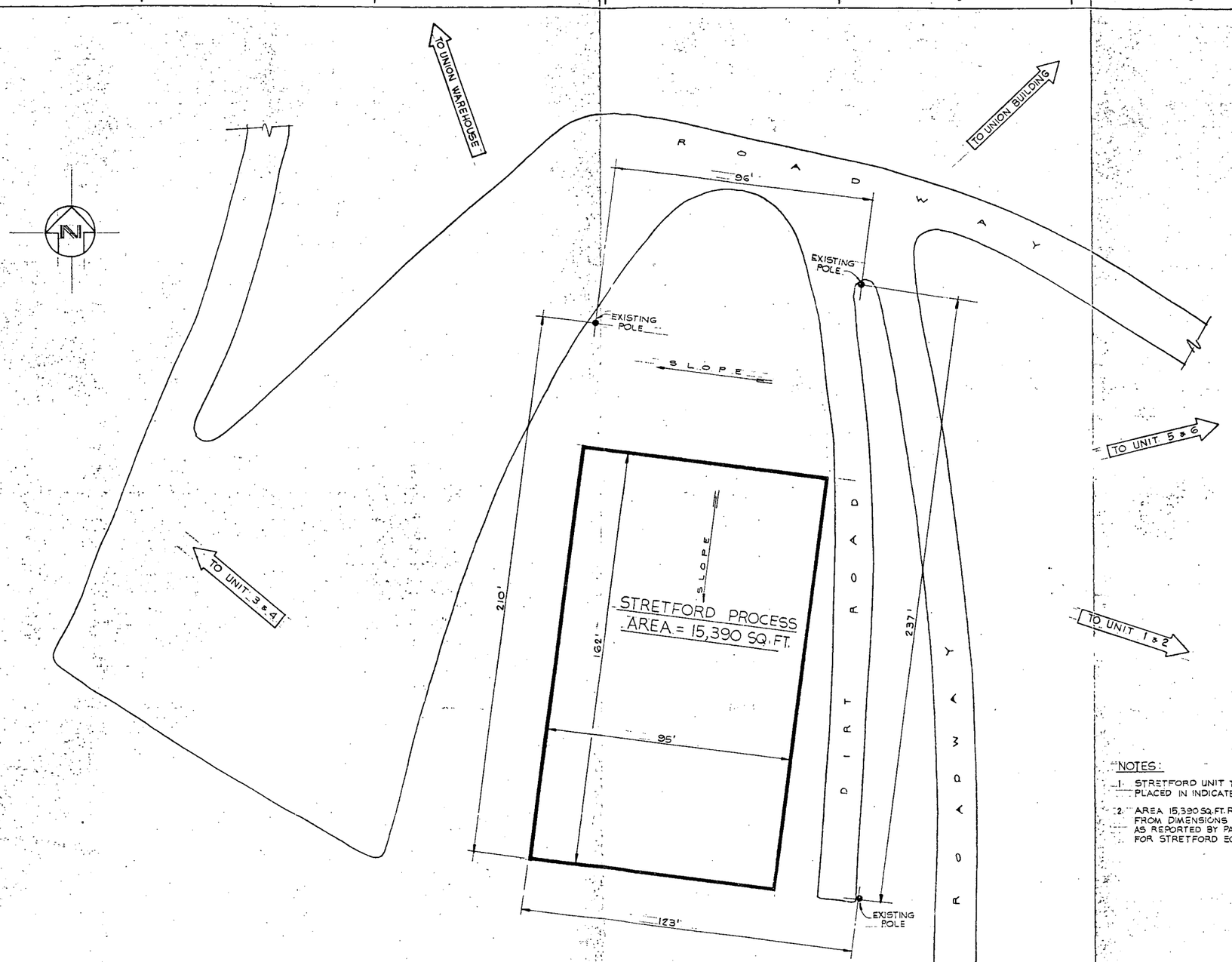

NOTES:

1. STRETFORD UNIT TO BE PLACED IN INDICATED AREA.
2. AREA 15,390 SQ.FT. RESULTS FROM DIMENSIONS 95' x 162' AS REPORTED BY PARSONS FOR STRETFORD EQUIPMENT.

REFERENCE DRAWINGS	REV.	ZONE	DATE	REVISION	DR.	CHK.	APPR. RECO	APPR.
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PG and E RETROFIT STUDY
UNITS 1 THRU 6
SITE PLAN STRETFORD ALTERNATIVE No. 2
CONSOLIDATION OF UNITS 1 THRU 6

JOB NO. S79007 | SK-005B | 0

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3.3 Combining Units 1 thru 6 with Units 7 and 8, or with Unit 15

In consideration of a possible site location for Units 1 thru 6, it was deemed necessary to investigate, in concept only, of course, the possibility of combining more than Units 1 thru 6 for a single Stretford Process Unit for the H_2S abatement requirement of PGandE on this Retrofit Conceptual Study.

The available sites for the placement of a Stretford System in near proximity to Units 1 thru 8 have limiting dimensions. For instance Alternative No. 1 (SK-006) has only available area of slightly in excess of the 95' x 162' dimensions for a Stretford System to service Units 1 thru 6. If Units 7 and 8 are added, then the Stretford System dimensions become much greater than the allowable site area; hence, this particular alternative could not be considered. Alternative No. 2 (SK-005A & B) has sufficient area for a larger Stretford System to include Units 7 and 8; however, it is quite remote from Units 7 and 8. Extra piping costs would make Alternative 2 an unlikely selection.

A second reason for not including Units 7 and 8 is that a failure in the operation of the Stretford System with Units 1 thru 8 combined would cause a loss of 290 MWe of power to PGandE. With only Units 1 thru 6 combined, a failure in the operation of the Stretford System would only cause a loss of 184 MWe of power to PGandE.

A third reason for not including Units 7 and 8 is that these Units can be more proximately combined with Unit 11 for a single Stretford System. The off-gas totals from 7, 8 and 11 is 29,931 lbm/hr. and the off-gas totals for Units 1 thru 6 is 30,245 lbm/hr. These totals are approximately equal; hence, from an off-gas total balance point of view, Units 7 and 8 should be combined with 11.

With respect to Unit 15, this Unit was not included with Units 1 thru 6 primarily because of its remoteness from Units 1 thru 6 and because Unit 15, just started-up, already has an installed Stretford System for only Unit 15 and it is separate and independent.

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3.4 Conclusions - Units 1 thru 6

The primary conclusion for recommendation of the Stretford site at power generation Units 3-4 have been adequately covered in the preceding paragraphs 3.1, 3.2 and 3.3.

Recapping these reasons:

a) No land rights clearances required from other organizations.

b) Less stainless steel noncondensable gas piping requiring than that of Alternative Site No. 2 (UOC junkyard).

c) Consolidation of Units 1-6 only, without 7 and 8 will allow no increase in the 95' x 162' outline dimensions for the Stretford unit. Our recommended site will not accommodate an increase in the outline dimensions.

d) In the event a consolidated power block is lost because of the Stretford operation, the power loss is 184 MWe not 290 MWe, as would be the case if Unit 7 and 8 noncondensable gas reported to the Stretford at Unit 3-4 site.

e) Breakup of Units 7-8 and 11 consolidation will unbalance the noncondensable gas flow balance in the piping network. Presently the noncondensable gas flow from Units 1-6 and that from Units 7-8 and 11 are for all practical purposes, equal.

3.5 Noncondensable Gas Piping Network

The piping arrangement for transporting the noncondensable gases from the power plant aftercondenser to the Stretford unit requires a blower situated at every power plant location. The blower discharges into stainless steel pipe running to the Stretford unit. The blowers are discussed in Section 7.1 of this report. Section 7.2 includes data sheets that were issued to obtain price quotations for all the blowers considered in this study.

The piping system can be fabricated from 304L Schedule 10 stainless steel. This alloy will withstand the highly corrosive vent gases. The pipe routes parallel existing steam supply lines where possible. In many instances it should be feasible to modify existing steam line supports to also hold the noncondensable gas pipeline. The stainless steel pipe need not be insulated, with the exception of a short section of pipe at the discharge of the blower as deemed necessary to protect personnel from the hot pipe. The pipe has been sized to carry the gas at an upset temperature of 120°F, though the gas will approach ambient temperature for the greater portion of the route. An economic tradeoff study weighing the installed cost of the pipe versus the energy cost associated with the blowers was utilized to specify the pipe diameters.

The sizes of the pipe carrying the gases from Units 1 and 2, Units 3 and 4, and Units 5 and 6 are 6" ϕ, 10"ϕ and 14" ϕ, respectively. The pipe from Units 1 and 2 is joined with the pipe from Units 5 and 6 just north of Unit 5 and 6. A 16" ϕ line runs from this junction to connect with the pipe from Unit 3 and 4 and the combined gas flows to the proposed Stretford location due east of Unit 4, through an 18" ϕ line.

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TABLE 3.5.1

ESTIMATE NONCONDENSABLE GAS BLOWER POWER REQUIREMENTS AND LINE SIZES

	Flow Rate* (lbm/hr.)	Blower** BHP	Blower Discharge Line Diameter	Blower Discharge Line Velocity (ft./sec.)
Units 1 and 2	2,839	27.6	6	39
Units 3 and 4	9,726	20.4	10	57
Units 5 and 6	17,680	92.7	14	61
Units 7 and 8	11,282	95.2	12	43
Units 9 and 10	11,282	76.3	12	45
Unit 11	18,649	41.8	14	58
Unit 12	11,124	23.4	12	48

*Note: These flow rates are for an aftercondenser gas discharge temperature of 120°F

**Assumes Stretford facility located at Units 3 and 4, Unit 11, and Unit 12

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4.1 Proposed Site at Units 7 and 8
SK-0027 (Alternative No. 2)

The proposed site at Units 7-8, east of the Unit 8 cooling tower and cyclone fence is the most attractive site for consolidation of Units 7-8 and 11. A minimum of site preparation and/or clearance effort in the form of a partial re-route of an existing steam line and grading for the Stretford system concrete base constitutes total site preparation and minimum man-hour effort.

The economic disadvantage associated with location of the Stretford at Units 7-8 is a noncondensable gas mass transport problem. The mass units in pounds per hour for the noncondensable gas transported from Unit 11 is 1.65 times the mass flow coming from combining Units 7 and 8.

Resulting in a 14" stainless steel, Schedule 10 pipe cost of $64.72 per foot mill price compared to a 12" pipe whose per foot cost is $39.53 for gas flow from Units 7-8 to the Stretford located at the Unit 11 site. The installed piping differential capital cost penalty is $300,000 and noncondensable gas blower capital cost penalty differential is approximately $60,000, or a total penalty of $360,000 if we were to use the available site at Units 7-8.

The advantage of the Unit 7-8 site is installation of the Stretford Process without a concurrent outage of Units 7-8 and 11, its non-critical impact on the man power and/or construction schedule, and the added cost of clearing Unit 11 site of the existing water purification equipment and the break out of the existing cyclone fence on the south side to accommodate a Stretford Process. When these points are assessed for the Final Report (Milestone No. 4) the Stretford site at Units 7-8 can well become the recommended site for consolidation of Units 7-8 and 11.

4.2 Proposed Site at Unit 11
SK-0028 (Alternative No. 1)

Using the Unit 11 site for consolidation of Units 7-8 and 11 requires removal of the existing water purification equipment. Relocation of the fence line pn the south side along with re-route of the 42" main steam line which supplies steam to Unit 11 turbine. The cost for site preparation will be addressed in the Final Report (Milestone No. 4).

Aside from the preceding disadvantages the highlights which make this site appealing are the lower capital cost for piping when transporting the total noncondensable gas from Units 7-8 versus that

from Unit 11. This was explained in Paragraph 4.1. The kW differential of 35 kW between the horsepower supplied to Units 7-8 and 11 noncondensable gas blowers gives the site at Unit 11 a capital plus operating cost advantage when evaluating noncondensable gas blowers.

4.3 Combining Units 7, 8, 11 with Unit 17

The possibility of combining Units 7, 8, and 11 with Unit 17 for purposes of placing a Stretford Process Unit was considered. A proposed site exists at Units 7 and 8 (Alternative No. 2, SK-0027), as well as at Unit 11 (Alternative No. 1, SK-0028). Unit 17 has not been built yet, but could be a possible location for the Stretford Process. Much the same thought was given here to this combination of Units as was given in Section 3.C above to Units 1 thru 6, 7 and 8, and Unit 15. Basically the reasons for not including Units 17 are as follows:

(1) Unit 17 is planned by PGandE to have its own self-contained Stretford Process Unit. To add capacity would involve Process redesign.

(2) Failure of operation of the Stretford System on Units 7, 8, 11 along with 17 would cause a loss of 330 MW of energy to PGandE whereas, without including Unit 17, there would be a loss of only 220 MW.

4.4 Conclusions - Units 7, 8, and 11

The primary conclusions for evaluation of the Unit 7-8 sites versus the Unit 11 site are enumerated below.

Unit 7-8 Site

a) Minimum man-hour effort for site preparation
b) Noncritical impact on construction schedule
c) Completion of noncondensable gas piping network for Units 7-8 and 11, to an interface near the condensers
d) Higher cost of noncondensable gas piping from Unit 11 versus noncondensable gas piping from Units 7-8
e) 142 kW for blowers at Unit 11 pumping noncondensable gas to Units 7-8

Unit 11 Site

a) Removal of existing water purification equipment
b) Re-route existing main steam line along fence on the south side of water purification system

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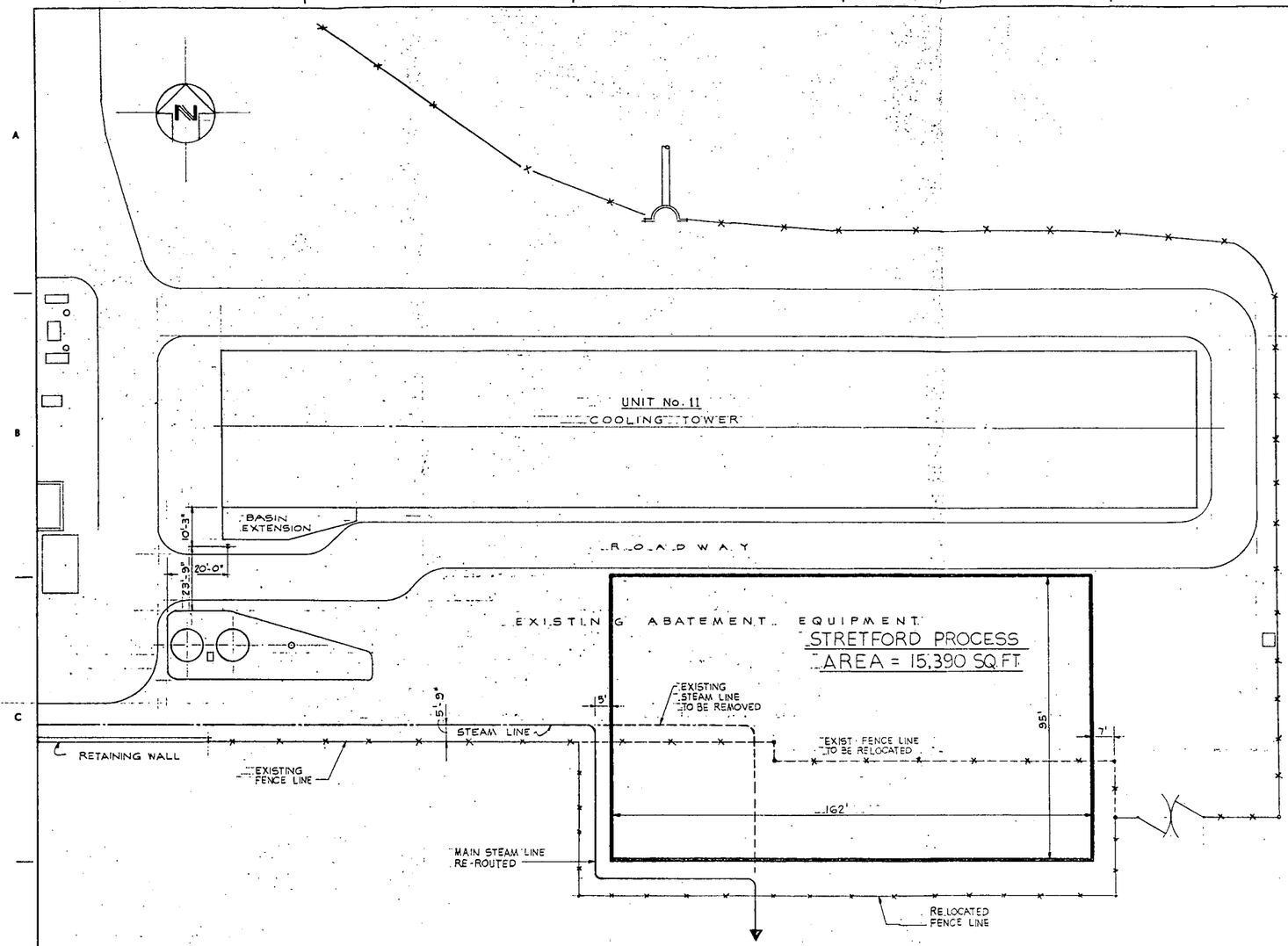
c) 107 kW for blowers at Unit 7-8 pumping noncondensable gas to Unit 11

d) Lower cost of noncondensable gas piping from Units 7-8 versus that from Unit 11

e) Permits Units 7 and 8 to stay on line.

The advantages under Unit 7-8 of items a, b and c may outweigh the capital cost disadvantages of items d and e and make the Stretford site east of Unit 8 the recommended location in the final analysis.



NOTES:

1. STRETFORD UNIT TO BE PLACED IN INDICATED AREA AFTER RE-LOCATION OF EXISTING FENCE AND MAIN STEAM PIPING.
2. AREA 15,330 SQ.FT. RESULTS FROM DIMENSIONS 95' x 162' AS PER REPORTED BY PARSONS FOR STRETFORD EQUIPMENT.

REFERENCE DRAWINGS	REV.	ZONE	DATE	REVISION	DR.	CHK.	APPR. RECD	APPR.
	0		6/14/79	ISSUED FOR MILESTONE REPORT #3	G.O.	JF	LFW	

ROGERS ENGINEERING CO., INC.
ENGINEERS - ARCHITECTS
111 PINE STREET, SAN FRANCISCO, CALIFORNIA 94111

SCALE 1" = 20' DATE 6-18-79
DR. G.O. CHK. JF ENG. LFW APPROVED

APPROVALS
DATE
DATE

P G and E RETROFIT STUDY
UNIT No. 11 SITE
SITE PLAN-STRETFORD ALTERNATIVE No. 1
CONSOLIDATION OF UNITS 7, 8 & 11

JOB NO. S79007 | SK-028 | 0

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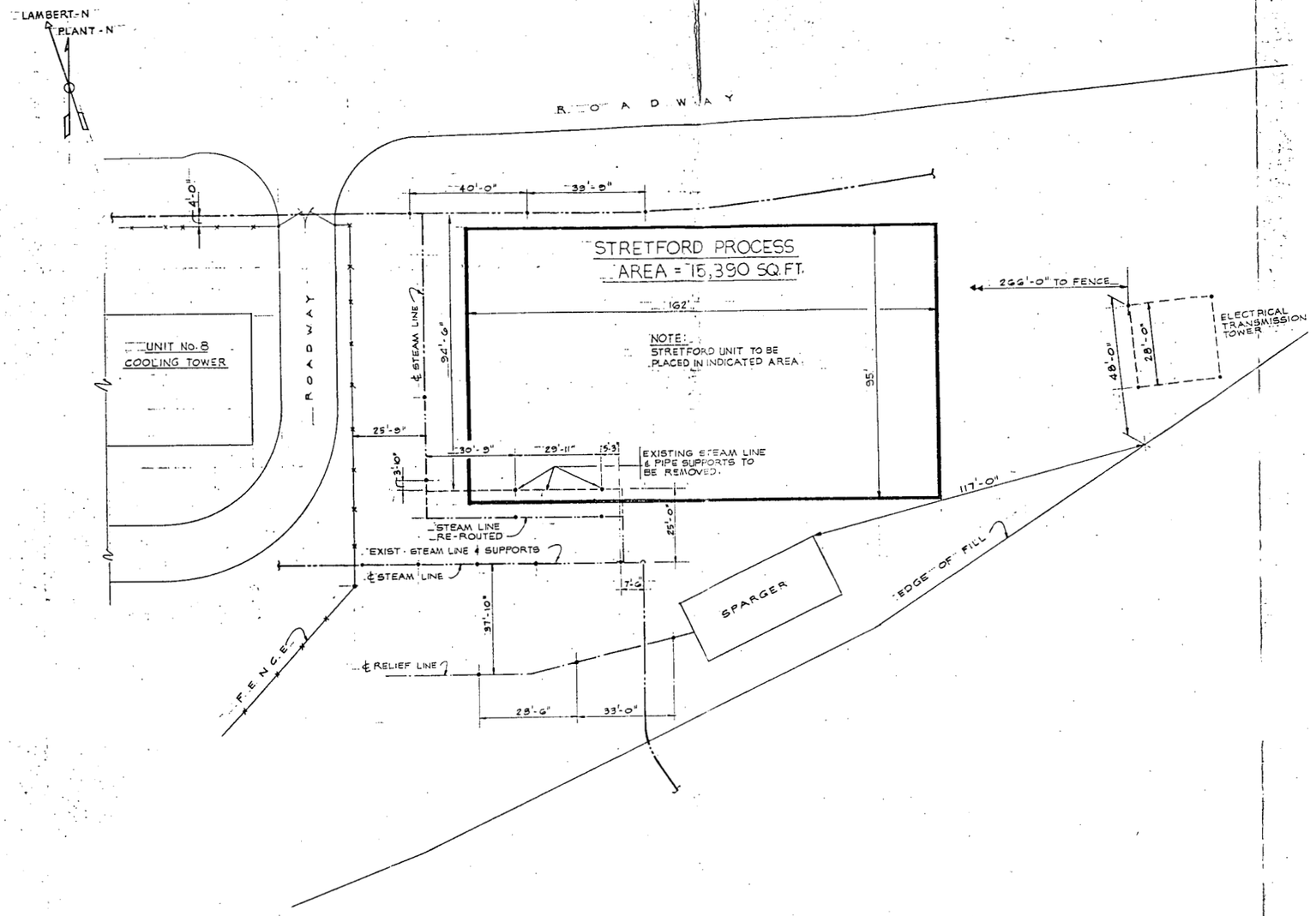

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STREET, SAN FRANCISCO, CALIFORNIA 941

SCALE 1" = 20' DATE 6-18-79

DR. CCO. CHK. JCF ENG. LFW APPROVED [illegible]

APPROVALS

DATE

DATE

PG and E RETROFIT STUDY
UNITS 7 & 8 SITE
SITE PLAN-STRETFORD ALTERNATIVE No. 2
CONSOLIDATION OF UNITS 7 & 11

JOB NO. S79007 | SK-027 | 0

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4.5 Noncondensable Gas Piping Network

The general description of the noncondensable gas piping network in Section 3.5 also applies for Units 7, 8 and 11. Two alternative piping schemes have been investigated corresponding to a Stretford system located either at Units 7 and 8, or at Unit 11.

A 12" ϕ pipe is required to transport the noncondensable gases from Units 7 and 8 down the mountain to a Stretford facility adjacent to Unit 11. The short section of pipe from Unit 11 to the Stretford system is 14" ϕ.

For a Stretford facility located at Units 7 and 8 a 14" ϕ SS pipe is needed to carry the gas from Unit 11 up to the abatement system. The noncondensable gases from Units 7 and 8 flow through a 12" ϕ pipe to the Stretford unit.

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5.1 Proposed Site At Units 9 and 10
SK-0029 (Alternative No. 1)

At a Project Managers' conference on June 19 it was established that a Stretford Process could not be located within 50 feet of a well. This criteria is documented in PCN 30.

Based on the criteria the plot east of Unit 9-10 gate entrance and illustrated on Drawing SK-0049 cannot be used. However just west of the gate entrance to the PGandE site and adjacent to the existing steam line sparger pit an open area exists which may be an attractive Stretford site for consolidation of Units 9-10 and 12.

A field trip will be made prior to writing up the final report to obtain verification dimensions on the sites ability to accommodate a 77' x 128' Stretford unit.

In evaluation of the conclusions shown in 5.4 and that of 5.3 two choices become available.

The first choice is to utilize the existing site within the PGandE fence line on the Unit 9-10 site. The ability to install the Stretford with modifications to existing steam piping which can be done during a scheduled unit outage prior to the Stretford installation is economically attractive and offers a noncritical impact on the overall Geyser construction schedule.

The alternative choice is to expand the Stretford process at Unit 14 to accommodate all the noncondensable gas flow from units 9-10 and 12.

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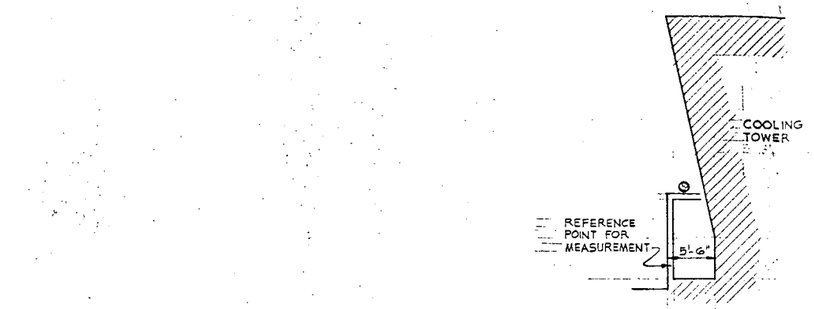
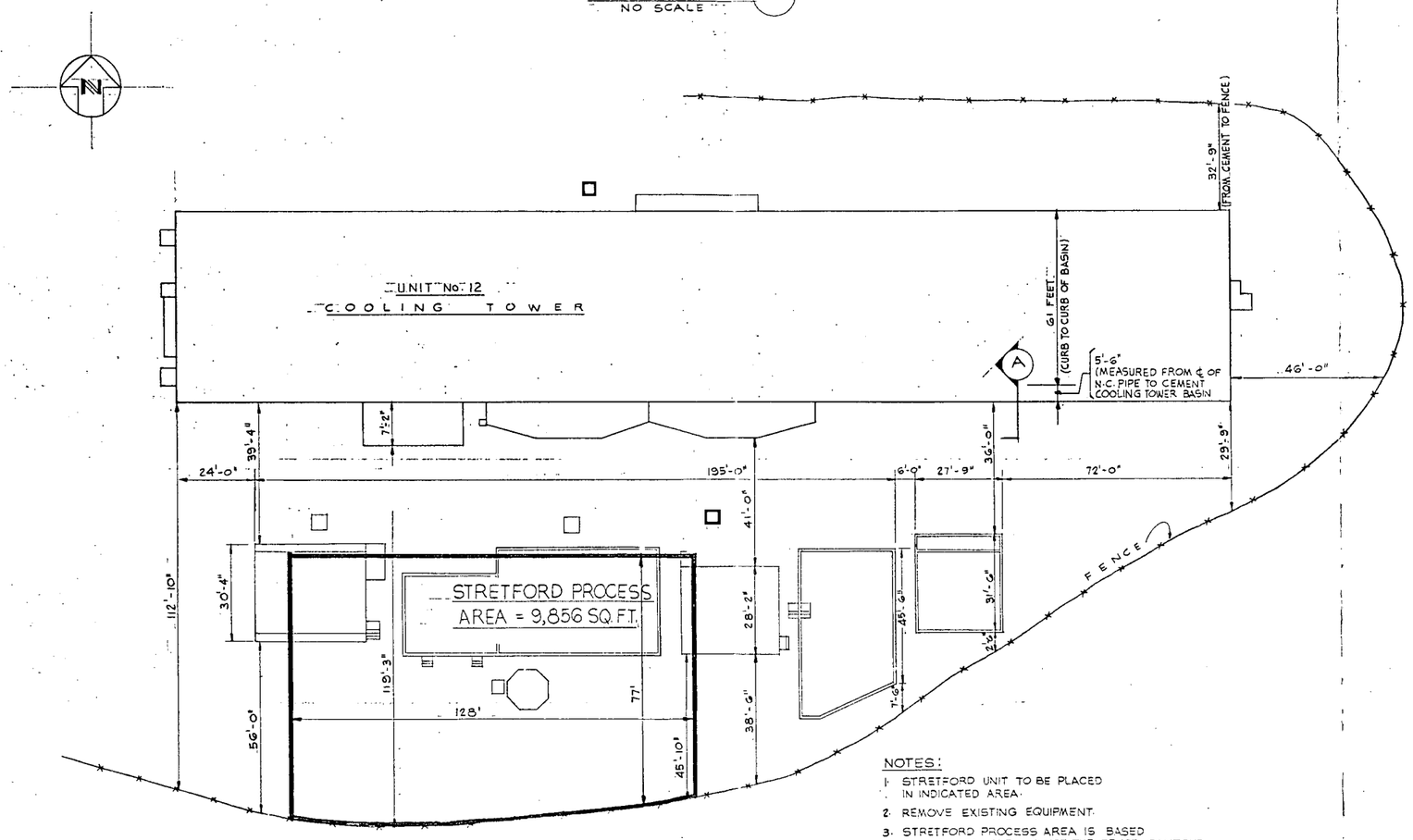
5.2 Proposed Site At Unit 12
SK-0030 (Alternative No. 2)

After removal of existing water purification equipment a Stretford process with outline dimensions of 77' x 128' can be installed according to the layout illustrated on Drawing SK-0030.

The disadvantage of this site is the man-hours required to remove the purification equipment and prepare for Stretford installation. This can have an undesirable impact on the construction schedule and unit outage since it forces maximum amount of man power concentration at Unit 12 site.



SECTION (A)
NO SCALE



NOTES:

1. STRETFORD UNIT TO BE PLACED IN INDICATED AREA.
2. REMOVE EXISTING EQUIPMENT.
3. STRETFORD PROCESS AREA IS BASED ON A RECTANGLE AND NOT THE FENCE CONTOUR.

GE 212

REFERENCE DRAWINGS

REV.	ZONE	DATE	REVISION	DR.	CHK.	APPR. RECO	APPR.
0		4/4/79	ISSUED FOR MILESTONE REPORT #3	C.O.	JF	LFW	

ROGERS ENGINEERING CO., INC.
ENGINEERS · ARCHITECTS
111 PINE STREET, SAN FRANCISCO, CALIFORNIA 94111

SCALE 1" = 20' DATE 6-18-79
DR. C.O. CHK. JF ENG. LFW APPROVED

APPROVALS
DATE
DATE

PG and E RETROFIT STUDY
UNIT No. 12 SITE
SITE PLAN - STRETFORD ALTERNATIVE NO. 1
CONSOLIDATION OF UNITS 9, 10 & 12

JOB NO. S79007 | SK-029 | 0

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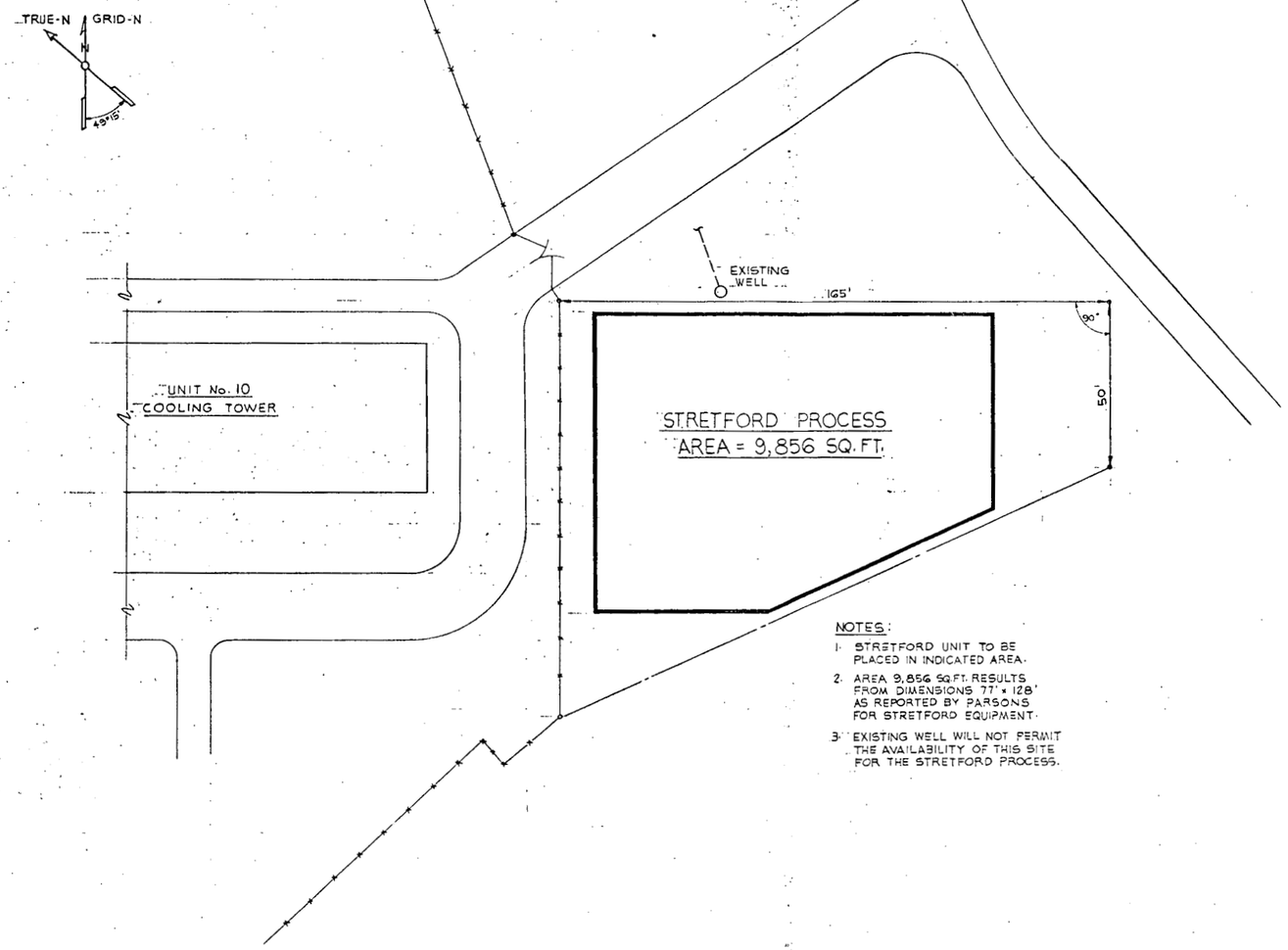

NOTES:

1. STRETFORD UNIT TO BE PLACED IN INDICATED AREA.
2. AREA 9,856 SQ.FT. RESULTS FROM DIMENSIONS 77' x 128' AS REPORTED BY PARSONS FOR STRETFORD EQUIPMENT.
3. EXISTING WELL WILL NOT PERMIT THE AVAILABILITY OF THIS SITE FOR THE STRETFORD PROCESS.

REFERENCE DRAWINGS	REV.	ZONE	DATE	REVISION	DR.	CHK.	APPR. RECO	APPR.
	◇0		6/21/79	ISSUED FOR MILESTONE REPORT #3	C.O.	JF	LFW	

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111 PINE STREET, SAN FRANCISCO, CALIFORNIA 94111

SCALE 1" = 20' DATE 6-18-79
DR. C.O. CHK. JF ENG. LFW APPROVED

APPROVALS
DATE
DATE

PG and E RETROFIT STUDY
UNITS 9 & 10 SITE
SITE PLAN - STRETFORD ALTERNATIVE No. 2
CONSOLIDATION OF UNITS 9, 10 & 12

JOB NO. S79007 | SK-030 | 0

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5.3 Combining Units 9, 10, 12 with Unit 14

A Stretford abatement facility is currently under construction at Unit 14 by R. M. Parsons Company. The possibility exists to enlarge the capacity of this facility to also accommodate the noncondensable gases from Units 9 and 10 and Unit 12. The gases would be pressurized at the power plant units with a blower and piped to the Unit 14 Stretford facility. Parsons has stated that the Unit 14 Stretford could be enlarged by adding a new oxidizer, oxidizer blower, circulation pump, and venturi scrubber. A cost estimate for this modification has been requested from Parsons and will be included in the final report.

The piping network for this sytem would cross very steep terrain and could not parallel existing roads or steam lines for the majority of the route. Thus, the installed cost of the stainless steel pipe would be high. Lacking the price information from Parsons, it can not be concluded at the present time that the piping and blower energy cost would be offset by a savings in the Stretford capital and operations and maintenance costs.

Another important economic consideration appears in the consolidation of Units 9, 10, 12 and 14. The current design for individual Stretford facilities tied to a single power plant unit is such that the scheduled maintenance outages of the power plant are sufficient to service the Stretford unit at the same time. Parsons has indicated that for single power plant installations, there is enough mechanical equipment redundancy built into the Stretford unit so that the Stretford equipment will never force an outage on the power plant.

By connecting the four power plant units to a single Stretford facility, the Stretford unit must operate 100% of the time, since the current size of the maintenance staff would prevent the four power plant units from having simultaneous scheduled outages. The replacement cost for the electrical energy from the four units involved is substantial.

Rogers

5.4 Conclusions - Units 9-10 and 12

The conclusions that must be evaluated in determination of a Stretford location to handle the noncondensable gas from Units 9-10 and 12 are:

Units 9-10

- Measure existing site adjacent to steam line sparger pit and insert evaluation conclusions and drawing into the final report (Milestone #4)
- Disregard Drawing SK-0029 titled Units 9-10, Alternative No. 1, because of its inability to meet PCN 30 criteria established June 19. No Stretford unit shall be located within 50 feet of a well.

Unit 12

- Removal of water purification equipment.
- Impact on construction schedule, since it forces maximum amount of man power at Unit 12 site.
- Impact on Unit 12 outage if Stretford installation lags condenser retrofit.

Rogers

5.5 Noncondensable Gas Piping Network

The remarks applicable for the noncondensable gas piping network in Section 3.5 also apply to the piping system for Units 9, 10 and 12.

The flow rate and molecular weight of the noncondensable gases from Units 9 and 10 collectively are nearly identical to those of the gases discharged from Unit 12. Thus, the piping network between Units 9 and 10 and Unit 12 is independent of the location of the Stretford facility. Regardless of whether the abatement system is located at Units 9 and 10 or at Unit 12, a 12" Φ stainless steel pipe is required to carry the noncondensable gases between power plant units to the Stretford unit.

Rogers

PRELIMINARY

6.0 STRETFORD ALTERNATIVES

It is normally desirable to use a lower unit cost of larger capacity units and thereby consolidate all the noncondensable vent gas abatement equipment into a minimum number of large processing units. There are, however, offsetting problems as follows:

(1) The vent gas is corrosive to unprotected carbon steel. Therefore, the vent gas collection system will require expensive materials of construction.

(2) In addition, since the gas is poisonous and the terrain is steep and subject to slides, the control and system design of the gas collection network must include expensive controls needed to shutdown the system on line failure.

(3) The cost of having back up compression units at each gas pick up point, which must include pressure and anti-surge controls along with recycle gas cooling systems.

(4) The large consolidated unit would need added equipment to insure redundancy to achieve a 100% operating factor (zero forced outage). While smaller units might achieve acceptable power penalties by planned maintenance during unit turnaround by taking a short forced outage of the paired operating unit.

To respond to the above problems the following alternatives were evaluated.

Alternative I

(a) Install a complete small Stretford unit close enough to each point of vent gas origin (i.e. Unit 1 and 2, etc.) so as to eliminate the need for the gas compression equipment and piping.

(b) Compare to a consolidated Stretford Unit with a gas collection system.

Alternative II

(a) Install a complete Stretford gas scrubber system only close enough to each point of vent gas origin so as to eliminate the need for the gas compression equipment.

Rogers

The scrubber system circulating fluid would be pumped to and from the centrally located regeneration and sulfur recovery system. This proposed system can be constructed of carbon steel.

(b) Compare to a gas collection system.

It should be noted that Parsons has made some preliminary evaluations of Alternative II and concluded that the liquid pumping costs were too high to offset the savings obtained by deleting the expensive gas piping and compression equipment.

This re-evaluation has been prepared to update and document the estimated costs for the subject alternatives. It is directed only to the proposed consolidation of Units 1 thru 6.

Rogers

PRELIMINARY

SUMMARY OF EVALUATION

ALTERNATIVE I

1.0 INDIVIDUAL STRETFORD SYSTEM AT THREE LOCATIONS

Installed Equipment Cost Estimate - 10^6 $	Level Annual	$/yr. (a)
Units 1 and 2 - 2.66	$ 389,690	
Units 3 and 4 - 4.50	659,250	
Units 5 and 6 - 5.5	805,750	
Operation and Maintenance		
Units 1 and 2	407,778	$/yr. (b)
Units 3 and 4	689,850	
UNits 5 and 6	843,150	
Power Penalty	296,400	$/yr. (d)
Sum of $/year Values	$3,795,468	

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PRELIMINARY

ALTERNATIVE I (Cont'd)

2.0 CONSOLIDATED STRETFORD SYSTEM NEAR UNITS 3 AND 4

Installed cost estimate (includes 20% adder for zero outage)

Units 1 thru 6 - 10^6 $	Level Annual	$/yr.	
7.8	$1,142,700	(a)	
Operation and Maintenance	$1,195,740	(b)	
Installed Cost Estimate Gas Collection Piping Units 1 thru 6			
1,143,096	167,464	(a)	
Gas Compressors (Includes 100% spare - Zero Outage)			
Units 1 and 2	$465,800	$ 68,240	(a)
Units 3 and 4	$451,600	67,185	(a)
Units 5 and 6	$550,700	80,678	(a)
Compressor Operation and Maintenance			
Units 1 thru 6	387,656	(c)	
Electric Power for Compression 110 kW x 8760 x 0.065	62,634		
Sum of $/yr. Values	$3,172,297		

NOTES:
(a) Installed Cost x 0.1465
(b) Installed Cost x (0.05 + 0.02) x [2.19]
(c) Installed Cost Sum x (0.10 + 0.02) x [2.19]
(d) Power Penalty - 48 hr. forced outage/year x Unit Rated kW x $0.065/kWh
Rated kW = one unit of pair = 12,500 + 27,500 + 55,000 = 45,000 kW
48 x 95,000 x 0.065

3.0 COMPARISON

Item	Level-Annual	$/yr.
Individual Units	$3,795,468	
Consolidated 1-6	3,172,297	
Difference	$ 623,171	

Favors Consolidated

Rogers

PRELIMINARY

SUMMARY OF EVALUATION

ALTERNATIVE II

1.0 INDIVIDUAL VENT GAS SCRUBBERS

Installed Equipment Cost Estimate $

Scrubbers		Level Annual	$/yr.
Delete Consolidated Unit	(283,000)		
Units 1 and 2	57,000		
Units 3 and 4	95,000		
Units 5 and 6	155,000		
Solution Charge	30,000		(1)
Pump and Recovery Power Units 1 thru 6 (includes 100% spares	372,000		
Liquid Lines	690,000		
Sub Total	$1,116,000	$163,494	(2)
Maintenance & Operation For Scrubbers & Pumping Equip. 189 kW x 8760 x 0.065		107,617	
Power Penalty		296,400	(5)
Sum of $/yr. Values		$671,602	

Rogers

PRELIMINARY

ALTERNATIVE II (Cont'd)

2.0 CONSOLIDATED SYSTEM WITH GAS COLLECTION AND COMPRESSION SYSTEM

Installed Equipment	Level Annual $/yr.	
Cost Estimate Gas Collection Piping Units 1 thru 6 1,143,096	$167,464	
Gas Compressors Units 1 thru 6 (includes 100% spares) 1,475,100	216,102	
Operation & Maintenance for Compressors	387,656	(4)
Electric Power for Compression 110 kW x 8760 x 0.065	62,634	
Sum of $/yr. Values	$833,856	

3.0 COMPARISON

Individual Vent Gas Scrubbers	$671,602
Consolidated With Gas Collection & Compression	833,856
Difference	$162,254

Favors Individual Gas Scrubbers

NOTES:
(1) 55,000 gal. x $0.55/gal.
(2) $ x 0.1465
(3) Sum Equipment Specified x (0.05 + 0.02) x [2.19]
(4) Cost Equipment Specified x (0.10 + 0.02) x [2.19]
(5) Power Penalty - 48 hr. forced outage/year x Unit Rated kW x $0.065/kWh
Rated kW = one unit of pair = 12,500 + 27,500 + 55,000 = 45,000 kW
48 x 95,000 x 0.065

Rogers

7.1 Blowers

The blowers used to transport the noncondensable gases from the power plant aftercondensers to the Stretford Unit have been specified for price quotations as being fabricated from stainless steel. However, several of the vendors have proposed alternative metal alloys or phenolic coated blower internals. All of the manufacturers have not responded to our quotation solicitation at this date, thus, a complete bid analysis and blower recommendation will be included in the final report.

The noncondensable gas piping networks have been designed so that one blower will be required (with a 100% standby) for each power plant location. Thus, one blower will be installed serving both Units 1 and 2. The blower will have a bypass loop with automatic controls so that the blower will continue to operate should one of the units have a forced or scheduled outage. This same design philosphy applies for the blowers located at Units 3 and 4, Units 5 and 6, Units 7 and 8, and Units 9 and 10.

Rogers

7.2 Data Sheets for Blowers

POWER VOLTS 460
CYCLES 60 PHASES 3
STEAM P.S.I.G. AT THROTTLE
EXHAUST

FAN OR BLOWER DATA SHEET

SPECIFICATION NO.
REQ. NO.

INSTRUCTIONS BIDDERS - FILL IN EVERY SPACE TO MAKE BID COMPLETE

A. GAS CHARACTERISTICS SERVICE — FLOWSHEET NO.	Unit 718		Unit 718			
PLANT EQUIP. NO.	16-012		16-013			
	A+B (2 Req'd.)		A+B (2 Req'd.)			
1. GAS CO_2, H_2S, NH_3, CH_4, H_2, N_2, Ar, H_2O						
2. S.P. GR. (AIR = 1.0)	0.97	(M.W. = 28.0)				
3. POUNDS PER HOUR	11,282		11,282			
4. STD. C.F.M. @ 60°F & 14.7 PSIA	2545		2545			
5. FLOW TEMP. °F	120		120			
6. CFM AT FLOW TEMP. & Inlet Press.	2981		2981			
B. PRESSURES						
1. SUCTION (psig)	14.0		14.0			
2. DIFFERENTIAL	6.3		1.3			
3. DISCHARGE	20.3		15.3			
C. OPERATION						
1. EFFICIENCY AT RATING						
2. B.H.P. AT RATING						
3. BID IMPELLER DIAM.						
4. MAX BHP FOR BID IMP. DIA						
5. R.P.M. OF FAN OR BLOWER						
6. R.P.M. OF DRIVER						
7. TIP SPEED						
8. OUTLET VELOCITY						
9. DIRECTION OF ROTATION CCW FACING COUPLING END CW						
10. NUMBER OF STAGES						
D. CONSTRUCTION & MATERIAL						
1. CASE MATERIAL	S.S.		S.S.			
CONSTRUCTION: HORIZ. OR VERT. SPLIT						
2. IMPELLER	S.S.		S.S.			
3. SHAFT MATERIAL	S.S.		S.S.			
4. SHAFT DIAMETER						
5. FLEXIBLE COUPLING						
6. COUPLING GUARD	Yes - Conform to Cal-OSHA					
7. BASE PLATE						
8. CLASS (FANS)						
9. ARRANGEMENT (FANS)						
10. INLET SCREEN REQUIRED	S.S.		S.S.			
11. CLEAN OUT REQUIRED						
12. VARIABLE INLET VANES REQ'D.	No		No			
MANUFACTURER						
MFR'S TYPE & SIZE						

E. BEARINGS & LUBRICATION SERVICE — FLOWSHEET NO.	Unit 718		Unit 718			
PLANT EQUIP. NO.	16-012		16-013			
	A+B (2 Req'd.)		A+B (2 Req'd.)			
1. THRUST (S.A.E. NO. ON FINAL DATA SHEET)						
2. RADIAL (S.A.E. NO. ON FINAL DATA SHEET)						
3. THRUST — GREASE PCKD. A / FLOOD OILNG. B / RING OILNG. C						
RADIAL — A / B / C						
4. TYPE OF CLOSURES						
5. METHOD OF SEALING						
6. VISIBLE LUBRICATORS: TYPE						
7. VISIBLE LUBRICATORS: CAPACITY						
8. BEARINGS WATER COOLED						
9. LUBRICATING OIL PUMP						
10. LUBRICATING OIL COOLER						
F. CONNECTIONS						
1A. INLET SIZE						
1B. INLET RATING						
1C. INLET FACING						
2A. DISCHARGE SIZE						
2B. DISCHARGE RATING						
2C. DISCHARGE FACING						
2D. DISCHARGE LOCATION						
G. TESTING STATE EXTRA COST IF ANY FOR EACH						
1. DYNAMIC BALANCING OF IMPELLERS						
2. WITNESSED PERFORMANCE TEST						
3. INSPECTION						
4. RUNNING TEST WITH ACTUAL DRIVER						
H. MISCELLANEOUS						
1. PRICE EACH F.O.B. F.A.S.						
2. WEIGHT POUNDS NET						
2A. WEIGHT BOXED FOR SHIPMENT						
3. SHIPMENT FROM RCPT OF ORDER WEEKS						
4. DRIVER H.P.						
5. TYPE OF DRIVER: MOTOR OR TURBINE						
6. DRIVER COUPLED, V-BELT, GEARED						
7. PERFORMANCE CURVE MANUFACTURERS NO.						
7A. PERFORMANCE CURVE FOREIGN PRINT NO.						
8. OUTLINE DRAWING MANUFACTURERS NO.						
8A. OUTLINE DRAWING FOREIGN PRINT NO.						
9. CROSS SECTION DWG MANUFACTURERS NO.						
9A. CROSS SECTION DWG. FOREIGN PRINT NO.						
10. M'F'R'S SERIAL NO. ON FINAL DATA SHEET						
Notes 1) Bearings must be sealed						
2) Gas is very corrosive due to H_2S, CO_2 & H_2O						

	REV	DATE		DATE		JOB NO.	REV.
718-718 16-013-A+B 718-711 16-012-A+B	0	6/22/71	Issued for Quotation		PG&E Geysers Retrofit	DWG NO. DS-16-012	0

EQ314

POWER VOLTS 460
CYCLES 60 PHASES 3
STEAM P.S.I.G. AT THROTTLE
EXHAUST

FAN OR BLOWER DATA SHEET

SPECIFICATION NO.
REQ. NO.

INSTRUCTIONS BIDDERS - FILL IN EVERY SPACE TO MAKE BID COMPLETE

	FLOWSHEET NO. / PLANT EQUIP. NO.	Unit 9|10 16-014 A|B (2 Req'd)		Unit 9|10 16-015 A|B (2 Req'd)
A. GAS CHARACTERISTICS SERVICE				
1. GAS CO_2, H_2S, NH_3, CH_4, H_2, N_2, Ar, & H_2O				
2. S.P. GR. (AIR = 1.0)		0.97	(mw = 28.0)	
3. POUNDS PER HOUR		11,282		11,282
4. STD. C.F.M. @ 60°F & 14.7 PSIA		2545		2545
5. FLOW TEMP. °F		120		120
6. CFM AT FLOW TEMP. & Inlet Press.		2981		2981
B. PRESSURES				
1. SUCTION (psia)		14.0		14.0
2. DIFFERENTIAL		4.9		1.7
3. DISCHARGE		18.9		15.7
C. OPERATION				
1. EFFICIENCY AT RATING				
2. B.H.P. AT RATING				
3. BID IMPELLER DIAM.				
4. MAX BHP FOR BID IMP. DIA				
5. R.P.M. OF FAN OR BLOWER				
6. R.P.M. OF DRIVER				
7. TIP SPEED				
8. OUTLET VELOCITY				
9. DIRECTION OF ROTATION CCW FACING COUPLING END CW				
10 NUMBER OF STAGES				
D. CONSTRUCTION & MATERIAL				
1. CASE MATERIAL		S.S.		S.S.
CONSTRUCTION: HORIZ. OR VERT. SPLIT				
2. IMPELLER		S.S.		S.S.
3. SHAFT MATERIAL		S.S.		S.S.
4. SHAFT DIAMETER				
5. FLEXIBLE COUPLING				
6. COUPLING GUARD		Yes - Conform to Cal OSHA		
7. BASE PLATE				
8. CLASS (FANS)				
9. ARRANGEMENT (FANS)				
10. INLET SCREEN REQUIRED		S.S.		S.S.
11. CLEAN-OUT REQUIRED				
12. VARIABLE INLET VANES REQ'D.		No		No
MANUFACTURER				
MFR'S TYPE & SIZE				

	FLOWSHEET NO. / PLANT EQUIP. NO.	Unit 9|10 16-014 A|B (2 Req'd)		Unit 9|10 16-015 A|B (2 Req'd)
E. BEARINGS & LUBRICATION SERVICE				
1. THRUST (S.A.E. NO. ON FINAL DATA SHEET)				
2. RADIAL (S.A.E. NO. ON FINAL DATA SHEET)				
3.	GREASE PCKD. / FLOOD OILNG. / RING OILNG.			
THRUST	A / B / C			
RADIAL	A / B / C			
4. TYPE OF CLOSURES				
5. METHOD OF SEALING				
6. VISIBLE LUBRICATORS: TYPE				
7. VISIBLE LUBRICATORS: CAPACITY				
8. BEARINGS WATER COOLED				
9. LUBRICATING OIL PUMP				
10. LUBRICATING OIL COOLER				
F. CONNECTIONS				
1A. INLET: SIZE				
1B. INLET: RATING				
1C. INLET: FACING				
2A. DISCHARGE SIZE				
2B. DISCHARGE RATING				
2C. DISCHARGE FACING				
2D. DISCHARGE LOCATION				
G. TESTING STATE EXTRA COST IF ANY FOR EACH				
1. DYNAMIC BALANCING OF IMPELLERS				
2. WITNESSED PERFORMANCE TEST				
3. INSPECTION				
4. RUNNING TEST WITH ACTUAL DRIVER				
H. MISCELLANEOUS				
1. PRICE EACH F.O.B. F.A.S.				
2. WEIGHT POUNDS NET				
2A. WEIGHT BOXED FOR SHIPMENT				
3. SHIPMENT FROM R'CPT OF ORDER WEEKS				
4. DRIVER H.P.				
5. TYPE OF DRIVER: MOTOR OR TURBINE				
6. DRIVER: COUPLED, V-BELT, GEARED				
7. PERFORMANCE CURVE MANUFACTURERS NO.				
7A. PERFORMANCE CURVE FOREIGN PRINT NO.				
8. OUTLINE DRAWING MANUFACTURERS NO.				
8A. OUTLINE DRAWING FOREIGN PRINT NO.				
9. CROSS SECTION DWG. MANUFACTURERS NO.				
9A. CROSS SECTION DWG. FOREIGN PRINT NO.				
10. M'F'R'S. SERIAL NO. ON FINAL DATA SHEET				

Notes: 1) Bearing must be sealed
2) Gas is very corrosive due to H_2S, CO_2 & H_2O

REV.	DATE		DATE
9|10-9|10-16-015 9|10-12-16-014	0 6/22/79	Issued for Quotation	JCJ

PG&E Geysers Retrofit

JOB NO. S-79007 REV.
DWG NO. DS-16-014 0

EQ314

POWER: VOLTS 460
CYCLES 60 PHASES 3
STEAM P.S.I.G. AT THROTTLE
EXHAUST

FAN OR BLOWER DATA SHEET

SPECIFICATION NO.
REQ. NO.

INSTRUCTIONS BIDDERS - FILL IN EVERY SPACE TO MAKE BID COMPLETE

A. GAS CHARACTERISTICS SERVICE	FLOWSHEET NO.	Unit 11		Unit 11				
	PLANT EQUIP. NO.	16-016		16-017				
		A & B (2 Req'd.)		A & B (2 Req'd.)				
1. GAS		$CO_2, H_2S, NH_3, CH_4, H_2, N_2, Ar, \& H_2O$						
2. S.P. GR. (AIR = 1.0)		1.1	(m.w. = 33.1)					
3. POUNDS PER HOUR		18,649		18,649				
4. STD. C.F.M. @ 60°F & 14.7 PSIA		3558		3558				
5. FLOW TEMP. °F		120		120				
6. CFM AT FLOW TEMP. & Inlet Press.		4167		4167				
B. PRESSURES								
1. SUCTION (psig)		14.0		14.0				
2. DIFFERENTIAL		6.4		1.5				
3. DISCHARGE		20.4		15.5				
C. OPERATION								
1. EFFICIENCY AT RATING								
2. B.H.P. AT RATING								
3. BID IMPELLER DIAM.								
4. MAX BHP FOR BID IMP. DIA.								
5. R.P.M. OF FAN OR BLOWER								
6. R.P.M OF DRIVER								
7. TIP SPEED								
8. OUTLET VELOCITY								
9. DIRECTION OF ROTATION CCW FACING COUPLING END CW								
10 NUMBER OF STAGES								
D. CONSTRUCTION & MATERIAL								
1. CASE: MATERIAL		S.S		S.S.				
CONSTRUCTION: HORIZ. OR VERT. SPLIT								
2. IMPELLER		S.S.		S.S.				
3. SHAFT MATERIAL		S.S.		S.S.				
4. SHAFT DIAMETER								
5. FLEXIBLE COUPLING								
6. COUPLING GUARD		Yes - Conform to Cal-OSHA						
7. BASE PLATE								
8. CLASS (FANS)								
9. ARRANGEMENT (FANS)								
10. INLET SCREEN REQUIRED		S.S.		S.S				
11. CLEAN-OUT REQUIRED								
12. VARIABLE INLET VANES REQ'D.		No		No				
MANUFACTURER								
MFR'S TYPE & SIZE								

E. BEARINGS & LUBRICATION SERVICE	FLOWSHEET NO.	Unit 11		Unit 11				
	PLANT EQUIP. NO.	16-016		16-017				
		A & B (2 Req'd.)		A & B (2 Req'd.)				
1 THRUST: (S.A.E. NO. ON FINAL DATA SHEET)								
2. RADIAL: (S.A.E. NO. ON FINAL DATA SHEET)								
3.	GREASE PCKD.	FLOOD OILNG.	RING OILNG.					
THRUST	A	B	C					
RADIAL	A	B	C					
4 TYPE OF CLOSURES:								
5. METHOD OF SEALING								
6. VISIBLE LUBRICATORS: TYPE								
7. VISIBLE LUBRICATORS: CAPACITY								
8. BEARINGS WATER COOLED								
9. LUBRICATING OIL PUMP								
10. LUBRICATING OIL COOLER								
F. CONNECTIONS								
1A. INLET: SIZE								
1B. INLET: RATING								
1C. INLET: FACING								
2A. DISCHARGE: SIZE								
2B. DISCHARGE: RATING								
2C. DISCHARGE: FACING								
2D. DISCHARGE: LOCATION								
G. TESTING STATE EXTRA COST IF ANY FOR EACH								
1. DYNAMIC BALANCING OF IMPELLERS								
2. WITNESSED PERFORMANCE TEST								
3. INSPECTION								
4. RUNNING TEST WITH ACTUAL DRIVER								
H. MISCELLANEOUS								
1. PRICE EACH F.O.B. F.A.S.								
2. WEIGHT POUNDS NET								
2A. WEIGHT BOXED FOR SHIPMENT								
3. SHIPMENT FROM R'CPT OF ORDER WEEKS								
4. DRIVER H.P.								
5. TYPE OF DRIVER: MOTOR OR TURBINE								
6. DRIVER: COUPLED, V-BELT, GEARED.								
7. PERFORMANCE CURVE MANUFACTURERS NO.								
7A. PERFORMANCE CURVE FOREIGN PRINT NO.								
8. OUTLINE DRAWING MANUFACTURERS NO.								
8A. OUTLINE DRAWING FOREIGN PRINT NO.								
9. CROSS SECTION DWG. MANUFACTURERS NO.								
9A. CROSS SECTION DWG. FOREIGN PRINT NO.								
10. M'FR'S. SERIAL NO. ON FINAL DATA SHEET								

Notes: 1) Bearings must be sealed.
2) Gas is very corrosive due to H_2S, CO_2, & H_2O.

REV.		DATE		DATE	
	0	6/22/79	Issued for Quotation		

11 – 11 16-017 A&B
11 – 7&8 16-016 A&B

PG&E Geysers Retrofit

JOB. NO. 5-79007 REV.
DWG. NO. DS-16-016 0

EQ314

POWER VOLTS 460
CYCLES 60 PHASES 3
STEAM P S I G AT THROTTLE
EXHAUST

FAN OR BLOWER DATA SHEET

SPECIFICATION NO
REQ. NO.

INSTRUCTIONS BIDDERS - FILL IN EVERY SPACE TO MAKE BID COMPLETE

	FLOWSHEET NO / PLANT EQUIP NO	Unit 12 / 16-018		Unit 12 / 16-019			
A. GAS CHARACTERISTICS SERVICE		A & B (2 Req'd)		A & B (2 Req'd)			
1. GAS CO_2, H_2S, NH_3, CH_4, H_2, N_2, A_r, H_2O		0					
2. S.P. GR. (AIR = 1.0)		1.1 (mw = 32.8)					
3. POUNDS PER HOUR		11,124		11,124			
4. STD. C.F.M. @ 60°F & 14.7 PSIA		2141		2141			
5. FLOW TEMP. °F		120		120			
6. CFM AT FLOW TEMP & Inlet Press		2507		2507			
B. PRESSURES							
1. SUCTION (psig)		14.0		14.0			
2. DIFFERENTIAL		5.2		1.4			
3. DISCHARGE		19.2		15.4			
C. OPERATION							
1. EFFICIENCY AT RATING							
2. B.H.P. AT RATING							
3. BID IMPELLER DIAM							
4. MAX BHP FOR BID IMP DIA							
5. R.P.M. OF FAN OR BLOWER							
6. R.P.M. OF DRIVER							
7. TIP SPEED							
8. OUTLET VELOCITY							
9. DIRECTION OF ROTATION CCW FACING COUPLING END CW							
10. NUMBER OF STAGES							
D. CONSTRUCTION & MATERIAL							
1. CASE MATERIAL		S.S		S.S			
CONSTRUCTION HORIZ OR VERT SPLIT							
2. IMPELLER		S.S		S.S			
3. SHAFT MATERIAL		S.S		S.S			
4. SHAFT DIAMETER							
5. FLEXIBLE COUPLING							
6. COUPLING GUARD		Yes	Conforms to Cal-OSHA				
7. BASE PLATE							
8. CLASS (FANS)							
9. ARRANGEMENT (FANS)							
10. INLET SCREEN REQUIRED		S.S.		S.S			
11. CLEAN OUT REQUIRED							
12. VARIABLE INLET VANES REQ'D		No		No			
MANUFACTURER							
M'FR'S TYPE & SIZE							

	FLOWSHEET NO / PLANT EQUIP NO	Unit 12 / 16-018		Unit 12 / 16-019			
E. BEARINGS & LUBRICATION SERVICE		A & B (2 Req'd)		A & B (2 Req'd)			
1. THRUST (S.A.E. NO ON FINAL DATA SHEET)							
2. RADIAL (S.A.E. NO ON FINAL DATA SHEET)							
3. THRUST / RADIAL — GREASE PCKD. A / A; FLOOD OILNG. B / B; RING OILNG. C / C							
4. TYPE OF CLOSURES							
5. METHOD OF SEALING							
6. VISIBLE LUBRICATORS. TYPE							
7. VISIBLE LUBRICATORS. CAPACITY							
8. BEARINGS WATER COOLED							
9. LUBRICATING OIL PUMP							
10. LUBRICATING OIL COOLER							
F. CONNECTIONS							
1A. INLET SIZE							
1B. INLET RATING							
1C. INLET FACING							
2A. DISCHARGE SIZE							
2B. DISCHARGE RATING							
2C. DISCHARGE FACING							
2D. DISCHARGE LOCATION							
G. TESTING STATE EXTRA COST IF ANY FOR EACH							
1. DYNAMIC BALANCING OF IMPELLERS							
2. WITNESSED PERFORMANCE TEST							
3. INSPECTION							
4. RUNNING TEST WITH ACTUAL DRIVER							
H. MISCELLANEOUS							
1. PRICE EACH F.O.B. F.A.S.							
2. WEIGHT POUNDS NET							
2A. WEIGHT BOXED FOR SHIPMENT							
3. SHIPMENT FROM R'CPT OF ORDER WEEKS							
4. DRIVER H.P.							
5. TYPE OF DRIVER. MOTOR OR TURBINE							
6. DRIVER COUPLED. V-BELT, GEARED							
7. PERFORMANCE CURVE MANUFACTURERS NO.							
7A. PERFORMANCE CURVE FOREIGN PRINT NO							
8. OUTLINE DRAWING MANUFACTURERS NO.							
8A. OUTLINE DRAWING FOREIGN PRINT NO.							
9. CROSS SECTION DWG MANUFACTURERS NO.							
9A. CROSS SECTION DWG. FOREIGN PRINT NO.							
10. M'FR'S SERIAL NO ON FINAL DATA SHEET							

Notes: 1) Bearing must be sealed
2) Gas is very corrosive due to H_2S, CO_2, H_2O

REV.	DATE	
12-12 16-019 A & B 12-29-10 16-018 A & B	06/22/11	Issued for Quotation

DATE

PGE Geysers Retrofit

JOB NO. S79007 REV.
DWG NO DS-16-018 0

EQ314

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8.1 Equipment Quotations

Table 8.1, entitled Equipment Summary All Units - Stretford Process, indicates the Equipment Quotations by various vendors.

Table 8.1.1 indicates the costs from vendors for the Stretford Chemicals (Inventory for the process.

Section 8.1.2 describes the Power Service and indications of associated costs related to the Stretford Units.

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TABLE 8.1

EQUIPMENT SUMMARY ALL UNITS

STRETFORD PROCESS

In one configuration under consideration three Stretford units are contemplated as follows:

Stretford Unit	#/Hr. N. C.	#/Hr. H_2S	Long Tons Sulfur/Day
Units 1 through 6 - 1	26,548	1,318	13.29
Units 7, 8, 9 - 2	25,730	1,347	13.68
Units 9, 10, 12 - 3	19,120	363	3.66

VENDOR

Stretford Unit		Parsons	J. T. Pritchard	Peabody Engr.g
1	Plot A	95' x 162'	125' x 125'	Not Stated
2	Plot A	95' x 162'	125' x 125'	Not Stated
3	Plot A	77' x 128'	100' x 100'	Not Stated
1	Installed Cost $ (± %)	4,800,000	(-10%, + 30%)*	
	Estimated $		3,610,000	Not Stated
2	"	5,000,000	3,610,000	Not Stated
3	"	3,200,000	1,870,000	Not Stated
1	One Time Royalty $	incl. above $	91,160	Not Stated
2	" " "	" "	89,160	Not Stated
3	" " "	" "	57,200	Not Stated

*Based on Gulf Coast installed price

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TABLE 8.1.1

STRETFORD CHEMICALS (INVENTORY)

VENDOR

Stretford Unit	Parsons	J. T. Pritchard	Peabody
1 Sol. gals/cost $	307,000/169,000	250,000/62,500	N. S.
2 Sol. gals/cost $	316,000/174,000	250,000/62,500	N. S.
3 Sol. gals/cost $	84,000/ 46,500		N. S.
Sol. Cost/gal. $	0.55	0.25	N. S.

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8.1.2 POWER SERVICE

8.1.2.1 TABLES 8.1.2.1 and 8.1.2.2 summarize the estimated kilowatt demand for each of the three Stretford facilities, the estimated kVA demand based on an assumed 0.85 power factor and the closest standard transformer size if an independent power supply si provided.

The estimated demands were obtained from R. M. Parsons Co. and include lighting. Largest motor will not exceed 200 hp. Service is required at 480 volts.

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TABLE 8.1.2.1

Stretford Facility for	Estimated Demand kW	kVA	Closest Standard Oil Insulated Transformer kVA[1]
Units 1 thru 6	1065	1252	1500 OA or 1000 kVA OA/FA (1288 kVA max.)
Units 7, 8 and 11	1095	1288	1500 OA or 1000 kVA OA/FA (1288 kVA max.)
Units 9, 10 and 12	300	353	500 OA

[1]OA - Self cooled rating at 55°C rise
FA - rating with fans
13% additional capacity available if 65°C temperature rise is utilized

TABLE 8.1.2.2

Stretford Facility for	Location	Existing Aux. Transformer Max. Capacity	Load	Existing Retrofit[2]	Estimated Increase with Stretford	Total
Units 1 thru 6	Unit 3 or 4	1546[1]	1185	1395	1252	2647 *
Units 7, 8 and 11	Unit 7 or 8	3500	2145	3113	1288	4401 *
Units ~~9~~ 7, 10 and 12	Unit ~~11~~ 12	4200	2145	2615	353	2965

[1]With fans, 65°C temperature rise
[2]Includes noncondensable gas blower

* Exceeds existing transformer capacity

8.1.2.2 Two alternatives have been considered for power service to the Stretford units:

a) From the power plant 480 volt auxiliary bus, or
b) an independent transformer connected to one of the high voltage transmission lines or the 22 kV distribution line now in use in some parts of the Geysers area.

8.1.2.3 The major problems with using the auxiliary bus are transformer capacity voltage drop and reliability. Table 8.1.2 summarizes the change in load on the auxiliary transformer. If the proposed Stretford facilities are located adjacent to the existing facilities no significant voltage drop problems are foreseen.

Reliability is a major consideration. Since one Stretford facility serves several power plants, failure of the power supply at the "host" unit is not tolerable.

8.1.2.4 For the Stretford facility proposed for Units 1 thru 6, the Alternative 1 site, with installation adjacent to the Unit 4 auxiliary transformers, does not have sufficient capacity; however, capacity can be provided with a replacement transformer. The alternative 2 site is too far away from the plant to utilize the auxiliary transformer of this particular plant.

For the Stretford facility proposed at Units 7 for Units 7 and 11, the transformers at these units have adequate capacity and voltage drop in the feeder is not a major problem.

8.1.2.5 Units 3, 4, 6 and 7 auxiliary transformers are connected between the generator circuit breaker and the main transformer and power is normally available whether or not the generator is in service. However a transmission line outage on main transformer or secondary connection failure would shutdown the Stretford facility. Reliability can be improved by providing a dual 480 volt supply, with one feeder from the auxiliary bus for each unit.

Unit 4 is unique with an auxiliary or start-up transformer connected at the main transformer circuit breaker. However failure of transmission line or the main transformer would effect the usefulness of this connection.

At Units 7 and 8, one auxiliary transformer is capable of picking up both the Stretford unit and auxiliary power load of both units; however, the 4,000 ampere bus on the secondary of the auxiliary

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transformer limits the supply to the existing 480 volt switchgear to 3,300 kVA. A circuit breaker connected to transformer terminal for a feeder to the Stretford unit will bypass this bottleneck.

Unit 11 in addition to the auxiliary transformer associated with each generator auxiliary or start-up transformer is connected to the 480V auxiliary power bus. This transformer is provided since the Stretford facility load is very small and does not present a problem regarding auxiliary transformer capacity.

8.1.2.6 The installation of a separate stepdown transformer supplied from either a transmission line or a local distribution line free of most power plant interruptions with an emergency tie to a unit auxiliary power bus appears to be the most attractive scheme.

For Unit 3, this would be from the Unit 3 auxiliary power bus and the local distribution line supplying the start-up bank for Unit 4. One auxiliary power transformer would be required.

For Unit 7, a new distribution line would be required and the alternative supply would be off either the Unit 7 or 8 auxiliary switchgear.

Unit 11 has an existing tie to an outside distribution line. A dual supply from the 480 volt switchgear is considered adequate.

8.1.2.7 Power service to noncondensable blowers will be taken from the individual unit auxiliary 480 volt switchgear or motor control center.

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8.2 Installation Costs

The following Section depicts the Total Cost Installed of Stretford Systems.

SUMMARY

Item	Direct Cost	GM Est.
Units 1 through 6	$ 8,267,400	$ 9,970,500
Unit 7, 8 and 11	8,353,200	10,073,900
Unit 9, 10 and 12	6,271,500	7,563,400
Totals	$22,892,100	$27,607,800

These costs are June 1979 costs. In the Final Report they will also be escalated to time of construction. Also the same factors have been used as in Milestone 1 and 2 reports for contingency and labor rates, etc.

The detailed breakdown of each unit Stretford System follows:

ROGERS ENGINEERING CO., INC.
111 PINE STREET
SAN FRANCISCO, CALIF. 94111
JOB NO.

PG-023

ROGERS ENGINEERING CO.,INC. COST ESTIMATE

JOB NAME-STRFD 11 JOB NO.-S79007 CLIENT-P G AND E ESTIMATE DATE- 29 JUNE 79

ITEM NO.	DESCRIPTION	MATL&EQPT	INSTALL	MANHOURS	TOTAL
54-291-4	FOUNDATION BLWR 7&8	890.	4193.	180.	5084.
54-291-5	FOUNDATION BLWR 11	890.	4193.	180.	5084.
54-293-8	EQ STRETFORD 7-8-11	5173800.	0.	0.	5173800.
54-293-9	EQ BLOWER 7&8	193344.	0.	0.	193344.
54-293-10	INSTALL BLOWER 7&8	165360.	65230.	2806.	230590.
54-293-11	EQ BLOWER 11	198432.	0.	0.	198432.
54-293-12	INSTALL BLOWER 11	171720.	65230.	2806.	236950.
54-294-1	EQ UNIT 7 ELEC	65126.	0.	0.	65126.
54-294-2	INSTALL ELECT & MISC	28620.	62435.	2685.	91055.
54-296-1	GAS BLWR 7&8 ELEC	2162.	2330.	100.	4492.
54-296-2	GAS BLWR 11 ELEC	8001.	2795.	120.	10796.
54-297-3	NC GAS PIPE 7-8-11	674160.	0.	0.	674160.
54-297-4	INSTALL PIPE 7-8-11	127200.	1025046.	44088.	1152246.
54-293-19	R CRANE,TRUCKS 7-11	31800.	18637.	802.	50437.
54-299-4	CONTROLS BLWR 7&8	114480.	16308.	701.	130788.
54-299-5	CONTROLS BLOWER 11	114480.	16308.	701.	130788.
ACCOUNT TOTAL		7070466.	1282705.	55170.	8353172.
365-1	CONST FIELD	0.	0.	0.	0.
365-2	GENRL ENG	0.	0.	0.	0.
365-3	OTHR ENGINEERING	0.	0.	0.	0.
ACCOUNT TOTAL		0.	0.	0.	0.

TABLE: 8.2.2
STRETFORD SYSTEM
UNITS 7, 8, 11

SHEET 1 OF 1

DRAWING NO.

REV.

ROGERS ENGINEERING CO., INC.
111 PINE STREET
SAN FRANCISCO, CALIF. 94111

JOB NO.

DG-023

TABLE: 8.2.1
STRETFORD SYSTEM
UNITS 1-6

SHEET 1 OF 1

DRAWING NO.

REV.

ROGERS ENGINEERING CO.,INC. COST ESTIMATE

JOB NAME-STRFD 1-6 JOB NO.-S79007 CLIENT-P G AND E ESTIMATE DATE- 29 JUNE 79

ITEM NO.	DESCRIPTION	MATL&EQPT	INSTALL	MANHOURS	TOTAL
54-293-1	EQ STRETFORD 1-6	4968850.	0.	0.	4968850.
54-293-2	EQ BLOWER 1&2	171720.	0.	0.	171720.
54-293-3	INSTALL BLOWER	139920.	55912.	2405.	195832.
54-293-4	EQ BLOWER 3&4	166632.	0.	0.	166632.
54-293-5	INSTALL BLOWER 3&4	152640.	55912.	2405.	208552.
54-293-6	EQ BLOWER 5&6	203520.	0.	0.	203520.
54-293-7	INSTALL BLOWER 5&6	184440.	65230.	2806.	249670.
54-297-1	NC GAS PIPE 1-6	534240.	0.	0.	534240.
54-297-2	INSTALL PIPE 1-6	101760.	838674.	36072.	940434.
54-291-1	FOUNDATION BLWR 1&2	890.	4193.	180.	5084.
54-291-2 F	OUNDATION BLWR 3&4	890.	4193.	180.	5084.
54-291-3	FOUNDATION BLWR 5&6	890.	4193.	180.	5084.
54-293-18	K CRANE,TRUCKS 1-6	31800.	18637.	802.	50437.
54-294-1	EQ UNIT 3 ELEC	65126.	0.	0.	65126.
54-294-2	INSTALL & MISC MTL	26076.	63832.	2745.	89908.
54-296-1	GAS BLWR 1&2 ELEC	5724.	2982.	128.	8706.
54-296-4	GAS BLWR 3&4 ELEC	3053.	1864.	80.	4917.
54-296-3	GAS BLWR 5&6 ELEC	13992.	4659.	200.	18651.
54-299-1	CONTROLS BLOWER 1&2	101760.	13978.	601.	115738.
54-299-2	CONTROLS BLOWER 3&4	108120.	13978.	601.	122098.
54-299-3	CONTROLS BLOWER 5&6	120840.	16338.	701.	137148.
ACCOUNT TOTAL		7102884.	1164545.	50088.	8267429.
365-1	CONST FIELD	0.	0.	0.	0.
365-2	GENRL ENG	0.	0.	0.	0.
365-3	OTHR ENGINEERING	0.	0.	0.	0.
ACCOUNT TOTAL		0.	0.	0.	0.

ROGERS ENGINEERING CO., INC.
111 PINE STREET
SAN FRANCISCO, CALIF. 94111

JOB NO.

DG-023

TABLE: 8.2.3
STRETFORD SYSTEM
UNITS 9,10,12

DRAWING NO.

REV.

SHEET 1 OF 1

ROGERS ENGINEERING CO.,INC. COST ESTIMATE

JOB NAME-STRFD 12 JOB NO.-S79007 CLIENT-P G AND E ESTIMATE DATE- 29 JUNE 79

ITEM NO.	DESCRIPTION	MATL&EQPT	INSTALL	MANHOURS	TOTAL
54-291-6	FOUNDATION BLWR 9&10	890.	4193.	180.	5084.
54-291-7	FOUNDATION BLWR 12	890.	4193.	180.	5084.
54-293-13	EQ STRETFORN 9-10-12	3246475.	0.	0.	3246475.
54-293-14	EQ BLOWER 9&10	188256.	0.	0.	188256.
54-293-15	INSTALL BLOWER 9&10	171720.	60571.	2605.	232291.
54-293-16	EQ BLOWER 12	181896.	0.	0.	181896.
54-293-17	INSTALL BLOWER 12	165360.	60571.	2605.	225931.
54-293-20	R CRANE,TRUCKS 9-12	25440.	16308.	701.	41748.
54-294-1	EQ UNIT 12 ELEC	10560.	0.	0.	10560.
54-294-2	INSTALL ELEC	50880.	52184.	2244.	103064.
54-296-1	GAS BLWR ELEC 9&10	6716.	2050.	88.	8766.
54-296-2	GAS BLWR ELEC 12	1081.	1072.	46.	2153.
54-297-4	NC GAS PIPE 9-10-12	642360.	0.	0.	642360.
54-297-5	INSTALL PIPE 9-10-12	114480.	1001750.	43086.	1116230.
54-299-6	CONTROLS BLOWER	114480.	16308.	701.	130788.
54-299-7	CONTROLS BLOWER 1&2	114480.	16308.	701.	130788.
ACCOUNT TOTAL		5035965.	1235507.	53140.	6271472.
365-1	CONST FIELD	0.	0.	0.	0.
365-2	GENRL ENG	0.	0.	0.	0.
365-3	OTHR ENGINEERING	0.	0.	0.	0.
ACCOUNT TOTAL		0.	0.	0.	0.

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8.3 Operation and Maintenance Costs

These costs are indicated in Table 8.3.1 which follows in this Section.

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TABLE 8.3.1

OPERATION AND MAINTENANCE COSTS

STEAM AND OPERATING SOLUTION

REPLACEMENT COST

VENDOR

Stretford Unit		Parsons	J. T. Pritchard	Peabody
1	Operating, Sol'n replacement cost/ day/L. T./Daily Cost $		80/1094	N. S.
2	"		80/1063	N. S.
3	"		80/393	N. S.
1	Steam requirements Press-psig/#/Hr./L. T./Day		50/3694	N. S.
2	"		50/3588	N. S.
3	"		50/988	N. S.