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PHASE III, STAGE II

MASTER

GEORGETOWN UNIVERSITY
INTEGRATED COMMUNITY ENERGY SYSTEM
PRELIMINARY DESIGN

COGENERATION AND ADDED ASH STORAGE

FINAL REPORT
NOVEMBER 1980

POPE, EVANS AND ROBBINS INCORPORATED
CONSULTING ENGINEERS

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GEORGETOWN UNIVERSITY
INTEGRATED COMMUNITY ENERGY SYSTEM
(GU - ICES)

PHASE III, STAGE II
PRELIMINARY DESIGN

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FINAL REPORT
NOVEMBER 1980

GEORGETOWN UNIVERSITY
37th & "O" Street, N.W.
Washington, D.C. 20057

Prepared for
U.S. DEPARTMENT OF ENERGY
Office of the Assistant Administrator
for Conservation and Solar Applications
Division of Buildings and Community Systems
Contract No. EC-77-C-02-4488 A003

GEORGETOWN UNIVERSITY
INTEGRATED COMMUNITY ENERGY SYSTEM
(GU - ICES)

PHASE III, STAGE II
PRELIMINARY DESIGN

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Potomac Electric Power Co.

GEORGETOWN UNIVERSITY
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(GU - ICES)

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EXECUTIVE SUMMARY

This report presents the results of the Phase III, Stage II, Preliminary Design for two elements in the Georgetown University ICES Program, namely:

- . The installation of a 2500 kW backpressure steam turbine generator within a new extension to the Heating and Cooling Plant, (Cogeneration Scheme A as described in Phase III, Stage I Report) and,
- . The provision of four additional ash silos for the university's atmospheric fluidized-bed (AFB) boiler plant (Added Storage Scheme C as described in Phase III, Stage I Report).

The backpressure turbine generator will operate at an inlet pressure of 625 psig saturated, the upper level at which the boiler can operate and discharge at 275 psig in summer months and 90 psig in winter months. Campus steam loads now peak during summers and winters at levels slightly over 100,000 lb/hr, the rated output of the AFB boiler. By 1984, due to new construction, the steam loads are expected to increase somewhat. It is proposed to operate the AFB boiler to supply campus steam requirements during 10 months of the year, during which time all steam produced by the AFB unit would first be passed through the turbine-generator before continuing at a reduced pressure to campus loads. During the months of April and November, when steam demands are low, the AFB plant is considered to be shut down for maintenance and the campus steam requirements supplied by either of the two 100,000 lb/hr gas/oil fired boilers. In a similar fashion, a gas/oil fired boiler would supplement the AFB boiler output when campus steam loads exceed 100,000 lb/hr.

The proposed installation has been reviewed and accepted by the utility, Potomac Electric Power Company (PEPCO). The turbine-generator output will operate in parallel with the utility. It is conservatively estimated that the university can generate about 8,200,000 kWh/yr under this scheme, or approximately 20 percent of its projected 1984 campus usage.

This project is both cost effective and energy effective. Based on 8,200,000 kWh/yr generation and a present (November 1980) capital cost of \$1,205,000, the discounted payback period for a 10 percent discount rate is 4.7 years. The annual energy savings will be about 58×10^9 Btu/yr, or the equivalent of 9300 barrels of oil.

To obtain maximum benefits from this project, every effort should be made to have it operational by June 1982 so as to reduce the cost impact of the annually imposed summer premium rates for purchased electricity which apply for the months of June through September. The long lead time of the turbine-generator is such that early approval to proceed must be provided if this target for completion is to be considered. Reference should be made to the schedule following.

Added ash storage capability will enhance the AFB plant's capability of operating for extended periods of time.

The initial AFB plant extension limitations were such that the built-in material storage capacities, assuming 80 percent load operation, were as follows:

Coal	- 12 days
Limestone	- 14 days
Bed material (bottom ash)	- 3.5 days
Flyash	- 2.3 days

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This ash storage limitation necessitates close scheduling of ash removal trucks in order to continue operations over a weekend. Truckers have not always been able to comply with these needs and the plant has been shut down unnecessarily as a result.

Added ash storage silos can be constructed in the existing enclosed cooling tower area where they will be concealed from view, yet accessible to trucks. Construction of four silos at this location will increase the ash storage capability to about 14 days each at 80 percent boiler load. This will eliminate potential plant shutdowns for reason of delayed ash removal.

Capital cost of construction is estimated at \$634,000 in November 1980 dollars. Its implementation is recommended.

Preliminary design drawings associated with this report are bound separately from the report.

Adding A/E fees, escalation, and the university's program management fees to the above, the combined cost of the two projects expressed in November 1980 dollars is as follows:

Cogeneration	\$1,205,000
Added Ash Storage	634,000
A/E Services	161,000
Escalation and Program Management	200,000
<hr/>	
TOTAL	\$2,200,000

GEORGETOWN UNIVERSITY

SCHEDULE - COGENERATION AND ADDED ASH STORAGE

1. BASIS FOR REPORT

1.1 Summary

Contract No. EC-77-C-02-4488 A003 set forth a work program to be performed in two stages: Stage I - Feasibility Analysis, and Stage II - Preliminary Design.

Stage I was authorized in October 1979 and outlined five alternative subsystems for study and evaluation. These were:

- . Cogeneration of Electricity
- . Added Coal, Limestone and Ash Storage
- . Hot and Cold Thermal Storage
- . Absorption Chillers
- . High Temperature Heat Pumps.

The pre-final report on Stage I containing the findings and recommendations was issued in April 1980.

Based upon this report, a Stage II - Preliminary Design was authorized in June 1980 for two of the work items identified in the Stage I - Final Report. These were:

- . Cogeneration Scheme A calling for the installation of a 2500 kW backpressure steam turbine generator operating at an inlet steam pressure of 625 psig saturated and a discharge steam pressure of 275 psig in summer months, and 90 psig in winter months.

- . Increased ash storage only, identified as Scheme C in the Stage I Final Report, in which further ash storage capability would be added within the cooling tower enclosure.

This report presents the preliminary design and supporting documentation for the above two work items.

1.2 Scope of Work

The Scope of Work for the Stage II - Preliminary Design was set forth in Exhibit IV to Contract EC-77-C-02-4488 and is repeated below in its entirety.

"Stage II - Preliminary Design

Stage II is the preparation of a preliminary design that will document the design analysis; calculations; computerized systems design simulation and schematic drawings; layout and general arrangement drawings; envelope drawings and site plans; a listing of material and process equipment specifications; preliminary procurement; delivery and installation schedules; the schematic design and outline specifications for instrumentation; a testing plan for the subsystem; an update of the program plans, procedures and schedules; a construction cost estimate; and a preliminary design report for the GU-ICES.

The Preliminary Design will form the basis for the District of Columbia planning approval, for funding commitments by the participating parties and for DOE's review and decision whether to proceed with the Final Design.

Task 8 - Design Analysis and Schematic Drawings

- 8.1 Prepare design calculations for each alternative subsystem approved for conceptual design. Establish the capacity and characteristics for all major equipment necessary to develop the preliminary drawings and specifications.

- 8.2 Model the energy flow in all of the selected subsystems and components over the applicable ranges determined in the design analysis. Flag constraints, discontinuous functions and model limiting conditions.
- 8.3 Develop schematic drawings for the GU-ICES subsystems, describing the processes and energy material flows throughout the year. Note the rated capacities of equipment and the annual performance projections.

Task 9 - Layout and General Arrangement Drawings

Prepare layout and general arrangement drawings for each of the subsystems selected under Task 4 above. Ensure that space is available for the subsystems and that there are access provisions for connections and appropriate structural support, and that operating conditions can be maintained. Describe modifications to existing facilities required to accommodate the proposed subsystems.

Task 10 - Envelope Drawings and Site Plans

Prepare envelope drawings and site plans for each of the approved conceptual design subsystems. Show all facility connections with utility and campus distribution systems.

Task 11 - Material and Process Equipment Specifications

Provide a preliminary listing of generic specifications for the materials and process equipment for each of the subsystems of the approved conceptual design. Include preliminary capacities, sizes, flows, controls, operations sequences, and special requirements.

Task 12 - Data Collection and Instrumentation Plan

From the energy and material flow diagrams of the conceptual design, identify measurement points that provide data for evaluating the performance of the demonstration project subsystems. Propose appropriate instrumentation at the measurement points and develop schematics for the data acquisition system. Estimate the accuracy for measurements for the probable (90% confidence level) variations in parametric input.

Develop a plan to record and analyze subsystem data for determining the measures of efficiency under varying demand, seasonal performance, annual performance, and utility flows for electricity, coal, solid waste, limestone sorbent/ash, gas, oil, diesel distillate, water and water softeners.

Task 13 - Work Management Plan for Phases IV through VII

Provide an updated work management plan based on the consolidation of subsystems in the conceptual design feasibility analysis, and preliminary commitments for funding and design.

Task 14 - Preliminary Procurement, Delivery and Installation Schedules

Provide preliminary schedules for the procurement, delivery and installation of the GU-ICES subsystems as developed from the approved conceptual design. Include critical paths for completion dates, pre-purchasing, access and storage requirements, realistic lead times, bad weather contingencies and interface with other systems.

Task 15 - Instrumentation Schematic Design and Outline Specifications

Provide a schematic design and outline specifications for instrumentation to collect the data according to the instrumentation plan developed in Task 12 above. This will form a basis for the Phase VI monitoring and Data Acquisition System. Detail the location of sensors, instrumentation, calibration and recording systems for continuous and intermittent monitoring. Provide general specifications for the detailed schematic including sensitivity ranges, power supply, accuracy and stability data.

Task 16 - Testing Plan

Develop a preliminary testing plan to collect, record, analyze and report data for the purpose of acceptance and for assessing the performance of the GU-ICES during the demonstration period. Adopt standard procedures for testing as required by DOE, the Environmental Protection Agency, and the National Bureau of Standards.

The testing plan will include installation verification, start-up test, performance tests and reporting for the acceptance of construction for each of the GU-ICES subsystems. Provide for annual installation verification and performance tests as input to Phase VI monitoring evaluation."

1.3 Organization of Report

The preceding Scope of Work defines Tasks 8 through 16 which constitute the work statement for this Stage II effort. The individual tasks overlap to some extent and it was found to be more convenient to group the discussion pertaining to each Task under more generic headings. This report, therefore, is organized in the following manner:

Task and Description	Applicable Report Section			
	2.0	3.0	4.0	5.0
8 - Design Analysis and Schematic Drawings				
. Design Calculations		x		
. Energy Flow	x			
. Schematic drawings		x		
9 - Layout/Gen. Arrangement		x		
10 - Envelope Drawings and Site Plans		x		
11 - Material and Process Equipment Spec's.		x		
12 - Data Collection and Instrumentation Plan		x	x	
13 - Work Management Plan for Phases IV through VII				x
14 - Preliminary Procurement, Delivery and Install. Sched.				x
15 - Instrumentation Schematic Design and Outline Spec's.		x	x	
16 - Testing Plan			x	

From the above, it will be noted that the task discussion is in some instances divided between two sections. From a review of the task description, it will be apparent that the full discussion becomes more cohesive when grouped in this manner.

2. FEASIBILITY ANALYSIS UPDATE

2.1 Energy Load Update

The Phase III, Stage I - "Feasibility Analysis" Final Report presented the present and projected 1984 steam and electrical load data. Based upon this data, several cogeneration schemes were analyzed and evaluated for cost effectiveness in which backpressure steam turbine generators would generate by-product electrical energy while performing as pressure reducing stations between the AFB boiler delivering steam at 625 psig saturated, and the campus steam requirements of 275 psig saturated during summer months and 90 psig saturated in winter months. Of the schemes evaluated, Scheme A was approved for Preliminary Design.

In Scheme A, a single backpressure turbine generator would be installed. During summer months, when existing central turbine driven chillers constitute the bulk of the campus steam load, the turbine generator will discharge at 275 psig saturated into the existing Heating and Cooling Plant header. During winter months when the turbine-driven chillers are shut down and the bulk of the campus steam load consists of heating equipment connected to the campus export steam lines, the turbine-generator will discharge at 90 psig saturated into the export line. Obviously, the greater pressure differential (625 to 90 psig) during winter months enables the generation level to be greater in the winter months than during the summer. Under Scheme A, a 100,000 lb/hr steam flow would produce a maximum of 1045 kW in the summer operating mode (625 to 275 psig), and 2270 kW in the winter operating mode.

Phase III, Stage I evaluations revealed that the campus steam loads could be considered in terms of two month blocks in each of which the two respective months bore a close resemblance in terms of peak steam load and monthly load. These groupings became:

Summer

July and August - Summer peak months
June and September
May and October

Off-Peak

April and November - Low months of each year.

Winter

January and February - Winter peak months
December and March

Expanding upon this approach, it was also possible to project the 1984 electrical energy usage into the hours of the recently enacted utility "Time-of-Day" rate structure which became effective on May 31, 1980. The following exhibits were drawn from the Stage I report and repeated here for the purpose of illustrating the load evaluation approach.

- Exhibit 2 - 1 Projected 1984 Annual Steam Load Duration Curve
- Exhibit 2 - 2 Projected 1984 Seasonal Steam Load Duration Curve
- Exhibit 2 - 3 1984 Electrical Load Duration Curve
- Exhibit 2 - 4 Cogeneration Scheme A - Steam/Electric Concurrence

PROJECTED 1984
ANNUAL STEAM LOAD DURATION CURVE

PROJECTED 1984
SEASONAL STEAM LOAD DURATION CURVES

1984 ELECTRICAL LOAD DURATION CURVE

COGENERATION SCHEME A - STEAM/ELECTRICAL CONCURRENCE

MONTHS	OFF-PEAK		INTERMEDIATE		ON-PEAK		COMBINED	
	STEAM 10 ⁶ lb	ELECTRICITY MWh	STEAM 10 ⁶ lb	ELECTRICITY MWh	STEAM 10 ⁶ lb	ELECTRICITY MWh	STEAM 10 ⁶ lb	ELECTRICITY MWh
JUN/SEP.	62.8	655.7	33.2	346.5	34.4	359.5	130.4	1361.7
JUL/AUG.	78.8	823.8	34.4	359.5	34.4	359.5	147.6	1542.8
SUB-TOTAL	141.6	1479.5	67.6	706.0	68.8	719.0	278.0	2904.5
MAY/OCT.	60.5	631.9	26.9	280.6	26.6	278.3	114.0	1190.8
NOV/APR.	0	0	0	0	0	0	0	0
JAN/FEB.	62.8	1424.4	28.5	646.0	26.7	606.1	118.0	2676.5
DEC/MAR.	52.8	1197.9	25.4	575.7	24.5	555.2	102.7	2328.8
SUB-TOTAL	176.1	3254.2	80.8	1502.3	77.8	1439.6	334.7	6196.1
TOTAL	317.7	4733.7	148.4	2208.3	146.6	2158.6	612.7	9100.6

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To arrive at the expected electrical cogeneration in 1984, it was assumed that the AFB boiler plant would be out of service for regular maintenance during the low load months of April and November, and that during the remaining months, the plant would be operational 95 percent of the time. This amounts to an annual availability of about 79 percent, or 6,950 hours per year of cogeneration operation.

Projected 1984 steam and electrical loads were developed in the following manner:

- . Present 1978 and 1979 steam loads were calculated from gas and oil fuel flow data assuming 83 percent boiler efficiency. These were subsequently corrected for summer and winter deviations from the mean and the resultant two year figures were then averaged. The above method of determining steam flow was used because steam flow charts were found to be inaccurate and data thus obtained was subsequently discarded.
- . Present (1979) electrical loads were obtained from a 12 months set of pulse readings provided by the electrical utility.
- . Present steam and electrical loads were projected to 1984 taking into account the expected loads of buildings planned for construction during this period.

The load evaluation and projections prepared in Stage I are considered to be valid. In an effort to insure that the economic evaluation is on the conservative side, it was further considered in this Stage II effort that continuing energy conservation measures will reduce steam usage by 10 percent below the projected values. The revised life cycle cost analysis performed herein for this cogeneration scheme assumes that the projected steam usage and hence the electrical cogeneration is reduced by 10 percent below the values calculated in Stage I.

2.2 Institutional Assessment Update

In the interim between the completion of Stage I work and this report on Stage II, the electric utility (Potomac Electric Power Company) has received approval to implement a "Time-of-Day" schedule effective on May 31, 1980. This schedule provides for generally higher charges during the summer months of June through September than during the remaining eight months which are classified as winter months. Throughout the year, hourly energy charges vary depending upon the time-of-day. Thus "on-peak" periods are the hours of 12 noon to 8 PM weekdays (excluding holidays); "intermediate" periods are from 8 AM to 12 Noon and 8 PM to 12 Midnight weekdays (excluding holidays); and "off-peak" periods are from 12 Midnight to 8 AM Weekdays, and all hours during Saturdays, Sundays and Holidays.

The schedule of monthly charges now applying to the university's main utility service is as follows:

	<u>Summer Months</u>	<u>Winter Months</u>
A. Customer Charge	\$ 165.00/mo.	\$ 165.00/mo.
B. Energy Charge:		
On-Peak Period	3.551¢/kWh	3.458¢/kWh
Intermediate Period	3.021¢/kWh	3.192¢/kWh
Off Peak Period	2.475¢/kWh	2.475¢/kWh
C. Production and Transmission Charge		
on Peak Billing Demand	\$7.00/kW	-
D. Distribution Charge	\$4.05/kW	\$4.05/kW

In the Stage I Final Report, the energy cost savings associated with cogeneration were calculated by making three assumptions, namely:

- . That of a proposed 14.7 percent rate increase proposal brought before the P.S.C. in Washington, D.C., a 10 percent increase would be approved.
- . That the savings of electrical energy co-generated on site would be in effect the cost of this block of energy if, instead of being generated on site, had been added to the block of energy purchased during that month.
- . That there would be no charge to the university for standby power because the university could, if the turbine generator failed at a time when peak demands were occurring, shut down the entire AFB plant thereby removing almost the equivalent of generator output in summer months.

The above assumptions were discussed with the utility and, in the absence of a fully defined utility policy on cogeneration, were agreed upon as formulating a reasonable basis for evaluating cost savings.

During the course of Stage II - Final Design, the utility was again contacted for the purpose of clarifying their final policy and rate structure for customer cogeneration. In the area of policy, the utility accepts cogeneration, but it has not yet developed its final rate structure. In the absence of such a structure, the assumptions made in the Stage I economic evaluations will again be employed. For a statement of the most recent utility position on this matter, refer to their September 22, 1980 letter in the Appendix.

2.3 Life Cycle Cost Analysis Update

In the Phase III, Stage I, Feasibility Analysis, life cycle cost analyses were performed for each cogeneration scheme considered for both a 10 percent and 3 percent discount rate. For the analysis performed on Cogeneration Scheme A, for which the preliminary design is herein presented, the cost of added coal (including limestone and ash removal) for cogeneration was calculated at \$84,000 per year and the cost of additional operating labor and maintenance was estimated at \$42,000 per year in current dollars. These charges remain the same for the life cycle cost update performed herein.

The savings in purchased electrical energy costs resulting from cogeneration were estimated at \$342,000 per year in current dollars. When the savings are computed on the now approved Rate Schedule, the annual savings become \$343,000. In recognition that university energy conservation measures may further reduce the projected campus steam usage and thereby reduce the electrical cogeneration output, it was assumed that 90 percent of the \$343,000, or \$309,000, annual savings would result from cogeneration.

A summary comparison of the Stage I and Stage II life cycle cost analyses follows:

	<u>Stage I</u>	<u>Stage II</u>
Investment	\$1,180,000	\$1,205,000
Coal cost for cogeneration	84,000	84,000
Labor/material cost for cogeneration	42,000	42,000
Annual purchased elect. savings	342,000	309,000
Discounted payback(10% discount)	3.97 yrs	4.72 yrs

The revised life cycle cost analysis follows.

GEORGETOWN UNIVERSITY ICES - 25 YEAR DISCOUNTED LIFE CYCLE COST ANALYSIS - FY 82 PROJECT - COGENERATION SCHEME A

Line	Description	(A) Current Dollars	(B) Short Term Escalation Factor	(C) (A)x(B) Escalated Values One-Time	(D) Recurring	(E) Long Term Differential Escalation Rate	(F) Long Term Factor (10% Discount) Rate	(G) Discounted Cost (F)x(C) or (F)x(D)	(F') Long Term Factor (3% Discount Rate)	(G') Discounted Cost (F')x(C) or (F')xD
1.	INVESTMENT	1,205	1.146	1,380	-	0%	0.911	1,257	.96	1,225
2.	COAL COSTS FOR OPTION	84	1.271	-	107	5	14.437	1,545	32.410	3,468
3.	ELECTRICAL COSTS FOR OPTION	0	1.396	-	0	7	17.800	0	42.591	0
4.	OPERATING LABOR & MATERIAL COSTS FOR OPTION	42	1.153	-	50	0	9.077	454	17.413	871
5.	OTHER COSTS FOR OPTION	0	-	-	0	-	-	0	-	0
6.	TOTAL 25 YEAR OPERATING COSTS (2+3+4+5)	-	-	-	-	-	-	1,999	-	4,339
7.	TOTAL PROJECT COSTS (1+6)	-	-	-	-	-	-	3,231	-	5,637
8.	COAL COSTS FOR STATUS QUO	0	1.271	-	0	5	14.437	0	32.410	0
9.	ELECTRICAL COSTS FOR STATUS QUO	309	1.396	-	431	7	17.800	7,672	42.591	18,357
10.	OTHER COSTS FOR STATUS QUO	0	-	-	0	-	-	0	-	0
11.	TOTAL COSTS FOR STATUS QUO (8+9+10)	-	-	-	-	-	-	7,672	-	18,357
12.	SAVINGS - INVESTMENT RATIO (11 - 6) ÷ 1	-	-	-	-	-	-	4.51	-	10.97
13.	DISCOUNTED PAYBACK PERIOD (Years)	-	-	-	-	-	-	4.72	-	4.04

All dollars in 1000's

References: 1. Life Cycle Costing Emphasizing Energy Conservation, Guideline for Investment Analysis,
ERDA - 76/130 Rev., May 1977

2. Instructions for Incorporation of Economic Analysis, 407: ARM, 19 March 1979, NAVFAC, Atlantic Division

REVISED ANALYSIS
NOVEMBER 1980

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3. PRELIMINARY DESIGN DOCUMENTS

3.1 General

The preliminary design documents consist of the following:

- . Drawings
- . Outline Construction Specifications
- . Turbine-Generator Prepurchase Specification
- . Calculations.

The specific task assignments included in part or in their entirety in this Section of the Report are:

- Task 8 - Design calculations (3.5)
- Task 8 - Schematic drawings (3.2)
- Task 9 - Layout and general arrangement drawings (3.2)
- Task 10- Envelope drawings and site plans (3.2)
- Task 11- Material and process equipment specifications (3.3,3.4)
- Task 12- Measurement points for data collection (3.2)
- Task 15- Location of instrumentation sensors (3.2)

3.2 Drawings

The drawings submitted herewith as part of this Report are tabulated in Table 3-1 below and submitted as an attachment to this report.

TABLE 3-1
PRELIMINARY DESIGN DRAWING LIST

Dwg. No.	Title	Reference Task No.
1	Architectural-Site Plan	10
2	Architectural-Fl. Plans, Sects. & Det.	9
3	Architectural-Elevations	9
4	Utilities Site Plan and Details	10
5	Mechanical-Flow Diagrams	9
6	Mechanical-Plans	9
7	Mechanical-Sections	9
8	Mechanical-Plan and Details	8, 12, 15
9	Mechanical-Sections	9
10	Mechanical-Details	9
11	Electrical-13.2 kV Single Line Diagram	9, 12
12	Electrical-480V Single Line Diagram	9
13	Electrical-Plans	9

As indicated on the above drawings, the proposed work involves construction centered about two main areas with miscellaneous work within the existing Heating and Cooling Plant and the AFB plant.

3.2.1 Cogeneration

The cogeneration project requires space not presently available in either the Heating and Cooling Plant or the AFB plant. To meet this requirement, it is proposed to construct an extension to the southwest corner of the Heating and Cooling Plant as shown on Drawings 1, 2 and 3. The extension will match the Heating and Cooling Plant in appearance and height. It will consist of two levels: a grade level which will house the turbine generator and its accessories, and a second floor which will contain miscellaneous equipment and provide for storage.

The turbine-generator and accessories will be as listed below:

- . 2500 kW steam turbine-generator with
 - 625 psig saturated inlet steam
 - 275 psig saturated discharge steam (summer operation) or,
 - 90 psig saturated discharge steam (winter operation).
- . 2500 kW/3125 kVa, 3 phase, 60 Hertz, 13,800 volts, synchronous generator and associated switchgear
- . Condensate pump, duplex
- . Auxiliary oil pump
- . Cooling water pump
- . Fluid cooler fan and pump
- . Roof fan
- . Air handling unit
- . Turbine-generator instrument panel

Steam piping will be extended from the AFB Plant, ahead of the existing pressure reducing station, to the turbine inlet. Discharge steam will be piped to the 275 and 90 psig steam headers, respectively, in the Heating and Cooling Plant. Condensate from the turbine-generator will

be returned to the existing condensate system.

Cooling air for the turbine generator room will be taken from the roof of the proposed extension, then ducted through an air handling unit on the second floor into the room below. Air balance is maintained by permitting room ventilating air to pass out through louvered openings in the personnel access door leading into the Heating and Cooling Plant.

Ventilation for the second floor space will be provided by an exhaust fan on the roof.

All roof mounted equipment will be screened from view by the parapet which will extend eight feet above the roof.

Electrical service for the turbine-generator auxiliaries will be drawn from a motor control center in the AFB plant. A new motor control center will be installed in the turbine-generator room from which all local distribution will emanate.

The turbine-generator output at 13,800 volts will be connected to utility feeder No. 14347 in the nearest adjacent manhole. Appropriate measures will be taken, as approved by the utility, to protect this service connection. The generator will at all times operate in parallel with the utility.

The existing AFB plant intercommunications and fire alarm systems will be extended to the turbine-generator building extension.

A separate instrument panel will be provided in the turbine generator room on which will be mounted the instruments and meters required to monitor plant performance. This panel will contain the following front mounted devices:

- . Turbine steam recording meters:
 - Inlet steam flow in lb/hr
 - Inlet steam temperature in degrees F
 - Inlet steam pressure in psig
 - Discharge steam flow in lb/hr.
 - Discharge steam temperature in degrees F
 - Discharge steam pressure in psig.
- . Generator output recording meters:
 - Watthour
 - Kilowatts
- . Other
 - Total elapsed time meter
 - Resettable elapsed time meters.

The generator switchboard will contain other direct indicating instruments which will include:

- Frequency meter
- Voltmeter, phase-to-phase
- Ammeter (current per phase)
- Wattmeter
- Power factor meter
- Synchroscope

Appropriate protective relaying, including a synchronizing check relay will be installed in the generator switchboard.

A reverse power relay will also be installed on the switchgear in New South Hall to protect the turbine generator from backfeeding into a fault on the campus distribution system ahead of the AFB plant.

3.2.2 Additional Ash Storage

The AFB Plant contains bunkers or silos that provide for limited in-plant storage of coal, limestone, bottom ash and flyash. By design, full load operation of the boiler burning 3.3 percent sulfur coal with 8 percent ash entails the following quantities of the above products.

Coal	9565 lb/hr	(4.8T/hr)
Limestone	3133 lb/hr	(1.6T/hr)
Bottom ash	2088 lb/hr	(1.05T/hr)
Flyash	1304 lb/hr	(0.65T/hr)

Assuming an average steaming rate of 80 percent (80,000 lb/hr), the above translates into the following daily quantities.

Coal	92T/Day
Limestone	31T/Day
Bottom ash	20T/Day
Flyash	12½T/Day

In actual plant operation, the above quantities are often higher than design conditions for a variety of factors. For storage planning purposes, the following daily quantities at 80 percent load were used:

Coal	92T/Day
Limestone	31½T/Day
Bottom ash	23T/Day
Flyash	18T/Day

In Stage I, the present in-plant storage facilities were evaluated as presented in Table 3-2 below.

TABLE 3-2
EXISTING AFB PLANT COAL, LIMESTONE AND ASH STORAGE CAPACITY

Material	Bulk Density (lb/ft ³) *	Storage Capacity (ft ³)	(Tons)	Days Storage at 80% Load
Coal	50	42,900	1,080	12
Limestone	90	9,740	440	14
Bed Material	67	2,480	80	3.5
Flyash	34	2,480	42	2.3
* Average value				

Whereas it would have been desirable to increase storage capacity of all materials to minimize the impact of potential miner's or trucker's strikes, the Stage I evaluations determined that the costs would be excessive in relation to the potential cost benefits to be derived therefrom.

Alternatively, it was concluded that present plant operations could be frequently impaired by the limited ash storage capacity now on hand and that increasing the ash storage to an approximate days equivalent of the present coal and limestone capacity would significantly improve reliability of plant operations. A Stage II Preliminary Design was authorized for this approach.

To eliminate the need for further building extensions, the preliminary design is based upon constructing four additional ash silos within the existing cooling tower enclosure immediately adjacent to the AFB Plant. The close proximity of this location to the AFB Plant simplifies the system modifications involved, yet retains the capability of being constructed without interfering with ongoing plant operations.

In this scheme, the two existing ash silos within the AFB Plant would be used for bottom ash storage. Of the four new silos proposed for placement within the cooling tower enclosure, one would be devoted to bottom ash storage, and three to flyash storage. With this addition, the proposed plant storage capacities would be as shown on Table 3-3 following.

TABLE 3-3
PROPOSED AFB PLANT STORAGE CAPACITY - COAL, LIMESTONE AND ASH

Material	Storage Capacity		Days Storage at 80% Load	Remarks
	(Ft ³)	(Tons)		
Coal	42,900	1,080	12	No change
Limestone	9,740	440	14	No change
Bottom Ash	8,300	278	14	Revised
Flyash	10,030	170	13.6	Revised

A flow diagram of the ash handling system including the proposed added storage appears on Drawing No. 5.

Equipment required for this installation is similar to that which is already installed and consists of the following:

- 4 - Mass screw conveyors for ash removal from new silos
- 4 - Retractable ash loading spouts for truck connection
- 2 - Bin vent filters
- 1 - Vent blower for loading spouts
- 3 - Remote controlled diverter valves

Existing blowers will continue to supply transport air for the expanded ash handling and storage system.

Control of the existing ash handling system is centered in a Solids Removal Panel located near the Central Control Room in the Heating and Cooling Plant. This panel now contains control switches, pilot lights, annunciator alarms, timing relays, and other control devices associated with the present system. It is proposed to add an extension to this panel to contain the control, indication and alarm devices associated with the operation of the additional ash silos. This panel extension will match the existing to the extent possible.

Local controls and indicating lights will be installed at a central point near the new silos from which point operation of the ash loading spouts and mass screw conveyors will be controlled.

3.3 Outline Construction Specifications

It is proposed that construction of the cogeneration installation and additional ash storage be performed under a single contract for which a qualified mechanical contracting firm would act as the prime contractor. The outline construction specifications contained in Appendix "A" are developed from this approach.

The outline specifications contain the appropriate Bid Documents and General Conditions which utilize AIA standard documents. Supplementary and Special Conditions are presented in near complete form. Technical provisions are presented in outline form in which the general requirements are described, though not in the detail of their final form.

3.4 Turbine-Generator Prepurchase Specification

The turbine-generator is a long lead delivery item over which close engineering control should be exercised. It is proposed that this unit and associated auxiliary equipment be prepurchased by Georgetown University and turned over to the Contractor for installation under the supervision of a manufacturer's representative.

The prepurchase specification for this unit appears in Appendix "B".

3.5 Calculations

Design Calculations are included in Appendix C
as follows:

Fluid Cooler

H & V in New Wing

Silo Volume Calculations

4. INSTRUMENTATION AND TESTING

4.1 Introduction

This section addresses the requirements of the following Tasks as defined in the Scope of Work:

- . Task 12 - Data Collection and Instrumentation Plan
- . Task 15 - Instrumentation Schematic Design and Outline Specifications
- . Task 16 - Testing Plan

Of the two work items approved for Preliminary Design, instrumentation applies to the Cogeneration item only. Additional ash storage does not require special instrumentation.

Instrumentation provided for the Cogeneration project is intended to provide accurate data from which the cost and energy effectiveness of cogeneration can subsequently be determined. For this purpose the following continuously recording instrumentation will be provided:

Turbine inlet: Steam flow pressure and temperature recorders

Turbine discharge: Steam flow, pressure and temperature recorder

Generator output: kWh and kW demand recorders.

A comparison of turbine inlet with turbine discharge steam conditions indicates the energy used in the turbine. The simultaneous record of kWh and demand kW provides data on the electrical output.

Other electrical indicating meters will be provided on the generator switchgear for the purpose of monitoring instantaneous generator output conditions.

4.2 Data Collection

Data pertaining to cogeneration should be recorded hourly and summarized monthly for ready assimilation into an annual report. A tentative form for this purpose follows on page 4-3.

Data thus collected will facilitate subsequent operations on the basis of load profiles, total generation, total energy charged to generation, and related factors.

To complete the economic evaluation of cogeneration effectiveness, it is necessary to analyze the monthly purchased power invoices and develop a calculated cost if cogeneration were not operative. The difference between the calculated monthly electrical costs without cogeneration, and the actual monthly cost represents the savings against which the projects effectiveness will be measured.

Partially offsetting costs attributable to cogeneration must be accounted for if the true cost effectiveness of the project is to be determined. These include:

- Additional manpower costs

- Preventive and corrective maintenance costs

- Cost per thousand pounds of steam production.

The university will prepare record forms on which this data will be recorded.

GEORGETOWN UNIVERSITY COGENERATOR

Time	Turbine Inlet Steam			Turbine Discharge Steam			Generator Output			
	Flow	Temp.	Press.	Flow	Temp.	Press.	KW	PF	V	A
	Klb/hr	°F	psig	Klb/hr	°F	psig				
0100										
0200										
0300										
0400										
0500										
0600										
0700										
0800										
0900										
1000										
1100										
1200										
1300										
1400										
1500										
1600										
1700										
1800										
1900										
2000										
2100										
2200										
2300										
2400										

Totalizer Readings @ 0100

Remarks:

Turbine inlet flow _____

Turbine discharge flow _____

kWh meter _____

4.3 Test Plan

The preliminary test plan for cogeneration follows:

<u>Function</u>	<u>Action</u>
. Installation verification	Ongoing inspections during construction
. Start-up tests	Performed by installation contractor under direction of T-G manufacturer's field engineer
. Performance tests	Initial tests by installation contractor. Further testing by GU after acceptance when campus steam loads permit operation near or at maximum output
. Acceptance tests	Combine with "start-up tests"
. Annual evaluation	Develop from "data collection" base
. Instrument verification	Recalibrate semi-annually first year; annually thereafter.

5. REVISED WORK MANAGEMENT PLAN

5.1 Introduction

A Modified Work Management Plan was issued in April 1979 as Report No. C-00-4488-2. Beyond Phase III, Stages I and II of which this is the concluding report, the Work Management Plan continued into the following remaining phases:

- Phase IV - Final Design
- Phase V - Construction
- Phase VI - System Tests
- Phase VII - Demonstration and Evaluation

The Work Management Plan contained flow charts and task descriptions which outlined the interrelationship of specific tasks within each Phase.

The revised Work Management Plan defined herein is based on an approach similar to that which was previously used. It sets forth the task relationships that apply to the two Preliminary Design projects reported on herein. For the sake of simplicity, Phases VI and VII above are combined and are entitled Phase VI - Demonstration and Evaluation.

Task flow charts for each of the succeeding phases follow.

5.2 Phase IV - Final Design

The revised Task Flow Chart for Phase IV - Final Design for Cogeneration and Added Ash storage follows.

TASK FLOW CHART - PHASE IV, FINAL DESIGN
COGENERATION AND ADDED ASH STORAGE

5.3 Phase V - Construction

TASK FLOW CHART - PHASE V, CONSTRUCTION
COGENERATION AND ADDED ASH STORAGE

5.4 Phase VI - Demonstration and Evaluation

TASK FLOW CHART - PHASE VI
DEMONSTRATION AND EVALUATION
COGENERATION AND ADDED ASH STORAGE

5.5 Schedule

Cogeneration and additional ash storage should be approved for final design immediately in order to derive the greatest economic return. This applies particularly to cogeneration. Under a newly approved rate structure which first became effective on June 1, 1980, the electrical utility now bills its customers during the summer months of June through September at a higher "Time-of-day" rate than applies during the other months of the year. Energy purchased during these summer months costs substantially more than during the months of October through May. There exists, therefore, a strong cost incentive to have the GU cogenerator operational before June 1982.

The turbine-generator is quoted with a 12 to 14 month lead time. Hence, in order to take advantage of turbine generation operation by June 1982, early action is required to bid this unit as a prepurchased item. The final design will be timed so as to take advantage of approved turbine-generator shop drawings in presenting a design for construction based upon actual requirements.

The schedule for implementing the two project items appears on Exhibit 5-1 following.

GEORGETOWN UNIVERSITY

SCHEDULE - COGENERATION AND ADDED ASH STORAGE

5.6 Summary

For maximum cost advantage to be derived by GU, the turbine-generator should be in operation by 1 June 1982 as indicated on the preceding schedule. For this date to be met, immediate action must be taken to approve the initiation of Final Design and concurrent requesting of bids for prepurchasing the long-lead turbine-generator and accessories. The schedule also takes advantage of the summer months for building construction work. If notice to proceed with final design and bidding of the turbine-generator is significantly delayed, the major benefits of on-site generation during the months when time-of-day metering is in effect are lost.

INVESTMENT CASH FLOW (1980 DOLLARS)

GEORGETOWN UNIVERSITY
INTEGRATED COMMUNITY ENERGY SYSTEM
(GU - ICES)

PHASE III, STAGE II
PRELIMINARY DESIGN

APPENDIX A

OUTLINE CONSTRUCTION SPECIFICATION

POPE, EVANS AND ROBBINS

THE AMERICAN INSTITUTE OF ARCHITECTS

AIA Document A305

Contractor's Qualification Statement 1979 EDITION

Required in advance of consideration of application to bid or as a qualification statement in advance of award of contract. Approved and recommended by The American Institute of Architects and The Associated General Contractors of America.

The Undersigned certifies under oath the truth and correctness of all statements and of all answers to questions made hereinafter.

SUBMITTED TO:

ADDRESS:

SUBMITTED BY:

NAME:

ADDRESS:

PRINCIPAL OFFICE:

Corporation ☐

Partnership ☐

Individual ☐

Joint Venture ☐

Other ☐

1.0 How many years has your organization been in business as a General Contractor?

2.0 How many years has your organization been in business under its present business name?

2.1 Under what other or former names has your organization operated?

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3.0 If a corporation answer the following:

3.1 Date of incorporation:

3.2 State of incorporation:

3.3 President's name:

3.4 Vice-president's name(s):

3.5 Secretary's name:

3.6 Treasurer's name:

4.0 If an individual or a partnership answer the following:

4.1 Date of organization:

4.2 Name and address of all partners (State whether general or limited partnership):

5.0 If other than a corporation or partnership, describe organization and name principals:

6.0 List states and categories in which your organization is legally qualified to do business. Indicate registration or license numbers, if applicable. List states in which partnership or trade name is filed.

7.0 We normally perform the following work with our own forces:

8.0 Have you ever failed to complete any work awarded to you? If so, note when, where, and why:

9.0 Within the last five years, has any officer or partner of your organization ever been an officer or partner of another organization when it failed to complete a construction contract? If so, attach a separate sheet of explanation.

10.0 On a separate sheet, list major construction projects your organization has in process, giving the name of project, owner, architect, contract amount, percent complete, and scheduled completion date.

11.0 On a separate sheet, list the major projects your organization has completed in the past five years, giving the name of project, owner, architect, contract amount, date of completion, and percentage of the cost of the work performed with your own forces.

12.0 On a separate sheet, list the construction experience of the key individuals of your organization.

13.0 Trade References:

14.0 Bank References:

15.0 Name of Bonding Company and name and address of agent:

16.0 Attach a financial statement, audited if available, including Contractor's latest balance sheet and income statement showing the following items:

- A. Current Assets (e.g., cash, joint venture accounts, accounts receivable, notes receivable, accrued income, deposits, materials inventory and prepaid expenses):
- B. Net Fixed Assets:
- C. Other Assets:
- D. Current Liabilities (e.g., accounts payable, notes payable, accrued expenses, provision for income taxes, advances, accrued salaries, and accrued payroll taxes):
- E. Other Liabilities (e.g., capital, capital stock, authorized and outstanding shares par values, earned surplus, and retained earnings):

Name of firm preparing financial statement and date thereof:

Is this financial statement for the identical organization named on page one?

If not, explain the relationship and financial responsibility of the organization whose financial statement is provided (e.g., parent-subsidiary).

Will this organization act as guarantor of the contract for construction?

17.0 Dated at

this

day of

19

Name of Organization:

By:
Title:

18.0

M
that he/she is the

being duly sworn deposes and says
of

Contractor(s), and that answers to the foregoing questions and all statements therein contained are true and correct.

Subscribed and sworn before me this

day of

19

Notary Public:

My Commission Expires:

THE AMERICAN INSTITUTE OF ARCHITECTS

AIA Document A701

Instructions to Bidders

1978 EDITION

Use only with the 1976 Edition of AIA Document A201, General Conditions of the Contract for Construction

TABLE OF ARTICLES

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AND CONTRACTOR
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INSTRUCTIONS TO BIDDERS

ARTICLE 1 **DEFINITIONS**

1.1 Bidding Documents include the Advertisement or Invitation to Bid, Instructions to Bidders, the bid form, other sample bidding and contract forms and the proposed Contract Documents including any Addenda issued prior to receipt of bids. The Contract Documents proposed for the Work consist of the Owner-Contractor Agreement, the Conditions of the Contract (General, Supplementary and other Conditions), the Drawings, the Specifications and all Addenda issued prior to and all Modifications issued after execution of the Contract.

1.2 All definitions set forth in the General Conditions of the Contract for Construction, AIA Document A201, or in other Contract Documents are applicable to the Bidding Documents.

1.3 Addenda are written or graphic instruments issued by the Architect prior to the execution of the Contract which modify or interpret the Bidding Documents by addition, deletions, clarifications or corrections.

1.4 A Bid is a complete and properly signed proposal to do the Work or designated portion thereof for the sums stipulated therein, submitted in accordance with the Bidding Documents.

1.5 The Base Bid is the sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents as the base, to which work may be added or from which work may be deleted for sums stated in Alternate Bids.

1.6 An Alternate Bid (or Alternate) is an amount stated in the Bid to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted.

1.7 A Unit Price is an amount stated in the Bid as a price per unit of measurement for materials or services as described in the Bidding Documents or in the proposed Contract Documents.

1.8 A Bidder is a person or entity who submits a Bid.

1.9 A Sub-bidder is a person or entity who submits a bid to a Bidder for materials or labor for a portion of the Work.

ARTICLE 2 **BIDDER'S REPRESENTATIONS**

2.1 Each Bidder by making his Bid represents that:

2.1.1 He has read and understands the Bidding Documents and his Bid is made in accordance therewith.

2.1.2 He has visited the site, has familiarized himself with the local conditions under which the Work is to be performed and has correlated his observations with the requirements of the proposed Contract Documents.

2.1.3 His Bid is based upon the materials, systems and equipment required by the Bidding Documents without exception.

ARTICLE 3 **BIDDING DOCUMENTS**

3.1 COPIES

3.1.1 Bidders may obtain complete sets of the Bidding Documents from the issuing office designated in the Advertisement or Invitation to Bid in the number and for the deposit sum, if any, stated therein. The deposit will be refunded to Bidders who submit a bona fide Bid and return the Bidding Documents in good condition within ten days after receipt of Bids. The cost of replacement of any missing or damaged documents will be deducted from the deposit. A Bidder receiving a Contract award may retain the Bidding Documents and his deposit will be refunded.

3.1.2 Bidding Documents will not be issued directly to Sub-bidders or others unless specifically offered in the Advertisement or Invitation to Bid.

3.1.3 Bidders shall use complete sets of Bidding Documents in preparing Bids; neither the Owner nor the Architect assume any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

3.1.4 The Owner or the Architect in making copies of the Bidding Documents available on the above terms do so only for the purpose of obtaining Bids on the Work and do not confer a license or grant for any other use.

3.2 INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS

3.2.1 Bidders and Sub-bidders shall promptly notify the Architect of any ambiguity, inconsistency or error which they may discover upon examination of the Bidding Documents or of the site and local conditions.

3.2.2 Bidders and Sub-bidders requiring clarification or interpretation of the Bidding Documents shall make a written request which shall reach the Architect at least seven days prior to the date for receipt of Bids.

3.2.3 Any interpretation, correction or change of the Bidding Documents will be made by Addendum. Interpretations, corrections or changes of the Bidding Documents made in any other manner will not be binding, and Bidders shall not rely upon such interpretations, corrections and changes.

3.3 SUBSTITUTIONS

3.3.1 The materials, products and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution.

3.3.2 No substitution will be considered prior to receipt of Bids unless written request for approval has been re-

ceived by the Architect at least ten days prior to the date for receipt of Bids. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data and any other information necessary for an evaluation. A statement setting forth any changes in other materials, equipment or other Work that incorporation of the substitute would require shall be included. The burden of proof of the merit of the proposed substitute is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

3.3.3 If the Architect approves any proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approvals made in any other manner.

3.3.4 No substitutions will be considered after the Contract award unless specifically provided in the Contract Documents.

3.4 ADDENDA

3.4.1 Addenda will be mailed or delivered to all who are known by the Architect to have received a complete set of Bidding Documents.

3.4.2 Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.

3.4.3 No Addenda will be issued later than four days prior to the date for receipt of Bids except an Addendum withdrawing the request for Bids or one which includes postponement of the date for receipt of Bids.

3.4.4 Each Bidder shall ascertain prior to submitting his bid that he has received all Addenda issued, and he shall acknowledge their receipt in his Bid.

ARTICLE 4

BIDDING PROCEDURE

4.1 FORM AND STYLE OF BIDS

4.1.1 Bids shall be submitted on forms identical to the form included with the Bidding Documents, in the quantity required by Article 9.

4.1.2 All blanks on the bid form shall be filled in by typewriter or manually in ink.

4.1.3 Where so indicated by the makeup of the bid form, sums shall be expressed in both words and figures, and in case of discrepancy between the two, the amount written in words shall govern.

4.1.4 Any interlineation, alteration or erasure must be initialed by the signer of the Bid.

4.1.5 All requested Alternates shall be bid. If no change in the Base Bid is required, enter "No Change."

4.1.6 Where two or more Bids for designated portions of the Work have been requested, the Bidder may, without forfeiture of his bid security, state his refusal to accept award of less than the combination of Bids he so stipulates. The Bidder shall make no additional stipulations on the bid form nor qualify his Bid in any other manner.

4.1.7 Each copy of the Bid shall include the legal name of the Bidder and a statement that the Bidder is a

sole proprietor, a partnership, a corporation, or some other legal entity. Each copy shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further give the state of incorporation and have the corporate seal affixed. A Bid submitted by an agent shall have a current power of attorney attached certifying the agent's authority to bind the Bidder.

4.2 BID SECURITY

4.2.1 If so stipulated in the Advertisement or Invitation to Bid, each Bid shall be accompanied by a bid security in the form and amount required by Article 9 pledging that the Bidder will enter into a contract with the Owner on the terms stated in his Bid and will, if required, furnish bonds as described hereunder in Article 7 covering the faithful performance of the Contract and the payment of all obligations arising thereunder. Should the Bidder refuse to enter into such Contract or fail to furnish such bonds if required, the amount of the bid security shall be forfeited to the Owner as liquidated damages, not as a penalty. The amount of the bid security shall not be forfeited to the Owner in the event the Owner fails to comply with Subparagraph 6.2.1.

4.2.2 If a surety bond is required it shall be written on AIA Document A310, Bid Bond, and the attorney-in-fact who executes the bond on behalf of the surety shall affix to the bond a certified and current copy of his power of attorney.

4.2.3 The Owner will have the right to retain the bid security of Bidders to whom an award is being considered until either (a) the Contract has been executed and bonds, if required, have been furnished, or (b) the specified time has elapsed so that Bids may be withdrawn, or (c) all Bids have been rejected.

4.3 SUBMISSION OF BIDS

4.3.1 All copies of the Bid, the bid security, if any, and any other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall be addressed to the party receiving the Bids and shall be identified with the Project name, the Bidder's name and address and, if applicable, the designated portion of the Work for which the Bid is submitted. If the Bid is sent by mail the sealed envelope shall be enclosed in a separate mailing envelope with the notation "SEALED BID ENCLOSED" on the face thereof.

4.3.2 Bids shall be deposited at the designated location prior to the time and date for receipt of Bids indicated in the Advertisement or Invitation to Bid, or any extension thereof made by Addendum. Bids received after the time and date for receipt of Bids will be returned unopened.

4.3.3 The Bidder shall assume full responsibility for timely delivery at the location designated for receipt of Bids.

4.3.4 Oral, telephonic or telegraphic Bids are invalid and will not receive consideration.

4.4 MODIFICATION OR WITHDRAWAL OF BID

4.4.1 A Bid may not be modified, withdrawn or canceled by the Bidder during the stipulated time period following the time and date designated for the receipt of Bids, and each Bidder so agrees in submitting his Bid.

4.4.2 Prior to the time and date designated for receipt of Bids, any Bid submitted may be modified or withdrawn by notice to the party receiving Bids at the place designated for receipt of Bids. Such notice shall be in writing over the signature of the Bidder or by telegram; if by telegram, written confirmation over the signature of the Bidder shall be mailed and postmarked on or before the date and time set for receipt of Bids, and it shall be so worded as not to reveal the amount of the original Bid.

4.4.3 Withdrawn Bids may be resubmitted up to the time designated for the receipt of Bids provided that they are then fully in conformance with these Instructions to Bidders.

4.4.4 Bid security, if any is required, shall be in an amount sufficient for the Bid as modified or resubmitted.

ARTICLE 5

CONSIDERATION OF BIDS

5.1 OPENING OF BIDS

5.1.1 Unless stated otherwise in the Advertisement or Invitation to Bid, the properly identified Bids received on time will be opened publicly and will be read aloud. An abstract of the Base Bids and Alternate Bids, if any, will be made available to Bidders. When it has been stated that Bids will be opened privately, an abstract of the same information may, at the discretion of the Owner, be made available to the Bidders within a reasonable time.

5.2 REJECTION OF BIDS

5.2.1 The Owner shall have the right to reject any or all Bids and to reject a Bid not accompanied by any required bid security or by other data required by the Bidding Documents, or to reject a Bid which is in any way incomplete or irregular.

5.3 ACCEPTANCE OF BID (AWARD)

5.3.1 It is the intent of the Owner to award a Contract to the lowest responsible Bidder provided the Bid has been submitted in accordance with the requirements of the Bidding Documents and does not exceed the funds available. The Owner shall have the right to waive any informality or irregularity in any Bid or Bids received and to accept the Bid or Bids which, in his judgment, is in his own best interests.

5.3.2 The Owner shall have the right to accept Alternates in any order or combination, unless otherwise specifically provided in Article 9, and to determine the low Bidder on the basis of the sum of the Base Bid and the Alternates accepted.

ARTICLE 6

POST BID INFORMATION

6.1 CONTRACTOR'S QUALIFICATION STATEMENT

6.1.1 Bidders to whom award of a Contract is under consideration shall submit to the Architect, upon request, a properly executed AIA Document A305, Contractor's Qualification Statement, unless such a Statement has been previously required and submitted as a prerequisite to the issuance of Bidding Documents.

6.2 OWNER'S FINANCIAL CAPABILITY

6.2.1 The Owner shall, at the request of the Bidder to whom award of a Contract is under consideration and no later than seven days prior to the expiration of the time for withdrawal of Bids, furnish to the Bidder reasonable evidence that the Owner has made financial arrangements to fulfill the Contract obligations. Unless such reasonable evidence is furnished, the Bidder will not be required to execute the Owner-Contractor Agreement.

6.3 SUBMITTALS

6.3.1 The Bidder shall, within seven days of notification of selection for the award of a Contract for the Work, submit the following information to the Architect:

- 1 a designation of the Work to be performed by the Bidder with his own forces;
- 2 the proprietary names and the suppliers of principal items or systems of materials and equipment proposed for the Work;
- 3 a list of names of the Subcontractors or other persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for the principal portions of the Work.

6.3.2 The Bidder will be required to establish to the satisfaction of the Architect and the Owner the reliability and responsibility of the persons or entities proposed to furnish and perform the Work described in the Bidding Documents.

6.3.3 Prior to the award of the Contract, the Architect will notify the Bidder in writing if either the Owner or the Architect, after due investigation, has reasonable objection to any such proposed person or entity. If the Owner or Architect has reasonable objection to any such proposed person or entity, the Bidder may, at his option, (1) withdraw his Bid, or (2) submit an acceptable substitute person or entity with an adjustment in his bid price to cover the difference in cost occasioned by such substitution. The Owner may, at his discretion, accept the adjusted bid price or he may disqualify the Bidder. In the event of either withdrawal or disqualification under this Subparagraph, bid security will not be forfeited, notwithstanding the provisions of Paragraph 4.4.1.

6.3.4 Persons and entities proposed by the Bidder and to whom the Owner and the Architect have made no reasonable objection under the provisions of Subparagraph 6.3.3 must be used on the Work for which they were proposed and shall not be changed except with the written consent of the Owner and the Architect.

ARTICLE 7

PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND

7.1 BOND REQUIREMENTS

7.1.1 Prior to execution of the Contract, if required in Article 9 hereinafter, the Bidder shall furnish bonds covering the faithful performance of the Contract and the payment of all obligations arising thereunder in such form and amount as the Owner may prescribe. Bonds may be secured through the Bidder's usual sources. If the furnish-

ing of such bonds is stipulated hereinafter in Article 9, the cost shall be included in the Bid.

7.1.2 If the Owner has reserved the right to require that bonds be furnished subsequent to the execution of the Contract, the cost shall be adjusted as provided in the Contract Documents.

7.1.3 If the Owner requires that bonds be obtained from other than the Bidder's usual source, any change in cost will be adjusted as provided in the Contract Documents.

7.2 TIME OF DELIVERY AND FORM OF BONDS

7.2.1 The Bidder shall deliver the required bonds to the Owner not later than the date of execution of the Contract, or if the Work is to be commenced prior thereto in response to a letter of intent, the Bidder shall, prior to commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be furnished.

7.2.2 Unless otherwise required in Article 9, the bonds

shall be written on AIA Document A311, Performance Bond and Labor and Material Payment Bond.

7.2.3 The Bidder shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of his power of attorney.

ARTICLE 8

FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

8.1 FORM TO BE USED

8.1.1 Unless otherwise required in the Bidding Documents, the Agreement for the Work will be written on AIA Document A101, Standard Form of Agreement Between Owner and Contractor, where the basis of payment is a Stipulated Sum.

ARTICLE 9

SUPPLEMENTARY INSTRUCTIONS

THE AMERICAN INSTITUTE OF ARCHITECTS

AIA Document A310

Bid Bond

KNOW ALL MEN BY THESE PRESENTS, that we _____
(Here insert full name and address or legal title of Contractor)

as Principal, hereinafter called the Principal, and _____
(Here insert full name and address or legal title of Surety)

a corporation duly organized under the laws of the State of _____
as Surety, hereinafter called the Surety, are held and firmly bound unto _____
(Here insert full name and address or legal title of Owner)

as Obligee, hereinafter called the Obligee, in the sum of _____

_____ Dollars (\$ _____),
for the payment of which sum well and truly to be made, the said Principal and the said Surety, bind
ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by
these presents.

WHEREAS, the Principal has submitted a bid for _____
(Here insert full name, address and description of project)

NOW, THEREFORE, if the Obligee shall accept the bid of the Principal and the Principal shall enter into a Contract
with the Obligee in accordance with the terms of such bid, and give such bond or bonds as may be specified in the bidding
or Contract Documents with good and sufficient surety for the faithful performance of such Contract and for the prompt
payment of labor and material furnished in the prosecution thereof, or in the event of the failure of the Principal to enter
such Contract and give such bond or bonds, if the Principal shall pay to the Obligee the difference not to exceed the penalty
hereof between the amount specified in said bid and such larger amount for which the Obligee may in good faith contract
with another party to perform the Work covered by said bid, then this obligation shall be null and void, otherwise to remain
in full force and effect.

Signed and sealed this _____ day of _____ 19____

_____	{	_____ (Principal) _____ (Seal)
(Witness)		_____ (Title)
_____	{	_____ (Surety) _____ (Seal)
(Witness)		_____ (Title)

THE AMERICAN INSTITUTE OF ARCHITECTS

AIA Document A311

Performance Bond

KNOW ALL MEN BY THESE PRESENTS: that

(Here insert full name and address or legal title of Contractor)

as Principal, hereinafter called Contractor, and,

(Here insert full name and address or legal title of Surety)

as Surety, hereinafter called Surety, are held and firmly bound unto

(Here insert full name and address or legal title of Owner)

as Oblige, hereinafter called Owner, in the amount of

Dollars (\$ _____),

for the payment whereof Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS,

Contractor has by written agreement dated

19____, entered into a contract with Owner for

(Here insert full name, address and description of project)

in accordance with Drawings and Specifications prepared by

(Here insert full name and address or legal title of Architect)

which contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

PERFORMANCE BOND

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that, if Contractor shall promptly and faithfully perform said Contract, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

The Surety hereby waives notice of any alteration or extension of time made by the Owner.

Whenever Contractor shall be, and declared by Owner to be in default under the Contract, the Owner having performed Owner's obligations thereunder, the Surety may promptly remedy the default, or shall promptly

1) Complete the Contract in accordance with its terms and conditions, or

2) Obtain a bid or bids for completing the Contract in accordance with its terms and conditions, and upon determination by Surety of the lowest responsible bidder, or, if the Owner elects, upon determination by the Owner and the Surety jointly of the lowest responsible bidder, arrange for a contract between such bidder and Owner, and make available as Work progresses (even though there should be a default or a succession of

defaults under the contract or contracts of completion arranged under this paragraph) sufficient funds to pay the cost of completion less the balance of the contract price; but not exceeding, including other costs and damages for which the Surety may be liable hereunder, the amount set forth in the first paragraph hereof. The term "balance of the contract price," as used in this paragraph, shall mean the total amount payable by Owner to Contractor under the Contract and any amendments thereto, less the amount properly paid by Owner to Contractor.

Any suit under this bond must be instituted before the expiration of two (2) years from the date on which final payment under the Contract falls due.

No right of action shall accrue on this bond to or for the use of any person or corporation other than the Owner named herein or the heirs, executors, administrators or successors of the Owner.

Signed and sealed this

day of

19

(Witness)

(Principal) (Seal)

(Title)

(Witness)

(Surety) (Seal)

(Title)

THE AMERICAN INSTITUTE OF ARCHITECTS

AIA Document A311

Labor and Material Payment Bond

THIS BOND IS ISSUED SIMULTANEOUSLY WITH PERFORMANCE BOND IN FAVOR OF THE OWNER CONDITIONED ON THE FULL AND FAITHFUL PERFORMANCE OF THE CONTRACT

KNOW ALL MEN BY THESE PRESENTS: that

(Here insert full name and address or legal title of Contractor)

as Principal, hereinafter called Principal, and,

(Here insert full name and address or legal title of Surety)

as Surety, hereinafter called Surety, are held and firmly bound unto

(Here insert full name and address or legal title of Owner)

as Oblige, hereinafter called Owner, for the use and benefit of claimants as hereinbelow defined, in the amount of

(Here insert a sum equal to at least one-half of the contract price)

Dollars (\$),

for the payment whereof Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS,

Principal has by written agreement dated

19

, entered into a contract with Owner for

(Here insert full name, address and description of project)

in accordance with Drawings and Specifications prepared by

(Here insert full name and address or legal title of Architect)

which contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

LABOR AND MATERIAL PAYMENT BOND

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that, if Principal shall promptly make payment to all claimants as hereinafter defined, for all labor and material used or reasonably required for use in the performance of the Contract, then this obligation shall be void; otherwise it shall remain in full force and effect, subject, however, to the following conditions:

1. A claimant is defined as one having a direct contract with the Principal or with a Subcontractor of the Principal for labor, material, or both, used or reasonably required for use in the performance of the Contract, labor and material being construed to include that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental of equipment directly applicable to the Contract.

2. The above named Principal and Surety hereby jointly and severally agree with the Owner that every claimant as herein defined, who has not been paid in full before the expiration of a period of ninety (90) days after the date on which the last of such claimant's work or labor was done or performed, or materials were furnished by such claimant, may sue on this bond for the use of such claimant, prosecute the suit to final judgment for such sum or sums as may be justly due claimant, and have execution thereon. The Owner shall not be liable for the payment of any costs or expenses of any such suit.

3. No suit or action shall be commenced hereunder by any claimant:

a) Unless claimant, other than one having a direct contract with the Principal, shall have given written notice to any two of the following: the Principal, the Owner, or the Surety above named, within ninety (90) days after such claimant did or performed the last of the work or labor, or furnished the last of the materials for which said claim is made, stating with substantial

accuracy the amount claimed and the name of the party to whom the materials were furnished, or for whom the work or labor was done or performed. Such notice shall be served by mailing the same by registered mail or certified mail, postage prepaid, in an envelope addressed to the Principal, Owner or Surety, at any place where an office is regularly maintained for the transaction of business, or served in any manner in which legal process may be served in the state in which the aforesaid project is located, save that such service need not be made by a public officer.

b) After the expiration of one (1) year following the date on which Principal ceased Work on said Contract, it being understood, however, that if any limitation embodied in this bond is prohibited by any law controlling the construction hereof such limitation shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.

c) Other than in a state court of competent jurisdiction in and for the county or other political subdivision of the state in which the Project, or any part thereof, is situated, or in the United States District Court for the district in which the Project, or any part thereof, is situated, and not elsewhere.

4. The amount of this bond shall be reduced by and to the extent of any payment or payments made in good faith hereunder, inclusive of the payment by Surety of mechanics' liens which may be filed of record against said improvement, whether or not claim for the amount of such lien be presented under and against this bond.

Signed and sealed this

day of

19

_____	{	_____ (Principal)	(Seal)
(Witness)		_____ (Title)	
_____	{	_____ (Surety)	(Seal)
(Witness)		_____ (Title)	

THE AMERICAN INSTITUTE OF ARCHITECTS

AIA Document A201

General Conditions of the Contract for Construction

*THIS DOCUMENT HAS IMPORTANT LEGAL CONSEQUENCES; CONSULTATION
WITH AN ATTORNEY IS ENCOURAGED WITH RESPECT TO ITS MODIFICATION*

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PROPERTY
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SEPARATE CONTRACTORS	13. UNCOVERING AND CORRECTION
OF WORK
7. MISCELLANEOUS PROVISIONS	14. TERMINATION OF THE CONTRACT

This document has been approved and endorsed by The Associated General Contractors of America.

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GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

ARTICLE 1

CONTRACT DOCUMENTS

1.1 DEFINITIONS

1.1.1 THE CONTRACT DOCUMENTS

The Contract Documents consist of the Owner-Contractor Agreement, the Conditions of the Contract (General, Supplementary and other Conditions), the Drawings, the Specifications, and all Addenda issued prior to and all Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a written interpretation issued by the Architect pursuant to Subparagraph 2.2.8, or (4) a written order for a minor change in the Work issued by the Architect pursuant to Paragraph 12.4. The Contract Documents do not include Bidding Documents such as the Advertisement or Invitation to Bid, the Instructions to Bidders, sample forms, the Contractor's Bid or portions of Addenda relating to any of these, or any other documents, unless specifically enumerated in the Owner-Contractor Agreement.

1.1.2 THE CONTRACT

The Contract Documents form the Contract for Construction. This Contract represents the entire and integrated agreement between the parties hereto and supersedes all prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification as defined in Subparagraph 1.1.1. The Contract Documents shall not be construed to create any contractual relationship of any kind between the Architect and the Contractor, but the Architect shall be entitled to performance of obligations intended for his benefit, and to enforcement thereof. Nothing contained in the Contract Documents shall create any contractual relationship between the Owner or the Architect and any Subcontractor or Sub-subcontractor.

1.1.3 THE WORK

The Work comprises the completed construction required by the Contract Documents and includes all labor necessary to produce such construction, and all materials and equipment incorporated or to be incorporated in such construction.

1.1.4 THE PROJECT

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part.

1.2 EXECUTION, CORRELATION AND INTENT

1.2.1 The Contract Documents shall be signed in not less than triplicate by the Owner and Contractor. If either the Owner or the Contractor or both do not sign the Conditions of the Contract, Drawings, Specifications, or any of the other Contract Documents, the Architect shall identify such Documents.

1.2.2 By executing the Contract, the Contractor represents that he has visited the site, familiarized himself with the local conditions under which the Work is to be performed, and correlated his observations with the requirements of the Contract Documents.

1.2.3 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work. The Contract Documents are complementary, and what is required by any one shall be as binding as if required by all. Work not covered in the Contract Documents will not be required unless it is consistent therewith and is reasonably inferable therefrom as being necessary to produce the intended results. Words and abbreviations which have well-known technical or trade meanings are used in the Contract Documents in accordance with such recognized meanings.

1.2.4 The organization of the Specifications into divisions, sections and articles, and the arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

1.3 OWNERSHIP AND USE OF DOCUMENTS

1.3.1 All Drawings, Specifications and copies thereof furnished by the Architect are and shall remain his property. They are to be used only with respect to this Project and are not to be used on any other project. With the exception of one contract set for each party to the Contract, such documents are to be returned or suitably accounted for to the Architect on request at the completion of the Work. Submission or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's common law copyright or other reserved rights.

ARTICLE 2

ARCHITECT

2.1 DEFINITION

2.1.1 The Architect is the person lawfully licensed to practice architecture, or an entity lawfully practicing architecture identified as such in the Owner-Contractor Agreement, and is referred to throughout the Contract Documents as if singular in number and masculine in gender. The term Architect means the Architect or his authorized representative.

2.2 ADMINISTRATION OF THE CONTRACT

2.2.1 The Architect will provide administration of the Contract as hereinafter described.

2.2.2 The Architect will be the Owner's representative during construction and until final payment is due. The Architect will advise and consult with the Owner. The Owner's instructions to the Contractor shall be forwarded

through the Architect. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents, unless otherwise modified by written instrument in accordance with Subparagraph 2.2.18.

2.2.3 The Architect will visit the site at intervals appropriate to the stage of construction to familiarize himself generally with the progress and quality of the Work and to determine in general if the Work is proceeding in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. On the basis of his on-site observations as an architect, he will keep the Owner informed of the progress of the Work, and will endeavor to guard the Owner against defects and deficiencies in the Work of the Contractor.

2.2.4 The Architect will not be responsible for and will not have control or charge of construction means, methods, techniques, sequences or procedures, or for safety precautions and programs in connection with the Work, and he will not be responsible for the Contractor's failure to carry out the Work in accordance with the Contract Documents. The Architect will not be responsible for or have control or charge over the acts or omissions of the Contractor, Subcontractors, or any of their agents or employees, or any other persons performing any of the Work.

2.2.5 The Architect shall at all times have access to the Work wherever it is in preparation and progress. The Contractor shall provide facilities for such access so the Architect may perform his functions under the Contract Documents.

2.2.6 Based on the Architect's observations and an evaluation of the Contractor's Applications for Payment, the Architect will determine the amounts owing to the Contractor and will issue Certificates for Payment in such amounts, as provided in Paragraph 9.4.

2.2.7 The Architect will be the interpreter of the requirements of the Contract Documents and the judge of the performance thereunder by both the Owner and Contractor.

2.2.8 The Architect will render interpretations necessary for the proper execution or progress of the Work, with reasonable promptness and in accordance with any time limit agreed upon. Either party to the Contract may make written request to the Architect for such interpretations.

2.2.9 Claims, disputes and other matters in question between the Contractor and the Owner relating to the execution or progress of the Work or the interpretation of the Contract Documents shall be referred initially to the Architect for decision which he will render in writing within a reasonable time.

2.2.10 All interpretations and decisions of the Architect shall be consistent with the intent of and reasonably inferable from the Contract Documents and will be in writing or in the form of drawings. In his capacity as interpreter and judge, he will endeavor to secure faithful performance by both the Owner and the Contractor, will not

show partiality to either, and will not be liable for the result of any interpretation or decision rendered in good faith in such capacity.

2.2.11 The Architect's decisions in matters relating to artistic effect will be final if consistent with the intent of the Contract Documents.

2.2.12 Any claim, dispute or other matter in question between the Contractor and the Owner referred to the Architect, except those relating to artistic effect as provided in Subparagraph 2.2.11 and except those which have been waived by the making or acceptance of final payment as provided in Subparagraphs 9.9.4 and 9.9.5, shall be subject to arbitration upon the written demand of either party. However, no demand for arbitration of any such claim, dispute or other matter may be made until the earlier of (1) the date on which the Architect has rendered a written decision, or (2) the tenth day after the parties have presented their evidence to the Architect or have been given a reasonable opportunity to do so, if the Architect has not rendered his written decision by that date. When such a written decision of the Architect states (1) that the decision is final but subject to appeal, and (2) that any demand for arbitration of a claim, dispute or other matter covered by such decision must be made within thirty days after the date on which the party making the demand receives the written decision, failure to demand arbitration within said thirty days' period will result in the Architect's decision becoming final and binding upon the Owner and the Contractor. If the Architect renders a decision after arbitration proceedings have been initiated, such decision may be entered as evidence but will not supersede any arbitration proceedings unless the decision is acceptable to all parties concerned.

2.2.13 The Architect will have authority to reject Work which does not conform to the Contract Documents. Whenever, in his opinion, he considers it necessary or advisable for the implementation of the intent of the Contract Documents, he will have authority to require special inspection or testing of the Work in accordance with Subparagraph 7.7.2 whether or not such Work be then fabricated, installed or completed. However, neither the Architect's authority to act under this Subparagraph 2.2.13, nor any decision made by him in good faith either to exercise or not to exercise such authority, shall give rise to any duty or responsibility of the Architect to the Contractor, any Subcontractor, any of their agents or employees, or any other person performing any of the Work.

2.2.14 The Architect will review and approve or take other appropriate action upon Contractor's submittals such as Shop Drawings, Product Data and Samples, but only for conformance with the design concept of the Work and with the information given in the Contract Documents. Such action shall be taken with reasonable promptness so as to cause no delay. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

2.2.15 The Architect will prepare Change Orders in accordance with Article 12, and will have authority to order minor changes in the Work as provided in Subparagraph 12.4.1.

2.2.16 The Architect will conduct inspections to determine the dates of Substantial Completion and final completion, will receive and forward to the Owner for the Owner's review written warranties and related documents required by the Contract and assembled by the Contractor, and will issue a final Certificate for Payment upon compliance with the requirements of Paragraph 9.9.

2.2.17 If the Owner and Architect agree, the Architect will provide one or more Project Representatives to assist the Architect in carrying out his responsibilities at the site. The duties, responsibilities and limitations of authority of any such Project Representative shall be as set forth in an exhibit to be incorporated in the Contract Documents.

2.2.18 The duties, responsibilities and limitations of authority of the Architect as the Owner's representative during construction as set forth in the Contract Documents will not be modified or extended without written consent of the Owner, the Contractor and the Architect.

2.2.19 In case of the termination of the employment of the Architect, the Owner shall appoint an architect against whom the Contractor makes no reasonable objection whose status under the Contract Documents shall be that of the former architect. Any dispute in connection with such appointment shall be subject to arbitration.

ARTICLE 3

OWNER

3.1 DEFINITION

3.1.1 The Owner is the person or entity identified as such in the Owner-Contractor Agreement and is referred to throughout the Contract Documents as if singular in number and masculine in gender. The term Owner means the Owner or his authorized representative.

3.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

3.2.1 The Owner shall, at the request of the Contractor, at the time of execution of the Owner-Contractor Agreement, furnish to the Contractor reasonable evidence that he has made financial arrangements to fulfill his obligations under the Contract. Unless such reasonable evidence is furnished, the Contractor is not required to execute the Owner-Contractor Agreement or to commence the Work.

3.2.2 The Owner shall furnish all surveys describing the physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site.

3.2.3 Except as provided in Subparagraph 4.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for the construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

3.2.4 Information or services under the Owner's control shall be furnished by the Owner with reasonable promptness to avoid delay in the orderly progress of the Work.

3.2.5 Unless otherwise provided in the Contract Documents, the Contractor will be furnished, free of charge, all copies of Drawings and Specifications reasonably necessary for the execution of the Work.

3.2.6 The Owner shall forward all instructions to the Contractor through the Architect.

3.2.7 The foregoing are in addition to other duties and responsibilities of the Owner enumerated herein and especially those in respect to Work by Owner or by Separate Contractors, Payments and Completion, and Insurance in Articles 6, 9 and 11 respectively.

3.3 OWNER'S RIGHT TO STOP THE WORK

3.3.1 If the Contractor fails to correct defective Work as required by Paragraph 13.2 or persistently fails to carry out the Work in accordance with the Contract Documents, the Owner, by a written order signed personally or by an agent specifically so empowered by the Owner in writing, may order the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of the Owner to stop the Work shall not give rise to any duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Subparagraph 6.1.3.

3.4 OWNER'S RIGHT TO CARRY OUT THE WORK

3.4.1 If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within seven days after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, after seven days following receipt by the Contractor of an additional written notice and without prejudice to any other remedy he may have, make good such deficiencies. In such case an appropriate Change Order shall be issued deducting from the payments then or thereafter due the Contractor the cost of correcting such deficiencies, including compensation for the Architect's additional services made necessary by such default, neglect or failure. Such action by the Owner and the amount charged to the Contractor are both subject to the prior approval of the Architect. If the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the Owner.

ARTICLE 4

CONTRACTOR

4.1 DEFINITION

4.1.1 The Contractor is the person or entity identified as such in the Owner-Contractor Agreement and is referred to throughout the Contract Documents as if singular in number and masculine in gender. The term Contractor means the Contractor or his authorized representative.

4.2 REVIEW OF CONTRACT DOCUMENTS

4.2.1 The Contractor shall carefully study and compare the Contract Documents and shall at once report to the Architect any error, inconsistency or omission he may discover. The Contractor shall not be liable to the Owner or

the Architect for any damage resulting from any such errors, inconsistencies or omissions in the Contract Documents. The Contractor shall perform no portion of the Work at any time without Contract Documents or, where required, approved Shop Drawings, Product Data or Samples for such portion of the Work.

4.3 SUPERVISION AND CONSTRUCTION PROCEDURES

4.3.1 The Contractor shall supervise and direct the Work, using his best skill and attention. He shall be solely responsible for all construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract.

4.3.2 The Contractor shall be responsible to the Owner for the acts and omissions of his employees, Subcontractors and their agents and employees, and other persons performing any of the Work under a contract with the Contractor.

4.3.3 The Contractor shall not be relieved from his obligations to perform the Work in accordance with the Contract Documents either by the activities or duties of the Architect in his administration of the Contract, or by inspections, tests or approvals required or performed under Paragraph 7.7 by persons other than the Contractor.

4.4 LABOR AND MATERIALS

4.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for all labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for the proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

4.4.2 The Contractor shall at all times enforce strict discipline and good order among his employees and shall not employ on the Work any unfit person or anyone not skilled in the task assigned to him.

4.5 WARRANTY

4.5.1 The Contractor warrants to the Owner and the Architect that all materials and equipment furnished under this Contract will be new unless otherwise specified, and that all Work will be of good quality, free from faults and defects and in conformance with the Contract Documents. All Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment. This warranty is not limited by the provisions of Paragraph 13.2.

4.6 TAXES

4.6.1 The Contractor shall pay all sales, consumer, use and other similar taxes for the Work or portions thereof provided by the Contractor which are legally enacted at the time bids are received, whether or not yet effective.

4.7 PERMITS, FEES AND NOTICES

4.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit and for all other permits and governmental

fees, licenses and inspections necessary for the proper execution and completion of the Work which are customarily secured after execution of the Contract and which are legally required at the time the bids are received.

4.7.2 The Contractor shall give all notices and comply with all laws, ordinances, rules, regulations and lawful orders of any public authority bearing on the performance of the Work.

4.7.3 It is not the responsibility of the Contractor to make certain that the Contract Documents are in accordance with applicable laws, statutes, building codes and regulations. If the Contractor observes that any of the Contract Documents are at variance therewith in any respect, he shall promptly notify the Architect in writing, and any necessary changes shall be accomplished by appropriate Modification.

4.7.4 If the Contractor performs any Work knowing it to be contrary to such laws, ordinances, rules and regulations, and without such notice to the Architect, he shall assume full responsibility therefor and shall bear all costs attributable thereto.

4.8 ALLOWANCES

4.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by these allowances shall be supplied for such amounts and by such persons as the Owner may direct, but the Contractor will not be required to employ persons against whom he makes a reasonable objection.

4.8.2 Unless otherwise provided in the Contract Documents:

- 1** these allowances shall cover the cost to the Contractor, less any applicable trade discount, of the materials and equipment required by the allowance delivered at the site, and all applicable taxes;
- 2** the Contractor's costs for unloading and handling on the site, labor, installation costs, overhead, profit and other expenses contemplated for the original allowance shall be included in the Contract Sum and not in the allowance;
- 3** whenever the cost is more than or less than the allowance, the Contract Sum shall be adjusted accordingly by Change Order, the amount of which will recognize changes; if any, in handling costs on the site, labor, installation costs, overhead, profit and other expenses.

4.9 SUPERINTENDENT

4.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during the progress of the Work. The superintendent shall represent the Contractor and all communications given to the superintendent shall be as binding as if given to the Contractor. Important communications shall be confirmed in writing. Other communications shall be so confirmed on written request in each case.

4.10 PROGRESS SCHEDULE

4.10.1 The Contractor, immediately after being awarded the Contract, shall prepare and submit for the Owner's and Architect's information an estimated progress sched-

ule for the Work. The progress schedule shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work.

4.11 DOCUMENTS AND SAMPLES AT THE SITE

4.11.1 The Contractor shall maintain at the site for the Owner one record copy of all Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked currently to record all changes made during construction, and approved Shop Drawings, Product Data and Samples. These shall be available to the Architect and shall be delivered to him for the Owner upon completion of the Work.

4.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

4.12.1 Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or any Subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

4.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate a material, product or system for some portion of the Work.

4.12.3 Samples are physical examples which illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

4.12.4 The Contractor shall review, approve and submit, with reasonable promptness and in such sequence as to cause no delay in the Work or in the work of the Owner or any separate contractor, all Shop Drawings, Product Data and Samples required by the Contract Documents.

4.12.5 By approving and submitting Shop Drawings, Product Data and Samples, the Contractor represents that he has determined and verified all materials, field measurements, and field construction criteria related thereto, or will do so, and that he has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

4.12.6 The Contractor shall not be relieved of responsibility for any deviation from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data or Samples under Subparagraph 2.2.14 unless the Contractor has specifically informed the Architect in writing of such deviation at the time of submission and the Architect has given written approval to the specific deviation. The Contractor shall not be relieved from responsibility for errors or omissions in the Shop Drawings, Product Data or Samples by the Architect's approval thereof.

4.12.7 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data or Samples, to revisions other than those requested by the Architect on previous submittals.

4.12.8 No portion of the Work requiring submission of a Shop Drawing, Product Data or Sample shall be commenced until the submittal has been approved by the Architect as provided in Subparagraph 2.2.14. All such

portions of the Work shall be in accordance with approved submittals.

4.13 USE OF SITE

4.13.1 The Contractor shall confine operations at the site to areas permitted by law, ordinances, permits and the Contract Documents and shall not unreasonably encumber the site with any materials or equipment.

4.14 CUTTING AND PATCHING OF WORK

4.14.1 The Contractor shall be responsible for all cutting, fitting or patching that may be required to complete the Work or to make its several parts fit together properly.

4.14.2 The Contractor shall not damage or endanger any portion of the Work or the work of the Owner or any separate contractors by cutting, patching or otherwise altering any work, or by excavation. The Contractor shall not cut or otherwise alter the work of the Owner or any separate contractor except with the written consent of the Owner and of such separate contractor. The Contractor shall not unreasonably withhold from the Owner or any separate contractor his consent to cutting or otherwise altering the Work.

4.15 CLEANING UP

4.15.1 The Contractor at all times shall keep the premises free from accumulation of waste materials or rubbish caused by his operations. At the completion of the Work he shall remove all his waste materials and rubbish from and about the Project as well as all his tools, construction equipment, machinery and surplus materials.

4.15.2 If the Contractor fails to clean up at the completion of the Work, the Owner may do so as provided in Paragraph 3.4 and the cost thereof shall be charged to the Contractor.

4.16 COMMUNICATIONS

4.16.1 The Contractor shall forward all communications to the Owner through the Architect.

4.17 ROYALTIES AND PATENTS

4.17.1 The Contractor shall pay all royalties and license fees. He shall defend all suits or claims for infringement of any patent rights and shall save the Owner harmless from loss on account thereof, except that the Owner shall be responsible for all such loss when a particular design, process or the product of a particular manufacturer or manufacturers is specified, but if the Contractor has reason to believe that the design, process or product specified is an infringement of a patent, he shall be responsible for such loss unless he promptly gives such information to the Architect.

4.18 INDEMNIFICATION

4.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner and the Architect and their agents and employees from and against all claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from the performance of the Work, provided that any such claim, damage, loss or expense (1) is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself) including the loss of use resulting therefrom,

and (2) is caused in whole or in part by any negligent act or omission of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or otherwise reduce any other right or obligation of indemnity which would otherwise exist as to any party or person described in this Paragraph 4.18.

4.18.2 In any and all claims against the Owner or the Architect or any of their agents or employees by any employee of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, the indemnification obligation under this Paragraph 4.18 shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the Contractor or any Subcontractor under workers' or workmen's compensation acts, disability benefit acts or other employee benefit acts.

4.18.3 The obligations of the Contractor under this Paragraph 4.18 shall not extend to the liability of the Architect, his agents or employees, arising out of (1) the preparation or approval of maps, drawings, opinions, reports, surveys, change orders, designs or specifications, or (2) the giving of or the failure to give directions or instructions by the Architect, his agents or employees provided such giving or failure to give is the primary cause of the injury or damage.

ARTICLE 5

SUBCONTRACTORS

5.1 DEFINITION

5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform any of the Work at the site. The term Subcontractor is referred to throughout the Contract Documents as if singular in number and masculine in gender and means a Subcontractor or his authorized representative. The term Subcontractor does not include any separate contractor or his subcontractors.

5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform any of the Work at the site. The term Sub-subcontractor is referred to throughout the Contract Documents as if singular in number and masculine in gender and means a Sub-subcontractor or an authorized representative thereof.

5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

5.2.1 Unless otherwise required by the Contract Documents or the Bidding Documents, the Contractor, as soon as practicable after the award of the Contract, shall furnish to the Owner and the Architect in writing the names of the persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each of the principal portions of the Work. The Architect will promptly reply to the Contractor in writing stating whether or not the Owner or the Architect, after due investigation, has reasonable objection to any

such proposed person or entity. Failure of the Owner or Architect to reply promptly shall constitute notice of no reasonable objection.

5.2.2 The Contractor shall not contract with any such proposed person or entity to whom the Owner or the Architect has made reasonable objection under the provisions of Subparagraph 5.2.1. The Contractor shall not be required to contract with anyone to whom he has a reasonable objection.

5.2.3 If the Owner or the Architect has reasonable objection to any such proposed person or entity, the Contractor shall submit a substitute to whom the Owner or the Architect has no reasonable objection, and the Contract Sum shall be increased or decreased by the difference in cost occasioned by such substitution and an appropriate Change Order shall be issued; however, no increase in the Contract Sum shall be allowed for any such substitution unless the Contractor has acted promptly and responsively in submitting names as required by Subparagraph 5.2.1.

5.2.4 The Contractor shall make no substitution for any Subcontractor, person or entity previously selected if the Owner or Architect makes reasonable objection to such substitution.

5.3 SUBCONTRACTUAL RELATIONS

5.3.1 By an appropriate agreement, written where legally required for validity, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by the terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities which the Contractor, by these Documents, assumes toward the Owner and the Architect. Said agreement shall preserve and protect the rights of the Owner and the Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that the subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the Contractor-Subcontractor agreement, the benefit of all rights, remedies and redress against the Contractor that the Contractor, by these Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with his Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the Subcontract, copies of the Contract Documents to which the Subcontractor will be bound by this Paragraph 5.3, and identify to the Subcontractor any terms and conditions of the proposed Subcontract which may be at variance with the Contract Documents. Each Subcontractor shall similarly make copies of such Documents available to his Sub-subcontractors.

ARTICLE 6

WORK BY OWNER OR BY SEPARATE CONTRACTORS

6.1 OWNER'S RIGHT TO PERFORM WORK AND TO AWARD SEPARATE CONTRACTS

6.1.1 The Owner reserves the right to perform work related to the Project with his own forces, and to award

separate contracts in connection with other portions of the Project or other work on the site under these or similar Conditions of the Contract. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, he shall make such claim as provided elsewhere in the Contract Documents.

6.1.2 When separate contracts are awarded for different portions of the Project or other work on the site, the term Contractor in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

6.1.3 The Owner will provide for the coordination of the work of his own forces and of each separate contractor with the Work of the Contractor, who shall cooperate therewith as provided in Paragraph 6.2.

6.2 MUTUAL RESPONSIBILITY

6.2.1 The Contractor shall afford the Owner and separate contractors reasonable opportunity for the introduction and storage of their materials and equipment and the execution of their work, and shall connect and coordinate his Work with theirs as required by the Contract Documents.

6.2.2 If any part of the Contractor's Work depends for proper execution or results upon the work of the Owner or any separate contractor, the Contractor shall, prior to proceeding with the Work, promptly report to the Architect any apparent discrepancies or defects in such other work that render it unsuitable for such proper execution and results. Failure of the Contractor so to report shall constitute an acceptance of the Owner's or separate contractors' work as fit and proper to receive his Work, except as to defects which may subsequently become apparent in such work by others.

6.2.3 Any costs caused by defective or ill-timed work shall be borne by the party responsible therefor.

6.2.4 Should the Contractor wrongfully cause damage to the work or property of the Owner, or to other work on the site, the Contractor shall promptly remedy such damage as provided in Subparagraph 10.2.5.

6.2.5 Should the Contractor wrongfully cause damage to the work or property of any separate contractor, the Contractor shall upon due notice promptly attempt to settle with such other contractor by agreement, or otherwise to resolve the dispute. If such separate contractor sues or initiates an arbitration proceeding against the Owner on account of any damage alleged to have been caused by the Contractor, the Owner shall notify the Contractor who shall defend such proceedings at the Owner's expense, and if any judgment or award against the Owner arises therefrom the Contractor shall pay or satisfy it and shall reimburse the Owner for all attorneys' fees and court or arbitration costs which the Owner has incurred.

6.3 OWNER'S RIGHT TO CLEAN UP

6.3.1 If a dispute arises between the Contractor and separate contractors as to their responsibility for cleaning up as required by Paragraph 4.15, the Owner may clean up

and charge the cost thereof to the contractors responsible therefor as the Architect shall determine to be just.

ARTICLE 7

MISCELLANEOUS PROVISIONS

7.1 GOVERNING LAW

7.1.1 The Contract shall be governed by the law of the place where the Project is located.

7.2 SUCCESSORS AND ASSIGNS

7.2.1 The Owner and the Contractor each binds himself, his partners, successors, assigns and legal representatives to the other party hereto and to the partners, successors, assigns and legal representatives of such other party in respect to all covenants, agreements and obligations contained in the Contract Documents. Neither party to the Contract shall assign the Contract or sublet it as a whole without the written consent of the other, nor shall the Contractor assign any moneys due or to become due to him hereunder, without the previous written consent of the Owner.

7.3 WRITTEN NOTICE

7.3.1 Written notice shall be deemed to have been duly served if delivered in person to the individual or member of the firm or entity or to an officer of the corporation for whom it was intended, or if delivered at or sent by registered or certified mail to the last business address known to him who gives the notice.

7.4 CLAIMS FOR DAMAGES

7.4.1 Should either party to the Contract suffer injury or damage to person or property because of any act or omission of the other party or of any of his employees, agents or others for whose acts he is legally liable, claim shall be made in writing to such other party within a reasonable time after the first observance of such injury or damage.

7.5 PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND

7.5.1 The Owner shall have the right to require the Contractor to furnish bonds covering the faithful performance of the Contract and the payment of all obligations arising thereunder if and as required in the Bidding Documents or in the Contract Documents.

7.6 RIGHTS AND REMEDIES

7.6.1 The duties and obligations imposed by the Contract Documents and the rights and remedies available thereunder shall be in addition to and not a limitation of any duties, obligations, rights and remedies otherwise imposed or available by law.

7.6.2 No action or failure to act by the Owner, Architect or Contractor shall constitute a waiver of any right or duty afforded any of them under the Contract, nor shall any such action or failure to act constitute an approval of or acquiescence in any breach thereunder, except as may be specifically agreed in writing.

7.7 TESTS

7.7.1 If the Contract Documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any portion of the Work to be inspected, tested or approved, the Contractor shall give the Architect timely notice of its readiness so the Architect may observe such inspection, testing or approval. The Contractor shall bear all costs of such inspections, tests or approvals conducted by public authorities. Unless otherwise provided, the Owner shall bear all costs of other inspections, tests or approvals.

7.7.2 If the Architect determines that any Work requires special inspection, testing, or approval which Subparagraph 7.7.1 does not include, he will, upon written authorization from the Owner, instruct the Contractor to order such special inspection, testing or approval, and the Contractor shall give notice as provided in Subparagraph 7.7.1. If such special inspection or testing reveals a failure of the Work to comply with the requirements of the Contract Documents, the Contractor shall bear all costs thereof, including compensation for the Architect's additional services made necessary by such failure; otherwise the Owner shall bear such costs, and an appropriate Change Order shall be issued.

7.7.3 Required certificates of inspection, testing or approval shall be secured by the Contractor and promptly delivered by him to the Architect.

7.7.4 If the Architect is to observe the inspections, tests or approvals required by the Contract Documents, he will do so promptly and, where practicable, at the source of supply.

7.8 INTEREST

7.8.1 Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at such rate as the parties may agree upon in writing or, in the absence thereof, at the legal rate prevailing at the place of the Project.

7.9 ARBITRATION

7.9.1 All claims, disputes and other matters in question between the Contractor and the Owner arising out of, or relating to, the Contract Documents or the breach thereof, except as provided in Subparagraph 2.2.11 with respect to the Architect's decisions on matters relating to artistic effect, and except for claims which have been waived by the making or acceptance of final payment as provided by Subparagraphs 9.9.4 and 9.9.5, shall be decided by arbitration in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association then obtaining unless the parties mutually agree otherwise. No arbitration arising out of or relating to the Contract Documents shall include, by consolidation, joinder or in any other manner, the Architect, his employees or consultants except by written consent containing a specific reference to the Owner-Contractor Agreement and signed by the Architect, the Owner, the Contractor and any other person sought to be joined. No arbitration shall include by consolidation, joinder or in any other manner, parties other than the Owner, the Contractor and any other persons substantially involved in a common question of fact or law, whose presence is

required if complete relief is to be accorded in the arbitration. No person other than the Owner or Contractor shall be included as an original third party or additional third party to an arbitration whose interest or responsibility is insubstantial. Any consent to arbitration involving an additional person or persons shall not constitute consent to arbitration of any dispute not described therein or with any person not named or described therein. The foregoing agreement to arbitrate and any other agreement to arbitrate with an additional person or persons duly consented to by the parties to the Owner-Contractor Agreement shall be specifically enforceable under the prevailing arbitration law. The award rendered by the arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

7.9.2 Notice of the demand for arbitration shall be filed in writing with the other party to the Owner-Contractor Agreement and with the American Arbitration Association, and a copy shall be filed with the Architect. The demand for arbitration shall be made within the time limits specified in Subparagraph 2.2.12 where applicable, and in all other cases within a reasonable time after the claim, dispute or other matter in question has arisen, and in no event shall it be made after the date when institution of legal or equitable proceedings based on such claim, dispute or other matter in question would be barred by the applicable statute of limitations.

7.9.3 Unless otherwise agreed in writing, the Contractor shall carry on the Work and maintain its progress during any arbitration proceedings, and the Owner shall continue to make payments to the Contractor in accordance with the Contract Documents.

ARTICLE 8

TIME

8.1 DEFINITIONS

8.1.1 Unless otherwise provided, the Contract Time is the period of time allotted in the Contract Documents for Substantial Completion of the Work as defined in Subparagraph 8.1.3, including authorized adjustments thereto.

8.1.2 The date of commencement of the Work is the date established in a notice to proceed. If there is no notice to proceed, it shall be the date of the Owner-Contractor Agreement or such other date as may be established therein.

8.1.3 The Date of Substantial Completion of the Work or designated portion thereof is the Date certified by the Architect when construction is sufficiently complete, in accordance with the Contract Documents, so the Owner can occupy or utilize the Work or designated portion thereof for the use for which it is intended.

8.1.4 The term day as used in the Contract Documents shall mean calendar day unless otherwise specifically designated.

8.2 PROGRESS AND COMPLETION

8.2.1 All time limits stated in the Contract Documents are of the essence of the Contract.

8.2.2 The Contractor shall begin the Work on the date of commencement as defined in Subparagraph 8.1.2. He shall carry the Work forward expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

8.3 DELAYS AND EXTENSIONS OF TIME

8.3.1 If the Contractor is delayed at any time in the progress of the Work by any act or neglect of the Owner or the Architect, or by any employee of either, or by any separate contractor employed by the Owner, or by changes ordered in the Work, or by labor disputes, fire, unusual delay in transportation, adverse weather conditions not reasonably anticipatable, unavoidable casualties, or any causes beyond the Contractor's control, or by delay authorized by the Owner pending arbitration, or by any other cause which the Architect determines may justify the delay, then the Contract Time shall be extended by Change Order for such reasonable time as the Architect may determine.

8.3.2 Any claim for extension of time shall be made in writing to the Architect not more than twenty days after the commencement of the delay; otherwise it shall be waived. In the case of a continuing delay only one claim is necessary. The Contractor shall provide an estimate of the probable effect of such delay on the progress of the Work.

8.3.3 If no agreement is made stating the dates upon which interpretations as provided in Subparagraph 2.2.8 shall be furnished, then no claim for delay shall be allowed on account of failure to furnish such interpretations until fifteen days after written request is made for them, and not then unless such claim is reasonable.

8.3.4 This Paragraph 8.3 does not exclude the recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9

PAYMENTS AND COMPLETION

9.1 CONTRACT SUM

9.1.1 The Contract Sum is stated in the Owner-Contractor Agreement and, including authorized adjustments thereto, is the total amount payable by the Owner to the Contractor for the performance of the Work under the Contract Documents.

9.2 SCHEDULE OF VALUES

9.2.1 Before the first Application for Payment, the Contractor shall submit to the Architect a schedule of values allocated to the various portions of the Work, prepared in such form and supported by such data to substantiate its accuracy as the Architect may require. This schedule, unless objected to by the Architect, shall be used only as a basis for the Contractor's Applications for Payment.

9.3 APPLICATIONS FOR PAYMENT

9.3.1 At least ten days before the date for each progress payment established in the Owner-Contractor Agreement, the Contractor shall submit to the Architect an itemized Application for Payment, notarized if required, supported

by such data substantiating the Contractor's right to payment as the Owner or the Architect may require, and reflecting retainage, if any, as provided elsewhere in the Contract Documents.

9.3.2 Unless otherwise provided in the Contract Documents, payments will be made on account of materials or equipment not incorporated in the Work but delivered and suitably stored at the site and, if approved in advance by the Owner, payments may similarly be made for materials or equipment suitably stored at some other location agreed upon in writing. Payments for materials or equipment stored on or off the site shall be conditioned upon submission by the Contractor of bills of sale or such other procedures satisfactory to the Owner to establish the Owner's title to such materials or equipment or otherwise protect the Owner's interest, including applicable insurance and transportation to the site for those materials and equipment stored off the site.

9.3.3 The Contractor warrants that title to all Work, materials and equipment covered by an Application for Payment will pass to the Owner either by incorporation in the construction or upon the receipt of payment by the Contractor, whichever occurs first, free and clear of all liens, claims, security interests or encumbrances, hereinafter referred to in this Article 9 as "liens"; and that no Work, materials or equipment covered by an Application for Payment will have been acquired by the Contractor, or by any other person performing Work at the site or furnishing materials and equipment for the Project, subject to an agreement under which an interest therein or an encumbrance thereon is retained by the seller or otherwise imposed by the Contractor or such other person.

9.4 CERTIFICATES FOR PAYMENT

9.4.1 The Architect will, within seven days after the receipt of the Contractor's Application for Payment, either issue a Certificate for Payment to the Owner, with a copy to the Contractor, for such amount as the Architect determines is properly due, or notify the Contractor in writing his reasons for withholding a Certificate as provided in Subparagraph 9.6.1.

9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on his observations at the site as provided in Subparagraph 2.2.3 and the data comprising the Application for Payment, that the Work has progressed to the point indicated; that, to the best of his knowledge, information and belief, the quality of the Work is in accordance with the Contract Documents (subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to the results of any subsequent tests required by or performed under the Contract Documents, to minor deviations from the Contract Documents correctable prior to completion, and to any specific qualifications stated in his Certificate); and that the Contractor is entitled to payment in the amount certified. However, by issuing a Certificate for Payment, the Architect shall not thereby be deemed to represent that he has made exhaustive or continuous on-site inspections to check the quality or quantity of the Work or that he has reviewed the construction means, methods, techniques,

sequences or procedures, or that he has made any examination to ascertain how or for what purpose the Contractor has used the moneys previously paid on account of the Contract Sum.

9.5 PROGRESS PAYMENTS

9.5.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents.

9.5.2 The Contractor shall promptly pay each Subcontractor, upon receipt of payment from the Owner, out of the amount paid to the Contractor on account of such Subcontractor's Work, the amount to which said Subcontractor is entitled, reflecting the percentage actually retained, if any, from payments to the Contractor on account of such Subcontractor's Work. The Contractor shall, by an appropriate agreement with each Subcontractor, require each Subcontractor to make payments to his Subsubcontractors in similar manner.

9.5.3 The Architect may, on request and at his discretion, furnish to any Subcontractor, if practicable, information regarding the percentages of completion or the amounts applied for by the Contractor and the action taken thereon by the Architect on account of Work done by such Subcontractor.

9.5.4 Neither the Owner nor the Architect shall have any obligation to pay or to see to the payment of any moneys to any Subcontractor except as may otherwise be required by law.

9.5.5 No Certificate for a progress payment, nor any progress payment, nor any partial or entire use or occupancy of the Project by the Owner, shall constitute an acceptance of any Work not in accordance with the Contract Documents.

9.6 PAYMENTS WITHHELD

9.6.1 The Architect may decline to certify payment and may withhold his Certificate in whole or in part, to the extent necessary reasonably to protect the Owner, if in his opinion he is unable to make representations to the Owner as provided in Subparagraph 9.4.2. If the Architect is unable to make representations to the Owner as provided in Subparagraph 9.4.2 and to certify payment in the amount of the Application, he will notify the Contractor as provided in Subparagraph 9.4.1. If the Contractor and the Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which he is able to make such representations to the Owner. The Architect may also decline to certify payment or, because of subsequently discovered evidence or subsequent observations, he may nullify the whole or any part of any Certificate for Payment previously issued, to such extent as may be necessary in his opinion to protect the Owner from loss because of:

- .1 defective Work not remedied,
- .2 third party claims filed or reasonable evidence indicating probable filing of such claims,
- .3 failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment,

- .4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum,
- .5 damage to the Owner or another contractor,
- .6 reasonable evidence that the Work will not be completed within the Contract Time, or
- .7 persistent failure to carry out the Work in accordance with the Contract Documents.

9.6.2 When the above grounds in Subparagraph 9.6.1 are removed, payment shall be made for amounts withheld because of them.

9.7 FAILURE OF PAYMENT

9.7.1 If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents any amount certified by the Architect or awarded by arbitration, then the Contractor may, upon seven additional days' written notice to the Owner and the Architect, stop the Work until payment of the amount owing has been received. The Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shut-down, delay and start-up, which shall be effected by appropriate Change Order in accordance with Paragraph 12.3.

9.8 SUBSTANTIAL COMPLETION

9.8.1 When the Contractor considers that the Work, or a designated portion thereof which is acceptable to the Owner, is substantially complete as defined in Subparagraph 8.1.3, the Contractor shall prepare for submission to the Architect a list of items to be completed or corrected. The failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents. When the Architect on the basis of an inspection determines that the Work or designated portion thereof is substantially complete, he will then prepare a Certificate of Substantial Completion which shall establish the Date of Substantial Completion, shall state the responsibilities of the Owner and the Contractor for security, maintenance, heat, utilities, damage to the Work, and insurance, and shall fix the time within which the Contractor shall complete the items listed therein. Warranties required by the Contract Documents shall commence on the Date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion. The Certificate of Substantial Completion shall be submitted to the Owner and the Contractor for their written acceptance of the responsibilities assigned to them in such Certificate.

9.8.2 Upon Substantial Completion of the Work or designated portion thereof and upon application by the Contractor and certification by the Architect, the Owner shall make payment, reflecting adjustment in retainage, if any, for such Work or portion thereof, as provided in the Contract Documents.

9.9 FINAL COMPLETION AND FINAL PAYMENT

9.9.1 Upon receipt of written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will

promptly make such inspection and, when he finds the Work acceptable under the Contract Documents and the Contract fully performed, he will promptly issue a final Certificate for Payment stating that to the best of his knowledge, information and belief, and on the basis of his observations and inspections, the Work has been completed in accordance with the terms and conditions of the Contract Documents and that the entire balance found to be due the Contractor, and noted in said final Certificate, is due and payable. The Architect's final Certificate for Payment will constitute a further representation that the conditions precedent to the Contractor's being entitled to final payment as set forth in Subparagraph 9.9.2 have been fulfilled.

9.9.2 Neither the final payment nor the remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that all payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or his property might in any way be responsible, have been paid or otherwise satisfied, (2) consent of surety, if any, to final payment and (3), if required by the Owner, other data establishing payment or satisfaction of all such obligations, such as receipts, releases and waivers of liens arising out of the Contract, to the extent and in such form as may be designated by the Owner. If any Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify him against any such lien. If any such lien remains unsatisfied after all payments are made, the Contractor shall refund to the Owner all moneys that the latter may be compelled to pay in discharging such lien, including all costs and reasonable attorneys' fees.

9.9.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by the issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance for Work not fully completed or corrected is less than the retainage stipulated in the Contract Documents, and if bonds have been furnished as provided in Paragraph 7.5, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

9.9.4 The making of final payment shall constitute a waiver of all claims by the Owner except those arising from:

- .1 unsettled liens,
- .2 faulty or defective Work appearing after Substantial Completion,
- .3 failure of the Work to comply with the requirements of the Contract Documents, or
- .4 terms of any special warranties required by the Contract Documents.

9.9.5 The acceptance of final payment shall constitute a waiver of all claims by the Contractor except those previously made in writing and identified by the Contractor as unsettled at the time of the final Application for Payment.

ARTICLE 10

PROTECTION OF PERSONS AND PROPERTY

10.1 SAFETY PRECAUTIONS AND PROGRAMS

10.1.1 The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work.

10.2 SAFETY OF PERSONS AND PROPERTY

10.2.1 The Contractor shall take all reasonable precautions for the safety of, and shall provide all reasonable protection to prevent damage, injury or loss to:

- .1 all employees on the Work and all other persons who may be affected thereby;
- .2 all the Work and all materials and equipment to be incorporated therein, whether in storage on or off the site, under the care, custody or control of the Contractor or any of his Subcontractors or Sub-subcontractors; and
- .3 other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

10.2.2 The Contractor shall give all notices and comply with all applicable laws, ordinances, rules, regulations and lawful orders of any public authority bearing on the safety of persons or property or their protection from damage, injury or loss.

10.2.3 The Contractor shall erect and maintain, as required by existing conditions and progress of the Work, all reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent utilities.

10.2.4 When the use or storage of explosives or other hazardous materials or equipment is necessary for the execution of the Work, the Contractor shall exercise the utmost care and shall carry on such activities under the supervision of properly qualified personnel.

10.2.5 The Contractor shall promptly remedy all damage or loss (other than damage or loss insured under Paragraph 11.3) to any property referred to in Clauses 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, any Subcontractor, any Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable and for which the Contractor is responsible under Clauses 10.2.1.2 and 10.2.1.3, except damage or loss attributable to the acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to his obligations under Paragraph 4.18.

10.2.6 The Contractor shall designate a responsible member of his organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and the Architect.

10.2.7 The Contractor shall not load or permit any part of the Work to be loaded so as to endanger its safety.

10.3 EMERGENCIES

10.3.1 In any emergency affecting the safety of persons or property, the Contractor shall act, at his discretion, to prevent threatened damage, injury or loss. Any additional compensation or extension of time claimed by the Contractor on account of emergency work shall be determined as provided in Article 12 for Changes in the Work.

ARTICLE 11

INSURANCE

11.1 CONTRACTOR'S LIABILITY INSURANCE

11.1.1 The Contractor shall purchase and maintain such insurance as will protect him from claims set forth below which may arise out of or result from the Contractor's operations under the Contract, whether such operations be by himself or by any Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

1. claims under workers' or workmen's compensation, disability benefit and other similar employee benefit acts;
2. claims for damages because of bodily injury, occupational sickness or disease, or death of his employees;
3. claims for damages because of bodily injury, sickness or disease, or death of any person other than his employees;
4. claims for damages insured by usual personal injury liability coverage which are sustained (1) by any person as a result of an offense directly or indirectly related to the employment of such person by the Contractor, or (2) by any other person;
5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting therefrom; and
6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

11.1.2 The insurance required by Subparagraph 11.1.1 shall be written for not less than any limits of liability specified in the Contract Documents, or required by law, whichever is greater.

11.1.3 The insurance required by Subparagraph 11.1.1 shall include contractual liability insurance applicable to the Contractor's obligations under Paragraph 4.18.

11.1.4 Certificates of Insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work. These Certificates shall contain a provision that

coverages afforded under the policies will not be cancelled until at least thirty days' prior written notice has been given to the Owner.

11.2 OWNER'S LIABILITY INSURANCE

11.2.1 The Owner shall be responsible for purchasing and maintaining his own liability insurance and, at his option, may purchase and maintain such insurance as will protect him against claims which may arise from operations under the Contract.

11.3 PROPERTY INSURANCE

11.3.1 Unless otherwise provided, the Owner shall purchase and maintain property insurance upon the entire Work at the site to the full insurable value thereof. This insurance shall include the interests of the Owner, the Contractor, Subcontractors and Sub-subcontractors in the Work and shall insure against the perils of fire and extended coverage and shall include "all risk" insurance for physical loss or damage including, without duplication of coverage, theft, vandalism and malicious mischief. If the Owner does not intend to purchase such insurance for the full insurable value of the entire Work, he shall inform the Contractor in writing prior to commencement of the Work. The Contractor may then effect insurance which will protect the interests of himself, his Subcontractors and the Sub-subcontractors in the Work, and by appropriate Change Order the cost thereof shall be charged to the Owner. If the Contractor is damaged by failure of the Owner to purchase or maintain such insurance and to so notify the Contractor, then the Owner shall bear all reasonable costs properly attributable thereto. If not covered under the all risk insurance or otherwise provided in the Contract Documents, the Contractor shall effect and maintain similar property insurance on portions of the Work stored off the site or in transit when such portions of the Work are to be included in an Application for Payment under Subparagraph 9.3.2.

11.3.2 The Owner shall purchase and maintain such boiler and machinery insurance as may be required by the Contract Documents or by law. This insurance shall include the interests of the Owner, the Contractor, Subcontractors and Sub-subcontractors in the Work.

11.3.3 Any loss insured under Subparagraph 11.3.1 is to be adjusted with the Owner and made payable to the Owner as trustee for the insureds, as their interests may appear, subject to the requirements of any applicable mortgagee clause and of Subparagraph 11.3.8. The Contractor shall pay each Subcontractor a just share of any insurance moneys received by the Contractor, and by appropriate agreement, written where legally required for validity, shall require each Subcontractor to make payments to his Sub-subcontractors in similar manner.

11.3.4 The Owner shall file a copy of all policies with the Contractor before an exposure to loss may occur.

11.3.5 If the Contractor requests in writing that insurance for risks other than those described in Subparagraphs 11.3.1 and 11.3.2 or other special hazards be included in the property insurance policy, the Owner shall, if possible, include such insurance, and the cost thereof shall be charged to the Contractor by appropriate Change Order.

11.3.6 The Owner and Contractor waive all rights against (1) each other and the Subcontractors, Sub-subcontractors, agents and employees each of the other, and (2) the Architect and separate contractors, if any, and their subcontractors, sub-subcontractors, agents and employees, for damages caused by fire or other perils to the extent covered by insurance obtained pursuant to this Paragraph 11.3 or any other property insurance applicable to the Work, except such rights as they may have to the proceeds of such insurance held by the Owner as trustee. The foregoing waiver afforded the Architect, his agents and employees shall not extend to the liability imposed by Subparagraph 4.18.3. The Owner or the Contractor, as appropriate, shall require of the Architect, separate contractors, Subcontractors and Sub-subcontractors by appropriate agreements, written where legally required for validity, similar waivers each in favor of all other parties enumerated in this Subparagraph 11.3.6.

11.3.7 If required in writing by any party in interest, the Owner as trustee shall, upon the occurrence of an insured loss, give bond for the proper performance of his duties. He shall deposit in a separate account any money so received, and he shall distribute it in accordance with such agreement as the parties in interest may reach, or in accordance with an award by arbitration in which case the procedure shall be as provided in Paragraph 7.9. If after such loss no other special agreement is made, replacement of damaged work shall be covered by an appropriate Change Order.

11.3.8 The Owner as trustee shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within five days after the occurrence of loss to the Owner's exercise of this power, and if such objection be made, arbitrators shall be chosen as provided in Paragraph 7.9. The Owner as trustee shall, in that case, make settlement with the insurers in accordance with the directions of such arbitrators. If distribution of the insurance proceeds by arbitration is required, the arbitrators will direct such distribution.

11.3.9 If the Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion thereof, such occupancy or use shall not commence prior to a time mutually agreed to by the Owner and Contractor and to which the insurance company or companies providing the property insurance have consented by endorsement to the policy or policies. This insurance shall not be cancelled or lapsed on account of such partial occupancy or use. Consent of the Contractor and of the insurance company or companies to such occupancy or use shall not be unreasonably withheld.

11.4 LOSS OF USE INSURANCE

11.4.1 The Owner, at his option, may purchase and maintain such insurance as will insure him against loss of use of his property due to fire or other hazards, however caused. The Owner waives all rights of action against the Contractor for loss of use of his property, including consequential losses due to fire or other hazards however caused, to the extent covered by insurance under this Paragraph 11.4.

ARTICLE 12

CHANGES IN THE WORK

12.1 CHANGE ORDERS

12.1.1 A Change Order is a written order to the Contractor signed by the Owner and the Architect, issued after execution of the Contract, authorizing a change in the Work or an adjustment in the Contract Sum or the Contract Time. The Contract Sum and the Contract Time may be changed only by Change Order. A Change Order signed by the Contractor indicates his agreement therewith, including the adjustment in the Contract Sum or the Contract Time.

12.1.2 The Owner, without invalidating the Contract, may order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Sum and the Contract Time being adjusted accordingly. All such changes in the Work shall be authorized by Change Order, and shall be performed under the applicable conditions of the Contract Documents.

12.1.3 The cost or credit to the Owner resulting from a change in the Work shall be determined in one or more of the following ways:

- .1 by mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- .2 by unit prices stated in the Contract Documents or subsequently agreed upon;
- .3 by cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- .4 by the method provided in Subparagraph 12.1.4.

12.1.4 If none of the methods set forth in Clauses 12.1.3.1, 12.1.3.2 or 12.1.3.3 is agreed upon, the Contractor, provided he receives a written order signed by the Owner, shall promptly proceed with the Work involved. The cost of such Work shall then be determined by the Architect on the basis of the reasonable expenditures and savings of those performing the Work attributable to the change, including, in the case of an increase in the Contract Sum, a reasonable allowance for overhead and profit. In such case, and also under Clauses 12.1.3.3 and 12.1.3.4 above, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data for inclusion in a Change Order. Unless otherwise provided in the Contract Documents, cost shall be limited to the following: cost of materials, including sales tax and cost of delivery; cost of labor, including social security, old age and unemployment insurance, and fringe benefits required by agreement or custom; workers' or workmen's compensation insurance; bond premiums; rental value of equipment and machinery; and the additional costs of supervision and field office personnel directly attributable to the change. Pending final determination of cost to the Owner, payments on account shall be made on the Architect's Certificate for Payment. The amount of credit to be allowed by the Contractor to the Owner for any deletion

or change which results in a net decrease in the Contract Sum will be the amount of the actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in any one change, the allowance for overhead and profit shall be figured on the basis of the net increase, if any, with respect to that change.

12.1.5 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if the quantities originally contemplated are so changed in a proposed Change Order that application of the agreed unit prices to the quantities of Work proposed will cause substantial inequity to the Owner or the Contractor, the applicable unit prices shall be equitably adjusted.

12.2 CONCEALED CONDITIONS

12.2.1 Should concealed conditions encountered in the performance of the Work below the surface of the ground or should concealed or unknown conditions in an existing structure be at variance with the conditions indicated by the Contract Documents, or should unknown physical conditions below the surface of the ground or should concealed or unknown conditions in an existing structure of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in this Contract, be encountered, the Contract Sum shall be equitably adjusted by Change Order upon claim by either party made within twenty days after the first observance of the conditions.

12.3 CLAIMS FOR ADDITIONAL COST

12.3.1 If the Contractor wishes to make a claim for an increase in the Contract Sum, he shall give the Architect written notice thereof within twenty days after the occurrence of the event giving rise to such claim. This notice shall be given by the Contractor before proceeding to execute the Work, except in an emergency endangering life or property in which case the Contractor shall proceed in accordance with Paragraph 10.3. No such claim shall be valid unless so made. If the Owner and the Contractor cannot agree on the amount of the adjustment in the Contract Sum, it shall be determined by the Architect. Any change in the Contract Sum resulting from such claim shall be authorized by Change Order.

12.3.2 If the Contractor claims that additional cost is involved because of, but not limited to, (1) any written interpretation pursuant to Subparagraph 2.2.8, (2) any order by the Owner to stop the Work pursuant to Paragraph 3.3 where the Contractor was not at fault, (3) any written order for a minor change in the Work issued pursuant to Paragraph 12.4, or (4) failure of payment by the Owner pursuant to Paragraph 9.7, the Contractor shall make such claim as provided in Subparagraph 12.3.1.

12.4 MINOR CHANGES IN THE WORK

12.4.1 The Architect will have authority to order minor changes in the Work not involving an adjustment in the Contract Sum or an extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes shall be effected by written order, and shall be binding on the Owner and the Contractor.

The Contractor shall carry out such written orders promptly.

ARTICLE 13

UNCOVERING AND CORRECTION OF WORK

13.1 UNCOVERING OF WORK

13.1.1 If any portion of the Work should be covered contrary to the request of the Architect or to requirements specifically expressed in the Contract Documents, it must, if required in writing by the Architect, be uncovered for his observation and shall be replaced at the Contractor's expense.

13.1.2 If any other portion of the Work has been covered which the Architect has not specifically requested to observe prior to being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work be found in accordance with the Contract Documents, the cost of uncovering and replacement shall, by appropriate Change Order, be charged to the Owner. If such Work be found not in accordance with the Contract Documents, the Contractor shall pay such costs unless it be found that this condition was caused by the Owner or a separate contractor as provided in Article 6, in which event the Owner shall be responsible for the payment of such costs.

13.2 CORRECTION OF WORK

13.2.1 The Contractor shall promptly correct all Work rejected by the Architect as defective or as failing to conform to the Contract Documents whether observed before or after Substantial Completion and whether or not fabricated, installed or completed. The Contractor shall bear all costs of correcting such rejected Work, including compensation for the Architect's additional services made necessary thereby.

13.2.2 If, within one year after the Date of Substantial Completion of the Work or designated portion thereof or within one year after acceptance by the Owner of designated equipment or within such longer period of time as may be prescribed by law or by the terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be defective or not in accordance with the Contract Documents, the Contractor shall correct it promptly after receipt of a written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. This obligation shall survive termination of the Contract. The Owner shall give such notice promptly after discovery of the condition.

13.2.3 The Contractor shall remove from the site all portions of the Work which are defective or non-conforming and which have not been corrected under Subparagraphs 4.5.1, 13.2.1 and 13.2.2, unless removal is waived by the Owner.

13.2.4 If the Contractor fails to correct defective or non-conforming Work as provided in Subparagraphs 4.5.1, 13.2.1 and 13.2.2, the Owner may correct it in accordance with Paragraph 3.4.

13.2.5 If the Contractor does not proceed with the correction of such defective or non-conforming Work within a reasonable time fixed by written notice from the Architect, the Owner may remove it and may store the materials or equipment at the expense of the Contractor. If the Contractor does not pay the cost of such removal and storage within ten days thereafter, the Owner may upon ten additional days' written notice sell such Work at auction or at private sale and shall account for the net proceeds thereof, after deducting all the costs that should have been borne by the Contractor, including compensation for the Architect's additional services made necessary thereby. If such proceeds of sale do not cover all costs which the Contractor should have borne, the difference shall be charged to the Contractor and an appropriate Change Order shall be issued. If the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the Owner.

13.2.6 The Contractor shall bear the cost of making good all work of the Owner or separate contractors destroyed or damaged by such correction or removal.

13.2.7 Nothing contained in this Paragraph 13.2 shall be construed to establish a period of limitation with respect to any other obligation which the Contractor might have under the Contract Documents, including Paragraph 4.5 hereof. The establishment of the time period of one year after the Date of Substantial Completion or such longer period of time as may be prescribed by law or by the terms of any warranty required by the Contract Documents relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which his obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to his obligations other than specifically to correct the Work.

13.3 ACCEPTANCE OF DEFECTIVE OR NON-CONFORMING WORK

13.3.1 If the Owner prefers to accept defective or non-conforming Work, he may do so instead of requiring its removal and correction, in which case a Change Order will be issued to reflect a reduction in the Contract Sum where appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 14

TERMINATION OF THE CONTRACT

14.1 TERMINATION BY THE CONTRACTOR

14.1.1 If the Work is stopped for a period of thirty days under an order of any court or other public authority

having jurisdiction, or as a result of an act of government, such as a declaration of a national emergency making materials unavailable, through no act or fault of the Contractor or a Subcontractor or their agents or employees or any other persons performing any of the Work under a contract with the Contractor, or if the Work should be stopped for a period of thirty days by the Contractor because the Architect has not issued a Certificate for Payment as provided in Paragraph 9.7 or because the Owner has not made payment thereon as provided in Paragraph 9.7, then the Contractor may, upon seven additional days' written notice to the Owner and the Architect, terminate the Contract and recover from the Owner payment for all Work executed and for any proven loss sustained upon any materials, equipment, tools, construction equipment and machinery, including reasonable profit and damages.

14.2 TERMINATION BY THE OWNER

14.2.1 If the Contractor is adjudged a bankrupt, or if he makes a general assignment for the benefit of his creditors, or if a receiver is appointed on account of his insolvency, or if he persistently or repeatedly refuses or fails, except in cases for which extension of time is provided, to supply enough properly skilled workmen or proper materials, or if he fails to make prompt payment to Subcontractors or for materials or labor, or persistently disregards laws, ordinances, rules, regulations or orders of any public authority having jurisdiction, or otherwise is guilty of a substantial violation of a provision of the Contract Documents, then the Owner, upon certification by the Architect that sufficient cause exists to justify such action, may, without prejudice to any right or remedy and after giving the Contractor and his surety, if any, seven days' written notice, terminate the employment of the Contractor and take possession of the site and of all materials, equipment, tools, construction equipment and machinery thereon owned by the Contractor and may finish the Work by whatever method he may deem expedient. In such case the Contractor shall not be entitled to receive any further payment until the Work is finished.

14.2.2 If the unpaid balance of the Contract Sum exceeds the costs of finishing the Work, including compensation for the Architect's additional services made necessary thereby, such excess shall be paid to the Contractor. If such costs exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or to the Owner, as the case may be, shall be certified by the Architect, upon application, in the manner provided in Paragraph 9.4, and this obligation for payment shall survive the termination of the Contract.

DIVISION 1 GENERAL REQUIREMENTS

SECTION 1A DEFINITIONS

The definitions listed below shall apply wherever the terms referred to are contained in the preceding General Conditions, and the succeeding Supplementary and Special Conditions and Technical Provisions.

(a) The term "Owner" shall be interpreted to mean Georgetown University, or parties designated by the Owner to act on behalf of the Owner.

(b) The terms "Architect" or "Engineer" as used herein shall be interpreted to mean the duly authorized representative of the Owner designated by the Owner to act in that capacity.

(c) The term "Contractor" shall be interpreted to mean the Contractor awarded the contract for services specified herein, and any and all Subcontractors to the Contractor.

(d) The term "job site" shall be interpreted to mean the vicinity of the Heating and Cooling Plant at Georgetown University.

(e) "Shown", "noted", "indicated" shall be interpreted to mean shown, noted, indicated, scheduled, detailed, or any other diagrammatic or written reference made on the Drawings.

(f) "Necessary", "reasonable", "proper", "correct" shall be interpreted to mean necessary, reasonable, proper or correct in the judgement of the Owner.

(g) "Directed", "required", "permitted" shall be interpreted to mean the direction, requirements, permission, order, designation or prescription of the Owner and "approved", "acceptable", "satisfactory" and words of like import shall mean approved by, or acceptable or satisfactory to the Owner. Where the word "approved" is used in these specifications and precedes the definition for a material, item of work, process or method it is intended that such material, item of work process or method must be submitted for review, and approval in writing by the Owner, must be obtained.

(h) "Provide", "furnish", "install" shall be interpreted to mean as follows: The terms "provide" or "provided" mean "furnish(ed)" and "install(ed)", and/or "connect(ed)", complete and ready for use or operation. The term "furnished" is intended to mean that the furnishing of the item or material; shall include delivery to the site, unloading from transport conveyance and storing at the site.

"Install" shall include the removal from storage, actual installation, erection and all adjustments, final cleaning and rubbish removal to make the items complete and ready for final acceptance.

SECTION 1B SUMMARY OF WORK

The Contractor shall furnish all labor, equipment, tools, materials, services and permits required to perform all work required by the Contract Documents.

The work to be performed under this subcontract shall include but not be limited to, the following as shown on the contract drawings and specifications:

1. Construction of a two-level extension to the Heating and Cooling Plant.
2. Installation of Owner-furnished turbine-generator, switchgear and accessories within the above building extension and the extension of steam, water, air, electrical, drainage and similar services thereto.
3. Furnishing and installation of additional ash storage silos within the Cooling Tower enclosure, including transport lines and auxiliary equipment.
4. Furnishing and installation of instrumentation, controls and alarms not supplied with Owner-furnished equipment.
5. Providing temporary power for construction.
6. Providing power, lighting and communications.
7. Performing acceptance tests.

SECTION 1C SUPPLEMENTARY AND SPECIAL CONDITIONS

1. EXECUTION, CORRELATION, INTENT AND INTERPRETATIONS

1.1 The Contract Documents shall be signed in not less than triplicate by the Owner and Contractor.

1.2 By executing the Contract, the Contractor represents that he has visited the site, familiarized himself with the local conditions under which the work is to be performed, and correlated his observations with the requirements of the Contract Documents.

1.3 The Contract Documents are complementary, and what is required by any one shall be as binding as if required by all. The intention of the Documents is to include all labor, materials, tools, equipment and other items as necessary for the proper execution and completion of the Work.

1.4 In case of conflict between the General Conditions of the Contract for Construction and these Special Conditions, the latter shall prevail. In case of conflict between the drawings and specifications, or within either document, the better quality or greater quantity of work shall prevail.

1.5 Omissions from the drawings or specifications furnished to the Contractor by the Owner, or the misdescription of details of work which are manifestly necessary to carry out the intent of the drawings and specifications, or which are customarily performed shall not relieve the Sub-contractor from performing such omitted or misdescribed details of the work, but they shall be performed as if fully and correctly set forth and described in the drawings and specifications.

1.6 Contractor shall check all drawings furnished to him immediately upon their receipt and shall promptly notify the Owner of any discrepancies. Figures marked on drawings shall be followed in preference to scale measurements. Large scale drawings shall in general govern small scale drawings. The Contractor shall compare all drawings and verify the figures before laying out the work and will be responsible for any errors which might have been avoided thereby.

2. COPIES FURNISHED AND OWNERSHIP

2.1 The Contractor will be furnished free of charge 5 sets of Contract Documents and two sets of drawings and specifications for Owner-furnished equipment. Contractor shall pay the reproduction costs for all additional sets requested by him. The Contractor shall pay all delivery costs.

2.2 All Drawings, Specifications and copies thereof furnished to the Contractor by the Owner are and shall remain the property of the Owner. They are not to be used on any other project, and with the exception of one signed contract set for each party to the Contract, are to be returned to the Owner on request at the completion of the Work.

3. TAXES

3.1 The Contractor shall pay all sales, consumer, use and other similar taxes required by law. Georgetown University has a tax exempt status as follows: District of Columbia Sales Tax Exemption Certificate No. 8040-02771-06 Federal Excise Tax Exemption No. A-112-480.

3.2 The Contractor shall also be responsible for the payment of all payroll taxes and contributions for unemployment insurance and old age pensions and annuities which are measured by the wages, salaries or other remuneration paid to the employees of the Contractor.

3.3 Acceptable evidence shall be submitted quarterly to the Owner that taxes required to be withheld by the District of Columbia or by the United States have been withheld and paid into a lawful depository.

3.4 The Contractor's bond in specific terms shall agree to indemnify the Owner against loss and costs should the Contractor fail to comply with preceding paragraphs of this Article.

4. PROGRESS SCHEDULE

4.1 Timely completion of construction, installations and testing is of vital importance to the Owner in order to minimize "on-peak" electrical demand and energy charges during the summer of 1982. The construction schedule requires completion of installation and testing 4½ months following delivery of the turbine-generator to the site. The progress schedule to be prepared by the Contractor under terms of the General Conditions preceding shall reflect this time limitation. To implement this schedule, the Contractor shall promptly man the project upon award and initiate continuous on-site construction within 15 working days from Notice to Proceed. Contractor manning, including premium time work, shall be implemented as required.

4.2 Failure of the Contractor to complete and make operational the turbine-generator installation in the specified time frame shall result in the Contractor paying the Owner as liquidated damages the sum of \$600 per day for each consecutive calendar day required to complete the work beyond that stated in 4.1 above. This figure is the calculated cost of purchasing electrical energy that would otherwise be generated during the "on-peak" billing months of June through September. The liquidated damages are calculated as follows:

Average generation rate - 1000 kW	
Purchased energy cost:	
Demand Charge - 1000 x \$7.00/30 days	= \$233/day
Energy charge - 24,000 kWh x \$.0356	= \$854/day
Sub-total	\$1087/day
Less cost of generation @ \$.02	480/day
Liquidated damages per day	\$ 600

5.0 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

5.1 Within 10 days after award of contract, the Contractor shall submit to the Owner for approval and record, a listing of equipment and materials for which shop drawings, product data or samples will be delivered to the Owner for approval and the scheduled date for each submission. This submission shall be on the form provided by the Owner.

5.2 Shop drawings shall be submitted by the Contractor in the form of one set of reproducible transparencies and one print of each drawing. Drawings shall have a clear space of 4" x 6" to receive the approval stamp. Following his review, the Owner will return the marked transparency to the Contractor. The Contractor shall obtain prints of the transparency as required to satisfy his needs.

5.2 Six copies of product data shall be submitted to the Owner. The Owner will return one marked copy to the Contractor.

5.3 When shop drawings are returned with the notation "Not Approved", the Contractor shall make necessary corrections thereto and shall resubmit the required number of corrected copies of Shop Drawings, cuts or new Samples until approved. The Contractor shall direct specific attention in writing or on resubmitted Shop Drawings to revisions other than corrections requested by the Construction Manager on previous submissions. Each resubmission shall be identified by a revision number and date of the revision.

5.4 Shop drawings, product data and/or samples shall be submitted for the following:

Ref. Spec. Section	Item	Shop Drawing	Product Data	Sample
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(List all items here)

6.0 CLEANING UP

6.1 The Contractor shall daily "broom clean" any work areas within the Heating and Cooling Plant and within the Fluidized Bed Boiler Plant. This shall be interpreted to mean that empty cartons, boxes, wrapping paper, tape and similar debris shall be fully removed from those areas daily and disposed of off site. Storage of equipment and materials to be installed in the above areas shall be limited to the minimum necessary to insure orderly day to day installation and to the extent permitted by the Owner.

7.0 PAYMENTS AND COMPLETION

7.1 Within ten days of award of contract, the Contractor shall submit to the Construction Manager a detailed cost breakdown on AIA Document G702 and G702A. Upon review and acceptance by the Construction Manager, the breakdowns shall form the basis for subsequent requests for payment.

7.2 Requests for payment may be submitted monthly.

7.3 The Contractor may include in his request for payment, 50 percent of the purchase cost of material and equipment and delivered to the job site, but not incorporated in the work as of the date of the request for payment.

7.4 Until the Work is 50 percent complete, the Owner will pay 90 percent of the amount due the Contractor on account of progress payments. At the time the Work is 50 percent complete and thereafter, if the manner of completion of the Work and its progress are and remain satisfactory to the Architect, and in the absence of other good and sufficient reasons, the Architect will (on presentation by the Contractor of Consent of Surety for each Application) authorize any remaining partial payments to be paid in full.

7.5 The full Contract retainage may be reinstated if the manner of completion of the Work and its progress do not remain satisfactory to the Architect (or if the Surety withholds its consent), or for other good and sufficient reasons.

8.0 INSURANCE

8.1 The insurance required by the General Conditions, Article 11, shall be written for not less than the following, or greater if required by law.

a. Workers' Compensation:

(a) State: Statutory

(b) Applicable Federal
(e.g. Longshoremen's): Statutory

(c) Employer's Liability:

b. Comprehensive General Liability (including Premises-Operations; Independent Contractors' Protective; Products and Completed Operations; Broad Form Property Damage):

1. Bodily injury:

\$2,000,000 Each Occurrence

2. Property Damage:

\$1,000,000 Each Occurrence

3. Products and Completed Operations to be maintained for 5 years after final payment.

4. Property Damage Liability Insurance will provide X, C or U coverage as applicable.

c. Contractual Liability:

1. Bodily Injury:

\$2,000,000 Each Occurrence

2. Property Damage:

\$1,000,000 Each Occurrence

d. Comprehensive Automobile Liability:

1. Bodily Injury:

\$2,000,000 Each Occurrence

2. Property Damage:

\$1,000,000 Each Occurrence

8.2 The Contractors' general liability, automobile liability, and property damage insurance policies shall name as additional insureds, Georgetown University, and such firm or firms designated by Georgetown University to act on its behalf in administering and supervising this Contract.

8.3 The Owner will provide a Builders Risk Insurance policy naming the Contractor as an additional insured party.

9. CHANGES IN THE WORK

9.1 The following limits of overhead and profit are established for changes in the work:

For Subcontractor's work, the Subcontractor is limited to 10% overhead plus 5% profit.

For Subcontractor's work, the Contractor is limited to 5% profit.

For work performed with his own forces the Contractor is limited to 10% overhead plus 5% profit.

10. EQUAL OPPORTUNITY

10.1 The Contractor and all Subcontractors shall not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin or age. The Contractor shall take affirmative action to insure that applicants are employed, and that employees are treated during employment without regard to their race, religion, color, sex, national origin or age. Such action shall include, but not be limited to the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the policies of non-discrimination.

10.2 The Contractor and all Subcontractors shall, in all solicitations or advertisements for employees placed by them or on their behalf, state that all qualified applicants will receive consideration for employment without regard to race, religion, color, sex, national origin or age.

11. PROTECTION OF PERSONS AND PROPERTY

11.1 The Contractor and his subcontractors shall hold a weekly tool box safety meeting. The Owner may attend any or all meetings. The record of each such meeting shall be prepared on a form provided by the Owner and a copy turned over to the Owner.

12. CONTRACTOR'S FIELD OFFICE AND CHANGE TRAILER

1.1 The Contractor shall provide his own temporary field office and change trailer at locations designated by the Owner. The office shall be equipped with a telephone for which service the Contractor shall make independent arrangements with the local Telephone Company. All work required to extend electric service to the office and change trailer shall be performed by the Contractor. The field office and change trailer shall be promptly removed from the site after acceptance of the Contractor's work.

13. UTILITY SHUTDOWNS

13.1 Utility outages required to perform the work included in this Contract shall be coordinated with the Owner. No work necessitating an outage shall be performed without the prior approval of the Owner. Outages will be permitted during non regular working hours only.

13.2 Requests for outages shall be filed in writing with the Owner. All outages shall be agreed upon in writing with the Owner five days in advance and the approved schedule for each outage strictly maintained. The amount of anticipated overtime cost to make the required connections shall be included in the Contract amount.

13.3 Isolation of utility services so as to permit their interruption for the performance of shutdown work will be performed by Georgetown University personnel. Restoration of services after completion of shutdown work will also be by Georgetown University personnel.

14. ENVIRONMENTAL PROTECTION

14.1 General: The Contractor shall perform his work in a manner which will prevent environmental pollution during the construction operations under this Contract. The control of environmental pollution requires consideration of noise, air, water, and land. The Contractor and his sub-contractors in the performance of this contract, shall comply with all applicable Federal, State, and Local laws, and regulations concerning environmental pollution control and abatement.

14.2 The Owner will notify the Contractor in writing of any non-compliance with the foregoing provisions and the action to be taken. The Contractor shall, after receipt of such notice, immediately take corrective action.

Such notice, when delivered to the Contractor or his authorized representative at the site of the work, shall be deemed sufficient for the purpose. If the Contractor fails or refuses to comply promptly, the Construction Manager may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs or damages by the Contractor unless it was later determined that the Contractor was in compliance.

14.3 Compliance with the provisions of this section by sub-contractors will be the responsibility of the Contractor.

14.4 Prior to commencement of the work the Contractor shall submit in writing for approval by the Construction Manager his proposals for implementing this section for environmental pollution control.

14.5 The Contractor shall not pollute streams, rivers or reservoirs with fuels, oils, bitumens, calcium chloride, acid construction wastes or other harmful materials. It is the responsibility of the Contractor to investigate and comply with all applicable Federal, State, County and Municipal laws concerning pollution of rivers and streams. All work under

this Contract shall be performed in such a manner that objectionable conditions will not be created in streams through or adjacent to the project areas.

14.6 Open burning of rubbish, debris and other combustibles will not be permitted at the site.

15. USE OF SITE

15.1 The work is to be performed on the premises of Georgetown University, Washington, D.C. The Contractor shall comply with Georgetown University regulations, as stated herein, and in all of his activities shall act in such a manner that he will not obstruct ongoing university functions, including truck deliveries to the existing plants.

15.2 The Contractor shall confine his equipment, storage of materials, and the operations of his workmen to the limits indicated on the Contract Drawings. On site storage space allocated to the Contractor shall not exceed that which is shown on the Contract drawing. The Contractor shall schedule his deliveries so as to enable his work to proceed expeditiously without exceeding the allocated storage space.

15.3 Parking of employee or Contractor vehicles on Georgetown University premises is expressly prohibited except for large construction vehicles or construction equipment which may be parked or stored within the work site with the prior consent of the Owner.

15.4 Contractor vehicular traffic to the site shall restrict itself to the access road indicated on the Contract drawings.

15.5 The existing Heating and Cooling Plant, Fluidized-Bed Boiler Plant, and all other university buildings are off-limits to Contractor personnel, except for such periods as the Contract calls for Contract work to be performed therein.

15.6 The Contractor will be site limited to one office/tool trailer not to exceed 40 feet in length, and one change or tool trailer not to exceed 40 feet in length to be located as shown on the Contract Drawings. Water and sewage connections for the trailers will not be available. Temporary electric service, if required, shall be provided by the Contractor from a designated service point in the Heating and Cooling Plant..

15.7 Contractor's personnel may use existing toilet facilities as designated by the Owner.

15.8 The Contractor shall furnish drinking water for his employees.

15.9 Water for construction purposes may be drawn from the hydrant on site. The use of hydrant water for this purpose shall comply with Georgetown University safety engineer requirements, and shall be carried out so as not to restrict the use of the hydrant for fire protection purposes. The hydrant shall be continuously accessible for fire protection purposes.

15.10 The Contractor shall be solely responsible for the security against theft, vandalism or other loss of any and all of his equipment, materials, tools, and appurtenances stored or used on the job site for the performance of his work. Neither the Owner nor the Construction Manager shall be held liable for any losses or damages that the Contractor may sustain due to theft, vandalism or similar reasons.

16. RECORD DRAWINGS

16.1 During the progress of the job, the Contractor shall keep a careful record at jobsite of all changes and corrections from the layouts shown on the drawings. The Contractor shall enter such changes and corrections on a set of prints promptly but in no case later than on a weekly basis. If the Contractor fails to maintain the record drawings as required herein, the Construction Manager will deduct from the progress payment an amount representing the estimated cost of maintaining the record drawings.

17. SIGNS

17.1 No signs or advertisement will be allowed to be displayed without the Owner's approval.

18. LABOR FORCE

18.1. The Contractor agrees that his proposed labor force will neither restrict nor impede work by the Owner's present labor force at the site, nor the labor forces of other Contractors on site, nor deliveries to the site, and that in the event the Contractor's choice of labor force does interfere with the Owner's or other Contractor's operations in the above manner, the Contractor will institute immediate action to eliminate the problem at no additional cost to the Contract.

DIVISION 2 SITE WORK

SECTION 2A REMOVALS

1. GENERAL REQUIREMENTS: Removals shall be performed without damage to adjacent structures, equipment and utilities to remain. All material, fixtures and equipment which have been removed and disconnected, but are not indicated or specified for reuse in the new work shall become the property of the Contractor and shall be removed from the activity by the Contractor at this own expense.

2. REMOVALS shall be as listed below and indicated on the drawings.

2.1 Concrete walls as indicated.

2.2 Asphalt paving as required.

2.3 Precast concrete fascia (for possible

3. PROTECTION: Contractor shall provide temporary dust barriers to protect personnel and equipment to remain.

4. BLASTING will not be permitted.

SECTION 2B EXCAVATION AND BACKFILL

1. GENERAL REQUIREMENTS: Bids shall be based on the following:

1.1 That surface elevations are approximately as indicated.

1.2 No major obstructions other than those indicated will be encountered.

1.3 Ground water elevations indicated are those which existed at the time of subsurface investigations and do not necessarily represent the permanent ground water table.

2. EXCAVATION

2.1 Excavations shall be as required for floor slab, paving and footings.

2.2 Excavations shall be kept free of surface water and ground water.

2.3 No additional payment will be made to the Contractor for type of material encountered except if directed by the Engineer to excavate beyond that indicated.

2.4 Blasting will not be permitted within 10 feet of existing structures.

2.5 Disposal: The Contractor shall remove from the site all excavated material not acceptable for backfill and shall dispose of it in a manner which complies with Federal, state and local requirements.

3. FILLING AND BACKFILLING

3.1 Backfilling shall be placed in 6 inch maximum layers and compacted to 95% of ASTM D1557 density.

3.1.1 Fill and backfill shall be materials classified as satisfactory in accordance with AASHTO soil classification groups A-1, A-2-4, A-2-5 and A-3 and be free of clay, rock or gravel larger than 2", debris, waste, frozen materials, vegetable and other deleterious matter.

SECTION 2C BITUMINOUS PAVING

1. GENERAL REQUIREMENTS: Bituminous paving shall be in accordance with the applicable sections of the District of Columbia Department of Highways and Traffic-Standard Specifications for Highways and Structures, and shall match existing for type and appearance.

SECTION 2D SITE UTILITIES

1. GENERAL REQUIREMENTS: Storm piping and electrical ducts shall be provided as indicated to connect to existing lines. The Contractor shall adjust locations and inverts as approved by the Engineer, to agree with actual location and inverts of existing utilities.

2. MATERIAL

2.1 Pipe shall be reinforced concrete conforming to ASTM Specification C76, Class IV.

2.1.1 Jointing Material shall be single ring gasket joints. Gasket and pipe ends shall conform to ASTM C443.

2.2 Electrical ducts shall be asbestos-cement conduit, concrete encased with 3000 psi concrete.

3. INSTALLATION

3.1 Installation shall conform to the location and inverts indicated, except that they shall be adjusted as approved by the Engineer to meet actual existing pipe and manhole locations and elevations.

3.2 Joints: Installation of joints shall be in accordance with the recommendations of the manufacturer of the gasket with regard to the use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing ducts, and other deleterious agents at all times. Gaskets shall be inspected before installation of the pipe and all loose or improperly affixed gaskets shall be removed and replaced as approved. The pipe shall be aligned with the previously installed pipe, and the joint pulled together. If, while pulling the joint, the gasket becomes loose and can be seen through the exterior joint recess when the pipe is pulled up to within one inch of closure, the pipe shall be removed and the joint remade.

3.3 Electrical ducts shall be placed on pre-formed separators assuring 3-inch concrete cover on all sides of each duct.

3.4 Electrical duct couplings shall be duct manufacturers standard product.

DIVISION 3 CONCRETE

SECTION 3A CAST-IN-PLACE CONCRETE

1. GENERAL REQUIREMENTS: Concrete work shall conform to the applicable requirements of ACI 301 and ACI 381 except as modified herein.

2. CONCRETE shall be ready-mixed per ASTM C94, and shall be normal weight, 6 per cent air-entrained concrete having minimum ultimate compressive strengths of 3000 psi at 28 days. Cement contents shall be 600 lbs. (6.4 sack) for 3000 psi concrete.

2.1 Cement shall conform to ASTM C150.

2.1.1 Type I - use with 3000 psi concrete.

2.2 Aggregate shall conform to ASTM C33. Maximum size of coarse aggregate for 3000 psi concrete shall be 3/4 inch to 1 1/2 inch range.

2.3 Water shall be potable.

2.4 Air-Entraining admixture shall conform to ASTM C260.

3. REINFORCEMENT

3.1 Reinforcing bars shall conform to ASTM A615, deformed, and of sizes indicated.

3.2 Welded steel wire fabric shall conform to ASTM A185, mesh and gage as indicated.

4. JOINT MATERIALS

4.1 Joint-Sealing Materials shall conform to ASTM D1850.

4.2 Expansion Joint Filler shall be preformed type conforming to ASTM (D1751) and D1752).

5. FINISHES

5.1 Other Than Slabs: Remove fins and loose material. Fill holes and voids larger than 1/2 inch diameter. Surfaces to be painted shall be wetted and brush-coated with portland cement-sand grout of thick consistency. Grout shall be wood floated to fill voids and shall be kept damp until set.

5.2 Slabs: Finish to true planes with no deviation exceeding 1/8 inch to 10 feet. Pitch surfaces to drains where drains occur. Steel trowel to a smooth, even, dense finish free from blemishes including trowel marks.

5.3 Chemical Floor Hardener: Chemical floor hardener shall be zinc or magnesium fluosilicate dissolved in water at 1 to 1 1/2 lbs per gallon of water, or an approved chemical floor hardener.

6. CURING: All concrete shall be damp cured for 7 days.

7. SHOP DRAWINGS: Following approval of materials, but before starting any work, shop drawings of all reinforcing steel shall be submitted to for approval.

8. TESTING

8.1 Slump tests shall be performed on all concrete deliveries to the site. Slump, as determined by ASTM C143 shall be 3 to 4 inches for 3000 psi concrete and 2 to 3 inches for 6000 psi concrete. Water shall not be added to the concrete mix after slump tests are performed.

8.2 Test cylinders: At his own expense, the Contractor shall provide the services of a testing laboratory approved by the Engineer to test concrete. The Contractor shall provide for test purposes three sets of test specimens taken from each 150 cubic yards or fraction thereof of each class of concrete placed. At least one set of test specimens shall be provided for each class of concrete placed in each 8-hour shift. Each set shall consist of two test specimens, and shall be made from a separate batch. Samples shall be secured in conformance with ASTM C172. Test specimens shall be made, cured, and packed for shipment in accordance with ASTM C31.

3. STRENGTH

3500 psi Ultimate compressive strength at
time of prestressing.

5000 psi Ultimate compressive strength at
28 days.

SECTION 3B PRECAST CONCRETE

1. GENERAL REQUIREMENTS: This section covers architectural precast concrete facia and column enclosure and precast concrete roof deck. Precast facia shall match color and texture of existing facia as approved by the Architect. Precast concrete fabricator shall be a member of the Prestressed Concrete Institute. Fabrication and erection shall be in accordance with the specifications and recommendations of the Prestressed Concrete Institute.

2. MATERIALS

2.1 Existing precast facia, removed under Section 2A, may be reused if undamaged.

2.2 Aggregate - ASTM C33

Fine and coarse aggregates for type of exposed finish shall be from a single source and pit for the entire job. They shall be clean, hard, strong, durable, and inert, free of staining or deleterious material.

2.3 Cement - ASTM C150, Type I.

Cement for exposed concrete finish shall be of one type and from one source throughout the entire job.

2.4 Reinforcement

2.4.1 Reinforcing bars shall conform to ASTM A615.

2.4.2 Welded steel wire fabric shall conform to ASTM A185.

2.5 Mixing water shall be clean, clear and free of deleterious quantities of salts, acids, alkalies, oils, detergents, organic material or other matter that may interfere with the color, setting, or strength of the concrete.

2.6 Pigments or other coloring agents, when required, shall be resistant to lime and other alkalies. The amount and type of coloring agent used shall not reduce the quality of the concrete below that specified.

DIVISION 4 MASONRY

SECTION 4A BRICK AND MASONRY UNIT WORK

1. GENERAL REQUIREMENTS: Masonry work shall be of the types indicated. Brick masonry shall match existing adjacent surfaces as approved by the Architect.

2. MATERIALS

2.1 Facing Brick shall be ASTM C216, grade SW, type FBS.

2.2 Concrete Masonry Units shall be hollow load bearing type conforming to ASTM C90, grade N-I as required for exterior walls.

3. SAMPLE PANEL

Before masonry work is started, a sample panel approved by the Architect, approximately 6 feet long by 4 feet high shall be provided. The panel shall show the workmanship, coursing, bond, tooling of joints, range of color, texture, color of mortar all of which shall match existing masonry construction.

DIVISION 5 METALS

SECTION 5A STRUCTURAL STEEL

1. GENERAL REQUIREMENTS: Unless otherwise specified hereinafter, all structural steel shall be in accordance with the AISC Specification for the Design, Fabrication and Erection of Steel for Buildings.

2. SHOP DRAWINGS shall be submitted to, and approved by, the Engineer prior to fabrication and erection.

3. MATERIALS

3.1 Structural Steel: ASTM A36.

3.2 High Strength Bolts: ASTM A325 or A490.

3.3 Welding Electrodes and Rods: AWS D1.1.

4. FABRICATION shall be in accordance with the applicable provisions of the AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings. Workmanship shall be equal to standard commercial practice in modern structural shops. Fabrication and assembly shall be done in the shop to the greatest extent possible. Field Bolting shall be used to the greatest extent possible.

4.1 Welding of Structural Steelworks shall be in accordance with AWS D1.1. In structures where welding might cause serious residual stresses, a detailed sequence of the welding, amplifying the requirements given by the AWS Specifications, shall be submitted by the Contractor for approval.

4.2 High-Strength Steel Bolts: The design and assembly structural joints using high-strength steel bolts shall be according to the RCRBSJ specification for "Structural Joints using ASTM A325 or A490 Bolts."

4.3 Shop Painting: Except as otherwise specified all structural steelwork, except zinc-coated surfaces and steelwork to be embedded in concrete or mortar, shall be shop prime painted.

5. ERECTION

5.1 General: Except as modified herein, erection shall be in accordance with the AISC manual of steel construction.

5.2 Connections: Anchor bolts and other connections between the structural steel and foundations shall be provided and shall be properly located and built into connecting work. Connections for which details are not indicated shall be designed in accordance with AISC "Manual of Steel Construction".

SECTION 5B MISCELLANEOUS METALS

1. GENERAL REQUIREMENTS: The Contractor shall verify all measurements and shall take all necessary field measurements before fabrication. Materials and parts necessary to complete each item shall be included, even though such work is not definitely shown or specified. Miscellaneous bolts and anchors, supports, braces, and connections necessary for completion of the miscellaneous metalwork shall be provided. In addition to those supports indicated, the Contractor shall provide all miscellaneous structural supports required for the support of equipment, piping and conduit.

2. MATERIALS

2.1 Structural Steel shapes and accessories shall conform to ASTM A36.

2.2 Steel Plates: Mild steel plates and special shapes of structural quality shall conform to ASTM A283.

2.3 Steel Sheets of structural quality shall conform to ASTM A570 or A611.

2.4 Steel Pipe shall conform to ASTM A120. Fittings for steel pipe shall be standard malleable iron fittings.

2.5 Bar Steel shall be hot-rolled, made by the Bessemer or open hearth process, including rounds and squares of all sizes, and flats six inches or less in width.

2.6 Checkered Steel Plate where shown shall conform to Federal Specification QQ-F-461, with flat back, class 1, pattern 10. Unless otherwise shown, checkered steel plate shall be not less than $\frac{1}{4}$ inch thick.

2.7 Sheet Steel: Patent levelled sheet steel shall be best commercial quality, open hearth, cold-rolled, pickled and full annealed.

2.8 Bolts and Nuts shall conform to ASTM A306.

2.9 Machine Screws shall conform to Specification FF-S-92.

2.10 Expansion Shields, plugs, bolts and other anchorage devices in masonry and concrete shall be approved type. Expansion shields shall be hot-dipped galvanized.

2.11 Welding shall conform to the applicable requirements of the standard code D1.1 for arc and gas welding of the American Welding Society.

3. METAL STAIRS: Stair construction shall be complete with all necessary struts, channels, stringers, bolts, anchors, and other accessories and shall be designed to sustain a live load of not less than 100 pounds per square foot. All members shall be securely welded together in accordance with approved industry standards; exposed and visible heads shall be ground smooth. Bolting or riveting will be permitted only where welding is not practicable, and all bolting or riveting shall be done accurately and neatly with concealed flush heads where practicable. Railings shall be constructed of 1½-inch inside diameter standard weight steel pipe. Steel railings shall be fabricated to the designed indicated. All joints and connections in railings shall be welded, without exposed fittings, and except where indicated otherwise all changes in direction shall be rounded neatly.

4. TUBULAR STEEL RAILINGS: Provide steel railings as indicated. Railings shall be 1-1/2 inch nominal size standard weight steel pipe. Provide posts, railings, pipe sleeves, flanges, cover plates, sub-framing, plates, anchors and other accessories and appurtenances required for a complete installation. Construct of tubular steel sections as shown. Tie and cross connections shall be mitered and/or coped, and joined by continuous fillet welds around flush and smooth. Make splices in concealed locations where practicable, with splice pieces of bar stock, secured with flat head countersunk screws through bottom of railing. Joints shall be flush and right between sections. Bend units carefully to required shapes without crimping or otherwise damaging the sections.

5. GRATING PLATFORMS, WALKWAYS AND RAILINGS shall consist of 1-1/2 inch deep grating conforming to Specification RR-G-661, Hangers and supports will be provided under section entitled "Structural Steel" in this Division. Double railing of 1-1/4 inch ID steel tubing shall be provided.

SECTION 5C METAL WALL PANELS

1. GENERAL REQUIREMENTS: Metal wall panel
(above rolling door)

2. CONSTRUCTION

2.1 Metal panels shall be 3 inch thick insulated
"A WALL" sandwich panel as manufactured by R.C. Mahon Company.

2.2 Slats shall be interlocking rollform steel capable of withstanding wind pressures of 20 psf and shall match slats of rollup door.

DIVISION 7 THERMAL/MOISTURE PROTECTION

SECTION 7A INSULATION

1. GENERAL REQUIREMENTS: Board-type glass fiber thermal insulation on concrete roof deck and rigid polystyrene board wall insulation shall be provided.

2. MATERIALS

2.1 Roof insulation shall be Glassbase Roof Insulation as manufactured by Owens/Corning or approved equal. It shall be composed of inorganic glass-fibers with a fiberglass reinforced mopping surface.

2.2 Wall insulation shall be extruded polystyrene plastic board insulation equal to Styrofoam SM manufactured by Dow Chemical, U.S.A.

3. THICKNESS OF INSULATION: Insulation board shall have a minimum thickness of 2". Actual installed thickness of insulation shall be such as to provide a coefficient of heat transmission of U-value through the completed roof and wall constructions air-to-air not in excess of 0.10 Btu per hour, per square foot, per degree F. temperature difference.

SECTION 7B BUILT UP ROOFING

1. GENERAL REQUIREMENTS: Roofing shall be a 3 ply plus gravel system, Owens/Corning Specification No. 323-1GD for application on insulated roof deck.
2. SURFACING MATERIALS: Slag aggregate shall conform to ASTM Specification D 1863.

SECTION 7C FLASHING AND SHEETMETAL

1. GENERAL REQUIREMENTS: Flashing shall be as indicated. Installation not shown in detail or covered elsewhere in the Specification shall meet the applicable requirements of the SMACNA Architectural Sheet Metal Manual.

2. MATERIALS: Materials shall conform to the respective specifications and to the requirements specified herein. Accessories and other items essential to complete the sheet metal installation shall be provided and shall be of the same materials as the items to which they are applied.

2.1 Stainless Steel: ASTM Specification A167, type 302 or 304, finish 2D, fully annealed, dead soft temper, 0.015" thick.

SECTION 7D SEALANTS

1. GENERAL REQUIREMENTS: Sealant and expansion joint cover shall be provided as indicated or specified.

2. MATERIALS

2.1 Sealant shall be a one or two component polysulphide (TT-S-00227, Class A, Type 2 or TT-S-00230, Class A, Type II), or "Dymeric" sealant by Tremco Mfg. Co.

2.2 Miscellaneous Materials: Provide backup materials, joint cleaners, bond breakers and joint primers as required and recommended by sealant manufacturer.

3. SURFACE PREPARATION: The joint design, shape, and spacing shall be as recommended by the sealant manufacturer. Surface preparation and sealant installation shall be in accordance with sealant manufacturer's instructions.

DIVISION 8 DOORS AND WINDOWS

SECTION 8A METAL DOORS AND FRAMES

1. GENERAL REQUIREMENTS: Provide interior and exterior hollow metal doors as shown.

1.2 Door and frame shall be prepared for specified hardware.

2. CONSTRUCTION OF DOORS: Doors shall be flush, 1-3/4 inch thick. Door clearances shall not exceed the following: 3/32" inch at jams and head; and 3/8 inch at bottom. Doors shall be fabricated of not less than 18 gage steel sheets. Exterior door shall have top and bottom edges closed flush and sealed against water penetration.

3. CONSTRUCTION OF FRAME: Pressed steel frame for doors shall be of the combination buck, frame, and trim type of the size and detail shown. Gage of metal shall be not lighter than 16-gage. Frames shall be knockdown type or welded unit type.

4. INSTALLATION: Frame shall be plumbed, leveled, and rigidly secured in place. Temporary spreaders shall be installed until the wall at the frame is completed and the frame is securely anchored in its final position. Wall anchors on door frame shall be installed approximately at the hinge and strike levels. Door shall be installed in conjunction with the application of hardware.

SECTION 8B SPECIAL DOOR

1. POWER OPERATED ROLLING STEEL DOOR

1.1 Curtain shall be formed of interlocking steel slats designed to safely resist a wind pressure of 20 pounds per square foot with an allowable fiber stress of 27,000 psi. Curtain shall roll up on a drum supported on brackets and shall be balanced by helical springs. Fenestration standard with the manufacturer shall be provided where indicated.

1.2 Finish: Curtain slats and hood shall be zinc coated with 1.25 ounces of zinc per square foot of surface in accordance with the requirements of ASTM A 525, and shall be phosphate treated. All other surfaces of door parts shall be given a shop coat of rust-inhibiting paint. Finish painting is specified in SECTION: PAINTING, GENERAL.

1.3 Electric Power Operator shall be furnished complete with electric motor, reduction gears, brackets, push-button controls, limit switches, and other accessories specified. The operator shall be so designed that the motor may be removed without disturbing the limit-switch timing and without affecting emergency auxiliary operators.

2. INSTALLATION: Door shall be installed by the manufacturer, or his authorized representative, in accordance with directions. Anchors and inserts for guides, brackets, motor, switches, and other work shall be accurately located. Upon completion, door shall be lubricated and adjusted to operate freely.

SECTION 8D HARDWARE

1. GENERAL REQUIREMENTS: Hardware for door shall consist of butt hinges, and latchset. Hardware shall match type and manufacturer of door hardware in adjoining building. Panic hardware shall be provided as shown on Door Schedule.

DIVISION 9 - FINISHES

SECTION 9A - PAINTING

1. DESCRIPTION OF WORK:

1.1 A. The extent of painting work is shown on the drawings and schedules, and as herein specified.

B. The work includes painting and finishing of interior and exterior exposed items and surfaces throughout the project, except as otherwise indicated.

C. The work includes field painting of exposed bare and covered pipes and ducts (including color coding), and of hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment, except as otherwise indicated. Identification banding of pipes and ducts is specified in Divisions 15 and 16.

D. "Paint" as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

E. Paint all exposed surfaces whether or not colors are designated in "schedules", except where the natural finish of the material is specifically noted as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint these the same as adjacent similar materials or areas. If color or finish is not designated, the Architect will select these from standard colors available for the materials systems specified.

1.2 PAINTING NOT INCLUDED:

A. The following categories of work are not included as part of the field-applied finish work, or are included in other sections of these specifications.

1) Shop Priming: Unless otherwise specified, shop priming of ferrous metal items is included under the various sections for structural steel, miscellaneous metal, hollow metal work, fabricated components such as shop-fabricated or factory-built architectural, mechanical and electrical equipment or accessories, and similar items.

2) Mechanical and Electrical Work: The shop priming and identification banding of mechanical and electrical work is specified in Divisions 15 and 16, respectively. The identification and finish painting of this work is included in this Section 9A.

3) Pre-Finished Items: Unless otherwise indicated, do not include painting when factory-finishing or installer finishing is specified for such items as (but not limited to) acoustic materials, finished mechanical and electrical equipment including light fixtures, switchgear and distribution cabinets, doors and equipment.

4) Concealed Surfaces: Unless otherwise indicated, painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas.

5) Finished Metal Surfaces: Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting, unless otherwise indicated. Galvanized items are not included in the category of finished materials and are to be field painted as specified for interior ferrous metal.

6) Operating Parts and Labels: Moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sinkages, sensing devices, motor and fan shafts will not require finish painting unless otherwise indicated. Do not paint over any code-required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

2.2 MATERIAL QUALITY:

A. Provide the best quality ("first line") grade of the various types of coatings as regularly manufactured by one or more of the following manufacturers: Dupont, Pratt and Lambert, Devoe, Benj. Moore, Glidden, O'Brien, Burning, Bruder, Martin-Senour, Pittsburgh, Sherwin Williams or Tnemec.

B. Provide undercoat paint produced by the same manufacturer as the finish coats. Use only thinners approved by the paint manufacturer, and use only within recommended limits.

3.2 SURFACE PREPARATION:

A. General: Perform preparation and cleaning procedures in strict accordance with the paint manufacturer's instructions.

3.3 INSTALLATION:

A. Mix and prepare and apply painting materials in accordance with manufacturer's directions.

B. Minimum Coating Thickness: Apply each material at not less than the manufacturer's recommended spreading rate, to establish a total dry film thickness as recommended by coating manufacturer for the type of paint system and surface involved.

3.4 CLEAN-UP AND PROTECTION: (later)

3.5 SCHEDULE OF PAINTING:

A. The types of paint and number of coats required on the various surfaces shall be as follows: No substitutions will be permitted except upon written approval of the Architect.

1. EXTERIOR FERROUS METAL: ALKYD ENAMEL SYSTEM

First Coat: Manufacturer's recommended primer. Second and Third Coats: Semi-gloss Alkyd Enamel.

Extent: Use on all exterior cold-rolled ferrous metal, including galvanized items.

2. INTERIOR FERROUS METAL: ALKYD ENAMEL SYSTEM

First Coat: Manufacturer's recommended primer. Second Coat: Enamel Undercoat. Third Coat: Enamel, semi-gloss.

Extent: Use this finish on all interior ferrous metal surfaces, except exposed uncovered pipes and ducts.

3. INTERIOR CONCRETE BLOCK: LATEX SYSTEM

First Coat: Apply manufacturer's recommended "medium" styrene-butadiene block filler.

Second Coat: Semi-gloss latex emulsion.

Extent: Use on all interior exposed block surfaces except those hereinbefore noted as not requiring a paint finish.

4. INTERIOR POURED-IN-PLACE CONCRETE: LATEX-ALKYD SYSTEM

First Coat: Pigmented latex wall primer and sealer. Second Coat: Eggshell alkyd wall enamel.

Extent: Use on all exposed concrete wall surfaces, except those hereinbefore noted as not requiring a paint finish.

5. Piping and Mechanical Equipment: Paint
piping, conduits, ductwork and mechanical and electrical equipment (except non-ferrous metal, plated, finished by manufacturer, permanently concealed, and where noted to be painted under other Sections). Properly clean, prepare and finish under this Section as herein specified. Paint materials shall be heat resisting type when applied to heating lines and equipment.a) Uninsulated Piping, Ductwork, Fittings and Equipment

1st coat	- Enamel Undercoater
2nd coat	- Alkyd Eggshell Enamel

b) Insulated Piping, Ductwork, Fittings and Equipment

1st coat	- Latex Flat
2nd coat	- Alkyd Flat

c) Machinery and Equipment

1st coat	- Epoxy Type Machinery Enamel
2nd coat	- Epoxy Type Machinery Enamel

6. Pipe Identification

- a) Comply with ANSI A13.1 "Scheme for the Identification of Piping Systems."
- b) Provide plastic coated fabric pipe markers, (banding), "All-Temperature" labels (W.H. Brady Co.), or approved equal. Indicate the pipe contents in printed, block letters. Provide labels of such length as to completely circumscribe the pipe and overlap not less than one in. upon one edge.
- c) Provide flow markers consisting of labels similar to the pipe markers with a large black arrow printed on the same background color to indicate the direction of flow of the pipe.
- d) Place a pipe marker and a flow marker on each pipe on each side of walls or floors through which pipes pass. Place markers adjacent to valves and fittings and for exposed piping locate markers as to be clearly visible to a person standing on the floor.
- e) On pipes or covering one in. and smaller in diameter requiring identifying markings, attach metal tag of not less than one in. in diameter, with lettering etched and filled with enamel, in lieu of stencils.

3.6 CLEANING

A. Remove paint spots, oil or stains upon adjacent surfaces not requiring painting and leave entire job clean.

DIVISION 14 CONVEYING SYSTEMS
SECTION 14A TROLLEY, HAND OPERATED

- 3. EQUIPMENT CRITERIA:
- 3.1 Lifting capacity - as shown

DIVISION 15 MECHANICAL

SECTION 15A GENERAL REQUIREMENTS

1. GENERAL: The work to be performed under this section of the Specifications consists of providing all labor, material, equipment, supervision, tools and services required for the complete mechanical installation, subject to the requirements of the Contract Documents.

2. MATERIALS: All Contractor-furnished equipment, material, fixtures, etc. shall be of the latest model for which replacement parts are readily available. Material and equipment shall be stored at the site, protected against physical damage and from the weather, condensation, dust, etc.

3. INSTRUCTION MANUALS: The Contractor shall furnish and submit to the Owner five hard bound Instruction Manuals containing all catalog data, shop drawings, performance curves and rating data, spare parts lists and manufacturers' operation and maintenance data, applicable to all Contractor-furnished equipment installed.

4. INSTALLATION AND COORDINATION: The Contractor shall install and connect all appliances and equipment as specified and indicated in accordance with manufacturer's instructions and recommendations. Furnish and install complete, auxiliary piping, valves, electric connections, and similar items, recommended by the manufacturer, or required for proper operation. Coordinate the work so that interferences between mechanical, electrical, architectural and structural work will be avoided.

5. PIPING AND SUPPORTS

5.1 Piping shall be run parallel with lines of building. Piping shall be so installed that after covering is applied there will be not less than 1/2 inch clear space between the finished covering of pipes and other work. All horizontal piping shall be properly supported from the structure. Vertical piping shall be supported at each floor and at the base elbow.

5.2 Provide vibration isolation in pipe hangers as required.

5.3 Hangers for piping shall be spaced to prevent sag and permit proper drainage.

5.4 Single pipe hangers shall generally be in accordance with Federal Specification WW-H-171D.

6. ACCESS PANELS: Furnish and install access panels for access to concealed valves, P-traps, cleanouts, steam traps, unions, expansion joints, dampers, and similar items where no other means of access, such as a readily removable, sectional ceiling is shown or specified.

7. OWNER FURNISHED EQUIPMENT: The Owner will furnish some pre-purchased equipment for installation under this contract. The Contractor shall unload this equipment upon its arrival at the job site; shall store and protect the equipment from the weather and from physical damage prior to installation; and shall perform all work, and provide all miscellaneous materials required for its proper installation as if the equipment were specified for furnishing by the Contractor.

8. DRIP PANS: Provide drip pans under all fluid conducting piping which runs over electric switchgear, busway, or electric motor starters. Each pan shall be pitched to a drain connection and drain shall be piped to discharge over a plumbing fixture or floor drain. Pans and pipes shall be copper.

9. PAINTING AND FINISHING

9.1 Factory finishes, shop priming, and special protective coatings are specified in the individual specification sections.

9.2 Field painting and equipment identification marking of mechanical and electrical equipment, but not touch-up painting of factory-finished items, is included in Section, "Painting and Finishing".

9.3 Where factory finishes are provided on equipment and no additional field painting is specified, all marred or damaged surfaces shall be touched up or refinished to leave a smooth, uniform finish at the time of final inspection.

10. MOTORS

10.1 Contractor-furnished motors shall conform to the following requirements.

10.2 Each motor shall have sufficient capacity to start and operate the machine it drives without exceeding the motor nameplate rating at the speed specified or at any speed and load which may be obtained by the drive actually furnished.

10.3 Each motor that is provided with automatic control shall also be capable of making as frequent starts as the control device may demand.

10.4 All belt-connected motors, regardless of size, shall be equipped with shafts and bearings that will withstand both the normal belt pull of the drive furnished and the momentary or continuous overloads due to acceleration or incorrect belt tension.

10.5 Motors shall be rated for continuous duty at 100 percent of rated capacity, and temperature rise shall be based on ambient temperature of 40 degrees celcius.

10.6 One-half horsepower and larger motors generally shall be polyphase motors. Motors smaller than one-half horsepower generally shall be single-phase motors.

10.7 Installation of all motors shall be in accordance with the Electrical Section of the specifications.

11. MOTOR STARTING EQUIPMENT

11.1 Unless otherwise specified, required for a particular application, or indicated by details or control diagrams on the drawings, each motor shall be provided with a motor starter.

11.2 Each Contractor-supplied starter and its component and related parts shall be properly designed and coordinated to suit the characteristics of the motor it controls and the driven equipment. Starters provided with automatic control shall be capable of making as frequent starts as the control devices may demand. Starters shall be in accordance with NEMA standards, and the National Electrical Code.

11.3 Unless otherwise specified or indicated, separately mounted starters shall have NEMA type 12 general purpose enclosures with doors arranged for padlocking. Each enclosure shall be so designed that the entire starter can be readily removed and shall be of sufficient size to permit easy access for repair, replacement, and making of connections.

12. MOTOR TERMINAL CONNECTIONS

12.1 Three phase motors shall have terminal boxes and provisions for rigid or flexible conduit connections.

12.2 Terminal boxes shall be of the oversize type, large enough for the size and number of connections required.

13. BELT DRIVES

13.1 Each Contractor-supplied motor-driven machine which is not direct connected and not provided with a factory-designed and factory-assembled belt drive shall be equipped with a V-belt drive.

13.2 Belts shall be endless, of reinforced cord and rubber construction. Cords shall be of long staple cotton, rayon, dacron or other suitable synthetic textile fibers. Belts shall be of correct cross section to fit properly in the sheave grooves. Belts for each drive shall be matched.

13.3 Sheaves shall be of cast-iron or steel, of bushing type with quick disconnect hubs.

14. BELT AND COUPLING GUARDS

14.1 Each Contractor-supplied belt drive shall be equipped with a guard. Guards not furnished as part of a factory made unit shall be constructed of No. 12 U.S. Standard gage 3/4-inch diamond mesh wire screen, or equivalent, welded to 1-inch steel angle frames and shall enclose all belts and sheaves.

14.2 Direct driven Contractor-supplied equipment shall be provided with coupling guards.

15. PRESSURE TANKS shall be best quality flange steel, constructed, tested, and stamped in accordance with the latest requirements of the American Society of Mechanical Engineers Code for Unfired Pressure Vessels. Tanks shall be welded. Steel tanks 36 inches or more in diameter shall be provided with a manhole. Manholes shall be located near the top and shall be accessible after tanks are installed.

16. LIFTING DEVICES

16.1 The Contractor shall furnish and install trolley beams and/or lifting eyes supported from the building structure as indicated to facilitate handling equipment, parts replacement, repairs and servicing.

16.2 Lifting eyes or U-bolts shall be of ample size for weight to be moved and shall be secured to the building structure at a location and in a manner satisfactory to the Owner. Trolley beam locations must be coordinated with piping and equipment layout and installed in a usable position free of interference with movement of suspended equipment or parts.

17. PACKAGED EQUIPMENT

17.1 Where packaged (factory assembled) mechanical and electrical equipment is furnished, a certificate shall be included with the submission of shop drawings or catalog data stating that the equipment complies with the National Electrical Code and applicable Underwriters' Laboratories Standards in respect to motor protection, grounding and protection against hazards.

17.2 Control circuits which do not extend beyond the packaged equipment may have control voltage other than 120 volts.

18. VIBRATION ISOLATION AND SOUND ATTENUATION: Mechanical equipment and associated piping and ductwork shall be mounted on vibration isolators as required to minimize transmission of vibrations and structure-borne noise to building structure or spaces.

Equipment and appurtenance noise transmission levels shall not exceed the sound pressure levels in the nine frequency bands as set forth by OSHA.

SECTION 15B PIPING SYSTEMS

EXCEPT PLUMBING

1. GENERAL REQUIREMENTS: This section of the specification covers all steam and process piping for the complete installation as shown, or as required, including, but not limited to the following.

- 1.1 Piping, tubing and fittings.
- 1.2 Valves.
- 1.3 Steam Traps and strainers.
- 1.4 Expansion joints and other specialties.

2. CONSTRUCTION AND WORKMANSHIP: All piping shall follow the general arrangement shown and shall be installed without springing or forcing, except where cold-springing is specified. Adequate clearance shall be provided from walls, ceilings and floors to permit the welding of joints. Unions or flanges shall be provided to facilitate dismantling the piping. Changes in size of steam mains shall be made with eccentric reducers or at suitable drip points. Piping shall not be buried, concealed, or insulated until it has been inspected, tested and approved.

3. MATERIALS

3.1 Steam Piping: Carbon steel, ASTM A-106, Seamless Grade B, Schedule 40, with screwed steel fittings, ANSI B16.11 up to 2 inches and welded steel fittings (MIL-F-18180) up to 24 inches.

3.2 Condensate Return: Carbon steel ASTM A-53, lap or butt welded, Grade B, Schedule 80; fittings as specified for steam piping.

3.3 Cold Water Supply: Type "K" copper (ASTM B88) with wrought copper sweat fittings.

3.4 Vents, drains, cooling water, and other piping: Carbon steel ASTM A-53, Grade B. Vents and drains shall be galvanized.

3.5 Fittings over 2 inches shall be welded and fittings 2 inches and smaller shall be forged steel, socket welded or screwed.

3.6 Unions: 3000 lb. unions shall be used where shown and at all connections to equipment not provided with flanges.

3.7 Flanges shall be in accordance with the service requirements.

3.8 Gate valves over 2-inch size shall be cast steel for steam service.

3.9 Valves for other services shall be IBBM for sizes over 2 inches. Valves 2 inches and smaller shall be bronze or cast steel. All valves shall have rising stems.

3.10 Gaskets shall be asbestos, spiral wound with copper for high pressure and shall be pressed asbestos for low pressures. Gaskets for low temperature water service shall be rubber.

3.11 Strainers shall be cast steel body with monel screens for high pressure service and cast iron or bronze, depending on size, for low pressure service.

4. INSTALLATION: Horizontal line of steam and return piping shall be installed to grade down in the direction flow. Condensate return systems shall be arranged to permit drainage of the system at all low points. All other lines shall be installed to drain back to source.

All piping shall be anchored and supported in a manner such that expansion and contraction will take place in the direction desired, vibration will be prevented and undue strains on equipment served will be avoided.

5. EXPANSION JOINTS: The Contractor shall make provision for thermal expansion and furnish all expansion joints, flexible metallic hose, vibration isolators and bellow joints as indicated and as required for system flexibility. Packless expansion joints shall conform to specification MIL-E-1781B.

6. STEAM TRAPS: All steam traps shall be inverted bucket type and shall be equipped with integral check valves or be installed in series with external check valves. Traps shall be installed with "Y" strainers and by-pass. Traps shall have a minimum capacity of three times the sustained calculated design condensate flow except where shown. Air traps shall have float-controlled valves arranged to close

promptly when water enters the traps. Air traps shall conform to the requirements for float-operated steam traps (non-thermostatic), Federal Specification WW-T-696, except that the valve mechanism shall be inverted so as to be closed, not opened, by rising water.

7. TESTING: All equipment piping shall be subjected to pressure testing. All equipment and apparatus necessary for the tests shall be furnished by the Contractor. All defects disclosed by the tests shall be rectified by the Contractor without delay. Tests shall be made subject to the prior approval of the Owner who will furnish steam, water, oil, compressed air and electric current for tests. Preparation for testing shall include thorough flushing and cleaning of all piping systems. Temporary strainers shall be used to protect all equipment and appurtenances from sediment and scale. Permanent strainers may be used, but screens shall be cleaned after testing.

8. Use dielectric unions or flanges where dissimilar metals are joined.

SECTION 15C PLUMBING

1. GENERAL REQUIREMENTS: The work to be performed under this section of the specifications consists of providing all labor, material, equipment supervision, tools and services for the complete plumbing installation as shown and/or as herein specified or reasonably implied.

All plumbing material and the installation shall be in accordance with the current edition of the plumbing code of the D.C. Department of Economic Development and the Plumbing Code for the Washington Metropolitan Area. The plumbing work shall include, but shall not necessarily be limited to the following.

- 1.1 Pipe and Fittings.
- 1.2 Floor drains.
- 1.3 Roof drains..
- 1.4 Testing.
- 1.5 Fixtures and accessories.
- 1.6 Valves.

2. VACUUM BREAKERS: Where indicated or otherwise required, vacuum breakers shall be installed and set at least 4 inches above the flood level of equipment or fixture rims to prevent contamination of water supply.

3. STERILIZATION: AT the completion of construction all lines shall be flushed and sterilized at the expense of the Contractor in conformance with AWWA C601, A Standard Procedure for Disinfecting Water Mains. After final flushing a test shall be made of the residual chlorine content of the water and submitted to the Owner for approval.

4. TESTS

4.1 All piping and equipment shall be tested as specified. Labor, materials instruments, power etc., required for testing, shall be furnished by the Contractor, unless otherwise indicated.

4.2 Test shall be performed in the presence of the Engineer and all authorities having legal jurisdiction.

4.3 In general, pressure tests shall be applied to piping only, before connection of equipment and appliances. In no cases shall any piping, equipment or appliances be subjected to pressures exceeding their rating.

4.4 All defective work shall be promptly repaired or replaced and the test shall be repeated until the particular system and component parts thereof receive the approval of the Engineer.

4.5 Any damages resulting from tests shall be repaired and/or damaged materials replaced, all to the satisfaction of the Engineer.

4.6 The duration of the tests shall be as determined by all authorities having jurisdiction, but in no case less than the time prescribed in each subdivision of the specification.

5. PIPING

5.1 All piping shall be grouped wherever practical, installed in straight, parallel lines, arranged and aligned in a uniform direct manner. All changes in direction of piping and sizes shall be made with fittings.

5.2 Pipe lines shall be guided, supported and anchored in such a manner that pipe lines shall not creep, sag or buckle.

5.3 All piping subject to stresses shall be anchored. Anchors shall be located where indicated on the drawings, and where necessary to control the direction and the movement of the pipe.

5.4 All piping to equipment shall be connected with either flanged or union connection for dismantling and removal.

5.5 All piping shall be reamed after cutting. All joints, when completed, shall be thoroughly cleaned of all excess pipe joint materials. Soldered joints shall be cleaned smooth with fine sandpaper.

5.6 Face or flush bushings, close nipples or street ells shall not be used.

5.7 Cleanouts shall be placed at all changes in direction, and shall be accessible.

5.8 Traps shall be provided for each fixture and piece of equipment requiring connection to drainage system. Traps shall be placed as near to the fixture as possible and no fixture shall be double trapped.

5.9 Piping shall be as follows:

5.9.1 Domestic hot and cold water: Type "L" Copper ANSI H 23.1-1967 with wrought bronze solder joint fittings.

Soil and waste piping: Extra Heavy Cast Iron with bell and spigot caulked fittings.

Sanitary vent: Galvanized Steel, Schedule 40 with galvanized malleable iron screwed drainage fittings.

5.10 Valves

5.10.1 Furnish and install valves as shown and as required.

5.10.2 Valves shall be installed only in vertical or horizontal positions unless specifically otherwise required by the drawings.

5.10.3 All valves shall be installed in accessible locations to facilitate easy removal for repair or replacement.

5.10.4 All valves shall be designed for repacking when wide open under pressure.

5.10.5 All valves shall be the product of one manufacturer and shall be Fairbanks, Jenkins, Crane or approval equal.

5.10.6 Gate Valves: All bronze, solid wedge threadless gate valves for brazed joint.

5.10.7 Globe Valves: All bronze with renewable composition disc and union bonnet, threadless globe valves for brazed joint.

5.10.8 Check Valves: All bronze swing check, solder end, 150 lbs., with regrinding bronze disc, screw-in cap.

6. FLOOR DRAINS: Cast iron with double drainage flange, weep holes, bottom outlet, round top and deep set tractor grade. Drain shall have caulking bottom outlet.

7. ROOF DRAINS: Cast iron with large sump and flange, bottom outlet, removable beehive dome and bolted flashing clamp device integral with gravel stop.

SECTION 15D HEATING AND VENTILATING

1. GENERAL REQUIREMENTS: The Contractor shall furnish and install all materials, tools, equipment, labor, and rigging as required for the installation of all heating and ventilating systems and related work as shown or specified.

2. DUCTWORK shall be galvanized steel and shall be in accordance with the SMACNA standards for low pressure ductwork.

3. FANS

3.1 Centrifugal exhaust shall be unit blower type complete with belt drive and weather cover which will also serve as a belt guard. Fan shall be provided with flanged outlet and inlet, drain and access door. Fan shall be similar to Buffalo belted vent sets.

3.2 Roof Exhaust Fan shall be low silhouette, belt driven with backward curved centrifugal wheel, weathertight aluminum construction complete with prefabricated curb, bird-screen, and disconnect switch.

4. AIR HANDLING UNITS: Furnish and install where shown a complete air handling unit similar to Trane Torrivent, complete with filter box and filters, dampers, heating coil, coil by-pass section, motor and belt drive.

5. GRAVITY ROOF VENTILATORS: Furnish and install ventilators similar to Swarthout "Lite-n-Aire". Ventilators shall have fusible links to provide for heat release in case of fire. Vents shall be provided with plastic blades to permit entry of light to space below.

6. AIR FILTERS: Furnish and install in all air handling units air filters complete with required corrosion resistant steel frames and clamps, gasketed and sealed to prevent air by-pass with space to retain a 2 inch thick prefilter on the entering air side. Main filter shall be American Air Filter, Dri-Pak 85% efficiency, or approved equal. Each filter bank shall be provided with a filter gauge.

7. AIR OUTLETS: The Contractor shall furnish and install all supply and return air outlets as shown. Registers, grilles, and diffusers shall be tightly fitted to ducts and to the ceiling and wall surfaces. Gaskets shall be used to prevent leakage at edges of diffusers, registers and grilles where installed on finished surfaces.

8. AUTOMATIC TEMPERATURE CONTROLS: The Contractor shall furnish a system of pneumatic or electric controls for the operation of the air conditioning, heating and ventilating systems. Smoke detection devices shall be included on all supply air systems.

9. BAGHOUSE FILTER: Provide baghouse filters to act as bin vents for the ash silos. Casing shall have flanged open bottom for attachment to silos with captured material falling directly into silos. Provide a screen at the opening to prevent bags and tools from entering silos. Housings shall be all welded construction, shipped in one piece ready for attachment of bags after setting in place. Bags shall be Nomex; reinforced as required by the manufacturer. Cleaning cycle shall be activated by a pressure differential switch that shall cause an entire cleaning cycle before resetting to await a new high differential pressure. Coat inside and out of all housings or casings with low glass epoxy suitable for exterior service.

10. VENT BLOWER: Provide a vent blower for use in connection with the ash unloading spouts. Blower shall be direct-connected to a 3500 rpm motor and the entire assembly shall be mounted on rubber-in-shear fibration structural frame isolation base. Fan wheel shall be sparkproof construction. Wheel shall be radial blade type capable of handling dry, dust-laden air at a maximum temperature of 400°F.

SECTION 15E FIRE PROTECTION SYSTEM

1. GENERAL REQUIREMENTS: The Contractor shall furnish and install all materials, tools, equipment, and labor required to install all fire protection systems and related work shown or specified.

2. Provide Class ABC fire extinguishers securely mounted against wall as shown.

SECTION 15F INSULATION

1. GENERAL: The Contractor shall insulate all piping, ductwork, and equipment as described. All insulating and finishing materials, including coatings, adhesives, vapor barriers, jackets, cements, and mastics shall conform to the requirements of all local codes and ordinances.

1.1 Insulation shall be applied only after piping and equipment have been tested. Apply insulation only over clean, dry surfaces, from which all dirt, oil, water, etc., have been removed.

1.2 All insulating materials shall be installed in accordance with the manufacturer's recommendations.

2. FIRE HAZARD RATING: Insulation shall not exceed 25 for flame spread and shall not exceed 50 for smoke developed in accordance with ASTM B-84.

3. PIPING INSULATION

3.1 Steam Piping: Asbestos-free calcium silicate or mineral fiber board of required thickness.

3.2 Low Temperature Piping: Fiberglass with fire retardant jacket. Cold Water piping to be provided with vapor barrier jacket.

3.3 Insulation Jacketing: Furnish and install over piping insulation an aluminum jacket not less than 0.16 inches thick with a low profit surface.

3.4 Fittings: Fittings shall be wrapped with glass cloth and coated with light gray mastic.

SECTION 15G STORAGE SILOS AND MECHANICAL EQUIPMENT

1. GENERAL: The work to be performed under this section includes the addition to an existing pneumatic conveying system, furnishing and installing storage silos to receive the conveyed material, and the mechanisms and associated chutes to discharge the material after storage.

2. APPLICABLE PUBLICATIONS

2.1 The latest edition of the following publication form a part of this specification to the extent indicated by the references thereto:

2.2 American Society for Testing and Materials (ASTM):

A36-75	Structural Steel
A63-76	Welded and Seamless Steel Pipe
A307-76b	Carbon Steel Externally and Internally Threaded Standard Fasteners

2.3 American Iron and Steel Institute (AISI):

Stainless and Heat Resisting Steels,
December 1974

2.4 American Welding Society (AWS) Standards:

D1.1	Structural Welding Code
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2.5 Federal Specifications:

TT-P-86G	Base, Red-Lead-Base, Ready-Mixed
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2.6 Military Standards:

MIL-STD-22D	Welded Joint Design
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3. WELDING

3.1 Welding shall be performed by welders certified in accordance with AWS Code D1.1. Certificates of welders by an independent testing laboratory shall be furnished to the Construction Manager before welding is performed.

3.2 Welding rod shall be compatible with the base metal and shall be submitted to the Construction Manager for approval with a description of the welding procedure to be followed.

3.3 Welding of pieces meeting at or about 90 degrees shall be in accordance with Military Standard 22, double fillet welded corner joint, type C2S.2, with both the inner and outer fillets of equal throat dimension. Throat shall be same as wall thickness.

3.4 Inner liner sheets shall be plug welded to the side walls in conformance with Military Standard 22, lap joint type LiV.1. Plugs shall be spaced no more than 24 inches on center, horizontally and vertically. Inner liner sheet shall be seal welded to base metal at splice joints to prevent dust from entering between liner and base sheet.

3.5 All welds shall be ground smooth.

4. BOLTING

4.1 Bolts shall be 5/8-inch minimum diameter in conformance with ASTM A307.

4.2 Bolt heads and heavy nuts shall be hexagonal shape.

4.3 At least two full threads shall remain exposed after joints are made up.

4.4 Bolt holes shall match spacing on equipment flanges. Matching chute flanges shall have spacing 7 inches maximum center-to-center.

5. PNEUMATIC CONVEYING SYSTEM

5.1 Material already installed was furnished by the Ducon Company and includes: pipe, fittings, couplings, special material handling valves, positive displacement blowers, air pollution control devices and associated fans and controls. The system is controlled from a panel in the existing Boiler Room and is known as the Solids Removal Control Panel (SRCP).

5.2 The Contractor shall obtain materials and equipment from the sole source and incorporate them into the working system as shown.

6. STORAGE SILOS

6.1 Silos shall be located as shown on structural supports by others. All base plates, shims, and grout required for proper leveling of the assembled silos shall be provided.

6.2 Silos shall conform to the dimensions shown. Dimensions are generally to the inside of plate, exclusive of liners.

6.3 Internal sloped walls shall be blast cleaned and coated with two 5-mil coats of Phenoline 372 as manufactured by Carboline or equal. The balance of the bin interior shall be coated with red lead conforming to Specification TT-P-86. External portions of bins shall be painted with the same red lead primer. Lined portions of bins shall not be painted.

7. CHUTES

7.1 Chutes shall conform to dimensions and shapes as shown. Dimensions shown are to inside of chute plates.

7.2 Minimum wall and flange thicknesses shall be 1/4-inch.

7.3 Flanged connections shall be formed from structural angles or bars with faces ground smooth. Final field connections shall be made using an elastomeric compound as a sealant to provide a dusttight connection. Compound shall be compatible with the material conveyed. Furnish one gallon of each different type to the Construction Manager, for use by the Owner.

7.4 Chutes shall be all welded construction, however the Contractor may, at his option, bend plates to form corners with only one side of a rectangular chute welded in place.

7.5 Where pipe is shown, the Contractor shall use ASTM A53 Grade B seamless steel pipe, schedule 40 minimum.

8. SHOP DRAWINGS

8.1 The Contractor shall submit shop drawings in accordance with SECTION 1C - SPECIAL PROVISIONS. Shop drawings shall be furnished for each chute and silo. Detailed drawings shall be at a scale no less than 3/8" - 1'-0".

9. MASS SCREW CONVEYOR

9.1 GENERAL CONSTRUCTION

9.1.1 The design, materials and construction shall meet all requirements for conveying and discharging the stated materials at the rate and conditions state in the data.

9.1.2 The design, materials and construction shall be in accordance with the Vendor's standard practice or recommendation for the intended service unless the requirements listed below preclude their use.

9.1.3 Grease lubrication fittings, when furnished, shall be standard Alemite hydraulic type. All bearings shall be adequately lubricated to protect against corrosion during shipment.

9.1.4 Drives shall have sprockets with quick-detachable type hubs. If applicable, coupling guards shall be furnished. Exposed shaft ends shall be covered to provide personnel protection. Provide spring held covers over tachometer reading ports.

9.1.5 Motors shall be squirrel cage induction type, 3 phase, 60 Hertz, 230/460 volts, 40 C ambient, ball bearing, horizontal, continuous duty, Class B insulation, NEMA design B with TEFC enclosures. When required, slide rails shall be furnished with the motor.

9.1.6 A speed switch shall be furnished and installed with a lock-out solenoid in a NEMA 12 enclosure, to monitor conveyor shaft speed. Include a speed reducer to insure contact closure.

9.1.7 Surfaces normally painted shall be cleaned, primed and finished with a top coat of Vendor's standard color. Other surfaces subject to corrosion shall be coated with a corrosion preventative that is readily removable with a commercial solvent.

9.2 DESIGN CRITERIA

Installation:	Outdoors
Service:	24 hours per day, 7 days per week
Material:	Fly ash sized 500 microns and less Bed material sized $\frac{1}{2}$ x 0 inches
Bulk Density:	Fly ash at 30 lb/cu ft Bed material at 60 lb/cu ft
Material	
Characteristics:	Abrasive
Temperature:	Ambient
Flow Rate:	Either material may be moved by any screw at the rate of 60 tons per hour

9.3 CONSTRUCTION FEATURES

9.3.1 Flights shall be helicoid with variable pitch set on a variable cone shaft.

9.3.2 Trough shall have flanged opening.

9.3.3 Trough ends shall be outside type with feet, supporting pillow block with outside dust seal.

9.3.4 Intermediate shaft supports are not permitted.

9.3.5 Flights and shaft shall be carbon steel.

9.3.6 Trough and cover shall be 1/4-inch thick Corten steel or approved equal with flat roof design. Cover shall be bolted in place and seams gasketed or sealed by other approved means to effect a dust tight enclosure.

- 9.3.7 Belt drive shall have a 1.2 service factor.
- 9.3.8 Motors shall be located as shown.
- 9.3.9 Drive unit shall be shaft mounted, spur gear type. Belt shall be positive drive type.

10. ASH LOADING SPOUT

10.1 GENERAL CONSTRUCTION

10.1.1 The design, materials and construction shall meet all requirements for conveying and discharging the stated materials at the rate and conditions listed below.

10.1.2 The design, materials and construction shall be in accordance with the Vendor's standard practice or recommendation for the intended service unless the requirements listed below preclude their use.

10.1.3 Grease lubrication fittings, when furnished, shall be standard Alemite hydraulic type. All bearings shall be adequately lubricated to protect against corrosion during shipment.

10.1.4 If applicable, coupling guards shall be furnished. Exposed shaft ends shall be covered to provide personnel protection.

10.1.5 Motors shall be squirrel cage induction type, 3 phase, 60 Hertz, 230/460 volts, 40 C ambient, ball bearing, horizontal, continuous duty, Class B insulation, NEMA design B with TEFC enclosures. When required, slide rails shall be furnished with the motor.

10.1.6 Surfaces normally painted shall be cleaned, primed and finished with a top coat of Vendor's standard color unless otherwise specified. Other surfaces subject to corrosion shall be coated with a corrosion preventative that is readily removable with a commercial solvent.

10.2 DESIGN CRITERIA

Installation:	Outdoors
Service:	24 hours per day, 7 days per week
Material:	Bed material and fly ash
Bulk Density:	Fly ash 30 lb/cu ft, bed material 60 lb/cu ft
Material	
Characteristics:	Abrasive
Temperature:	Ambient to 300 F

10.3 CONSTRUCTION FEATURES

10.3.1 Each unit shall be designed for dust free operation. A connection shall be provided on the stationary portion of the assembly for a vacuum dust removal system.

10.3.2 The spout shall be capable of a 5 foot vertical travel.

10.3.3 An automatic level sensing device shall be provided to stop associated screw conveyor when the truck is full.

10.3.4 All components in contact with the ash being handled shall be constructed of abrasion resistant material.

10.3.5 Other accessories shall include slack cable switch and limit switch.

10.3.6 Lifting speed shall be approximately 40 feet per minute.

SECTION 15H CONTROLS AND INSTRUMENTATION

1. GENERAL REQUIREMENTS: Furnish and install all instruments and controls specified as shown.
2. INSTALLATION: The Owner will furnish various instruments and controls as shown. The Contractor shall install same in accordance with Manufacturer's instructions. The Contractor shall provide all miscellaneous clamps, hangers, supports and the like to make a complete and workmanlike installation.
3. PIPE, FITTINGS AND VALVES: The Contractor shall use three piece flareless fittings for use in connecting all instruments requiring compressed air service. Tubing shall be type K copper unless otherwise specified. Tubing shall be bent using tools especially designed for this purpose.
4. TESTING BEFORE OPERATION: All work installed by the Contractor shall be tested for air tightness. Instruments furnished by the Contractor shall be tested as required under Mection 15J of this specification.
5. TESTING DURING OPERATION: All instrumentation shall be observed during operation. Instrumentation provided by the Contractor that does not perform in accordance with specification shall be repaired or replaced immediately. Instrumentation furnished to the Contractor by the Owner that fails during operation shall be removed by the Contractor for action by the Owner.
6. PRESSURE INDICATORS: Shall be locally mounted, blow-out back, phenolic case type with shut off valve and syphon if required.
7. THERMOMETERS: Shall be glass encased red reading mercury with separable sockets. Wells shall have sufficiently long neck to meet insulation specified thickness.
8. INSTRUMENT PANEL: Provide a panel for mounting of recording equipment and indicators as shown. Panel shall

be free standing NEMA type 12 with a full height hinged rear access door. Instruments shall be flush mounted on the face. Enclosure shall be 12 gauge, reinforced as required, complete with top and bottom panels. Interior shall be painted white and exterior shall be grey primed with a final coat of oil-resistant tan epoxy. All wiring shall be brought to a numbered terminal strip, with corresponding numbers taped on the connected wiring. Conduit shall be arranged for top entry. Provide lamicaid nameplates. Panel shall have filtered vent openings on each side at top and bottom.

8.1 RECORDER: Provide two-pen recorders as shown. Charts shall be four-inches high, permitting a horizontal trace. Approximately six hours of operation shall be visible.

8.2 INDICATOR: Provide integrators and running time indicators as shown. One running time indicator shall be resettable and one fixed. Time indicators shall register up to 99,999.9 hours. Integrator shall have six digits.

9. FIELD INSTRUMENTS: Provide field transmitters to actuate panel instruments.

9.1 Flow elements shall be 316 stainless steel orifice plates, complete with orifice flanges for welding into lines. Flow transmitters shall be complete with 3-valve manifolds, and be compatible with a 4 to 1 turndown. Transmitted signal shall be 4 to 20 mA, linearized either at the instrument or at the recorder.

9.2 Pressure transmitters shall be installed complete with isolation valve directly adjacent to the transmitter. Signal shall be 4 to 20 mA.

9.3 Temperature transmitters shall be thermocouples type K installed in weatherproof carbon steel wells. Wells shall be selected to assure proper sensing in process line and with due regard for thickness of insulation.

SECTION 15J MECHANICAL EQUIPMENT ACCEPTANCE TESTING

1. GENERAL REQUIREMENTS: The Contractor shall provide labor, materials, tools, and equipment as required to perform a complete acceptance testing program on all sub-systems, complete systems, and finally the entire new plant. The Contractor shall instruct Owner's personnel in use of Contractor furnished equipment after tests have been accepted.

2. PRELIMINARY ACCEPTANCE PROCEDURES

2.1 In starting up the system or any of its components, adhere to procedures that assure a complete, safe and efficient operating plant. Procedures shall include, but not be limited to, the following.

2.2 Strip off all protective coating and clean equipment of dirt and grease. Touch up or restore finish where required.

2.3 Inspect bearings for cleanliness and alignment and remove any foreign materials found. Grease and oil as necessary and in accordance with the manufacturer's recommendations. Replace bearings that run rough or noisy.

2.4 Adjust tension in V-belt drives, adjust variable pitch sheaves and drives for proper equipment speed, change belts and sheaves if necessary to obtain proper equipment speed, remove any foreign materials from sheaves or belts before starting operation, adjust drives for alignment of sheaves and V-belts.

2.5 Adjust direct drives for proper alignment of flexible couplings, provide lubrication if a particular coupling so requires, check security of couplings to drives and driven shafts, set drive components to assure free rotation with no undesirable stresses present on the coupling or attached equipment.

2.6 Check each motor for amperage comparison to nameplate value. Correct any conditions that produce excessive current flow and that exist due to equipment malfunction. Check the speeds and rotation of each motor and piece of driven apparatus to assure that they are operating at the desired point.

2.7 Check pump packing glands or mechanical seals for cleanliness and adjustment before running pump. Inspect shaft sleeves for scoring and proper placement of packing and replace if necessary. Inspect mechanical faces,

chambers and seal rings and replace if necessary. Make sure the piping system is free of dirt and scale before circulating liquid through the pumps. Check all seal, cooling and flush water connections and make sure of water supply at the proper pressure. Check all drains.

2.8 Inspect both hand and automatic control valves, clean bonnets and stems, tighten packing glands to assure no leakage but permit valve stems to operate without galling. Replace packing in valves as required to retain maximum adjustment after system is judged complete. Replace entire packing in any valve that continues to leak after adjustment, remove and repair bonnets that leak, coat packing gland threads and valve stems with a surface preparation similar to molybdenum disulfide after cleaning.

2.9 Inspect and make certain that all control valve seats are free from foreign material and are properly positioned for the intended service.

2.10 Tighten flanges and packing glands after the system has been placed in operation. Replace gaskets in flanges that show any signs of leakage after tightening.

2.11 Inspect screwed joints for leakage and remake each joint that appears to be faulty. Do not wait for rust to form. Clean threads on both parts, apply compound and remake joints.

2.12 Clean strainers, dirt pockets, orifices, valve seats and headers in all fluid systems after the system has been placed in operation to assure their being free from foreign materials.

2.13 Remove rust, scale and foreign materials from equipment and renew any defaced surfaces. If equipment is badly marred, provide new materials.

2.14 Inspect each pressure gauge for calibration and replace those that are defaced, broken or read incorrectly. Calibration tag shall be tied to each pressure gauge showing date of test, test data and name of tester.

3. EQUIPMENT AND SYSTEMS TESTING

3.1 The Contractor shall perform all testing of individual equipment items, as well as subsystems and complete systems, in accordance with the acceptance testing procedure prepared by the Owner's Engineer. All testing shall be completed within the construction period. Testing shall be performed by the Contractor on all Owner-furnished and Contractor-furnished equipment and systems. The Contractor shall assist in the testing of the turbine generator by operating all Owner furnished Contractor installed, and Contractor furnished equipment, required to demonstrate performance.

3.2 Testing of Owner-furnished equipment shall be supervised by the equipment manufacturer's representatives to the extent set forth in the acceptance testing procedure.

3.3 Deficiencies caused by the Contractor shall be promptly corrected by the Contractor at no additional cost to the Owner.

3.4 The Contractor shall maintain complete records of all testing on forms approved by the Engineer. Five copies of all accepted test results shall be turned over to the Engineer within 7 days following acceptance of the respective tests.

3.5 The Contractor shall notify the Engineer not less than 48 hours prior to each proposed test. The Engineer reserves the right to witness any and all tests.

SECTION 16A

ELECTRICAL WORK

1. WORK INCLUDED

1.1 This section of the specification includes the furnishing and installation of the complete power, lighting, controls and alarms of the electrical systems for the turbine-generator installation, added ash storage installation, and associated work.

1.2 The work includes, but is not limited to, the following principal systems and equipment.

1.2.1 The electrical installation and connection of an Owner-furnished steam turbine generator and associated switch-gear and alarms.

1.2.2 The furnishing and installation of 2-way, 4-inch duct between manhole SE-19 and turbine-generator room.

1.2.3 The furnishing and installation of two motor control panelboards; and feeder circuit breakers for the motor control panelboards in an existing motor control center.

1.2.4 The wiring of all electrical driven or controlled equipment associated with the installation, including power, controls and grounding.

1.2.5 The furnishing and installation of a lighting system extension into the new spaces and to the added ash storage area.

1.2.6 The furnishing and installation of an extension to the Solids Removal Panel in the existing Heating and Cooling Plant.

2. GENERAL REQUIREMENTS

2.1 The Contractor shall submit proof, if requested by the Engineer, that the materials, equipment or devices that he furnishes and installs under this contract, meet the requirements of the Underwriters' Laboratories, Inc. as regards fire and casualty hazards.

2.2 The installation shall conform to the requirements of the current issue of the District of Columbia Electrical Code and the National Safety Code.

3. ELECTRICAL POWER OUTAGES

Electrical power outages, if required, shall be scheduled in accordance with Specification Section 1C.

4. PRIMARY ELECTRICAL SERVICE WORK

4.1 Primary cable shall be stranded single conductor, shielded, 15kV, type EPR (ethylene-propylene-rubber-insulated) with copper conductors.

4.2 Primary cable splices in Manhole SE-19 shall be made to existing 3-way cable tap boxes utilizing the unused terminal.

4.3 Primary cable terminations shall be made using stress relief cones Elastimold Model 35 MSC or approved equal.

4.4 Arcproofing shall be applied to all exposed primary cables and splices in Manhole SE-19.

4.5 New underground duct shall be 4-inch asbestos cement duct, concrete encased.

5. CONDUIT AND FITTINGS

5.1 Exposed conduit shall be either rigid galvanized steel or rigid aluminum, but not a combination of both. Conduit installed below the building slab or conduit passing through concrete shall be rigid steel only.

5.2 Short lengths of flexible conduit or portable cable, as indicated, shall be used to make connections at motors and other equipment subject to vibration.

5.3 Fittings for steel conduits shall be made of malleable iron. Fittings for aluminum conduits shall be made of malleable iron or aluminum alloy.

5.4 Bushings shall be grounding type, insulated grounding type.

5.5 The minimum size conduit installed shall be 3/4-inch.

5.6 Conduit supports shall be in accordance with applicable Code.

5.7 Conduit penetrations through existing or new floors or walls shall be patched to match adjacent surfaces.

6. EXPANSION FITTINGS

Each conduit that is rigidly secured to the building construction on opposite sides of an expansion joint, or to long runs that may be subject to excessive stresses, shall be provided with an approved expansion fitting.

7. OUTLET BOXES

Outlet boxes, provided as required for switches, outlets, etc., shall be cast metal with matching gasketed cover plates.

8. JUNCTION BOXES AND PULL BOXES

Junction and/or pull boxes shall be furnished in accordance with NEC requirements. Boxes with an internal volume of less than 150 cubic inches shall be cast metal with matching gasketed covers. Boxes of greater than 150 cubic inches of volume shall be galvanized steel with covers secured by screws.

9. WIRES AND CABLES (600 VOLT INSULATION)

9.1 All conductors shall be copper. Aluminum is not acceptable. Insulation shall be type THW or cross linked polyethylene. Conductors for installation in high temperature areas shall be types AVA, SF-2 or MI. For power and control wiring operating at 110 volts to ground or greater, the minimum size conductor shall be No. 12 AWG.

9.2 Conductor splices or joints shall be made with approved pressure or compression type fittings.

10. CABLE IDENTIFICATION

10.1 All power feeders shall be identified in accordance with the feeder schedule on the drawing in each pull box, switchboard, panel and point of termination.

10.2 Control wires shall bear the wire number identification at both ends.

11. COLOR CODING

All secondary conductors, feeders and branch circuit shall be color coded as follows:

<u>208Y/120 Volts</u>	<u>Phase</u>	<u>480Y/277 Volts</u>
Black	A	Yellow
Red	B	Brown
Blue	C	Orange
White	Neutral	Gray
Green	Ground	Green

12. GROUNDING

The entire installation shall be grounded in accordance with NEC requirements. In addition to NEC requirements, grounding conductors shall be provided with each feeder and branch circuit for 277/480 volt systems. Building steel, the turbine generator and other major equipment shall be grounded.

13. WIRING

13.1 All wiring shall generally be installed in rigid metal conduit.

13.2 Control, signal and alarm wiring shall not be installed in the same raceways as power wiring.

14. PANELBOARDS

Panelboards for lighting shall contain molded case circuit breakers. The interrupting ratings of the circuit breakers shall be coordinated with available fault currents.

15. MOTOR CONTROL PANELBOARDS

Furnish and install Motor Control Panelboards sized and located as shown in the plans. 225 Ampere main lugs shall be provided. Motor starters to be combination type using molded case circuit breaker. Motor Control Panelboard in Ash Handling area shall have outdoor weatherproof NEMA Type 3 enclosure. Motor Control Panelboard in turbine-generator room shall have indoor NEMA Type 2 enclosure. Panelboards shall be GTE Sylvania type CMC-CDP or approved equal.

16. DISCONNECT SWITCHES

Motors shall be provided with local heavy duty disconnect switches in NEMA 12 enclosures. Where indicated on the elementary diagrams, such switches shall be furnished with an integrally mounted disconnect switch interlock device.

17. DRY TYPE TRANSFORMERS

Small dry type 480-208/120 volt transformers shall be provided for 120 volt and/or 208 volt requirements.

18. RECEPTACLES

Convenience receptacles shall be of the grounding type.

19. SOLIDS REMOVAL PANEL EXTENSION

The Solids Removal Panel Extension shall match the existing panel in height and depth and be of similar construction and finish. Annunciator shall match existing.

20. LIGHTING

Lighting throughout the Turbine-Generator plant addition shall consist of two lamp 8 foot industrial fluorescent fixtures similar to the fixtures in the existing plant. Outdoor lighting shall be high pressure sodium vapor similar to that existing in the AFB Plant.

21. INTERCOMMUNICATIONS SYSTEM EXTENSION

The additional intercommunications handset stations and loudspeakers shall be identical with those installed in the AFB plant and shall be connected to the same system.

22. FIRE ALARM SYSTEM

The fire alarm system in the existing AFB plant shall be extended to cover the turbine-generator plant extension and the added ash storage area.

23. PROTECTIVE RELAY SETTINGS

The Contractor shall provide the labor and test equipment required to set and check each protective relay against settings provided by others.

24. BIN LEVEL SWITCHES

Level switches that are mounted from the roof of the ash storage bins shall be "Bindicator" type with revolving foil instead of the paddle wheel.

Level switches that are sidewall mounted shall be "Dynatrol" vibrating type.

25. LOCAL CONTROL AND INDICATIVE DEVICES

Local pushbutton, selector switch, pilot lights and similar devices shall be heavy duty, oil tight.

26. NAMEPLATES

The Contractor shall provide and install liminated, engraved nameplates on all principal electrical equipment.

27. TESTING

The Contractor shall perform tests on completed work including, but not limited to, the following:

- (1) Meggar testing of all feeders and branch circuits.
- (2) Meggar testing of motors.
- (3) Motor rotations.
- (4) Testing of all controls for proper operation.

GEORGETOWN UNIVERSITY
INTEGRATED COMMUNITY ENERGY SYSTEM
(GU - ICES)

PHASE III, STAGE II
PRELIMINARY DESIGN

APPENDIX B

TURBINE - GENERATOR
PREPURCHASE SPECIFICATION

POPE, EVANS AND ROBBINS

STEAM TURBINE SYNCHRONOUS GENERATION UNIT,
SWITCHGEAR AND ACCESSORIES

1. APPLICABLE PUBLICATIONS: The following publications of the issues listed below, but referred to thereafter by basic designations only, form a part of this specification to the extent indicated by references thereto:

1.1 American National Standards Institute (ANSI)
Publications:

C12-1965 (Rev. 1969)	Electricity Metering, Code for
C37.20-1974	Switchgear Assemblies and Metal-Enclosed Bus
C39.1-1972	Electrical Analog Indicating Instruments, Requirements for
C39.2-1964	Direct-Acting Electrical Recording Instruments
Z35.1-1972	Accident Prevention Signs, Specifications for
SI.4-1971 (R. 1976)	Specification for Sound Level Meters

1.2 American Society of Mechanical Engineers (ASME):

PTC 6-1976	Steam Turbines
PTC 20.3-1970	Pressure Control Systems Used on Steam Turbine Generator Units

1.3 National Electrical Manufacturers Association (NEMA):

ICS-1970 (R1975)	Industrial Control and Systems
MG 1-1978	Motors and Generators.
SG 4-1975	A.C. High-Voltage Circuit Breakers.
46-112 (R1971)	NEMA Standards for Speed and Pressure Control of Steam- Turbine Generator Units

1.4 Occupational Safety and Health Act of 1970 as Revised and Amended (OSHA):

Part 1910 (1972) Occupational Safety and Health Standards (19 CRF 1910):

2. NATURAL FREQUENCY: Natural frequency of any rotating part shall not be within 25 percent of the normal operating rotational speed.

3. GENERAL

3.1 This specification includes the requirements for furnishing a backpressure steam turbine synchronous generator unit with excitation system, generator totally enclosed, with water-air cooler, 13.8 kV switchgear, and accessories as herein specified; for furnishing the services of an erection supervisor to direct the installation by others; and for providing the services of a field test engineer to supervise start up testing. A single Vendor shall be responsible for the furnish and coordination of the steam turbine, generator, and switchgear including all protective devices, relays and recommendations for their proper settings.

3.1.1 The turbine generator shall be capable of operating as a single unit and of synchronizing and operating in parallel with the utility service of the Potomac Electric Power Company. After installation of the steam turbine generator, the Vendor shall provide supervisory personnel for field testing as specified below. The Vendor shall guarantee the satisfactory parallel operation with the utility and shall include in his bid all additional equipment and engineering services required to satisfy the guarantee.

3.1.2 All equipment required under this contract will be installed by the Owner under another contract, but under the direction of the turbine manufacturer's Erection Supervisor, whose services shall be included in the bid price.

3.1.3 The sound pressure levels around the turbine-generator unit at any point three feet from the equipment shall not exceed the sound pressure levels indicated by OSHA Section 1910 for continuous personnel exposure. After installation, during the operational test, the manufacturer

shall take readings using test procedures and equipment as outlined in ANSI Publication S1.4, Specification for Sound Level Meters. The A scale shall be used for overall sound level readings. Test data obtained after installation shall be certified by an approved testing laboratory and shall be submitted to the Owner for his records. All costs for testing and certification shall be borne by the Vendor.

3.2 Design

3.2.1 The unit shall be of the horizontal-shaft type, of a design and construction which has proven its durability, reliability, and design efficiency by units already in operation for a minimum period of five years.

3.2.2. The design of the unit shall be such that it will be capable of operating with either steady or varying load without undue vibration or noise.

3.3 Material and Workmanship: All materials shall be new and of a quality proven successful in their respective uses in similar service and under similar conditions. Workmanship shall be proven by submission of signed shop inspection certificates.

3.4 Painting and Shipping: All exposed unmachined surfaces shall receive one coat of paint before shipment. All parts shall be suitably prepared for shipment to protect the equipment against damage while in transit. Paint shall be Vendor's standard paint suitable for the temperature to which it will be exposed.

4. TESTING

4.1 Factory Tests: The turbine, generator and switchgear shall each be tested at the factory before shipment. Tests conducted at the factory shall include the following:

4.1.1 Turbine Tests: The turbine shall be operated under steam at no load and the following tests and observations shall be made:

4.1.1.1 Check the balance and general operation at rated speed and overspeed range.

4.1.1.2 Adjust the turbine control mechanism, and observe the operation of the speed governor and all other control devices.

4.1.1.3 Check the setting of the overspeed trip, operating at approximately 110 percent of rated speed, and all other safety devices.

4.1.1.4 Check the operation of the auxiliary oil pump and its controls.

4.1.2 Generator Tests: The no-load tests on the generator shall include:

4.1.2.1 Measurement of cold resistance of armature and field windings.

4.1.2.2. Mechanical inspection and balance.

4.1.2.3 No-load field current at rated voltage and frequency, voltage phase balance, phase sequence.

4.1.2.4 High-potential tests of stator and rotor.

4.1.2.5 Operation at 110 percent of rated speed.

4.1.2.6 Insulation resistance of field and armature.

4.1.2.7 Open circuit saturation curve (voltage versus exciter field amps).

4.1.3 In addition the Vendor shall, as a minimum, provide the following component tests:

4.1.3.1 Test of oil pumps.

4.1.3.2 Test auxiliary oil pump regulator.

4.1.3.3 Speed governor test and adjustment.

4.1.3.4 Emergency overspeed governor test and adjustment, simulating normal operating load.

4.1.3.5 Stop valve and throttle valve test.

4.1.3.6 Steam seal regulator test, if applicable.

4.1.3.7 Balance of turbine rotor and operation of turbine rotor to 110% of rated speed for at least three minutes.

4.1.3.8 Assembly of turbine for physical fit and alignment.

4.1.3.9 Physical and chemical analysis of major rotating parts.

4.1.3.10 Heat stabilization of rotor.

4.1.3.11 Ultrasonic test on rotor.

4.1.3.12 Non-destructive testing of buckets and rotor.

4.1.3.13 Hydrostatic test of high pressure turbine casing.

4.1.4 Switchgear Tests: Switchgear shall be subjected to the following tests as a minimum.

4.1.4.1 High potential tests of bus and breaker.

4.1.4.2 Functional tests of all instruments and alarms.

4.1.4.3 Set point, check point tests of all protective relays.

4.1.5 Owner Witness: The Owner reserves the right to witness any or all factory testing. The Vendor shall provide a minimum of 5 working days advance notice prior to his intended start of each test.

4.2 Tests After Installation:

4.2.1 Mechanical

4.2.1.1 Tests will be made by the Owner after installation of the turbine-generator unit to determine its steam consumption at various loads for comparison with guaranteed performance. Such tests will be made in accordance with the latest applicable rules of ASME and ANSI for conducting performance tests specifically, ASME PTC 6 and PTC 20.3.

4.2.1.2 The Vendor shall provide supervisory personnel to direct the performance of all tests. The Vendor shall provide the services of an approved Testing Laboratory to certify test gages and to take data during test runs. The Owner will supply steam and water for use during testing at the site and operating personnel.

4.2.1.3 During the initial field testing of the turbine, the Vendor shall obtain the signature analysis for vibration. Both the start up and normal spectrum shall be checked, and results recorded for future comparison. All records shall become the property of the University.

4.2.1.4 All test equipment and wiring required for the above shall be furnished by the Vendor.

4.2.2 Electrical

4.2.2.1 The Owner, under the supervision of the Vendor, will perform two groups of tests after the turbine generator installation is complete. The first group of tests will be performed prior to operating in parallel with the utility service. The generator circuit breaker shall be in its test position. The second group of tests will be performed operating in parallel with utility service. Such tests will be made in accordance with the latest applicable rules of ANSI and NEMA for conducting performance tests specifically, ANSI C37-20 and NEMA MG-1.

4.2.2.2 Prior to parallel operation, calibrate and set each of the protective relays associated with the switchgear furnished under this specification in accordance with the Vendor's recommendations. Operate each of the alarm and safety shut down devices associated with the steam turbine generator to insure their proper functions. Simulate fault or malfunction conditions for all relays and devices. Check the operation of the generator circuit breaker.

4.2.2.3 After all of the protective devices and alarms have been checked for proper operation, the new generator shall be synchronized with the existing 13.2 kV system. Tests shall ensure that the new generator can synchronize with and operate in parallel with the utility service. The parallel operation test will continue for an 8 hour continuous period. All tests shall be supervised by the Vendor. If any malfunctions occur during the test period, corrective actions will be taken as recommended by the Vendor, and the 8 hour test repeated. The Vendor shall bear the cost of corrective action required to meet the specification requirements.

5. SHOP DRAWINGS

5.1 Within 60 days after contract award, the Vendor shall furnish outline arrangement drawings and associated notes which fix the final dimensions, locations, and connections of the turbine, generator, oil tank, exhaust, switchgear, and all other major equipment and interfaces with connecting equipment piping and controls. Drawings shall provide all loading information including vertical and horizontal static and dynamic loads, to properly support the equipment. Method and location of supports shall be indicated. Piping forces,

moment limitations, expansion and entrapped energy data shall be furnished. The Vendor shall also furnish the sizes and weights of the various shipping components and an installation sequence for re-assembling the turbine and the generator in place. The drawings shall be submitted for approval by the Owner for arrangement and compatibility with the requirements of the existing plant. Electrical shop drawings shall also be furnished within 60 days of contract award. Drawings shall indicate generator, exciter, general arrangements, three line diagrams, schematic, interconnecting and control diagrams, cubicle arrangements and complete bill of materials. Drawings shall include interconnection diagrams from the new to the existing wiring. Catalog cuts and/or descriptive literature shall be submitted for components to fully define the proposed equipment.

5.2 Final drawings shall be submitted for approval by the Owner within 60 days after approval of the outline arrangement drawings.

5.3 Drawings shall be coordinated and submitted only by the Vendor. Drawings prepared by a subcontractor to the Vendor shall bear the Vendor's stamp of approval before submission to the Owner for approval. Drawings submitted by anyone other than the approved Vendor will not be acceptable.

5.4 The Owner will submit design drawings indicating installation and support of the equipment under the installation contract for comments and approval by the Vendor. Vendor shall return approval drawings to the Owner within 30 days of receipt.

6. OPERATING AND MAINTENANCE INSTRUCTIONS

6.1 The Vendor shall furnish with the equipment, 6 bound copies of instruction manuals covering all phases of operation and maintenance of the equipment. These manuals shall be illustrated with cuts and drawings to describe the operation, construction and adjustment of the various parts of the equipment and controls, and maintenance procedures recommended to maintain all equipment specified herein in first class operating condition. The manuals shall contain a spare parts listing to facilitate the ordering and renewal of parts.

6.2 The Vendor shall train operating personnel at the site in the proper procedures for operation and maintenance of the unit. Instruction shall include courses in both the turbine and generator. The course of instruction shall not be less than 24 hours, taking place during normal working hours.

6.2.1 The course of instruction shall include information concerning operations in parallel with the local electrical utility company.

6.2.2 During the first year of operation, the Vendor shall be recalled to the site, at no additional cost to the Owner, for additional instruction and consultation with the operating personnel. Three separate site visits for a total of 24 hours at the site shall be included in the Vendor's bid for this purpose.

7. QUALITY ASSURANCE: Quality assurance procedures for determination of alignment of turbine and generators shall be submitted for approval by the Owner prior to shipment.

8. RATING AND DESIGN CONDITIONS

8.1 Rated Capacity: The turbine-generator unit shall have a capacity of 2500 kW. The unit shall be capable of a 10 percent overload for a period of two hours within any 24 hour period.

8.2 Rated Steam Conditions: The turbine shall be designed for operation at the following rated steam conditions:

8.2.1	Pressure at turbine throttle valve inlet flange	625 Psi gauge
8.2.2	Temperature at turbine throttle valve inlet flange	493 Degrees F
8.2.3	Pressure at turbine exhaust flange	275 psig summer 90 psig winter

8.3 Generator Rating:

Kilowatts-normal	2,500
Kilowatts-2 hour overload	2,750
Kilovoltamperes-normal	3,125
Kilovoltamperes-2 hours overload	3,440
Power factor	0.8
Number of phases	3
Frequency	60 Hertz
Volts	13.8 kV
Rated speed	1800 rpm
Exciter	Brushless Rotary

8.4 Oil Coolers

Maximum cooling water temperature	85 Degrees F
Maximum cooling water pressure	150 Psi gauge
Normal cooling water pressure	50 Psi gauge

8.5 Generator Air Cooler

Maximum cooling water temperature	85 Degrees F
Maximum cooling water pressure	150 Psi gauge
Normal cooling water pressure	50 Psi gauge

8.6 Generator Switchgear:

Phases and frequency	3 phase, 60 Hertz
Nominal voltage rating	15,000
Basic impulse rating	95kV
Main bus	Three phase, 1200 amperes
Ground bus	400 ampere
Generator breaker:	
Type	Air, draw-out type
Maximum continuous rating	1200 amperes
Interrupting capacity	500 MVA
Control voltage	120 volts, 60 Hertz

8.7 The turbine shall be so proportioned that the rated exhaust steam pressures as specified will not be exceeded when the turbine is carrying a kilowatt load equal to or less than 100 percent capacity. At loads above 100 percent capacity, the exhaust pressures will be permitted to rise above the rated values by no more than 5 percent.

9. INSTALLATION SERVICES AND ACCESSORIES

9.1 The Owner will provide foundation and bolts as recommended by the Vendor. The Vendor shall provide all setting and sole plates required, shims for proper setting and alignment of equipment. The Vendor shall provide an Erection Supervisor to supervise required rigging, and setting of turbine-generator by the Owner.

9.2 The Owner will furnish all steam, water and drain piping, valves and traps which are external to the unit.

9.3 The Owner will furnish and install all circuit wiring and raceways between the turbine-generator, switchgear, existing 13.8 kV system and remote mounted auxiliaries.

9.4 The Owner will furnish steam and water for testing and for operation of the unit.

9.5 The Vendor shall provide all tools and lifting devices required for the reassembly of the turbine and generator and removal of turbine rotor and all other equipment or portions of equipment which require maintenance or replacement. Special tools and devices required for maintenance shall remain at the site and become the property of the Owner.

9.6 The Vendor shall provide all necessary information required for the proper design of the turbine-generator foundation, interconnecting piping and proper access for maintenance and operation.

10. STEAM TURBINE: The steam turbine shall have, but not necessarily be limited to the following features and accessories, all of which shall comply with the latest standards of ANSI and NEMA:

10.1 Steam Strainer: A suitable steam strainer with a screen of corrosion-resistant metal, located ahead of the throttle valve and its seat shall be provided. The screen shall be readily removable without disturbing flanged connections in the steam piping.

10.2 Trip and Throttle Valve: A combined trip and throttle valve shall be provided. In conjunction with the emergency overspeed governor, it shall function to stop automatically the flow of steam into the turbine at a predetermined overspeed. Trip shall have manual means of checking while unit is on line.

10.3 Governing Valve: The flow of steam into the turbine shall be controlled by the speed governor through a governor-controlled valve. The design of the valve shall minimize throttling losses. The valve shall be actuated by means of a suitable relay-controlled hydraulic mechanism. The valve, valve stem and valve seats shall be made of corrosion and erosion-resistant material especially suited for the service.

10.4 Speed Governor: A governor shall be provided for controlling the turbine speed by varying the admission of steam into the turbine. The speed-governing system shall be in accordance with the "NEMA Standards for Speed Governing and Pressure Control of Steam-Turbine Generator Units," Publication No. 46-112. Governor shall be Woodward 2301, or approved equal, operating from either of two downstream pressure signals.

10.5 Emergency Overspeed Governor: An emergency overspeed governor, entirely independent of the speed governor, shall be provided. It shall function to trip the throttle valve and the generator circuit breaker at a predetermined overspeed and thereby stop the flow of steam into the turbine and take the generator off the line. The mechanism shall be arranged for manual tripping and for manual resetting at a speed of not less than one percent above rated speed.

10.6 Turbine Casing: The turbine casing shall be constructed of materials which have proven suitable for successful operation under the specified steam conditions. Where working stresses permit, the casing may be made of close-grained cast iron.

10.6.1 The casing of the steam chest and first stage shall be hydrostatically tested in the Vendor's assembly plant at a pressure not less than 50 percent in excess of steam pressures to which it may be subjected in normal operation. Other sections shall be tested to 110 percent of design pressure. The test shall be witnessed by the Owner or its representative.

10.6.2 The casing and diaphragms or blade rings shall be split at the horizontal centerline and shall be designed to facilitate the removal of necessary parts for inspection and repair.

10.6.3 A hand valve shall be provided to improve part-load performance.

10.7 Turbine Rotor: The turbine rotor shall be of high-quality heat-treated forged steel, designed and constructed so that injurious distortions will not occur with changes in load on the unit. The completed rotor shall be in dynamic balance so that it will run smoothly and without undue vibration.

10.8 Steam Nozzles: The nozzles shall be designed to produce efficient expansion of the steam. The materials used shall be selected for their strength and for their corrosion-and erosion-resistant qualities.

10.9 Blading: The blades shall be made of materials which are selected for their strength and for their corrosion and erosion-resistant qualities. They shall have the form and the dimensions which are essential to efficiency and strength.

10.9.1 All blading shall be securely and adequately anchored in place, and rotor blading shall be readily renewable.

10.10 Main Bearings: The unit bearing shells shall be horizontally split and lined with high-grade babbitt. They shall be arranged for pressure lubrication and shall operate without injurious temperature rise or undue wear. The bearing shells shall be readily removable without removing the rotors.

10.10.1 Install a means to prevent leakage of oil or oil vapors from the bearing housings.

10.11 Thrust Bearing: The turbine shall be provided with a thrust bearing to maintain the correct axial relation between the rotating and the stationary parts. The bearing shall be arranged for pressure lubrication. Means shall be provided whereby the axial position of the turbine rotor may be adjusted when the unit is at rest.

10.12 Shaft Seals: Efficient shaft seals shall be provided where the turbine shaft passes through the turbine casing and between stages. These shaft seals shall be spring backed metallic labyrinth type.

10.12.1 Steam piping connecting integral parts and integral accessories of the turbine to an admission point on the turbine shall be free of scale and of all foreign matter.

10.13 Lubrication: A suitable electric driven oil pump shall be furnished to deliver oil from the reservoir supplied with the unit at sufficient pressure for hydraulic operation of the control mechanism and for lubrication of the bearings of the unit prior to startup.

10.13.1 The oil piping shall include interconnecting piping to and from the bearings, oil seal glands, oil reservoir, oil pumps, oil coolers, control devices, servo-mechanisms, and other components included as an integral part of the unit. It shall also include any oil piping forming an integral part of the turbine or any component part or any integral accessory. The supply and return oil piping shall be made of seamless steel and shall have a minimum of flanged joints. It shall be accurately fabricated resulting in a minimum of field cutting, burning, fitting and welding.

10.13.2 Twin oil coolers shall be supplied as part of the oil system. The twin oil coolers shall have 5/8-inch outside diameter tubes.

10.13.3 Twin oil filters with switching valves shall be supplied as part of the oil system. The twin oil filters shall not pass impurities of 50 microns or larger.

10.13.4 Provisions shall be made to transfer the operation of the coolers and filters without shutting down the turbine-generator unit.

10.13.5 Each oil cooler shall have ample capacity to remove the heat absorbed in the oil and to keep the bearing oil drain temperatures at approximately 160 degrees F. Oil cooler tubes and tube sheets shall be composed of a copper nickel alloy with a nickel content of 30 percent. Provide inlet and outlet 4-inch dial thermometers.

10.13.6 All trips shall be provided to shut down the turbine and simultaneously trip the generator off the line. Alarms shall be provided and set to go off before shutdown.

10.13.7 The main oil pump may be directly driven by the turbine shaft if the configuration and location permit this arrangement.

10.13.8 There shall be no possible contamination of the condensate by the oil. All safeguards to prevent oil entering the condensate shall be clearly defined in submitted shop drawings.

10.14 Heat Insulating Material and Jacket: The turbine parts enclosing steam at a high temperature shall be covered with heat insulating material. This material shall be furnished by the Vendor for installation by others and shall include a suitable removable sheet metal jacket. Jacket shall be 18 gauge steel minimum or 16 gauge aluminum minimum. Either material requires reinforcement to provide protection against mechanical damage. Surface temperature shall not exceed 125 degrees F at 80 F ambient. Jacket finish shall be baked enamel coating if the base metal is steel and be polished if the base metal is aluminum.

10.15 Couplings: Couplings, if required, shall be arranged to be readily disconnected:

10.16 Panel: A local start-up panel shall be furnished by the Vendor which shall include the main steam gauges and a tachometer. It shall include, but not necessarily be limited to the following:

- . Initial steam pressure gauge
- . First-stage steam pressure gauge
- . Exhaust steam pressure gauge
- . Oil pressure gauges with high and low set point alarms and low set points to trip the turbine valve and generator circuit breaker.
- . Tachometer to indicate turbine speed in rpm. Readout shall be digital.
- . Temperature detector for the main oil drain line.

10.17 Temperature detectors with high temperature alarm contacts shall be locally mounted in the main bearing oil drain lines. Oil pressure gauges and gland seal pressure gauges shall be mounted in their appropriate lines.

10.18 Cleaning: After fabrication, all oil and integral steam piping shall be internally cleaned to remove grease, oil, sand, rust, mill scale, welding scale, welding beads and any other foreign material. Before subjecting the piping to the cleaning process, any parts which may be damaged by the cleaning process shall be removed or otherwise protected from injury. Following the cleaning process, the interior of the piping and flanges shall be protected with a rust preventative, and the ends of the piping closed to prevent entrance of foreign material.

11. GENERATOR

11.1 General Requirements: The generator shall be an alternating current synchronous machine rated 2500 kW, 13,800 volts, 3125 kVa, horizontal, 3 phase, 60 Hertz, 0.8 lag to 0.8 leading power factor, 1800 RPM, driven by a geared steam turbine. The generator shall be of the salient pole, brushless revolving field type, designed and constructed in accordance with all applicable provisions of NEMA Standard MG 1. The generator armature shall be capable of operating at 150 percent of rated armature current for at least one minute, starting from stabilized temperatures at rated conditions. The Generator field windings shall be capable of operating at a field voltage of 150 percent of rated load field voltage for at least one minute starting from stabilized temperatures at rated conditions.

The generator shall be capable of a 10 percent overload for two hours out of 24 hours at rated power factor, frequency and voltage.

11.2 Construction Requirements

11.2.1 Stator: The stator coils shall be insulated with multiple layers of mica tape and vacuum pressure impregnated with epoxy-resin to eliminate any voids and form a long lasting and durable insulation of the stator coils. The stator insulation shall be Class B.

11.2.2 Rotor: The rotor windings shall consist of multiple layers of rectangular or strap wire with each layer treated with a suitable filled epoxy resin or Nomex. The rotor shaft shall be a heat-treated forged steel assembly, stress relieved and machined to insure a sound product. The rotor insulation shall be Class B. The rotor assembly shall be balanced to minimize vibration.

11.2.3 Bearings: All bearings shall be oil ring and/or pressure lubricated (as required), sleeve type, split to permit removal for inspection and maintenance without major disassembly.

Bearings shall be provided with a positive visual checkpoint on oil flow through the bearings. Bearings shall be insulated where necessary to prevent the flow of "shaft current".

11.2.4 Enclosure: The generator shall be totally enclosed with water to air heat exchanger type (TEWAC) enclosure.

11.2.5 Air Cooler: The air coolers shall have sufficient capacity to dissipate adequately the heat losses of the generator when operated at rated load and supplied with cooling water at a maximum temperature of 85°F and a maximum inlet pressure of 150 psig. The cooler shall be provided with a deflector or baffle to ensure that if a water leak occurs, water will be directed away from the iron components of the stator. A water collection sump with a manual drain valve and a water level sensor to read out on an alarm annunciator, to be furnished by others, shall be provided.

11.2.6 Armature Connections: The generator shall be wye-connected, with provision for the neutral to be made up externally to permit installation of a differential relay protection current transformer in each phase. Two end leads of each of the three windings (a total of 6 leads), shall be brought out through the generator frame to an enclosure adequately sized for mounting three current transformers connecting the generator neutral, and for extending the generator phase leads. Furnish and install a ground lug on the underside of the generator for a number 4/0 equipment ground.

11.2.7 Excitation System: The generator excitation system shall be of the brushless type with a rotating armature generating a three phase ac voltage. The entire assembly shall be mounted on the main shaft extension of the generator. A solid state three phase rectifier shall be mounted to the brushless exciter shaft on revolving heat sinks. Terminal voltage shall be maintained within $\pm 0.5\%$ from no load to full load at rated voltage. A static voltage regulator system shall be furnished, installed and connected in the Switchgear Auxiliary cubicle as specified in section 12 following.

11.2.8 Accessories: The generator shall be equipped with six (6) resistance temperature detectors, two per phase, suitably distributed around the circumference of the stator, located between coil sides and in position to sense high temperature. Each bearing shall be equipped with a resistance temperature detector, mounted so as to detect maximum bearing temperature. All resistance temperature detectors shall have a resistance of 10 ohms at 25°C and shall be brought out of the frame through bushings to a separate terminal box for connections by others to remote indicators.

12. TURBINE GENERATOR SWITCHGEAR

12.1 General: The turbine generator switchgear shall be free standing, metal-clad arranged for mounting on leveling channels built into the floor. The switchgear shall consist of a generator cubicle and an auxiliary cubicle, each of which shall not exceed 36 inches in width, 94 inches in depth, and 95 inches in height. All switchgear components shall be mounted on or within grounded metal enclosures. Secondary control devices and wiring shall be isolated by grounded metal barriers from all high voltage primary devices. Major components of primary circuits, such as the circuit breaker instrument transformers, buses and primary cable terminals shall be isolated by grounded metal barriers. The generator circuit breaker shall be of the draw-out type. Provisions for testing the breaker in the draw-out position shall be included. Buses, connections and joints shall be insulated throughout. All bus joints shall be silver-plated and connected with not less than four bolts per joint. Bus bars shall be braced to withstand magnetic stresses equal to the circuit breaker interrupting capacity. Interlocking shall be provided for proper sequencing and safe operation.

12.2 Applicable Standards: The switchgear shall be designed, assembled and tested in strict accordance with the latest revision of American National Standards Institute publication Switchgear Assemblies and Metal-Enclosed Bus ANSI C37.20-1974.

12.3 Arrangement: When viewed from the front, the generator cubicle shall be on the right and the auxiliary cubicle on the left.

12.4 Generator Circuit Breaker: The circuit breaker shall be operated by an electrically charged, mechanically and electrically trip-free, stored-energy operating mechanism. Electrical devices for opening and closing the breaker, including recharging the stored energy mechanism, shall be designed for operation at 120 volts, 60 Hertz. The switchgear shall include the control power transformer for providing this source of energy from the load side of the generator breaker. Provision shall be included for manual charging of the mechanism and for slow closing of the contacts for inspection or adjustment. The circuit breaker shall be equipped with secondary disconnecting contacts which shall automatically engage in the operating positions. The breaker compartment shall be furnished with a mechanism which will move the breaker between the operating and disconnect positions. The mechanism shall be designed so that the breaker will be self-aligning and will be rigidly held in the operating position without the necessity of locking bars or bolts. In the disconnect position the breaker shall be easily removable from the compartment by

rolling. Interlocks shall prevent moving the breaker to or from the operating position unless its contacts are in the open position. The operating springs shall be automatically discharged when the breaker is rolled fully into the compartment or is moved into the disconnect position. Means shall be provided for padlocking the breaker in either the connected (operating) position or disconnected position. When locked in the disconnected position, the breaker shall be movable to the test position and completely removable from the compartment. Padlocking shall not interfere with operation of the breaker or its mechanism. The circuit breaker shall meet the requirements of the National Electrical Manufacturer's Association standard for A.C. High-Voltage Circuit Breakers SG 4-1975.

12.5 Instrument Transformers:

12.5.1 Current transformers shall have ratios as shown on the one line diagram. Current transformers shall have mechanical rating equal to the momentary rating of the circuit breakers, and shall be insulated for full voltage rating of the switchgear.

12.5.2 Potential transformers shall be drawout type, equipped with current limiting fuses. The transformers shall have ratios as noted on the one line diagrams. Accuracy class shall be 0.3.

12.6 Control Wiring: Switchgear wire shall be No. 14 AWG minimum, type SIS tinned copper wire as defined by the National Electrical Code. Control wiring shall extend from terminal to terminal without intervening splices. The switchgear shall be complete with terminal strips as required to facilitate control wiring. Each control wire shall be identified by wire number at each terminal.

12.7 Indicating Instruments: All indicating instruments shall be 4½-inch square, switchboard semi-flush type with 250 degree expanded scale, General Electric Type AB-40, or approved equal and shall meet all requirements of American National Standards Institute ANSI C39.1. Instrument switches shall be heavy duty rotary type rated 600 volts a-c, General Electric Type SB-1, or approved equal.

12.8 Protective Relays: Protective relays shall be semi-flush, switchboard mounting type complete with integral test provisions and test plugs for testing operation against an external simulated fault power source.

12.9 Switchboard Instruments and Controls: Instruments and controls shall be furnished as shown on Figure 1 attached. Ratings shall be as shown.

12.8.1 The generator cubicle shall include, but not necessarily limited to, the following instruments and controls:

- 3 - Current transformers, single secondary, for metering and miscellaneous relaying, General Electric Type JAG-O, or approval equal.
- 3 - Current transformers, single secondary, for generator differential relaying, General Electric Type JAG-O, or approved equal.
- 1 - Current transformer, single secondary, for voltage regulation, General Electric Type JAG-O, or approved equal.
- 2 - Potential transformers with current limiting primary fuses, for monitoring generator output voltage, General Electric Type JVM, or approved equal.
- 2 - Potential transformers with current limiting primary fuses, for monitoring utility system voltage, General Electric Type JVM, or approved equal.
- 1 - Power directional relay, Device No. 32, General Electric Type ICW, or approved equal.
- 1 - Neutral overcurrent relay, Device No. 50/51N, General Electric Type IAC, or approved equal.
- 3 - Time overcurrent relays with voltage restraint, Device No. 51V, General Electric Type IJCV, or approved equal.
- 1 - Overvoltage relay for generator ground protection, Device No. 59, General Electric Type IAV, or approved equal.
- 3 - Generator differential relays, Device No. 87G, General Electric Type CFD, or approved equal.
- 1 - Ammeter, 0-150 ampere scale.
- 1 - Ammeter switch, 4-position ("off", "ØA", "ØB" and "ØC")

- 1 - Voltmeter, 0-15kV scale.
- 1 - Voltmeter switch, 4-position ("off", "A-B", "B-C" and "C-A").
- 1 - Frequency meter, 55 to 65 Hertz scale.
- 1 - Power factor meter, 0.5 lag to 0.5 lead scale.
- 1 - Kilowatt - hour meter, General Electric Type DS-63, or approved equal.
- 1 - Circuit breaker control switch, General Electric Type SB-1, or approved equal.
- 2 - Circuit breaker position indicating lights; one with red color cap, one with green color cap.

12.8.2 The auxiliary cubicle shall contain a front mounted synchronizing swing panel for synchronizing the turbine-generator with the utility; generator exciter rheostat, voltage regulator, governor control, and associated equipment. The synchronizing panel shall contain provisions for both manual and automatic synchronization. The panel shall include, but not be limited to, the following:

- 1 - Governor control switch.
- 1 - Synchronizing switch.
- 1 - Synchronizing check relay, voltage, phase angle and frequency matching Device No. 25. General Electric Type No. GES, or approved equal.
- 1 - Synchroscope.
- 1 - set - Synchronizing lights.
- 1 - Frequency meter, 55 to 65 Hertz scale.
- 1 - Voltmeter, 0-15kV scale.
- 1 - Temperature Meter, General Electric Type DB-40.
- 1 - Switch, Temperature Meter, General Electric Type SB-1.

The manual operator for the generator field rheostat shall be operable from the front of the auxiliary cubicle. The rheostat shall be capable of controlling generator power factor up to 80 percent leading at rated generator output. The turbine governor's electronic components shall be mounted within the auxiliary cubicle.

12.9 Finish: All steel surfaces shall be chemically cleaned and treated to provide a bond between the primer coating and the metal surfaces. All interior surfaces shall be primed and finished with white enamel. Exterior surfaces shall be primed and finished in light gray.

12.10 Relay Calibration: The Vendor shall prepare relay coordination curves and relay settings for all protective relays. These shall be submitted for approval with other shop drawings.

12.11 Primary Cable Entry and Exit: Provisions shall be made for the Owner's 15kV, single conductor #4/0 EPR cable per phase to enter and exit either from above, from below, or a combination thereof. The exact method of entry shall be determined during shop drawing review. Clamp type terminals shall be provided for terminating the incoming and outgoing cables. Sufficient space shall be allowed for Owner-installed stress cones on each 15kV cable termination within the switchgear.

12.12 Nameplates and Signs: All switchgear front-mounted devices, and all internal fuse blocks, shall be suitably identified by means of engraved lamicoid nameplates affixed by means of two machine screws each. In addition, each exposed face of the switchgear shall bear a "DANGER HIGH VOLTAGE" sign, with 4-inch high lettering.

13. GENERATOR NEUTRAL GROUNDING

13.1 General Requirements: The generator neutral grounding shall be of the high resistance type using a distribution transformer with a secondary resistor to reduce the possibility of fault damage at the ground fault point and shall provide rapid and automatic isolation of the generator circuit. The generator relaying for ground fault detection shall be obtained by a voltage relay connected in parallel on the secondary side of the neutral transformer. The grounding scheme shall have, but not necessarily be limited to the following components, all of which shall comply with the latest standards of ANSI, NEMA and IEEE.

13.1.1 Grounding Transformer: The grounding transformer shall be single phase distribution type with primary voltage rated approximately 1-1/2 times the generator line-to-neutral voltage. The transformer secondary shall be rated 120 volts. Transformer shall be air-insulated type with Class B insulation and shall be suitable for indoor wall mounting. The transformer shall be sized to make transformer current equal to the capacitive charging current of all the electrical system to avoid high transient overvoltage.

13.1.2 Loading Resistor: The secondary loading resistor shall be sized to have an energy loss rating at least equal to the capacitive kVA during fault conditions. The resistor shall be selected on a continuous duty basis. The resistor shall be of indoor, open frame type with screening. The resistor shall meet all requirements of IEEE standard 32-1972.

13.1.3 Voltage Relay: A voltage relay ANSI Device 59 shall be connected in parallel on the secondary side of the grounding transformer. The relay shall be wired to trip the generator circuit breaker under ground fault conditions and another isolated auxiliary contact shall be provided for wiring to a remote alarm by others. The overvoltage relay shall be General Electric Type IAV, or approved equal and shall be mounted in the switchgear generator cubicle.

GEORGETOWN UNIVERSITY
INTEGRATED COMMUNITY ENERGY SYSTEM
(GU - ICES)

PHASE III, STAGE II
PRELIMINARY DESIGN

APPENDIX C

DESIGN CALCULATIONS

Sheet

Fluid Cooler

APP-C1 & C2

H & V in New Wing

APP-C3 to C6

Silo's Volume Calculations

APP-C7 to C9

PROJECT GU-TGP.E.R. PROJECT NO. 790

CONTRACT NO. _____

BY ABW DATE 8/4/80

CHKD _____ DATE _____

SUBJECT FLUID COOLER

COOLING FOR

Generator = 120 gpm
 Oil Cooler = 60
 Gear Box = 20 ?
 200 GPM

WB Temp in DC = 78°F

TRIAL I

Cooling Water Range = 105-85=20°
 Approach = 85-78=7°

OR

TRIAL II

Range = 105-90=15°
 Approach = 90-78=12°

BAC CURVES Bull. 5405/1-0 July 1978

TRIAL I Performance Factor = 11.8
 TRIAL II Performance Factor = 7.8

Try 7.8 for unit size 50-2.

Spray

Pump = 1½P

Coil Δp = 4.8 psi

Fans = 15P

Wgt = 10,000 lb

Operating

Air Flow = 31,000 cfm

PROJECT GU - TG
 P.E.R. PROJECT NO. 790 CONTRACT NO. _____
 BY ABW DATE 8/4/80 CHKD _____ DATE _____
 SUBJECT FLUID COOLER PUMP

FLOW = 200 gpm
 TEMP = 90° to 105°F Fitts.
 PIPE LENGTH = 60 x 2 x 1.5
 = 180 ft

4" Pipe
 = 2.25/c x 180 = 4.1 ft
 Air Cooler = 4.8 psi = 11.1
 Gen Cooler = 20.
 35.2 ft

SF = 20%
 = 7
 42 ft
 Say 40'

$$\text{Cooling Pump} = \frac{200 \times 40}{3000}$$

- 3 P

Size
 50-2 \$9000

Winter
 Htr and Solenoid incl.

PROJECT GU-ICESP.E.R. PROJECT NO. 790

CONTRACT NO. _____

BY ABW

DATE

10/9/80

CHKD _____

DATE _____

SUBJECT H & V IN NEW WING

$$\begin{aligned} \text{Vol} &= 32 \times 36 \times 26 \\ &= 30,000 \text{ ft}^3 \end{aligned}$$

$$\begin{aligned} \text{Vol} &= 32 \times 36 \times 19 \\ &= 22,000 \text{ ft}^3 \end{aligned}$$

Gr. Floor

$$\begin{aligned} \text{Try } 12 \text{ Air Changers/hr} \\ &= \frac{12 \times 22000}{60} = 4400 \text{ CFM} \end{aligned}$$

Q Loss @ 60°F Winter

$$\text{Walls Gross } (104)(19) = 1976 \text{ ft}^2$$

$$\text{Doors } 100$$

Walls Net

$$\text{Floor } 1152 \times .3 \times 5/6$$

$$\text{Infil } 1 \text{ AC} \times 22000 \times .02$$

$$\begin{aligned} 100 \times 1 &= 100 \\ 1,876 \times 3 &= 563 \\ &= 288 \\ &= 440 \end{aligned}$$

1391

$$1391 \times (60-5) = 76,500 \text{ Btu/hr}$$

$$Q = (\text{cfm})(1.08)(T)$$

$$76,500 = \text{cfm}(1.08)(07)$$

$$= \frac{76,500}{4,400}(1.08)$$

$$= 16^\circ\text{F}$$

across coil

PROJECT GU-ICESP.E.R. PROJECT NO. 790

CONTRACT NO. _____

BY ABW DATE 10/8/80

CHKD _____ DATE _____

SUBJECT _____

Try Summer

$$Q = \text{cfm} (1.08) (103-95) = 8.64 \text{ (cfm)}$$

$$Q = (1391) (15^{\circ}\text{F}) \approx 20,100$$

$$\text{cfm}_{\text{min}} = \frac{20,100}{8.6} = 2400 \text{ Subject to check.}$$

Use 4400 cfmOperating Floor

$$\text{Try } 12 \text{ AC/hr} = \frac{12 \times 30,000}{60} = 6000 \text{ cfm}$$

Heat Loss

$$\text{Walls Net } (104) (26) = 2704 \times .3 = 811$$

$$\text{Clg } 1152 \times .15 = 173$$

$$\text{Infil } (\frac{1}{2}) 30,000 (.02) = 300$$

$$\underline{1284}$$

$$1284 \times (60-5) = 70,600 \text{ Btu/hr}$$

If boiler room air is used @ 80°F ,
draw in 6000 cfm

$$Q = (6000) (1.08) (80-60) = 130,000 \text{ Btu/hr}$$

$$\text{Area of Louver} = \frac{6000 \text{ cfm}}{500 \text{ ft/min}} = 12 \text{ ft}^2 \text{ gross}$$

PROJECT GU-ICESP.E.R. PROJECT NO. 790

CONTRACT NO. _____

BY ABWDATE 10/6/80

CHKD _____

DATE _____

SUBJECT EQUIPMENT

(1) Roof Fan = 6000 cfm @ 3/4" SP

Swartwout 40QA - 5B w/ 2 HP motor
500 rpm

Pre-fab curb type S12A

(2) Inlet Silencer

IAC Type ML

36" x 24" x 3 ft long

(3) AHU

4400 cfm @ 3.0" external SP

AAF inverted size 6 MP HV unit

Steam distributing coil 1 row - 6 FPI

1" S.P.

21" x 32"

940 fpm

Filter = Serviside

 $\Delta p = .4" \text{ S.P.}$ Inlet damper $\Delta p = .2" \text{ SP}$

Duct = 100 equiv lf = 1.0" S.P.

Outlet = 0.2" S.P.

TOTAL ΔSP	=	1.0
		.4
		.2
		1.2
		<hr/> 2.8

P = 5

Say 3.0"

PROJECT GU-ICES

P.E.R. PROJECT NO. 790

CONTRACT NO.

BY ABW DATE 10/7/80

CHKD DATE

SUBJECT EQUIPMENT

(4) Unit Heater

Operating Floor = Not requiredGround Floor

Blow at door.

$$\frac{76,000}{2} = 38,000 \text{ Btu/hr @ 5 psig}$$

AAF YU 1020 1/25 HP 38 MBH

2 Required Horizontal Blow

PROJECT GEORGETOWN UNIVERSITYP.E.R. PROJECT NO. 790

CONTRACT NO. _____

BY JEWDATE 11/11/80CHKD ABWDATE 11/11/80SUBJECT SILO'S VOLUME CALCULATIONS

$$= 1.73 \text{ ft.}$$

$$V_1 = (22 + 20.3) \frac{3}{2} \cdot 17 \approx 1080 \text{ ft}^3$$

PROJECT GEORGETOWN UNIVERSITY

P.E.R. PROJECT NO. 790

CONTRACT NO. _____

BY JEW

DATE 11/11/80

CHKD ABW

DATE 11/11/80

SUBJECT SILO'S VOLUME CALCULATIONS

$$h = 11.23 \text{ ft}$$

$$B = 345 \text{ ft}^2 = \text{Area of upper base}$$

$$B' = 98 \text{ ft}^2 = \text{" " lower "}$$

$$V_2 = \frac{1}{3}h (B + BB' + B')$$

$$= \frac{1}{3} (11.23) \quad 345 + \quad 345 \times 98 + 98 = 2347 \text{ ft}^3$$

PROJECT GEORGETOWN UNIVERSITYP.E.R. PROJECT NO. 790

CONTRACT NO. _____

BY JEW DATE 11/11/80 CHKD ABW DATE 11/11/80SUBJECT SILO'S VOLUME CALCULATIONS

$$V_3 = \frac{1}{6} h [ab + (a+a')(b+b') + a'b']$$

$$= \frac{1}{6} (6.1) [(7)(14) + (7 + 1.5)(14+7) + (1.5)(7)] =$$

$$= 98 + 178.5 + 10.5 \text{ ft}^3 = 287 \text{ ft}^3$$

$$\text{Total Volume} = V_1 + V_2 + V_3 = (1080 + 2347 + 287) \text{ ft}^3 = 3714 \text{ ft}^3/\text{SILO}$$

$$1 - \text{Bed material silo} = (3714 \text{ gross} \times 90\%) \times \frac{67}{2000} = 112 \text{ ton}$$

$$3 - \text{Fly ash silos} = 3714 \times 3 \times .9 \times \frac{34}{2000} = 170.5 \text{ ton}$$

GEORGETOWN UNIVERSITY
INTEGRATED COMMUNITY ENERGY SYSTEM
(GU - ICES)

PHASE III, STAGE II
PRELIMINARY DESIGN

APPENDIX D

COST ESTIMATES
(November 1980 Costs)

COGENERATION

	<u>Page</u>
Summary Sheet	S1
Mechanical Work	1 - 6
Electrical Work	7 - 8
Architectural/Structural Work	9 - 10

ADDITIONAL ASH STORAGE

Summary Sheet	S1
Mechanical Work	1
Electrical Work	2
Architectural/Structural Work	-
(See Cogeneration)	

A/E SERVICES	)
ESCALATION AND PROGRAM MANAGEMENT	) 1

PROJECT: ICES PRELIMINARY DESIGN COGENERATION	PAGE 51 OF 51
	W.O.:
	EST. BY: ABW/RB/YS/M&A
	APP'D. BY: VB

CLIENT: GEORGETOWN UNIVERSITY	DATE: November 1980
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DESCRIPTION: SUMMARY

REMARKS:

NO.	ITEM	UNIT	QUANTITY	COST	AMOUNT
A 1	Mechanical Spec. Section 15A (p.1)				\$ 25,000
2	" " " 15B (p.3)				99,380
3	" " " 15C (p.4)				9,330
4	" " " 15D (p.4)				14,800
5	" " " 15E (p.4)				500
6	" " " 15F (p.5)				38,700
7	" " " 15H (p.5)				27,220
8	" " " 15J (p.6)				6,000
9	Electrical Spec. Section 16A (p.7&8)				152,580
	Sub-Total				373,510
	Contractor's OH & P 25%				93,490
	Sub-Total				467,000
	Contingency 10%				47,000
	Sub-Total				514,000
B	Turbine-Generator quote, Dec.1979				425,000
	Escalation to 12/80				50,000
					475,000
C	Structure (p. 9 & 10)				216,000
	TOTAL - A, B & C				\$1,205,000

PROJECT: ICES PRELIMINARY DESIGN COGENERATION		PAGE 1 OF 10		W.O.:		EST. BY: LJS
						APP'D. BY: ABW
CLIENT: GEORGETOWN UNIVERSITY		DATE: NOVEMBER 1980				
DESCRIPTION: SPECIFICATION SECTION 15A						
REMARKS: MECHANICAL WORK						
NO.	ITEM	UNIT	QUANTITY	COST	AMOUNT	
1	Labor for T-G	-	LS		\$ 23,000.	
2	Hand Trolley (Beam by Structural)					
	2 Ton	1	LS		1,000.	
	6 Ton	1	LS		1,000.	
3	Vibration Isolation	-	-		-	
	(Incl. w/Equip)					
	TOTAL SECTION 5A				\$ 25,000.	

PROJECT: ICES PRELIMINARY DESIGN COGENERATION		PAGE 2 OF 10			
		W.O.:	EST. BY: LJS		
			APP'D. BY: ABW		
CLIENT: GEORGETOWN UNIVERSITY		DATE: NOVEMBER 1980			
DESCRIPTION: SPECIFICATION SECTION 15B					
REMARKS: MECHANICAL WORK					
NO.	ITEM	UNIT	QUANTITY	COST	AMOUNT
1	Steam Piping				
	8" Sch. 40 A106	LF	200		\$ 13,400.
	10" Sch. 40 A106	LF	60		4,350.
	12" Sch. 40 A106	LF	250		21,750.
2	Valves				
	8" 600# Gate	EA	1		5,670.
	10" 300#	EA	1		3,870.
	12" 300#	EA	1		5,020.
	4" x 6" relief	EA	1		575.
3	Cond. Return Piping				
	2" Sch. 40 A106	LF	250		3,050.
	Steam Trap Stations	EA	4		1,425.
	Cond. Pump	EA	1		3,850.
4	Steam Separator	EA	1		4,250.
5	Expansion Joint Inlet	EA	1		1,950.
	Expansion Joint Outlet	EA	1		1,150.

PROJECT: ICES PRELIMINARY DESIGN COGENERATION		PAGE 3 OF 10		EST. BY: LJS	
		W.O.:		APP'D. BY: ABW	
CLIENT: GEORGETOWN UNIVERSITY		DATE: NOVEMBER 1980			
DESCRIPTION: SPECIFICATION SECTION 15B					
REMARKS: MECHANICAL WORK					
NO.	ITEM	UNIT	QUANTITY	COST	AMOUNT
6	Cooling Water Piping				
	3" Sch. 40 A106 incl. trim	LF	180		\$ 6,200.
7	Cooling Water Pump	EA	1		4,970.
8	Evaporative Cooler	EA	1		11,000.
9	Exhaust Head	EA	1		400.
10	Silencers for Exist.	EA	2		6,000.
	Safety Valve Vents				
	TOTAL - SECTION 15B				\$ 99,380.

PROJECT: ICES PRELIMINARY DESIGN COGENERATION		PAGE 4		OF 10	
		W.O.:		EST. BY: LJS	
				APP'D. BY: ABW	
CLIENT: GEORGETOWN UNIVERSITY		DATE: NOVEMBER 1980			
DESCRIPTION: SPECIFICATION SECTION 15C					
REMARKS: MECHANICAL WORK					
NO.	ITEM	UNIT	QUANTITY	COST	AMOUNT
1	Roof Drain	-	LS		\$ 940.
2	Make Up to Cooler	LF	70		315.
3	Drain Piping, 6" XH CI incl. Trench	LF	70		7,025.
4	Floor Drain	EA	3		170.
5	4" XH CI	LF	60		880.
	TOTAL - SECTION 15C				\$ 9,330.
	SPECIFICATION 15D H & V				
1	3 HP Roof Fan	EA	1		2,110.
2	Air Handler 15000 cfm	EA	1		6,825.
3	Ductwork	LB	2000		3,620.
4	Blending Box	EA	1		750.
5	Temp. Controls	EA	1		1,500.
	TOTAL - SECTION 15D				\$ 14,800.
	SPECIFICATION 15E - FIRE PROTECTION				
1	2 - ABC Fire Ext. -Chemical	EA	2		\$ 100.
2	CO ₂	LS			400.
	TOTAL - SECTION 15E				\$ 500.

PROJECT: ICES PRELIMINARY DESIGN COGENERATION		PAGE 5 OF 10			
		W.O.:	EST. BY: LJS		
			APP'D. BY: ABW		
CLIENT: GEORGETOWN UNIVERSITY		DATE: NOVEMBER 1980			
DESCRIPTION: SPECIFICATION SECTION 15F - INSULATION					
REMARKS: MECHANICAL WORK					
NO.	ITEM	UNIT	QUANTITY	COST	AMOUNT
1	Steam Piping				
	8"Ø x 6" thk	LF	300		\$ 17,400.
	10"Ø x 3" thk	LF	120		4,080.
	12"Ø x 3" thk	LF	360		14,040.
2	Duct Anti Sweat	SF	300		2,100.
3	Turbine	SF	125		1,080.
	TOTAL - SECTION 15F				\$ 38,700
	SPECIFICATION SHEET 15H - INSTRUMENTATION AND CONTROLS				
1	Control Panel	EA	1		\$ 20,000.
	- Electrical	-	LS		4,000.
2	Pressure Gauges	EA	5		225.
3	Temp. Gauges	EA	5		420.
4	Flow Elements	EA	3		1,440.
5	Thermostat	EA	1		135.
6	Turbine Trip Actuators	EA	2		1,000.
	TOTAL - SECTION 15H				\$ 27,220.

PROJECT: ICES PRELIMINARY DESIGN COGENERATION		PAGE 7 OF 10		EST. BY: YSS	
		W.O.:		APP'D. BY: VB	
		DATE: November 1980			
CLIENT: GEORGETOWN UNIVERSITY					
DESCRIPTION: SPEC. SECTION 16A					
REMARKS: ELECTRICAL WORK					
NO.	ITEM	UNIT	QUANTITY	COST	AMOUNT
1	Generator Control Switchgear	ea	1	89,600	89,600
	15 kV, including controls,				
	metering and relaying				
2	15 kV Underground Fiberduct	ft	100	29.30	2,930
3	15 kV Shielded Cable, 4/0	ft	450	22.20	2,220
	type EPR				
4	Work in Manhole SE-19			1,980	1,980
5	15 kV Potheads	ea	12	280	3,360
6	Generator Neutral Grounding,	ea	1	16,500	16,500
	Distr. Transformer Type				
7	Motor Control Panelboard in	ea	1	6,730	6,730
	Turbine-Generator area				
8	Equipment Grounding			3,520	3,520

[illegible]

MMP

August 6, 1980

GEORGETOWN UNIVERSITY CORE I.C.E.S.

NEW GENERATOR HOUSE: PRELIMINARY COST ESTIMATE

Based upon information and drawings available to date, the following is an estimate of the Architectural and Structural work involved in the project:

Demolition and Alterations	\$ 4,981.00
Structure	158,734.00
Doors and Panels	11,555.00
Hoist Beam	3,300.00
Finishes and Sundries	<u>3,838.00</u>
	\$182,408.00
General Conditions	<u>32,000.00</u>
	\$214,408.00
Contingency	<u>21,440.00</u>
	\$235,848.00
Escalation (November 1980)	<u>9,435.00</u>
Anticipated Cost	\$245,283.00

OF THE \$245,000 TOTAL, \$216,000 IS APPLICABLE TO COGENERATION.

Assumes Nov. 1980 midpoint of construction.

MMP

We have excluded all costs related to the following:

- a) Wall Insulation
- b) Casing to Fire Protection
- c) Mechanical, Electrical and Utilities Work
- d) Fees

At present, we have assumed that the existing external wall reaching from first floor level to roof level will be removed to permit the installation of the new floor beams, and will subsequently be reinstated.

MMP

DC/atm

[illegible]

PROJECT: ICES PRELIMINARY DESIGN ADDED ASH STORAGE	PAGE 1 OF 2
	W.O.:
	EST. BY: LJS
	APP'D. BY: ABW

CLIENT: GEORGETOWN UNIVERSITY	DATE: November 1980
-------------------------------	---------------------

DESCRIPTION: SPECIFICATION SECTION 15G - ASH SYSTEM

REMARKS:

NO.	ITEM	UNIT	QUANTITY	COST	AMOUNT
1	Structural Steel	-	LS		\$ 90,000.
2	Decking	-	LS		25,000.
3	Bins	-	LS		90,000.
4	Ladder	-	LS		2,000.
5	Bin Painting	-	LS		10,000.
6	Stairs	-	LS		10,000.
7	Ash Pipe	-	LS		17,500.
8	Diverter Valves	-	LS		10,500.
9	Slide Gates	-	LS		9,000.
10	Screw Conveyors	-	LS		33,000.
11	Ash Loading Spout	-	LS		22,000.
12	Dust Collector	-	LS		7,000.
13	Bin Vents	-	LS		6,000.
14	Crane Rental	-	LS		24,000.
	TOTAL - SECTION 15G				\$356,000.
	SPECIFICATION SECTION 15I - BIN INDICATION SYSTEM				
	Bin Level Indicators	EA	8		\$ 3,000.
	Alterations to Existing Panel	-	LS		4,000.
	Alarm Box	EA	1		1,000.
	TOTAL - SECTION 15I				\$ 8,000.

PROJECT: ICES PRELIMINARY DESIGN ADDED ASH STORAGE	PAGE 2	OF 2
	W.O.:	EST. BY: YSS
		APP'D. BY: VB
CLIENT: GEORGETOWN UNIVERSITY	DATE: November 1980	
DESCRIPTION: SPEC. SECTION 16A		
REMARKS: ELECTRICAL WORK		

NO.	ITEM	UNIT	QUANTITY	COST	AMOUNT
1	Motor Control Panelboard, outdoor, weatherproof type, complete with combination starters, pushbuttons & pilot lights	ea	1	20,000	\$ 20,000
2	Wiring - Power and Control cables, conduits, fittings including feeder for Motor Control Panelboard	LS		20,000	20,000
3	Outdoor Lighting in Ash Silo Area			3,500	3,500
4	Solids Removal Control Panel Extension	ea	1	7,500	7,500
5	Miscellaneous	LS		5,000	5,000
	SUB TOTAL				\$ 56,000
	TESTING 5%				3,000
					\$ 59,000

A/E Services - Cost Estimate

A. FINAL DESIGN	\$100,000
Training Plan	5,000
Testing Plan	5,000
Acceptance Plan	2,000
 B. TURBINE-GENERATOR PREPURCHASE	
Finalize Specification bid documents	5,000
Bid/Award	2,000
Shop Drawing Review	5,000
 C. CONSTRUCTION	
Bid/Award	2,000
Inspection Services during Construction	20,000
Assistance to GU during checkout and acceptance	10,000
Operator training	5,000
	<hr/>
	\$161,000

GEORGETOWN UNIVERSITY
INTEGRATED COMMUNITY ENERGY SYSTEM
(GU - ICES)

PHASE III, STAGE II
PRELIMINARY DESIGN

APPENDIX E

PEPCO DATA

	<u>Page</u>
1. PEPCO letter to GU dated September 22, 1980	APP-E1 & E2
2. PEPCO SCHEDULE GT, effective May 31, 1980	APP-E3 to E6

POTOMAC ELECTRIC POWER COMPANY

1900 PENNSYLVANIA AVENUE, N. W., WASHINGTON, D. C. 20068

(202) 872-2000

DIRECTOR
FOR PHYSICAL PLANT

OCT - 8 1980

RECEIVED

September 22, 1980

Mr. John B. Anderson
Director of Physical Plant
Georgetown University
Washington, D. C. 20057

Dear John:

Although our cogeneration rate design studies won't be finalized for a few months yet, there are some preliminary guidelines which underlie our studies and which we have used in response to customer inquiries:

- PEPCO favors the use of an "interruptible" rate under which a customer would interrupt load if its cogenerator or small power production facility failed during one of PEPCO's summer peaking periods. This would alleviate the need for backup generating capacity.
- The standby charge in existing Rider GT-2 will not be applicable to qualifying cogenerators and small power producers. However, a cost-based standby charge will be developed for facilities unable to operate in the above interruptible mode based on the assumed diversity for the individual cogeneration customers, or sum of cogeneration customers' loads.
- Our cogeneration rate will be based largely on a marginal energy concept similar to the DC-GT tariff which we recommended you use for your economic feasibility study. Because we are still unsure of the extent of the capacity savings attributable to cogeneration (if any), we have not yet determined how the production and distribution demand charges will be applied to cogenerators.

POTOMAC ELECTRIC POWER COMPANY

Mr. John B. Anderson

- 2 -

September 22, 1980

The above guidelines would be applicable to both your cogeneration and solar photovoltaic installations. We do not expect to be able to discuss rate design in detail until late this year; however, we will be able to provide you with more definitive information as our studies progress over the next few months.

Very truly yours,

Vincent J. Cushing
Manager, Corporate Planning

DC - GT

TIME METERED GENERAL SERVICE SCHEDULE "GT"

AVAILABILITY - Shall be applicable in the District of Columbia portion of the Company's service area to customers whose maximum demand is in excess of 1000 kw during two or more billing months per year. Any customer presently on Schedule DC-GT whose maximum demand is less than 900 kw for any twelve consecutive months may at his option elect to continue service on this schedule or elect to be served under any other applicable schedule.

Available for low voltage electric service.

Available for auxiliary or emergency service when modified by Rider No. "GT-2", for primary service when modified by Rider No. "GT-3" and for heating service when modified by Rider No. "GT-4".

Not available for temporary service, supplementary loads metered separately from lighting and other usage in the same occupancy, or railway propulsion service.

CHARACTER OF SERVICE -

SECONDARY SERVICE - The service supplied under this schedule normally will be alternating current, sixty hertz, three phase, four wire, 120/208 volts or 265/460 volts.

PRIMARY AND HIGH VOLTAGE SERVICE - The service under this schedule when modified by Primary Service Rider "GT-3A", normally will be alternating current, sixty hertz, three phase, three wire, at 13.2 KV or 33 KV, and when modified by High Voltage Rider "GT-3B", will be 69 KV or above. Primary service voltage levels will be specified by the Company on the basis of its available facilities and the magnitude of the load to be served.

Date of Issue: May 19, 1980

Date Effective: May 31, 1980

Issued by William F. Schmidt, Vice President
1900 Pennsylvania Avenue, N. W.
Washington, D. C. 20068

DC - GT

SCHEDULE OF MONTHLY CHARGES -

	<u>SUMMER MONTHS</u>	<u>WINTER MONTHS</u>
A. Customer Charge	\$165.00 per month	\$165.00 per month
B. Energy Charge		
On Peak Period	3.551¢ per kwhr	3.458¢ per kwhr
Intermediate Period	3.021¢ per kwhr	3.192¢ per kwhr
Off Peak Period	2.475¢ per kwhr	2.475¢ per kwhr
C. Production and Transmission Charge		
On Peak Billing Demand	\$7.00 per kw	-
D. Distribution Charge	\$4.05 per kw	\$4.05 per kw
E. Minimum Charge - The Customer Charge and the Distribution Charge.		

SEASON DESIGNATION -

SUMMER MONTHS, for purposes of application of this rate schedule, are the billing months of June through September, and WINTER MONTHS are the billing months of January through May, plus October through December..

RATING PERIODS -

Weekdays - (Excluding Holidays)

On Peak Period	12:00 noon	to	8:00 p.m.
Intermediate Period	8:00 a.m.	to	12:00 noon
	and	8:00 p.m.	to 12:00 midnight
Off Peak Period	12:00 midnight	to	8:00 a.m.

Saturdays, Sundays and Holidays

Off Peak Period All Hours

Holidays

New Year's Day, Washington's Birthday, Memorial Day, Independence Day, Labor Day, Columbus Day, Veterans' Day, Thanksgiving Day, Christmas Day.

Date of Issue: May 19, 1980

Date Effective: May 31, 1980

Issued by William F. Schmidt, Vice President
1900 Pennsylvania Avenue, N. W.
Washington, D. C. 20068

DC - GT

BILLING DEMANDS -

Production and Transmission (Summer Months Only)

The billing demand shall be the maximum 30 minute demand recorded during the on-peak period of the billing month.

Distribution (All Months)

The billing demand shall be the maximum 30 minute demand recorded during the billing month, but shall not be less than the highest such demand established during the previous eleven months, except as modified by Rider No. "GT-4".

FUEL ADJUSTMENT - Charges for fuel and interchange, computed in accordance with the provisions of "Fuel Adjustment Charge Rider FA", modified as follows - the amount per kilowatt-hour for billing purposes will be the unit amount per kilowatt-hour as developed in Step (c) of the "Fuel Adjustment Charge Rider FA" less 1.53823¢ per kwh. The resulting net factor will be multiplied by appropriate adjustment factors for secondary service and for primary and high voltage service, recalculated annually, to compensate for differences in transmission and distribution efficiencies. This fuel adjustment combined with monthly charges under the provisions of this schedule, constitute the total charge for the service which the Company furnishes.

METER READING - Watthour meters will be read to the nearest 10 kilowatt-hours and bills rendered accordingly.

RIDER NO. "GT-1" - POWER FACTOR - This Rider is applied to and becomes part of Time Metered General Service Schedule "GT" if the customer is found to have a leading power factor or a lagging power factor of less than 85 percent. Until power factor corrective equipment satisfactory to the Company shall have been installed by the customer, the demand charges will be multiplied by a factor of 1.111.

Date of Issue: May 19, 1980

Date Effective: May 31, 1980

Issued by William F. Schmidt, Vice President
1900 Pennsylvania Avenue, N. W.
Washington, D. C. 20068

DC - GT

RIDER NO. "GT-2" - AUXILIARY OR EMERGENCY SERVICE - This Rider is applied to and becomes part of Time Metered General Service Schedule "GT" when part or all of the customer's electric or other power requirements normally are supplied by his own power producing equipment and auxiliary service is desired for emergency or abnormal conditions. In any such case, the customer shall contract in advance for the maximum number of kilowatts which the Company is to stand ready to supply for his use which will be termed the "contract demand". The billing demand during each rating period will be the contract demand. If during any month the maximum metered demand on the Company exceeds the then existing contract demand, such metered demand becomes the contract demand for the following months until changed by agreement or by the substitution of a new and higher metered demand pursuant to this Rider.

RIDER NO. "GT-3A" - PRIMARY SERVICE - This Rider is applied to and becomes part of Time Metered General Service Schedule "GT" when the Company furnishes service directly from its electric system at voltages of 13 KV or above, the customer providing at his own expense, all necessary transformers, converting apparatus, switches, disconnectors, regulators and protective equipment. In such case the service will be measured at the primary voltage and a discount of 5% will be allowed on the total bill, excluding the Fuel Adjustment Charge.

RIDER NO. "GT-3B" - HIGH VOLTAGE SERVICE - This Rider is applied to and becomes part of Time Metered General Service Schedule "GT" when the Company furnishes service directly from its electric system at voltages of 69 KV or above, the customer providing at his own expense, all necessary transformers, converting apparatus, switches, disconnectors, regulators and protective equipment. In such case the service will be measured at the high voltage and a discount of 10% will be allowed on the total bill, excluding the Fuel Adjustment Charge.

Date of Issue: May 19, 1980

Date Effective: May 31, 1980

Issued by William F. Schmidt, Vice President
1900 Pennsylvania Avenue, N. W.
Washington, D. C. 20068

REVISIONS			
NO.	DESCRIPTION	DATE	APPROVED

PLAN - EL 123'-4"
SCALE: 1/8" = 1'-0"

LEGEND
 Δ CADWELD CONNECTION
 ○ 1/4" x 10'-0" COPPER CLAD STEEL GROUND ROD
 -G- GROUND VES. 1/2" BARS TUNED COPPER

PLAN - EL 106'-10"
SCALE: 1/8" = 1'-0"

PART PLAN - EL 106'-10"
SCALE: 1/8" = 1'-0"

35% SUBMISSION
 21, NOV. 1980

POPE, EVANS AND ROBBINS
 INCORPORATED
 CONSULTING ENGINEERS

GEORGETOWN UNIVERSITY
 WASHINGTON, D.C.

COGENERATION AND ADDED ASH STORAGE

PLANS

ELECTRICAL

SHEET NO.

13

OF

JOB NO.

GEORGETOWN UNIVERSITY DRAWN: APPR: DATE:

EXISTING MOTOR CONTROL CENTER FDB - MCC-2 IN ELECTRICAL EQUIPMENT ROOM FDB PLANT, ROOM EL. 106'-10"

FURNISH, INSTALL AND TEST TWO (2) THERMAL MAGNETIC CIRCUIT BREAKERS SIZED AS SHOWN IN AVAILABLE SPACE. THE CIRCUIT BREAKERS TO BE OF THE SAME MAKE & TYPE AS THE EXISTING EQUIPMENT.

MOTOR CONTROL PANELBOARD NO.1

480V, 3Ø, 3W, 60HZ. INDOOR ENCLOSURE
LOCATION: TURBINE-GENERATOR ROOM
SEE NOTE #1

MOTOR CONTROL PANELBOARD NO.2

480V, 225A, 3Ø, 3W, 60HZ. OUTDOOR WEATHERPROOF ENCLOSURE
LOCATION: ASH SLO
(SEE NOTE #2)

NOTES:

1. MOTOR CONTROL PANELBOARD NO.1 FURNISHED IN TURBINE-GENERATOR ROOM TO BE CIRCUIT BREAKER TYPE, SIZED AS INDICATED ON THE SINGLE-LINE DIAGRAM; INDOOR, DRIP PROOF ENCLOSURE GTE SYLVANIA TYPE CMC-COP OR APPROVED EQUAL.
2. MOTOR CONTROL PANELBOARD NO.2 FURNISHED IN ASH SLO AREA TO BE CIRCUIT BREAKER TYPE, SIZED AS INDICATED ON THE SINGLE-LINE DIAGRAM; OUTDOOR, WEATHER PROOF ENCLOSURE GTE SYLVANIA TYPE CMC-COP OR APPROVED EQUAL.
3. CONTROL EQUIPMENT FURNISHED WITH OPERATED DEVICE.

LEGEND:

- ☒ STARTER, NONREVERSING, SIZE AS SHOWN ON DWG.
- ☒ STARTER, REVERSING, SIZE AS SHOWN ON DWG.
- ☒ CIRCUIT BREAKER, MAGNETIC ONLY TRIP SIZE AS INDICATED.

35% SUBMISSION
21, Nov. 1980

POPE, EVANS AND ROBBINS
CONSULTING ENGINEERS

GEORGETOWN UNIVERSITY
WASHINGTON, D.C.

COGENERATION AND ADDED ASH STORAGE

480V SINGLE LINE DIAGRAM

ELECTRICAL

GEORGETOWN UNIVERSITY

DRAWN

APPR.

DATE:

JOB NO.

SHEET NO.

12

OF

13.2 KV SINGLE LINE DIAGRAM

REVISIONS			
NO.	DESCRIPTION	DATE	APPROVED

LEGEND:

- 25 - SYNCHRONIZING RELAY
- 26 - GENERATOR THERMAL DEVICE
- 27 - UNDERVOLTAGE RELAY
- 32 - DIRECTIONAL POWER RELAY
- 51V - OVERCURRENT RELAY, VOLTAGE RESTRAINT
- 52 - AIR BREAKER
- 59 - OVERVOLTAGE RELAY
- 67 - DIRECTIONAL OVERCURRENT RELAY
- 86 - LOCKOUT RELAY
- 87G - GENERATOR DIFFERENTIAL RELAY
- SYN - SYNCHROSCOPE
- AM - AMMETER
- VM - VOLTMETER
- WM - KW METER
- PF - POWER FACTOR METER
- REC. WMX - TRANSDUCER FOR REMOTE RECORDING TYPE KW METER
- F - FREQUENCY METER
- * - DENOTES METER MOUNTED ON SEPARATE INSTRUMENT PANEL
- WHU - KILOWATT HOUR METER
- AS - AMMETER SWITCH

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COOPERATION AND ADDED ASH STORAGE
13.2 KV SINGLE LINE DIAGRAM
ELECTRICAL

SHEET NO.
11
OF
JOB NO.

REVISIONS			
NO.	DESCRIPTION	DATE	APPROVED

DETAIL 1
SCREW CONVEYORS
MSC. 7A, 7B, 7C & 7D

DETAIL 2
ASH LOADING SPOUT
ALS - 2A, 2B, 2C & 2D

ITEM NO.	DESCRIPTION
1	PRESSURE RECORDER
2	FLOW RECORDER
3	KW RECORDER
4	TEMPERATURE RECORDER
5	KWH INTEGRATOR
6	FLOW INTEGRATOR
7	RUNNING TIME INTEGRATOR
8	RESETTABLE RUNNING TIME INTEGRATOR

DETAIL 3
INSTRUMENT PANEL
SCALE: 1" = 1'-0"

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COGENERATION & ADDED ASH STORAGE
DETAILS
MECHANICAL

SHEET NO.
10
OF
JOB NO.

SECTION C
SCALE: 1/8" = 1'-0"

SECTION B
SCALE: 1/8" = 1'-0"

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POPE, EVANS AND ROBBINS INCORPORATED CONSULTING ENGINEERS		GEORGETOWN UNIVERSITY WASHINGTON, D.C. COGENERATION AND ADDED ASH STORAGE		SHEET NO. 9
SECTIONS MECHANICAL		DATE:		JOB NO.

REVISIONS			
NO.	DESCRIPTION	DATE	APPROVED

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21, Nov. 1980

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GEORGETOWN UNIVERSITY WASHINGTON, D.C. COGENERATION AND ADDED ASH STORAGE	SHEET NO. 8 OF
PLAN AND DETAILS MECHANICAL	DRAWN: _____ APPR: _____ DATE: _____ JOB NO. _____

REVISIONS			
NO.	DESCRIPTION	DATE	APPROVED

SECTION A
SCALE: 1/8"=1'-0"

ELEVATION C
SCALE: 1/8"=1'-0"

SECTION B
SCALE: 1/4"=1'-0"

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21, Nov. 1980

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GEORGETOWN UNIVERSITY WASHINGTON, D.C. COOPERATION AND ADDED ASH STORAGE	SECTIONS MECHANICAL		SHEET NO. 7 OF JOB NO.
	DRAWN:	APPR:	DATE:
	DATE:		

REVISIONS			
NO.	DESCRIPTION	DATE	APPROVED

NOTES

1 - * TO BE ADJUSTED FOR MFG. SELECTED.

2 - REMOVE EXISTING 1" VALVE & NIPPLE AND REINSTALL.

PLAN
EL. 123'-4"
SCALE: 1/8" = 1'-0"

PLAN
EL. 106'-10"
SCALE: 1/8" = 1'-0"

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21, Nov. 1980

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	GEORGETOWN UNIVERSITY WASHINGTON, D.C. COGENERATION AND ADDED ASH STORAGE PLANS MECHANICAL
SHEET NO. 6	DATE: JOB NO.:

ASH HANDLING AND STORAGE FLOW DIAGRAM

PIPING AND INSTRUMENT FLOW DIAGRAM
* DENOTES INSTRUMENTS MOUNTED ON INSTRUMENT PANEL

FLUID COOLER PIPING FLOW DIAGRAM

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GEORGETOWN UNIVERSITY
WASHINGTON, D.C.
COGENERATION AND ADDED ASH STORAGE

FLOW DIAGRAMS

MECHANICAL

SHEET NO.

5

OF

JOB NO.

SITE UTILITIES PLAN
SCALE 1" = 20'-0"

A
4
DETAIL

REVISIONS			
NO.	DESCRIPTION	DATE	APPROVED

NOTES:

1. FURNISH AND INSTALL A 2-WAY 4" DUCT BETWEEN MANHOLE SE-19 AND SWITCHGEAR IN THE TURBINE-GENERATOR ROOM, RESURFACE TO MATCH EXISTING.
2. FURNISH, INSTALL AND CONNECT 3-1/2" 210, 10KV CABLE BETWEEN MANHOLE SE-19 AND SWITCHGEAR IN THE TURBINE-GENERATOR ROOM.
3. EXTEND 6" STORM DRAIN TO CATCH BASIN RESURFACE TO MATCH EXISTING.
4. FURNISH AND INSTALL CABLE RACKS, HOOKS AND INSULATORS IN MANHOLE SE-19, AS REQUIRED TO SUPPORT THE FEEDER INSTALLED IN NOTE #2 ABOVE AT 2'-0" MAXIMUM INTERVALS.
5. CABLE SHIELDS AT ENTRANCE TO THE CABLE BOX SHALL BE BOLDED TO GROUND WITH A #2 BARE TINED COPPER GROUND WIRE.
6. THE NEW FEEDER IN THE MANHOLE SE-19 SHALL BE ARC PROOFED/FIRE-PROOFED.
7. RESET EXISTING CLEANOUTS AND CATCH BASIN COVERS FLUSH WITH NEW PAVED AREA WITHIN COOLING TOWER ENCLOSURE.

35% SUBMISSION
21, Nov. 1980

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GEORGETOWN UNIVERSITY
WASHINGTON, DC

COOPERATION AND APPROPRIATE STORAGE
UTILITIES SITE PLAN AND DETAILS

GEORGETOWN UNIVERSITY DRAWN: APPR: DATE: SHEET NO. 4 OF 4

REVISIONS			
NO.	DESCRIPTION	DATE	APPROVED
1		10-21-80

NOTE:
PROVIDE A NEW ROLL-UP DOOR 16'-0" WIDE X 16'-0" HIGH AT ASH STORAGE. CUT PORTION OF EXISTING METAL PANEL OVERLAPPING NEW DOOR TO FIT.

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NOV. 21, 1980

METCALF AND ASSOCIATES Architects - Planners Washington, D.C.		MMP. CONSULTING ENGRS. WASHINGTON D.C.	
GEORGETOWN UNIVERSITY WASHINGTON D.C.		SHEET NO. 3 OF	
ADDITION TO COGENERATION AND ASH STORAGE ELEVATIONS - ARCHITECTURAL		DATE: 11/19/80 JOB NO.

<u>SYMBOLS</u>
EXISTING CONG. AS INDICATED ON PLANS.
CMU - CONG. MASONRY UNIT
BRICK
EXISTING BUILDING
NEW ADDITION
POROUS FILL STONE OR GRAVEL
EARTH
EXISTING MANHOLE
EXISTING HYDRANT
EXISTING GRASS AREA AND TREES TO REMAIN
METAL (LARGE SCALE)
EXISTING FENCE TO REMAIN
EXISTING CONTOURS
EXISTING SPOT ELEVATION
FIBERGLASS
DRYWALL
EXISTING CATCH BASIN.
AREA FOR CONTRACTOR'S OFFICES AND STORAGE

LOG OF SOIL BORING

BORING NO. N1

BORING NOS. E7 & E8

BORING NOS. E10 & E11

LEGEND FOR SOIL BORING

LEGEND FOR SOIL BORING

35% SUBMISSION
NOV. 21, 1980

NOTES

THE SOIL BORING INFORMATION
WAS TAKEN FROM DRAWINGS
SHEET H-G20 PREPARED BY
POPE, EVANS AND ROBBINS
DATED SEPTEMBER 26 1977

METCALF AND ASSOCIATES
Architects · Planners
Washington, D.C.

MMP,
CONSULTING ENGRS,
WASHINGTON D. C.

GEORGETOWN UNIVERSITY
WASHINGTON D.C.

ADDITION TO COGENERATION
AND ASH STORAGE
SITE PLAN — ARCHITECTURAL

SHEET NO.
1
OF

GEORGETOWN UNIVERSITY	DRAWN: F.N	APPROVED:	DATE: 11/19/80	JOB NO.
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