APÉNDICE 2

ESPECIFICACIONES DE EQUIPO

TRITURADORA DEL PRF (PRF SHREDDERS)

SNC·LAVALIN
Constructors Inc.

Bothell, Washington

SPECIFICATION SP-F595

REVISION A

FOR A

PRF SHREDDING SYSTEM

FOR

CONTRACT NO. 22069700

ARECIBO RENEWABLE ENERGY PROJECT
ARECIBO, PUERTO RICO

By:		Date:	8/24/2011
Project Technical Manager:		Date:	8/24/11
Approval:		Date:	8/24/2011

REVISION INDEX

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1. EXTENT OF WORK

This Specification covers the requirements for the engineering, design, manufacture and delivery of a complete municipal solid waste system including all required accessories and appurtenances as specified herein. If a conflict arises between this specification and any attached specifications, this document takes precedence. Additionally, the mechanical requirements for all of the various equipment types are included (Sections 3.1 through 3.3). Seller's design is to adhere only to the requirements for those equipment items applicable to the system described in Attachments A, B and C.

1.1 WORK INCLUDED

The following equipment and services shall be provided in accordance with this Specification. The equipment and services to be furnished include, but are not limited to the following:

1.1.1 Three complete PRF shredding systems including four pedestal cranes with associated equipment

1.1.2 Baseplate for shredders, drive motors and other associated equipment as required

1.1.3 Iron removal station.

1.1.4 One lot of belt conveyors including two (2) self-propelled traveling trippers

1.1.5 Lubrication system with controls (if required)

1.1.6 Couplings and guards

1.1.7 Layout and loads for foundation design, including special embeds for foundations

1.1.8 All local instrumentation, required hardware and associated equipment necessary to ensure a complete installation

1.1.9 Any special tools required for the installation, operation, and maintenance of the equipment

1.1.10 All equipment tests and inspections required by applicable codes and standards as specified herein

1.1.11 Seller shall provide documents, equipment and/or services that meet the requirements of all the drawings and specifications listed in all the attachments. If any discrepancies exist, this specification takes priority.

1.1.12 The Seller shall also include any other equipment necessary to provide a system capable of meeting complete plant requirements, whether or not this equipment is specifically called out in this specification.

1.1.13 Option of engineering services of a qualified representative for inspection of the completed installation and supervision of the initial equipment startup. The representative shall also instruct plant personnel in the proper operation of the equipment.

1.1.14 Option for finish painting

1.2 WORK NOT INCLUDED

The following will be performed by others:

1.2.1 Receiving, unloading, storing and installing the equipment

1.2.2 Interconnecting wire, cable and conduit between Seller equipment and plant wiring

1.2.3 Power supply at 480 and/or 4160 VAC, 3 phase, 60 hz

1.2.4 System grounding

1.2.5 Control system hardware for remote control

1.2.6 Foundations, anchor bolts and equipment pedestals

1.2.7 Feed and discharge chutes

1.2.8 Motor starters for 480 and/or 4160 VAC, 3 phase motors

2. APPLICABLE CODES, STANDARDS AND REGULATIONS

Equipment covered in this specification shall comply with all currently approved standards, safety codes, and test codes in effect as of the date of this specification, including the following:

Anti-Friction Bearing Manufacturers Association	(AFBMA)
American Iron and Steel Institute	(AISI)
National Board of Fire Underwriters	(NBFU)
Occupational Safety and Health Administration	(OSHA)
Steel Structures Painting Council	(SSPC)
Applicable Building Codes	

3. TECHNICAL REQUIREMENTS

3.1 BASIS OF DESIGN

3.1.1 The system shall be designed by the Seller to meet the performance requirements specified in Attachment C.

3.1.2 The Seller has the responsibility for providing final dimensions and equipment designs compatible with the equipment supplied by others and the final system general arrangement.

3.1.3 All equipment shall be designed for continuous duty (24 hr/day, 7 days/week) for the conditions specified in Attachment B.

3.1.4 All equipment shall be in accordance with OSHA requirements and shall be provided with all necessary guards and safety devices.

3.1.5 Replacement parts for the equipment shall be interchangeable to the maximum extent possible.

3.1.6 The shredding system shall include, but not be limited to, all necessary feeders, shredders, conveyors, screens, pedestal cranes, chutework and other equipment necessary to shred municipal waste into pieces of a size specified in Attachment C. The system shall accept the solid waste from the Buyer's trucks. It shall shred the solid waste and shall transport it to the PRF storage building. The following items describe requirements of the various components.

3.1.7 Shredders shall be top feed and bottom discharge, and shall consist of, but not be limited to the following:

3.1.7.1 Rugged steel housing provided with suitable access to all parts requiring maintenance or replacement. Easily replaceable wear liners shall be included where required to protect surfaces subject to heavy wear. Wear liners shall be replaceable without rotor removal.

3.1.7.2 Cutters selected for the specified application. Cutters shall be alloy steel to resist wear and shall be attached to a statically and dynamically balanced rotor.

3.1.7.3 Rotor assembly including cutters, cutter support, shaft, bearings and flywheel (if required) shall be designed for long life for the application intended and for minimum vibration. Bearings shall be heavy-duty, anti-friction type. Bearing lubrication provisions shall be provided as recommended by Seller.

3.1.8 The shredder drive components and drive motor shall be as recommended by Seller. Drive and motor components shall include, but not be limited to, the following:

- Direct and/or hydraulic drive application is desired.
- If direct drive, drive motor(s) horsepower shall be as recommended by the Seller for the application specified. Motor shall be a crusher duty motor with 1.15 service factor, 250% pullout torque and space heater. Seller to supply WK^2 required for motor with quote.

3.1.9 A common shredder and drive base shall be included and shall consist of the following:

3.1.9.1 The base shall be a rugged, structural steel assembly designed for common support of the shredder drive motor and drive components.

3.1.9.2 The base shall be designed to mount to a concrete foundation (by others) and shall include provisions for alignment of the drive motor and drive components.

3.1.9.3 Shredder, base and components shall be completely assembled and aligned at Seller's plant prior to shipment.

3.1.10 A bearing temperature monitoring system is to be included on each bearing and shall consist of the following:

- 100 OHM, platinum, resistance temperature detector. The detector shall be tip sensitive spring loaded with a connection head located in the bearing housing.

3.1.11 All belt conveyors supplied shall be designed in accordance with CEMA, 3rd edition, with a minimum of Class "C" idlers.

3.1.12 Screens and any other ancillary equipment shall be provided if deemed necessary by Seller to obtain the absolute size requirement of the Buyer. Seller shall describe size/distribution, etc.

3.1.13 Two magnetic separators (one acting as a spare) shall be provided to remove ferrous metals from the solid waste.

3.1.14 Belt conveyors and two traveling trippers shall be provided. The belt conveyors in the PRF Storage Building along with the two traveling trippers shall be capable of receiving and transporting additional PRF fuel from the Return Conveyor (from the boiler feed system).

3.2 ELECTRICAL REQUIREMENTS

3.2.1 Motors

Refer to Specification SP-E200, Attachment E.

3.3 CLEANING AND PAINTING

Manufacturer's standard

4. TESTS, REPORTS AND QUALITY ASSURANCE

4.1 TESTING

4.1.1 Buyer shall be notified prior to testing to determine if test witnessing is required.

4.1.2 The equipment shall be hydrostatically tested in the shop.

4.1.3 Shop tests shall be performed for all components and sub-assemblies along with a full functional test of the complete system and all auxiliary equipment. This test shall be performed with all equipment connected in the same manner as it will be in the field to permit verification of proper system operation. All wiring shall be checked by actual operating tests for accurate conformity to wiring diagrams and for continuity.

4.1.4 Functional and operational tests shall be performed for all devices such as recorders, annunciators, indicators and lights. All indication, alarm and interlock circuits shall be tested to ensure proper operation. Recorder pens shall be checked at zero, half scale and full scale using suitable test inputs. Alarm set points shall be adjusted to required valves and actuated to alarm their corresponding annunciator points.

4.1.5 Seller at a minimum shall include the following instrument and control systems testing:

- 100% I/O point function check.
- Simulations of all analog and digital control loops.
- Verification of point logic functions including alarm reporting and protective control actions.

4.2 GUARANTEES AND WARRANTY

4.2.1 The equipment shall be guaranteed to meet the performance requirements as stated in Attachment C. A performance test to verify guaranteed capacity will be performed.

4.3 REPORTS

With equipment shipment, the Seller shall submit the following:

4.3.1 Certified test reports for all tests.

4.3.2 Instrumentation

4.3.2.1 An ISA style data sheet shall be provided for each instrument supplied under this specification. Representative copies can be supplied by the Buyer if required. Each data sheet shall include, as a minimum, the following:

Tag Number	Service
Process Fluid	Process Span
Calibration	Sizing Data
Setpoint	Contact Rating
Enclosure NEMA Rating	Manufacturer
Model Number	

All data sheets shall be submitted to and must receive Buyer approval prior to Seller purchasing any instrument.

4.3.2.2 Instrument tag numbers will be assigned by the Seller and reviewed by the Buyer. The Buyer will supply a tag structure and loop range for the Seller to use. Any instrument tag number revisions will be supplied by the Buyer to the Seller as comments on the Buyer's return of the Seller's Piping & Instrumentation Diagrams.

4.3.3 Instrument Calibration

4.3.3.1 All instruments shall be calibrated. A Calibration Sheet shall be provided for each instrument supplied under this specification. Each Calibration Sheet shall include, as a minimum, the following information:

- Date
- Tag Number
- Service

- Calibration Reference
- Signature of Calibrator

4.3.3.2 Each analog instrument shall be calibrated at 0%, 25%, 50%, 75%, and 100% of span, showing the desired and actual reading.

4.3.3.3 Each digital instrument shall be transitioned from normal to above setpoint and back to normal. Desired and actual setpoints shall be recorded as well as reset.

4.4 QUALITY CONTROL

Seller Quality Control activities shall be in accordance with SLCI Specification PSQC-001.

5. MARKINGS, NAMEPLATES AND SHIPMENT

5.1 MARKING

All equipment and components shall be identified with equipment numbers per Attachment C and match-marked to assist field assembly and erection. All items shipped shall be accompanied by instructions for storing and protection.

5.2 IDENTIFICATION PLATES

5.2.1 Equipment names and numbers shall be as stated in Attachment C.

5.2.2 Any fittings and material shipped loose shall have a metal tag with identifying number securely affixed by means of metal chain.

5.2.3 All instruments shall be provided with a non-corrosive identification tag.

5.2.4 All control panels shall bear the UL508 label.

5.3 SHIPPING

5.3.1 Seller Preparation for Shipment shall be in accordance with SLCI Specification PSQC-001.

5.3.2 All equipment and components shall be properly packaged to withstand shipment without damage. Each package shall be clearly labeled on the outside as to its contents. Seller shall include a complete packing list and bill of material.

5.3.3 All equipment shall be sealed to prevent entry of water, dirt or other foreign matter. Seals used on nozzles shall not affect threads, weld preparation or flange faces.

6. SPARE PARTS AND SPECIAL TOOLS

6.1 SPARE PARTS

The Seller shall supply all spares needed for startup and testing. Quote separately from the base proposal.

The Seller shall provide a list of spare parts and consumables required during the installation, startup, and on-site testing for all equipment furnished.

6.2 SPECIAL TOOLS

The Seller shall provide all special tools and devices required for the installation, operation, and maintenance of the furnished equipment, whether from the Seller or any sub-Seller. The special tools shall be accompanied by any necessary explanatory information.

Attachment A

Information and Drawing Requirements from Seller

A1 VENDOR DRAWINGS AND DATA REQUIREMENTS

Drawings and data shall be furnished in accordance with the attached "Matrix of Required Documents."

Comments on returned documents do not relieve the Seller of meeting Purchase Order schedule requirements. If, by the Seller's opinion, the comments change the scope sufficiently to require a cost or schedule adjustment, then the Seller must notify the Buyer and resolve such differences in a timely manner to insure that the original delivery schedule is maintained.

Resubmitted prints shall be sent to the Buyer within 2 weeks of their return to the Seller. All documents returned to the Seller must be reissued unless specifically noted otherwise.

Vendors shall "cloud" and provide a written description of all changes made on each revision of the drawings.

A2 PROJECT-SPECIFIC INFORMATION

Drawings, manuals and transmittals shall include the following project-specific information:

SNC Lavalin Constructors Inc. Contract No. 22069700
P.O. Number _____, Specification SP-E595
Project Name: Arecibo Renewable Energy Project
Project Location: Arecibo, Puerto Rico

Equipment and instruments shall be identified on drawings with Buyer-supplied names and identification tag numbers.

A3 MANUALS

The Seller shall submit Installation, Operation and Maintenance Manual(s). Material shall not be submitted in loose form but shall be completely fastened together and bound. A spare parts list shall be submitted separately. **In additions to hard copies, an electronic, searchable version of the manual (.pdf) shall be provided.** Manuals shall also include but are not limited to following:

- Installation, start-up and initial test instructions (including pre-operational cleaning and testing).
- Operating instructions, including but not limited to safety precautions and operating limits.
- Maintenance procedures, routine adjustments, preventive maintenance schedules and any predictive maintenance recommendations.
- Parts illustrations, including parts lists adequate for the purpose of identifying and ordering replacement parts and designation of the number required per component, and lists of recommended spare parts.
- Detailed descriptions of the functions of each principal component of a system.
- Safety precautions.
- Inspection procedures
- Operating procedures
- All post-award documents required in Purchase Order Exhibit B shall be included.

A4 DRAWINGS PROVIDED ON DISK

Seller shall provide Purchaser with an Autodesk (AutoCAD / Navisworks) compatible 3-D model or 3-D solids model and 2-D General Arrangement drawings including physical outline and connection/interface locations. Seller acknowledges and agrees Buyer may use these drawings to show interconnects or modification to Seller equipment. Buyer will reproduce the Seller drawing on a Buyer drawing with Buyer drawing block and drawing number. Seller letterhead (name, drawing No., notes, etc.) will remain. These drawings will then be treated the same as other Buyer drawings (Buyer's property).

A5 INSTRUMENT NUMBERING, TAGGING AND DATA SHEETS

All instruments, if required by the attached Purchase Order Exhibit B, Drawing and Document Delivery Schedule shall be uniquely numbered and supplied with Data Sheets showing calibration, setpoints, Seller, type, model number, use, etc. Seller shall use Buyer instrument numbers or Buyer-approved numbering system. Instruments shall be calibrated at the factory. Completed ISA data sheets shall be provided before the equipment is shipped.

A6 MASTER BILL OF MATERIAL

A6.1 Scope

A master bill of material shall identify all equipment, components, devices, etc., in a master list to aid in shipping and receiving processes. The master bill of material and packing lists shall be sent with the shipment and a copy shall be sent to the SNC-LAVALIN CONSTRUCTORS Bothell Office at the time of shipment.

A6.2 Master Bill of Material

A master Bill of Material (BM) shall be developed. The BM shall include, but not be limited to, all equipment, major components, devices, motors, instruments, piping specialties, control panels, major electrical components, etc. Tag numbers whether provided by SNC-Lavalin Constructors or the supplier shall be assigned to motors, panels, pumps, instruments, safeties, etc., and shall be itemized on the BM.

The BM shall identify: job number, purchase order number, purchase order item number, name of item, tag number, manufacturer's name, model number, and if the item is part of a skid and which skid, or is the item shipped loose.

A preliminary BM shall be supplied with the bid. A second BM shall be supplied after general arrangements are approved (if it is different than the preliminary BM) and a final to be issued prior to shipping.

A6.3 Assembly Drawings

All assembly drawings shall be listed in the BM. Each assembly drawing shall clearly identify all components with the appropriate tag number. The assembly drawings shall identify which items are shipped as part of the assembly or are shipped loose.

A6.4 Packing Lists

Packing lists shall identify, in a clear and concise manner, items listed in the Bill of Materials or assembly drawings such that SLCI for each shipment can identify that each element of the contract or purchase order that has been received; is in proper condition; whether it is a complete assembly, partial assembly, or loose item. The packing lists shall list applicable assembly drawings and elements provided with tag numbers (SLCI or equipment supplier).

Packing lists for any item shipped loose or as a subassembly separate from the primary assembly and without a tag number or assigned identification number (e.g., piping components wiring harnesses, etc.) shall identify the assembly drawing where the item is best shown. The packing list shall also include identification markings designated by the Seller, as shown on the referenced assembly drawing.

Note that one lot is not an acceptable description. One (1) bag of 50 bolts per assembly drawing _____ is or 50 1"x2" A325 bolts for assembly of _____ would be acceptable.

Attachment B

Project Specific Data

B1 SITE CONDITIONS

Plant Location:	Barrio Cambalache, Arecibo, Puerto Rico
Plant Elevation:	15 ft ASL
Equipment Location:	Indoors
Ambient Conditions:	
Outdoor	
Dry Bulb Temperature (°F):	86
Wet Bulb Temperature (°F):	79.7 @ 86 coincidental dry bulb
Relative Humidity (%):	76
Design High Temperature (°F):	100
Design Low Temperature (°F):	60
Indoor	
Dry Bulb Temperature (°F):	100
Design High Temperature (°F):	115
Design Low Temperature (°F):	60
Building Code	IBC 2009 as adopted/amended by the Puerto Rico 2011 Building Code
Site Classification	Site Class E
Seismic Zone:	IBC (I=1.25) Ss=1.15 and S1=0.38
Wind Load:	Exposure C; hurricane prone region; wind speed (3 second gust) = 145mph, Iw = 1.15
Ground Snow Load (psf):	0 (Pg ground snow)

B2 PROJECT DESIGN

This project will be a nominal 60 MW capacity rankine cycle power plant consist of two (2) spreader-stoker boilers and one (1) steam turbine in a 2-on-1 configuration. The boilers will be designed for processed refuse fuel derived from municipal solid waste, as well as automotive shredder residue, processed urban wood waste and tire chips as combustion fuel to produce steam. Boiler generated steam will be fed to a non-reheat, condensing steam turbine to generate electricity. Steam turbine discharge will be exhausted to a surface condenser and cooling water will be supplied by a mechanical draft cooling tower system. Boiler feedwater will be heated by steam turbine extractions through a series of indirect & direct contact feedwater heaters in this Rankine cycle system.

B3 UTILITIES AVAILABLE

B3.1 Electric

Power Supply	4160 Volts, 3 phase, 60 Hz
	480 Volts, 3 phase, 60 Hz, 65 kA IC
	120 Volts, 1 phase, 60 Hz, 22 kA IC
	125 Volts DC
	120 Volts, 1 phase, 60 HZ, 22 kA IC, for essential power.

B4 MOTORS.

Motors shall be the squirrel-cage-induction type designed for full voltage starting. Motor voltages shall be selected based on requirements set forth in the table below:

Less than ¾ hp	120 V, single phase, 60 Hz
¾ hp - 250 hp	460 volts, 3 phase, 60 Hz
251 hp - 2,500 hp	4,000 volts, 3 phase, 60 Hz
2,501 hp and above	13,200 volts, 3 phase, 60 Hz

Motors shall be rated for continuous operation at full load with a temperature rise not to exceed NEMA Class B. Medium and low voltage motor windings shall have a Class F insulation system conforming to the requirements of NEMA MG-1 suitable for tropical environments.

Low voltage motors shall be provided with a service factor of 1.15 in accordance with NEMA MG 1-12.47. Medium voltage motors shall be sized to include a minimum margin of 15% between the driven equipment's requirement and the motor nameplate (medium voltage motors can be either 1.0 or 1.15 service factor). Motors shall not operate in the service factor range at any operating point of the driven equipment.

Medium and low voltage motors shall be capable of starting and accelerating the load to full speed with 80% and 90% rated motor voltage at the motor terminals, respectively, depending on the application. In general, locked rotor kVA/hp shall be NEMA Code G or less for motors rated for continuous duty. In some cases where motors with an 80% starting capability are either not available or not economical, the electrical distribution system shall be analyzed to verify if adequate starting voltage exists. Starting current for DC motors will be limited to approximately 500% of rated full load current.

Totally enclosed fan-cooled motors shall be provided in high dust environments. Open drip proof enclosures shall be used for medium voltage motors located indoors, weather protected NEMA Type II enclosures shall be provided for all outdoor medium voltage motors. Low voltage motors located indoors shall be either open drip proof or totally enclosed. Low voltage motors located outside shall be either totally enclosed or weather protected NEMA Type II. All motors located outdoors and motors rated 25 hp or greater shall be furnished with space heaters that are automatically energized when the motor is idle. Motors installed in hazardous areas shall meet the requirements and recommendations of the National Electrical Code (NEC, NFPA 70).

Attachment C

Performance Requirements

C1 PROCESS CONFIGURATION

Municipal Solid Waste (MSW) will be delivered to the facility in self-unloading trucks. These trucks shall first be weighed and passed through a radiation detector before being unloaded to the tippling floor inside the MSW Receiving and Processing Building. Front end loaders will transport the MSW toward pedestal cranes and the cranes will lift and feed MSW into three shredders. If unacceptable material is observed, the cranes will deposit them into reject material containers.

The shredded MSW will be transported by a conveyor belt past a magnetic separator where a portion of the ferrous metals will be removed. The resulting Processed Refuse Fuel (PRF) is transported to the PRF Storage Building on belt conveyors. Traveling trippers running across the PRF Storage Building ceiling will divert PRF into two piles.

This system shall feed the shredding system at the rate described later in this section.

Delivery rate of Solid Waste – At least as much capacity to match rate of production

Size distribution of PRF – See below

PRF Size Distribution		
Mesh Size - Inches	Range Weight % Passed	
3 - dimensional	Recommended	Range
6	100	100
4	95	85 - 100
2	85	75 - 95
1	70	60 - 80
3/4	60	50 - 70
1/2	.50	40 - 60
1/4	30	20 - 40
1/8	20	10 - 30
1/16	10	5 - 15

Size of each grade level reject container – 300 gallon (Approx. 42"x48"x54-1/4")
Number of reject containers - 15

C2 PRF SYSTEM

C2.1 PRF Flow Rates (Total)

Nominal Continuous Flow Rate, tons/hr	83.5
Maximum Flow Rate, tons/hr	100.0

C2.2 PRF Characteristics for System Design

Predicted Density, lb/ft^3	5

C2.3 PRF Conveyor #1

Type of Conveyor	Belt Conveyor
Design Capacity, ton/hr	83.5
Maximum Flow Rate, tons/hr	102.0
Collection Point	Shredder #1-3
Discharges to:	Magnetic Separator Inlet
Incline Length, ft	
Horizontal Length, ft	
Vertical Rise, ft	
Minimum Width, inches	By Seller (See sketch for recommended width)

C2.4 PRF Conveyor #2

Type of Conveyor	Belt Conveyor
Normal Operation Capacity, ton/hr	83.5
Design Capacity, ton/hr	100.0
Collection Point	Magnetic Separator Outlet

Discharges to:	PRF Conveyor #4 & 6
Incline Length, ft	
Horizontal Length, ft	
Vertical Rise, ft	
Minimum Width, inches	By Seller (See sketch for recommended width)

C2.5 PRF Conveyor #3

Type of Conveyor	Belt Conveyor
Design Capacity, ton/hr	0
Maximum Flow Rate, tons/hr	2
Collection Point	Magnetic Separator
Discharges to:	PRF Conveyor #4
Incline Length, ft	
Horizontal Length, ft	
Vertical Rise, ft	
Minimum Width, inches	By Seller

C2.6 PRF Conveyor #4

Type of Conveyor	Belt Conveyor, Reversible
Design Capacity, ton/hr	0
Maximum Flow Rate, tons/hr	2
Collection Point	PRF Conveyor #3
Discharges to:	Dump Truck
Incline Length, ft	
Horizontal Length, ft	
Vertical Rise, ft	

Minimum Width, inches	By Seller (See sketch for recommended width)

C2.7 PRF Conveyor #5

Type of Conveyor	Belt Conveyor
Design Capacity, ton/hr	83.5 + 50 = 133.5*
Maximum Flow Rate, tons/hr	150.00*
Collection Point	PRF Conveyor #2
Discharges to:	Traveling Tripper (West Side)
Incline Length, ft	
Horizontal Length, ft	
Vertical Rise, ft	
Minimum Width, inches	By Seller

C2.8 PRF Conveyor #6

Type of Conveyor	Belt Conveyor
Design Capacity, ton/hr	83.5 + 50 = 133.5*
Maximum Flow Rate, tons/hr	150.00*
Collection Point	PRF Conveyor #2
Discharges to:	Traveling Tripper (East Side)
Incline Length, ft	
Horizontal Length, ft	
Vertical Rise, ft	
Minimum Width, inches	By Seller

* = additional flow from Return Conveyor included

Attachment D

Equipment Data Sheets

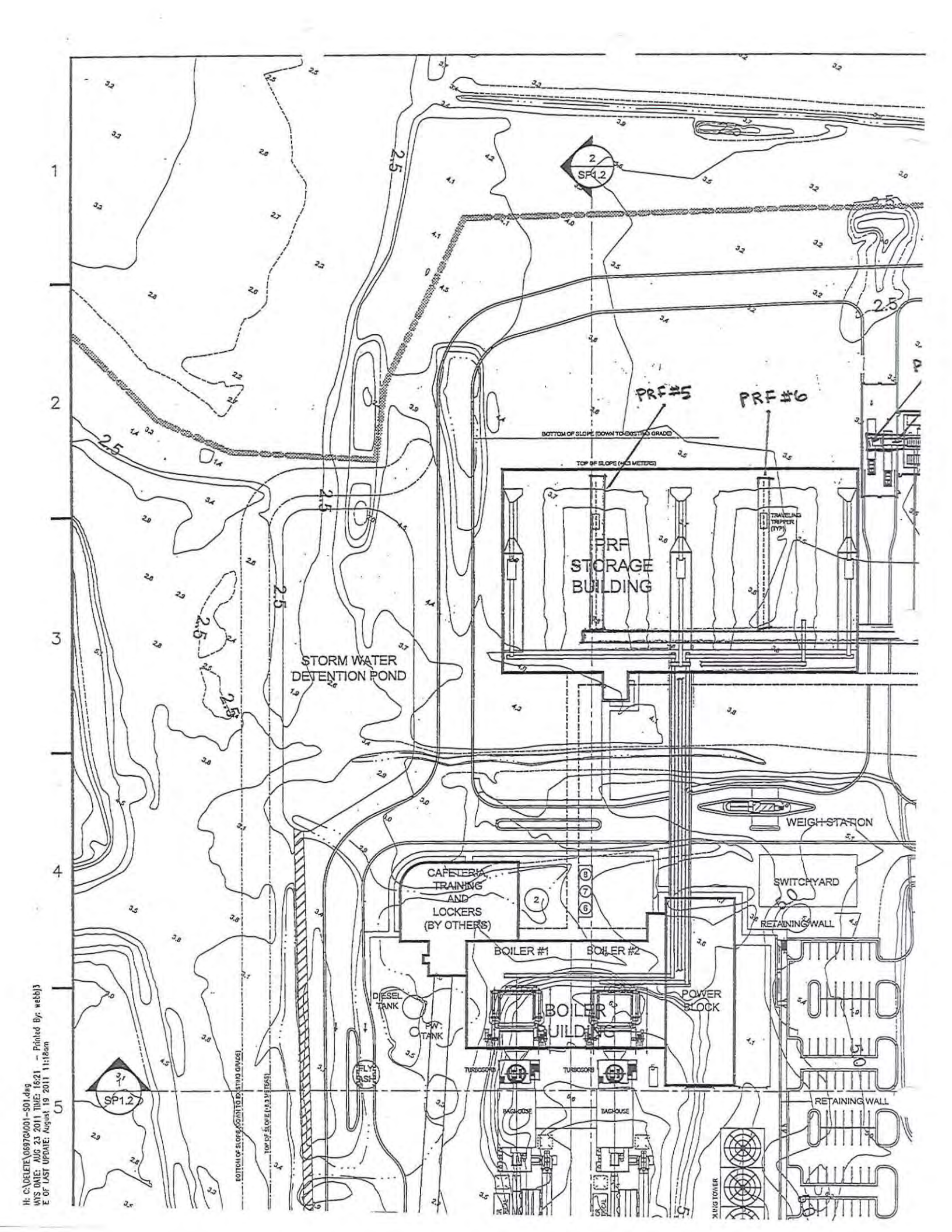
Seller shall submit complete data specifying design, construction, arrangement and mechanical performance of each major equipment item for the purpose of bid evaluation. This data shall be presented in Sellers own format

Attachment E

List Of Attached Drawings And Specifications

The following list comprises those drawings and specifications referred to in this specification (to be provided later):

Attachment No.	Rev	Description
PSQC-001 2nd Edition	2	Procurement Specification Quality Control — Mechanical
SP-E200	0	Electric Motors
0697 GA031 Sht 01	A	PRF Shredding System General Arrangement
0697_02 Sketch 001	A	Section View of Magnetic Separation System
0697_02 Sketch 002	A	Detailed Overhead View of MSW Receiving Building
0697_02 Sketch 003	A	Section View of Shredder System
0697_02 Sketch 004	A	Section View of Magnetic Separator Gantry Frame



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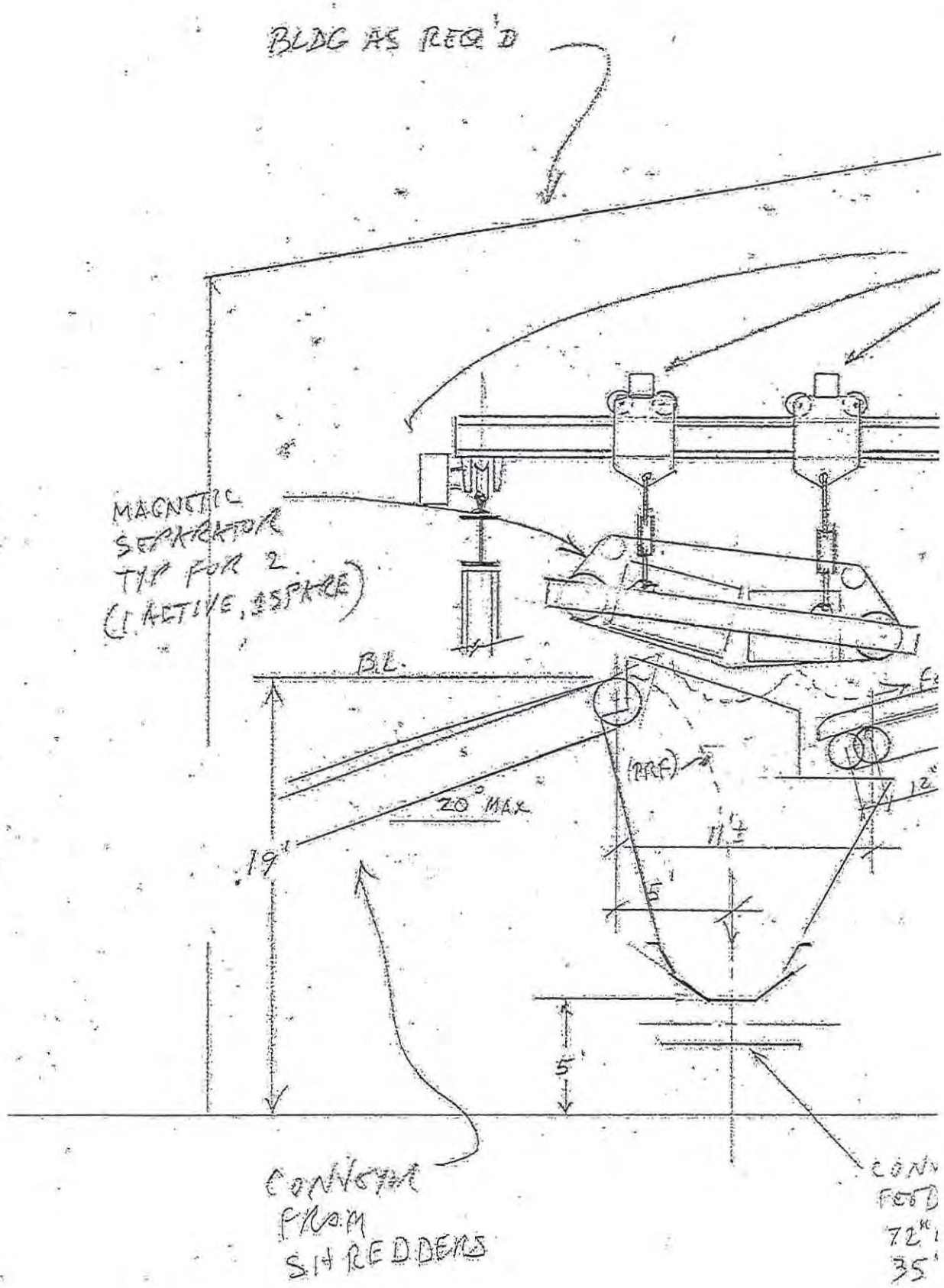
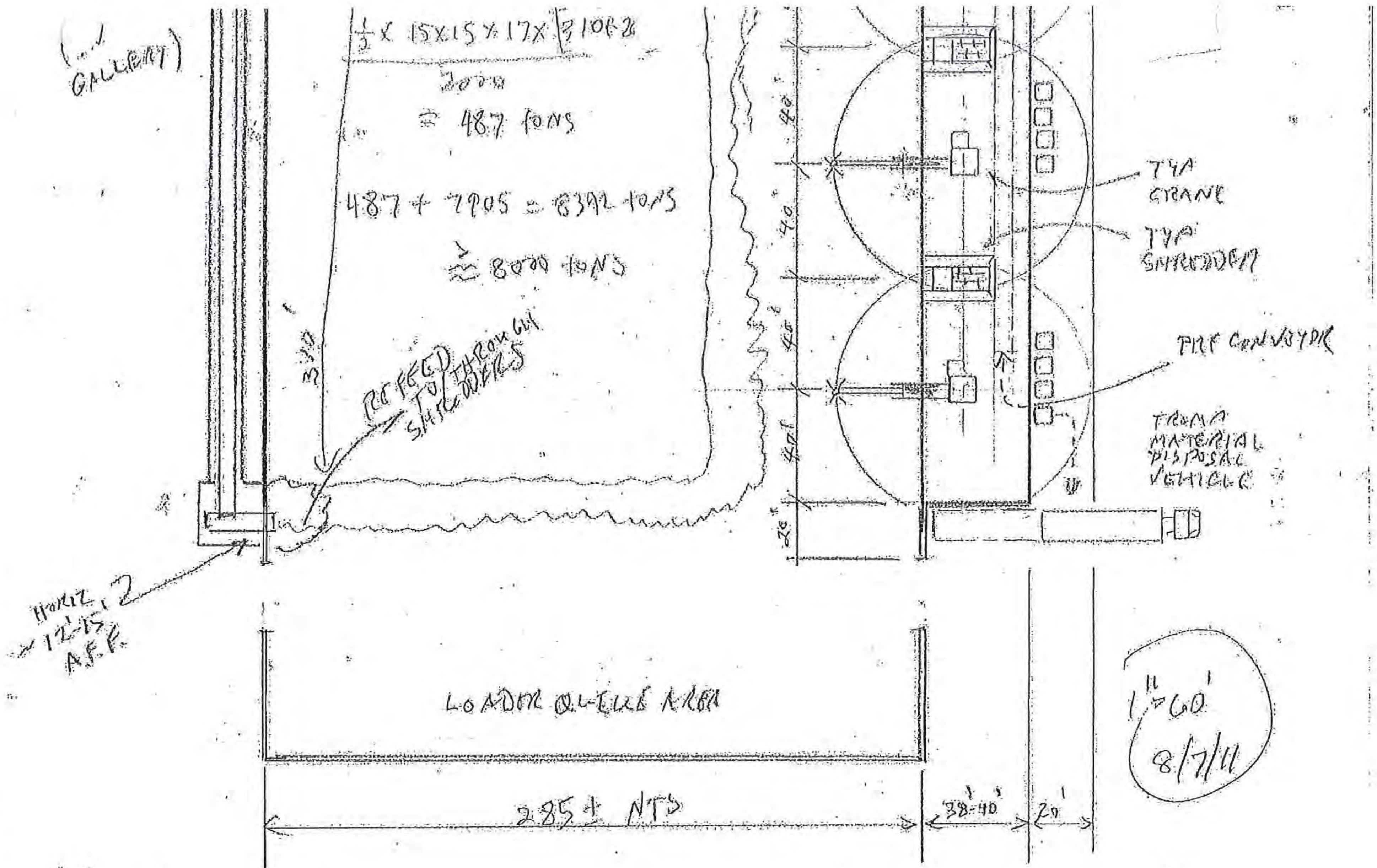
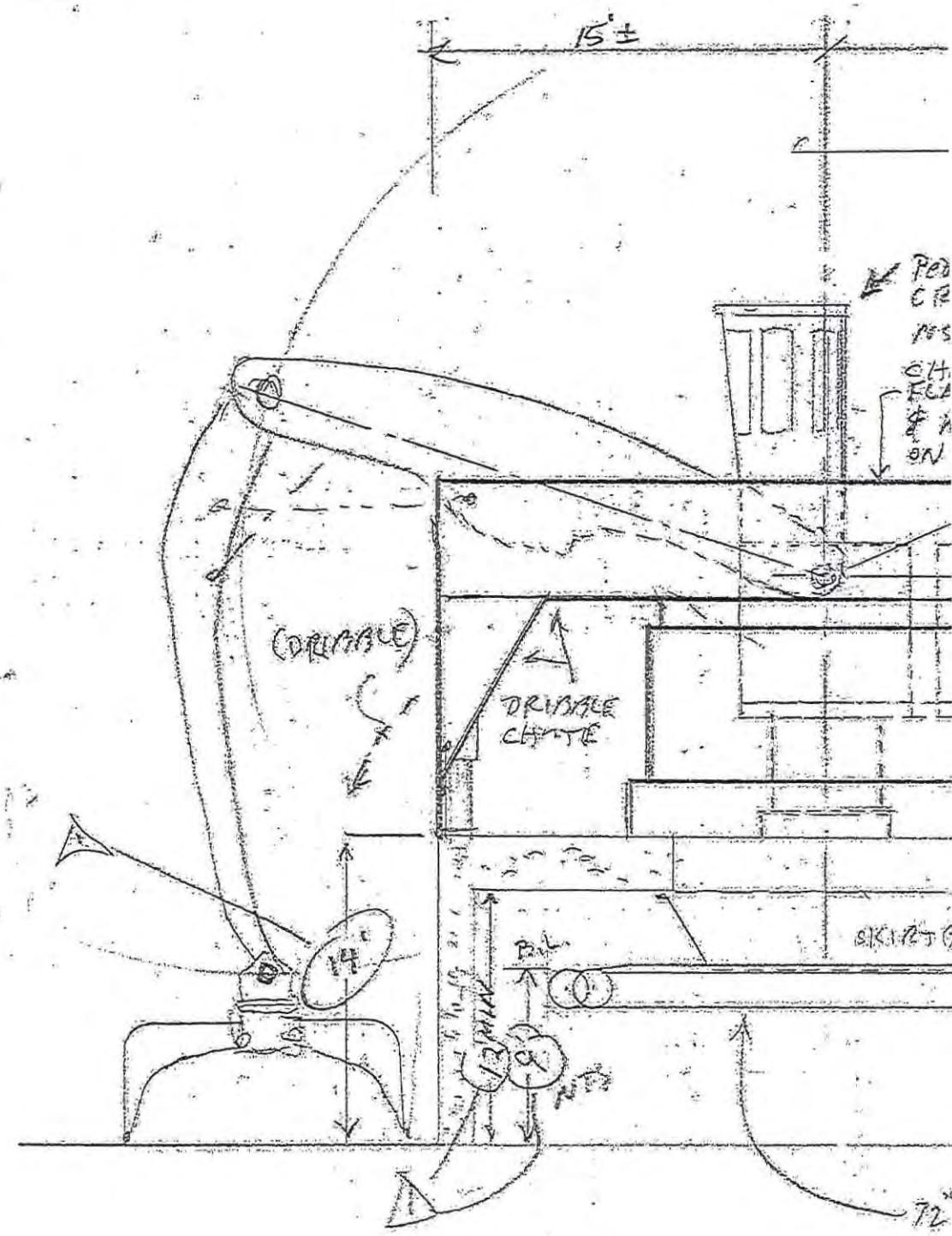
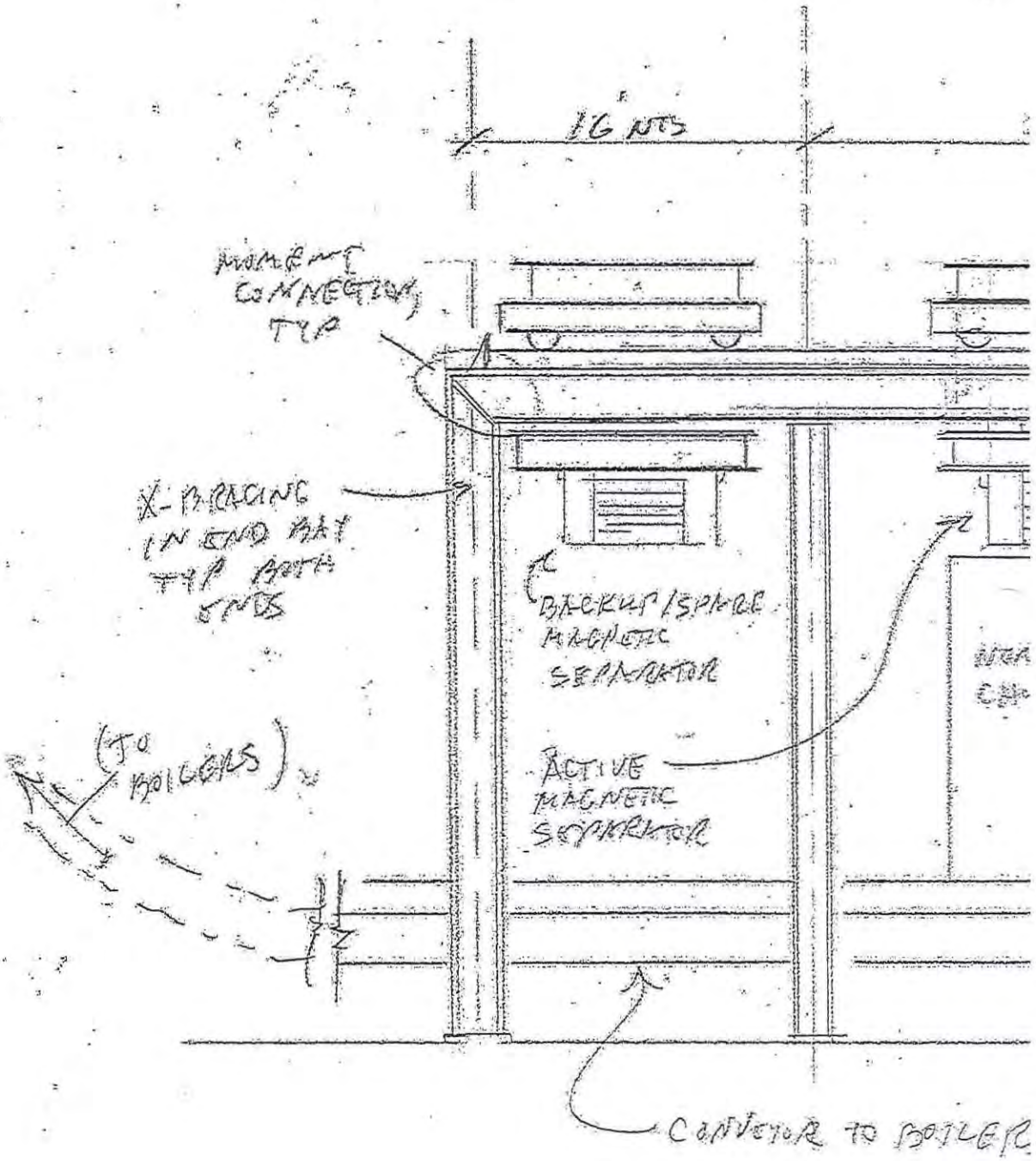

BLDG AS REQ'D
MAGNETIC SEPARATOR TYP FOR 2 (1 ACTIVE, 1 SPARE)
B.L.
20° MAX
19'
(REF)
11½'
5'
5'
12'
CONV'R FROM SHREDDERS
CONV'R FEED
72"
35'


GALLERY)
= 487 TONS
487 + 7905 = 8392 TONS
≈ 8000 TONS
RE FEED THROUGH TO SHREDDERS
HORIZ 2
12'-15'
A.F.F.
LOADER QUEUE AREA
285 ± NTS
38-40'
20'
40'
TYP CRANE
TYP SHREDDER
TYP CONVEYOR
MATERIAL DISPOSAL VEHICLE
1" = 60'
8/7/11



ELEV/SECTION THRU
TYP SHREDDER


16 MTS
MOMENT CONNECTION TYP
X-BRACING IN END BAY TYP BOTH ENDS
BACKUP/SPARE MAGNETIC SEPARATOR
ACTIVE MAGNETIC SEPARATOR
(TO BOILERS)
CONVEYOR TO BOILER

EQUIPO MECÁNICO PARA MANEJAR CENIZAS (MECHANICAL ASH HANDLING)

SNC·LAVALIN
Constructors Inc.

Bothell, Washington

SPECIFICATION SP-A090

REVISION A

FOR

MECHANICAL ASH HANDLING SYSTEM

FOR

CONTRACT NO. 22069700

ARECIBO RENEWABLE ENERGY PROJECT
ARECIBO, PUERTO RICO

ORIGINAL

By:		Date:	8/22/2011
Project Technical Manager:	Martin J. Dick	Date:	8/22/11
Approval:	William A. Graf	Date:	8/22/2011

REVISION INDEX

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1. EXTENT

This Specification covers the requirements for the engineering, design, manufacture and delivery of a complete mechanical ash handling system including all required accessories and appurtenances as specified herein. If a conflict arises between this specification and any attached specifications, this document takes precedence. Additionally, the mechanical requirements for all of the various equipment types are included (Section 3.1 through 3.12). Seller's design is to adhere only to the requirements for those equipment items applicable to the system described in Attachments A, B, C, and D

1.1 WORK INCLUDED

The following equipment and services shall be provided in accordance with this Specification. The equipment and services to be furnished include, but are not limited to the following:

1.1.1 Dry drag chain ash conveying system with sectionalized water jacketing for collecting ash and particles from the boiler grate discharge hopper. The grate ash shall be discharged via a system of drag chain conveyors to a belt of chain conveyor by others.

1.1.2 Grate discharge hopper (design only).

1.1.3 Grate discharge hopper (fabrication option).

1.1.4 Dry bottom ash collecting conveyors of the drag chain type for collecting bottom ash from the Turbosorp Circulating Dry Fluid Bed Scrubber Hopper(s) and Boiler Air Heater Hopper(s).

1.1.5 Dry fly ash collecting conveyors of the drag chain type for collecting fly ash from the Turbosorp Baghouse Hopper(s).

1.1.6 Elevated fly ash storage silo.

1.1.7 Fly ash unloading system.

1.1.8 Control valves, level switches, zero speed switches and other control devices.

1.1.9 All structural steel supports from Seller furnished equipment to Buyer's foundations including support structures and ladders for storage bin.

1.1.10 Layout and loads for foundation design, including anchor bolt sizes and locations.

1.1.11 Electric motor drives, gear boxes, and drive components for all conveyors and ash conditioners.

1.1.12 Logic for controlling all aspects of the system documented in both Boolean and ladder logic, and written format.

1.1.13 All local instrumentation, required hardware and associated equipment necessary to ensure a complete installation.

1.1.14 Any special tools required for the installation, operation, and maintenance of the equipment.

1.1.15 All equipment tests and inspections required by applicable codes and standards as specified herein.

1.1.16 Seller shall provide equipment and/or services that meet the requirements of all the drawings and specifications listed in Attachment C and all other attachments. If any discrepancies exist, this specification takes priority.

1.1.17 The Seller shall also provide any other equipment necessary to provide a system capable of meeting complete plant requirements, whether or not this equipment is specifically called out in this specification.

1.1.18 Option of engineering services of a qualified representative for inspection of the completed installation and supervision of the initial equipment startup. The representative shall also instruct plant personnel in the proper operations of the equipment.

1.1.19 Delivery of all equipment furnished to specified destination.

1.1.20 Option for finish painting.

1.2 WORK NOT INCLUDED

The following will be performed by others:

1.2.1 Receiving, unloading, storing and installing the equipment.

1.2.2 Interconnecting wire, cable and conduit between Seller equipment and plant wiring.

1.2.3 Power supply.

1.2.4 System grounding.

1.2.5 Controls, control panels and control system hardware for remote control.

1.2.6 Foundations, anchor bolts and equipment pedestals.

1.2.7 Screw auger conveyors (if required) for conveying fly ash from the various sources to the mechanical drag conveyors.

1.2.8 Grate discharge hopper (material and labor).

1.2.9 Motor starters.

1.2.10 Heat tracing, if required.

1.2.11 Insulation.

2. APPLICABLE CODES, STANDARDS AND REGULATIONS

Equipment covered in this specification shall comply with all currently approved standards, safety codes, and test codes in effect as of the date of this specification, including the following:

American Iron and Steel Institute	(AISI)
Steel Structures Painting Council	(SSPC)
Applicable Building Codes	(as noted in Attachment B)

3. TECHNICAL REQUIREMENTS

3.1 BASIS OF DESIGN

The grate ash shall be collected by drag chain conveyor with sectionalized water jacketing. The material shall be conveyed out of the conveyor trough in dry form and discharged to a system by others. The fly ash and free carbon particles shall be conveyed in dry form to ash conditioning and disposal system. The dry ash shall be metered out of the fly ash silo by a rotary valve, conditioned to a dust-free state by a mixer and discharged into Buyer-supplied open trucks.

3.1.1 The system shall be designed by the Seller to meet the performance requirements specified in Attachment C and to generally match the arrangement shown on the equipment layout (Attachment D). The dimensions and work points shown are preliminary, and are intended for bid purposes only unless depicted otherwise.

3.1.2 The Seller has the responsibility for providing final dimensions, equipment designs compatible with the equipment supplied by others and the final system general arrangement.

3.1.3 All equipment shall be designed for continuous duty (24 hr/day, 7 days/week) for the conditions specified in Appendix C.

3.1.4 All equipment shall be in accordance with OSHA requirements and shall be provided with all necessary guards and safety devices.

3.1.5 Replacement parts for the equipment shall be interchangeable to the maximum extent possible.

3.2 BOTTOM ASH SYSTEM

3.2.1 Grate bottom ash system shall reliably convey and cool the grate bottom ash in a neat and clean manner with a minimal amount of spillage, leakage and ash carryover. Ash accumulations and spillage requiring frequent cleanup are not acceptable.

3.2.2 Bottom ash system shall handle RDF ash up to 3-inch diameter and tramp metal.

3.2.3 Bottom ash system shall mate up with and receive ash from the grate discharge hopper(s), air heater hopper(s), and Turbosorp bed hopper(s).

3.2.4 The dry drag chain conveyor and hopper discharge chutes shall seal the boiler and connect to ash hopper. Ash hopper shall be designed by Seller.

3.2.5 The ash conveyor trough shall be the stationary type located under hopper discharge chutes.

3.2.6 Hopper discharge chute shall include an access door and be refractory lined.

3.2.7 The conveyor trough shall include sectionalized water jacketing .

3.2.8 Chain conveyors shall travel not more than 10 fpm.

3.2.9 Conveyor shall be designed to handle surges of incoming ash flow. These surges may be instant or may last several hours depending on boiler fueling and combustion operations. During the surges, conveyor speed will be up to doubled in speed through a variable frequency drive on the motor.

3.2.10 Flights shall be a minimum of 6 in. high, 24 in. wide, and 0.5 in. thick.

3.2.11 The conveying system and trough section shall permit routine inspection and maintenance of all critical components (i.e., bearings, sprockets, chains, and flights) while the unit is operating. Drain and fill connections shall be supplied.

3.2.12 Access shall be provided to quickly enter and manually clear the trough in the event of a jam.

3.2.13 The trough and conveyor shall be capable of being jammed without causing damage to the unit.

3.2.14 The chain, flights, and sprockets shall be designed to minimize wear and resist shock loads. Chains should not wear against rub rails or side plates. Chains shall be supported by flights.

3.2.15 Removable wear plates shall be provided for those regions of flight contact.

3.2.16 All bearings shall be roller bearing type and located on the exterior of the trough or conveyor and be easily accessible.

3.2.17 Manual screw take-ups shall be provided to tighten conveyor chains.

3.2.18 Shear pin overload protection shall be provided to the wet ash conveyor drive system.

3.2.19 Conveyor shall include a mounted zero speed switch as specified in Attachment B.

3.3 FLY ASH CONVEYORS

3.3.1 The Fly Ash System shall reliably convey fly ash from the Turbosorp baghouse hoppers to the fly ash silo.

3.3.2 The Fly Ash System shall reliably convey, store and condition fly ash having the various ash densities and properties listed in Attachment C. The conveyors shall be designed to handle surges of incoming ash flow without exceeding 10 fpm chain travel speed. These surges may last several hours.

3.3.3 Chain conveyors shall travel not more than 10 fpm.

3.3.4 Conveyor shall be designed to handle surges of incoming ash flow. These surges may be instant or may last several hours depending on boiler fueling and combustion operations. During the surges, conveyor speed may be up to doubled in speed through a variable frequency drive on the motor.

3.3.5 The fly ash conveyors shall be adequately enclosed, gas and air tight to suppress ash leakage and ash combustion. Conveyors shall have hinged access doors, removable covers and sealed takeup assemblies.

3.3.6 Each conveyor shall include a mounted zero speed switch as specified in Attachment C.

3.3.7 Each conveyor shall include a drive with shear pin overload protection.

3.3.8 All bearings shall be externally located and be roller bearing type.

3.3.9 Conveyors and all equipment supplied shall be capable of withstanding high temperatures from burning ash without excessive warpage.

3.3.10 Flights shall be at least 0.5 in. thick and a minimum height of 6 in.

3.3.11 Manual chain take-ups shall be provided with a minimum of 2 ft adjustment.

3.3.12 The chain conveyors shall be a one compartment design with the conveying flights traveling on the bottom of the conveyor and the return flights supported above.

3.3.13 The conveyors shall be equipped with replaceable wear strips for the upper flights and full width wear plates for the bottom flights. Removal of wear plates shall not cause damage to the conveyor trough.

3.3.14 Each conveyor shall be designed for field locating of infeed chutes and pipes.

3.3.15 Each conveyor shall include a steel panel bolted on the bottom which can be removed for emergency dumping of conveyed ash.

3.4 FLY ASH SILO

3.4.1 The fly ash silo capacity shall be as specified in Attachment C.

3.4.2 The fly ash silo shall be equipped with four non-nuclear point level detectors at the high-high, high, low, and low-low levels. It shall also be equipped with access door(s) and bin vent filters.

3.4.3 The silo shall be equipped with a conical bottom and vibrators. Angle of cone sides shall be not less than 60° from true horizontal.

3.4.4 Rappers shall be provided on the silo bottom cone to assist in unloading.

3.4.5 An automatic slide gate shall be provided at the silo outlet as described in Section 3.5.4. Two poke holes at 180° shall be provided above the slide gate.

3.4.6 A relief panel shall be provided which will prevent structural damage to the silo or its support structures in the event of an internal explosion.

3.5 MIXER/CONDITIONER/UNLOADER

3.5.1 A mixer-conditioner capable of discharging the amount of ash specified in Attachment C shall be located underneath the fly ash silo.

3.5.2 The mixer shall be horizontal paddle-type. Twin counter rotating mixing shafts shall be mounted inside a horizontal dust tight chamber.

3.5.3 The system shall provide a uniform mixed product.

3.5.4 Mixer shall be equipped with rotary feeder with a mechanically variable speed drive and slide gate above it. The slide gate shall be electropneumatic solenoid operated. The solenoid shall have a high temperature coil and waterproof enclosure.

3.5.5 Spraying nozzles shall be located inside the mixing tub to uniformly wet the ash.

3.5.6 A chute shall be supplied for directing conditioned ash into an open truck or shipping container.

3.5.7 Platforms with access ladders shall be designed to accommodate the system and provide operator access for loading truck. The mixer and platform elevation shall allow discharging into a 14-foot high truck.

3.6 CONTROL SYSTEM

Provide design for a control system to be integrated into the plant control system provided by others.

3.7 SUPPORTS AND WALKWAYS

3.7.1 Platforms and walkways shall be provided to access all elevated conveyor drives, mixers, and areas requiring routine access.

3.7.2 Platforms and walkways shall be designed for 100 psf live load.

3.7.3 Handrails and ladders shall be designed in accordance with all applicable codes.

3.7.4 Supports, platforms and walkways shall be galvanized.

3.8 GEAR DRIVES

Gear drives shall be mounted parallel shaft, helical, gear motors rated for severe duty by Eurodrive or approved equal. Motor sizing shall be based on surge conditions with dry ash densities twice the value of normal conditions.

3.9 ELECTRICAL REQUIREMENTS

3.9.1 Motors

Refer to Attachment B of this specification.

3.9.2 Wiring

Vendors standard for service.

3.10 INSTRUMENTATION

3.10.1 Unless otherwise specified, all process switches (temperature, level, speed, etc.) shall be furnished with contacts rated for 5 amps, 120 VAC. Switches shall have dry contacts.

3.10.2 All motor control devices, such as limit switches, pressure switches, etc., shall be provided with dry contacts and wired to terminals.

3.10.3 All items to be installed shall be in NEMA 4 enclosures.

All instruments shall be provided with alphanumeric SS tags in accordance with ISA 5.

3.10.4 All control valves shall be manufactured by ASCO or equal. Valves shall be 120 VAC with Class H coil and waterproof enclosure.

3.11 STRUCTURAL REQUIREMENTS

Vendor Standard

3.12 CLEANING AND PAINTING

Vendor Standard

Attachment A

Later ??

Attachment B

Project-Specific Data

B1 SITE CONDITIONS

Plant Location:	Barrio Cambalache, Arecibo, Puerto Rico
Plant Elevation:	15 ft ASL
Equipment Location:	Indoors
Ambient Conditions:	
Outdoor	
Dry Bulb Temperature (°F):	86
Wet Bulb Temperature (°F):	79.7 @ 86 coincidental dry bulb
Relative Humidity (%):	76
Design High Temperature (°F):	100
Design Low Temperature (°F):	60
Indoor	
Dry Bulb Temperature (°F):	100
Design High Temperature (°F):	115
Design Low Temperature (°F):	60
Building Code	IBC 2009 as adopted/amended by the Puerto Rico 2011 Building Code
Site Classification	Site Class E
Seismic Zone:	IBC (I=1.25) Ss=1.15 and S1=0.38
Wind Load:	Exposure C; hurricane prone region; wind speed (3 second gust) = 145mph, Iw = 1.15
Ground Snow Load (psf):	0 (Pg ground snow)

B2 PROJECT DESIGN

This project will be a nominal 60 MW capacity rankine cycle power plant consist of two (2) spreader-stoker boilers and one (1) steam turbine in a 2-on-1 configuration. The boilers will be designed for processed refuse fuel derived from municipal solid waste, as well as automotive shredder residue, processed urban wood waste and tire chips as combustion fuel to produce steam. Boiler generated steam will be fed to a non-reheat, condensing steam turbine to generate electricity. Steam turbine discharge will be exhausted to a surface condenser and cooling water will be supplied by a mechanical draft cooling tower system. Boiler feedwater will be heated by steam turbine extractions through a series of indirect & direct contact feedwater heaters in this Rankine cycle system.

B3 UTILITIES AVAILABLE

B3.1 Electric

Power Supply	4160 Volts, 3 phase, 60 Hz
	480 Volts, 3 phase, 60 Hz, 65 kA IC
	120 Volts, 1 phase, 60 Hz, 22 kA IC
	125 Volts DC
	120 Volts, 1 phase, 60 HZ, 22 kA IC, for essential power.

B4 MOTORS.

Motors shall be the squirrel-cage-induction type designed for full voltage starting. Motor voltages shall be selected based on requirements set forth in the table below:

Less than ¾ hp	120 V, single phase, 60 Hz
¾ hp - 250 hp	460 volts, 3 phase, 60 Hz
251 hp - 2,500 hp	4,000 volts, 3 phase, 60 Hz
2,501 hp and above	13,200 volts, 3 phase, 60 Hz

Motors shall be rated for continuous operation at full load with a temperature rise not to exceed NEMA Class B. Medium and low voltage motor windings shall have a Class F insulation system conforming to the requirements of NEMA MG-1 suitable for tropical environments.

Low voltage motors shall be provided with a service factor of 1.15 in accordance with NEMA MG 1-12.47. Medium voltage motors shall be sized to include a minimum margin of 15% between the driven equipment's requirement and the motor nameplate (medium voltage motors can be either 1.0 or 1.15 service factor). Motors shall not operate in the service factor range at any operating point of the driven equipment.

Medium and low voltage motors shall be capable of starting and accelerating the load to full speed with 80% and 90% rated motor voltage at the motor terminals, respectively, depending on the application. In general, locked rotor kVA/hp shall be NEMA Code G or less for motors rated for continuous duty. In some cases where motors with an 80% starting capability are either not available or not economical, the electrical distribution system shall be analyzed to verify if adequate starting voltage exists. Starting current for DC motors will be limited to approximately 500% of rated full load current.

Totally enclosed fan-cooled motors shall be provided in high dust environments. Open drip proof enclosures shall be used for medium voltage motors located indoors, weather protected NEMA Type II enclosures shall be provided for all outdoor medium voltage motors. Low voltage motors located indoors shall be either open drip proof or totally enclosed. Low voltage motors located outside shall be either totally enclosed or weather protected NEMA Type II. All motors located outdoors and motors rated 25 hp or greater shall be furnished with space heaters that are automatically energized when the motor is idle. Motors installed in hazardous areas shall meet the requirements and recommendations of the National Electrical Code (NEC, NFPA 70).

Attachment C

Design Requirements

The bottom ash handling system shall be designed to collect bottom ash from the boiler's grate discharge hopper, air heater hopper, and Turbosorp bed hoppers for transfer to the inlet of the Owner supplied bottom ash handling system.

The fly ash handling system shall be designed to collect ash from the Turbosorp baghouse hoppers and move it to the fly ash storage silo, condition it in a pug mill, and discharge it into trucks.

C1 BED ASH SYSTEM

C1.1 Bottom Ash Flow Rates (Total)

Nominal Continuous Flow Rate, tons/hr	10.6
Maximum Flow Rate, tons/hr	25.4

C1.2 Ash Characteristics for System Design

Bottom Ash Density for Conveying, lb/ft^3	40
Bottom Ash Density for Storage Capacity, lb/ft^3	70
Fly Ash Density for Conveying, lb/ft^3	10
Fly Ash Density for Storage Capacity, lb/ft^3	35
Density for Structural Capacity, lb/ft^3	120

C1.3 Bottom Ash Conveyor B11

Type of Conveyor	Drag Chain with sectionalized water jacketing
Design Capacity, ton/hr	3.9
Maximum Flow Rate, tons/hr	7.8
Bottom Ash Collection Point	Grate Discharge Hopper for Boiler 1
Discharges to:	Bottom Ash Conv B12

Incline Length, ft	
Horizontal Length, ft	
Vertical Rise, ft	
Minimum Width, inches	By Seller

C1.4 Fly Ash Conveyor F13

Type of Conveyor	Drag Chain
Normal Operation Capacity, ton/hr	0.00
Design Capacity, ton/hr	2.1
Ash Collection Point	Turbosorp Bed Hopper for Boiler 1
Discharges to:	Fly Ash Conv F11
Incline Length, ft	
Horizontal Length, ft	
Vertical Rise, ft	
Minimum Width, inches	By Seller

C1.5 Fly Ash Conveyor F12

Type of Conveyor	Screw Conveyor
Design Capacity, ton/hr	1.4
Maximum Flow Rate, tons/hr	2.8
Ash Collection Points	Air Heater Hopper for Boiler 1
Discharges to:	Fly Ash Conv F11
Incline Length, ft	
Horizontal Length, ft	
Vertical Rise, ft	
Minimum Width, inches	By Seller

C1.6 Fly Ash Conveyor F11

Type of Conveyor	Drag Chain

Design Capacity, ton/hr	1.4
Maximum Flow Rate, tons/hr	4.9
Ash Collection Points	Fly Ash Convs F12 & F13
Number of Collection Points	2
Discharges to:	Bottom Ash Conv B12
Incline Length, ft	
Horizontal Length, ft	
Vertical Rise, ft	
Minimum Width, inches	By Seller

C1.7 Bottom Ash Conveyor B12

Type of Conveyor	Drag Chain
Design Capacity, ton/hr	5.3
Maximum Flow Rate, tons/hr	12.7
Bottom Ash Collection Point	Fly Ash Conv F11 & Bottom Ash Conv B11
Number of Collection Points	2
Discharges to:	Bottom Ash Conv B31
Incline Length, ft	
Horizontal Length, ft	
Vertical Rise, ft	
Minimum Width, inches	By Seller

C1.8 Bottom Ash Conveyor B21

Type of Conveyor	Drag Chain with sectionalized water jacketing
Design Capacity, ton/hr	3.9
Maximum Flow Rate, tons/hr	7.8

Bottom Ash Collection Point	Grate Discharge Hopper for Boiler 2
Discharges to:	Bottom Ash Conv B22
Incline Length, ft	
Horizontal Length, ft	
Vertical Rise, ft	
Minimum Width, inches	By Seller

C1.9 Fly Ash Conveyor F23

Type of Conveyor	Drag Chain
Normal Operation Capacity, ton/hr	0.00
Design Capacity, ton/hr	2.1
Ash Collection Point	Turbosorp Bed Hopper for Boiler 2
Discharges to:	Fly Ash Conv F21
Incline Length, ft	
Horizontal Length, ft	
Vertical Rise, ft	
Minimum Width, inches	By Seller

C1.10 Fly Ash Conveyor F22

Type of Conveyor	Screw Conveyor
Design Capacity, ton/hr	1.4
Maximum Flow Rate, tons/hr	2.8
Ash Collection Points	Air Heater Hopper for Boiler 2
Discharges to:	Fly Ash Conv F21
Incline Length, ft	
Horizontal Length, ft	
Vertical Rise, ft	
Minimum Width, inches	By Seller

C1.11 Fly Ash Conveyor F21

Type of Conveyor	Drag Chain
Design Capacity, ton/hr	1.4
Maximum Flow Rate, tons/hr	4.9
Ash Collection Points	Fly Ash Convs F22 & F23
Number of Collection Points	2
Discharges to:	Bottom Ash Conv B22
Incline Length, ft	
Horizontal Length, ft	
Vertical Rise, ft	
Minimum Width, inches	By Seller

C1.12 Bottom Ash Conveyor B22

Type of Conveyor	Drag Chain
Design Capacity, ton/hr	5.3
Maximum Flow Rate, tons/hr	12.7
Bottom Ash Collection Point	Fly Ash Conv F21 & Bottom Ash Conv B21
Number of Collection Points	2
Discharges to:	Bottom Ash Conv B51
Incline Length, ft	
Horizontal Length, ft	
Vertical Rise, ft	
Minimum Width, inches	By Seller

C1.13 Bottom Ash Conveyor B31

Type of Conveyor	Drag Chain

Design Capacity, ton/hr	10.6
Maximum Flow Rate, ton/hr	25.4
Bottom Ash Collection Point	Bottom Ash Conveyors B12 & B22
Number of Collection Points	2
Discharges to:	10' inside client supplied ash handling building
Incline Length, ft	
Horizontal Length, ft	
Vertical Rise, ft	
Minimum Width, inches	By Seller

C2 FLY ASH SYSTEM

C2.1 Fly Ash Characteristics for System Design

Density for Conveying, lb/ft^3	30-45
Density for Storage Capacity, lb/ft^3	40
Density for Structural Capacity, lb/ft^3	90
Temperature at Pick Up Points	
Sand/Cinder Separator Outlet (set by boiler manufacturer)	320 °F
ESP Hoppers (set by boiler manufacturer)	320 °F

C2.2 Fly Ash Flow Rates (Total)

Nominal Continuous Flow Rate, tons/hr	8.2
Maximum Flow Rate, tons/hr	16.4

C2.3 Fly Ash Conveyor F51 through F54

Type of Conveyor	Drag Chain

Design Capacity, ton/hr	F31 = 4.1 F32 = 8.2 F33 = 8.2
Maximum Flow Rate, ton/hr	F31 = 8.2 F32 = 16.4 F33 = 16.4
Fly Ash Collection Points	Turbosorp Baghouse Collection Points
Number of Collection Points	4
Conveyor B Discharges to:	Fly Ash Silo
Maximum Inlet Temperature, °F	320
Incline Length, ft	
Horizontal Length, ft	
Vertical Rise, ft	
Minimum Width, inches	By Seller

C2.4 Fly Ash Silos

Quantity	1
Working Storage Capacity, ft3	2400 Option: 4200 ft3
Silo Inside Diameter, ft.	By Seller
Silo Straight Section Height, ft.	By Seller
Outlet Connection	Pug Mill

C2.5 Fly Ash Pug Mills

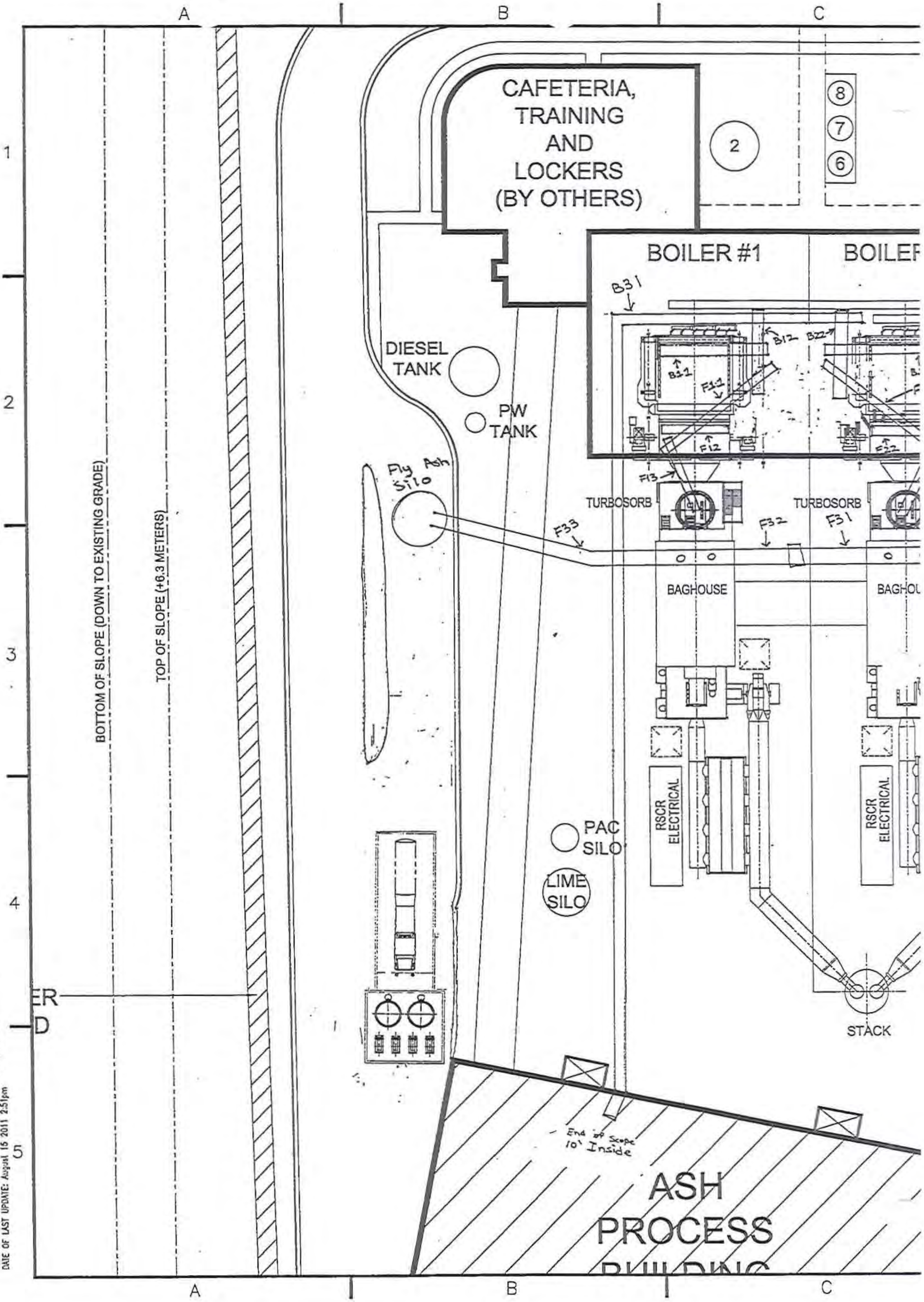
Quantity	1
Location	Unloading Floor beneath the silo
Capacity, tons/hr	50
Inlet	From Silo
Discharge	To Trucks
Discharge % Moisture Range	2 - 40

Attachment D

List of Attached Drawings and Specifications

The following list of drawings and standards forms part of this specification.

Drawing/Spec No.	Description
PSQC-001	Procurement Specification/Quality Control — Mechanical
SP-E200 Rev 0	Electric Motors
0697 GA030 Sht 01 Rev A	Ash Handling General Arrangement
0697 GA030 Sht 02 Rev A	Ash Handling General Arrangement



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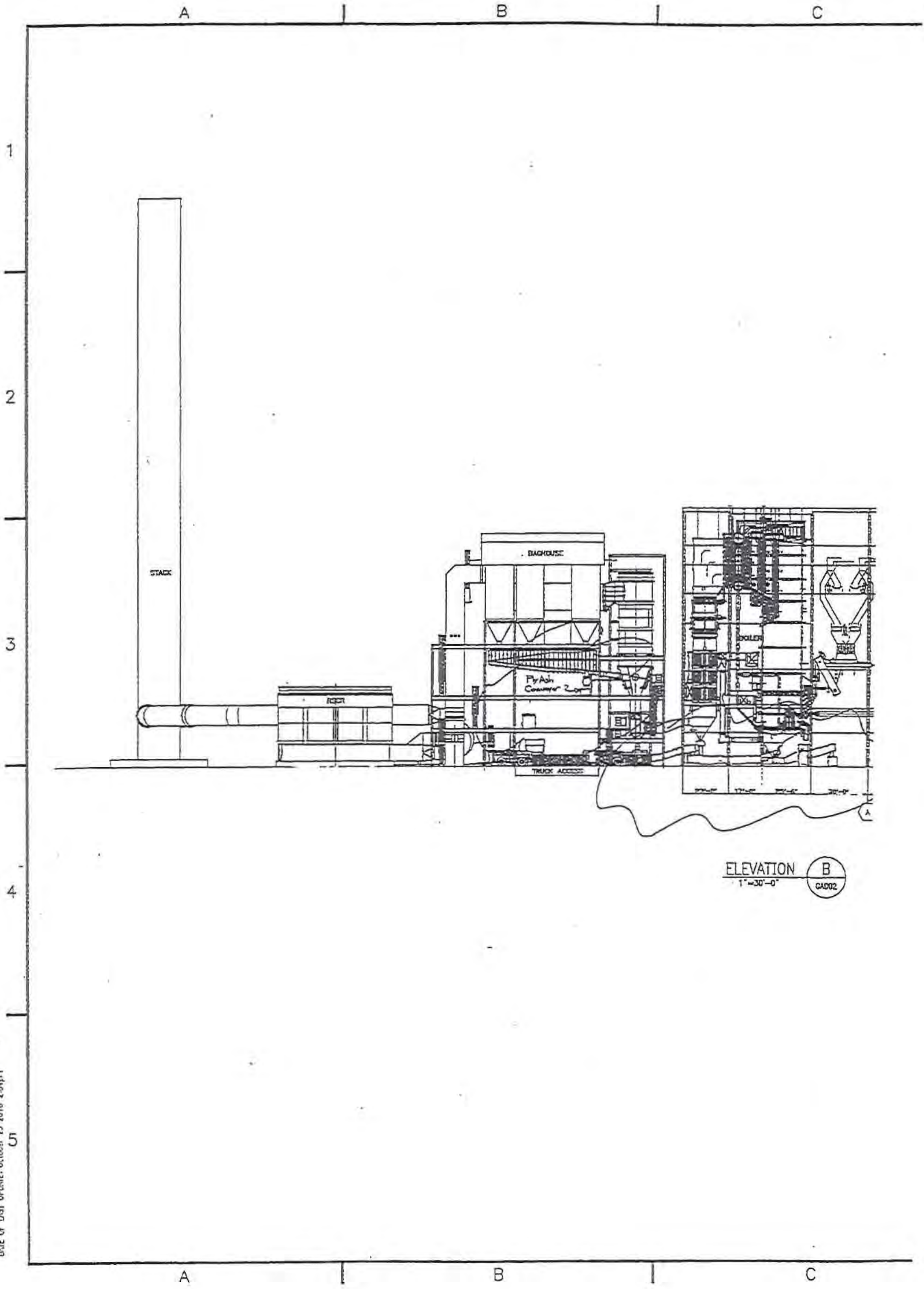

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MANEJADORA DEL PRF (PRF MATERIAL HANDLING)

SNC·LAVALIN
Constructors
Bothell, Washington

SPECIFICATION SP-F905.1

REVISION 0

FOR

PRF MATERIAL HANDLING SYSTEM

FOR

PROPOSAL NO. 22069700

ARECIBO RENEWABLE AND ALTERNATE ENERGY PROJECT
ARECIBO, PUERTO RICO

ORIGINAL

Engineer:		Date:	8/22/11
Project Technical Manager:		Date:	8/22/11
Approval:		Date:	8/22/11

REVISION INDEX

Revision 0 dated August 22, 2011

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1. EXTENT OF WORK

This Specification covers the requirements for the engineering, design, manufacture and delivery of a complete Processed Refuse Fuel Handling System including all required accessories and appurtenances as specified herein.

WORK INCLUDE COMPLETENESS AND INTENT

The work called for in this Specification shall be complete in every detail and shall conform to the particular details set out in the Specification. Any equipment not specifically mentioned in the specification but is required for the safe, efficient, proper and convenient operation and maintenance of the equipment shall be deemed to have been included and shall be included by the bidder.

Plant reliability is of the utmost importance. Consequently, the intent of this Specification is to obtain equipment of proven reliability and design for the Processed Refuse Fuel (PRF) handling facilities.

The PRF handling and transfer system to the powerhouse shall operate on an "on demand" basis to provide adequate PRF fuel to satisfy the demands of two power plant units amounting to a total power generation of 77 MW. The reclaim and delivery system to the powerhouse shall be capable of operating 24 hours per day, 7 days per week, 356 days per year.

Bidders shall make the best selection of equipment and materials based on the requirements of the Specification and having due regard for the conditions under which the equipment will operate.

TERMINAL POINTS FOR THIS CONTRACT

The terminal points for this contract shall be:

a) Discharge of two (2) belt conveyor travelling trippers into Fuel Storage Building
b) The inlet of the three (3) apron conveyors being fed by mobile equipment and responsible for fuel feed uptake.
c) The inlet flange of the screw crossfeed conveyors located on the fuel feed hoppers within the powerhouse.
d) The final outlet flanges of the screw crossfeed conveyors to the final discharge of the return conveyor system.
e) The underside of all baseplates for supporting the PRF handling facilities.
f) PRF equipment concrete foundations within the fuel receiving building.
g) PRF equipment supporting floor steel within the powerhouse.
h) Instrument and service air supply to individual components.
i) Junction boxes, cubicles and motor terminal boxes.
j) Fixed grounding points for external grounding of equipment being supplied.

1.1 WORK INCLUDED

The information included in this Specification relates to the complete supply of all structural, mechanical, and electrical equipment associated with the required PRF handling facilities.

The work shall consist of the design, manufacture, testing, delivery, and guaranteeing of all equipment and structure associated with the complete PRF handling facilities for the Arecibo Renewable Energy Project.

The work shall conform to the requirements of this specification and the associated drawings.

This will consist of the following equipment and associated structures:

See "0697 _02 FD030 – Fuel Flow Diagram" for a depiction of system equipment layout, numbering, and fuel flow progression

- Three (3) apron conveyors, to be loaded by means of mobile transport equipment
- Three (3) vibrating conveyor feeders
- Five (5) fully functional PRF transfer belt conveyors from the vibrating feeder outlets to the powerhouse feed conveyors.
- One (1) reversing transfer belt conveyor for PRF redundancy line.
- Four (4) fully functional belt conveyors for transfer from storage building to the powerhouse, responsible for main elevation gain.
- Appropriate gallery housing and associated supporting structures for Powerhouse feed conveyors #120 and 220, exposed to outdoor conditions.
- Two (2) fully functioning reversible transfer conveyors for boiler unit feed redundancy.
- Four (4) screw type cross-feed conveyors, two per boiler unit.
- Four (4) transfer belt conveyors responsible for fuel return from boiler feed overflow to distribution conveyor.
- All appropriate and necessary sets of transition chute work, skirting, and supports at critical connection and transfer points.
- All additional steelwork and fabrication to complete a fully functional operating system.
- All conveyor and diverter gate drives.
- All applicable guarding.
- All associated safety switches and junction boxes.

- All liner plate material for interconnecting chutework. Flop gates, and conveyor skirting.
- All bolts, washers, and nuts for interconnecting chutework and support structure
- Surface preparation, prime and finish coat painting of all supplied equipment and structures.

1.2 ALTERNATIVES

The bidder shall in all cases bid against the requirements of the Specification and associated drawings. However, bidders may offer alternatives together with full technical and pricing details, provided that they firstly submit bids for the specified requirements.

Only alternatives that serve to reduce capital cost and improve efficiency of the operation will be considered.

1.3 WORK NOT INCLUDED

The following work is not included in this Specification and will be supplied by others:

- Fuel receiving building structure and foundations
- Fuel storage building structure and foundations
- Installation, testing, and commissioning of all PRF handling equipment provided by the contractor
- Design and construction of all concrete foundations associated with the PFR handling equipment. Note that the contractor shall provide all loads for equipment within his scope of work.
- Switchgear, motor control centers, trays and electrical cabling between purchasers supplied control room and contractor supplied junction boxes, unless otherwise specified in this Specification.
- Power supply to motor terminal boxes
- Lubricating oils, grease, and hydraulic oils (other than the initial fill)
- Auxiliary supplies of AC and DC to energize controls

2. APPLICABLE CODES, STANDARDS AND REGULATIONS

2.1 CODES AND STANDARDS

Equipment covered in this specification shall comply with all currently approved standards, safety codes, and test codes in effect as of the date of this specification, including the following:

American Chain Association	(ACA)
American Gear Manufacturer's Association	(AGMA)
Anti-Friction Bearing Manufacturers Association, Inc.	(AFBMA)
American Iron and Steel Institute	(AISI)
American Institute of Steel Construction	(AISC)
American National Standards Institute	(ANSI)
American Society for Testing Materials	(ASTM)
American Society of Mechanical Engineers	(ASME)
American Welding Society	(AWS)
Conveyor Equipment Manufacturer's Association	(CEMA)
Institute of Electrical & Electronic Engineers	(IEEE)
Instrument Society of America	(ISA)
National Electrical Code	(NEC)
National Electrical Manufacturers Association	(NEMA)
National Fire Protection Agency	(NFPA)
Occupational Health and Safety Act	(OSHA)
Steel Structures Painting Council	(SSPC)
Uniform Building Code	(UBC)\
Applicable Building Codes	(as noted in Attachment B)

3. TECHNICAL REQUIREMENTS

3.1 PRF HANDLING SYSTEM FUNCTION

The function of the complete PRF Handling System is to receive, store, reclaim, and feed PRF to the two new boilers associated with the Arecibo Renewable and Alternate Energy Project. The PRF plant handling facilities shall be a triple (3) line system capable of providing 100% redundancy to all units at boiler maximum combustion rate (BMCR) using PRF having an average heating value of 5,700 BTU/lb.

The complete system is designed to move to storage, store, reclaim and transport PRF to the power boilers in an efficient and effective manner. As there are minimal facilities to store PRF in the powerhouse the system will run on a continuous basis 24 hour per day, 7 days per week, and 365 days per year.

3.2 FUEL RECEIVING FACILITIES

The MSW receiving and processing system is **not** included in the scope of this material handling specification.

3.3 FUEL DISTRIBUTION AND RECLAIM

"0697 GA001" is a general arrangement which includes the PRF Storage Building and layout of the associated handling system.

Fuel distribution and reclaim within the fuel storage building will be performed by operators utilizing up to three (3) mobile rubber tired loaders such as a CAT 980 each having a 10 yd capacity bucket. These loaders will be responsible for reclaiming and depositing the PRF into one of three (3) PRF accepting apron conveyors.

Each of the PRF apron conveyors will serve to provide a consistent uptake of fuel and have the capacity to accept a fully loaded loader bucket at any time during normal operation. Fuel will be transferred by belt conveyor from the apron conveyors to associated PRF vibrating feeders. Each of the vibrating feeders shall meter a smooth flow of fuel from the fuel storage and transportation system to the powerhouse via a series of transfer conveyors. Seller to provide appropriate transfer chute work and skirt plates as needed.