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SPECIFICATION FOR: MELT SPIN SEMI-PRODUCTION LINE (MSSL)		SSC IDENTIFICATION NO.	

1. APPROVALS

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2. REVISIONS/APPROVALS

REV. NO.	DESCRIPTION OF REVISION

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1. SCOPE

This specification defines the requirements for a highly flexible Melt Spinning Semi-production Line (MSSL).

The MSSL shall be highly instrumented and capable of melt spinning filaments from lignin, polyolefins, and pitches, and in the future other polymers, either as continuous tows or as a spun bond, non-woven web. The overall equipment system shall be capable of producing homo, bi, and tri-component fibers. The line shall be rated at >=120,000 kg (264,000 lb) of annual production, based on 24,000 filament (24k) polyethylene (PE) tow with 1.0 denier per filament (dpf) and 6,000 annual operating hrs, with a melt spinning capacity of at least 20 kg/hr (44 lb/hr) at speeds of >= 2,000 m/min and a spun bond capability of 600 mm width at 200 m/min rate. The Seller shall deliver and install a fully integrated equipment system that includes compounding, pelletizing, melt-spinning and spun bond capabilities. The melt spinning line shall include flexibility to melt spin tow or blow spin mat by simple reconfiguration of the equipment; i.e., by easily moving the required component of the equipment into/out of place for each of the two, distinct operations. Data acquisition and control shall be centralized in a dedicated control center. The MSSL shall be installed in a new building that is currently in design.

2. APPLICABLE DOCUMENTS

The current revisions of the following documents are incorporated by reference:

American National Standards Institute, Inc (ANSI)/National Fire Protection Association (NFPA) 70E, National Electrical Code.

American Society for Testing and Materials (ASTM) C1055, Standard Guide for Heated System Surface Conditions That Produce Contact Burn Injuries.

American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code.

ASME B31 Code for Pressure Piping.

National Electrical Manufacturers Association (NEMA) 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).

Company Specification for Special Project 017144.

Underwriters' Laboratories, Inc. (UL) 508, Standard for Industrial Control Equipment.

US 29 Code of Federal Regulations (CFR) 1910, Occupational Safety and Health Standards.

3. REQUIREMENTS

3.1 SYSTEM REQUIREMENTS

The MSSL shall satisfy the following system requirements:

- >= 120,000 kg annual production capacity of 24,000 (24k) filament PE tow (1.0 dpf) based on 6,000 annual operating hrs (20 kg/hr).
- Filament spinning capability of 0.5-1.5 dpf.
- Capability for homo, bi, and tri-component spinning with all equipment needed to prepare highly controlled and variable morphology filaments.
- Availability >= 6,000 hrs per year.
- Tow size from 3,000 (3k) – 24,000 (24k) filaments at 1.0 dpf

- Maximum tow spinning line speed >= 2,000 m/min
- All wetted surfaces shall be corrosion resistant and capable of resisting the corrosive and abrasive nature of feedstock materials specified in this document.
- Melt spinning operating temperature range of 150°–350ºC.
- A tow line with controlled, 3-stage dual roll godet drawing rolls with a temperature capability of 200ºC.
- Metering of spin finishes and cutter aspirators.
- A tow interlacing station and drive rolls with capability of variable tension and span control.
- Capability for spun-bond, nonwoven webs with 600 mm (24”) minimum width and capable of achieving spinning speeds >= 200 m/min (approximately 600 ft/min).
- A twin-screw polymer compounding and pelletizing line with a capacity of at least 60 kg/hr (132 lb/hr), with controlled gravimetric feeding of powders/pellets/liquids for precursor and master batch preparation.
- A standard polymer pelletizing system (with water bath) and an inert gas, water-free system for solidification/pelletizing of lignin powder. A single system for pelletizing conventional polymers and lignin, respectively, is preferred.
- A pyrolysis oven and ultrasonic batch for cleaning components of the equipment, including spinnerets.
- A fully integrated system with computer control and data acquisition.
- The data acquisition and control system shall prevent unauthorized access to restricted information.
- All required capabilities within the facility constraints described in Section 3.10.

The MSSL design, operation, and maintenance shall be fully documented as specified herein. All documentation shall be provided in the English language.

The Seller shall submit with its Proposal a summary of overall system design and performance parameters demonstrating that it satisfies the system requirements.

3.2 GENERAL EQUIPMENT CONFIGURATION AND LAYOUT

The general MSSL configuration is illustrated in Figure 1 and shall include the following equipment modules:

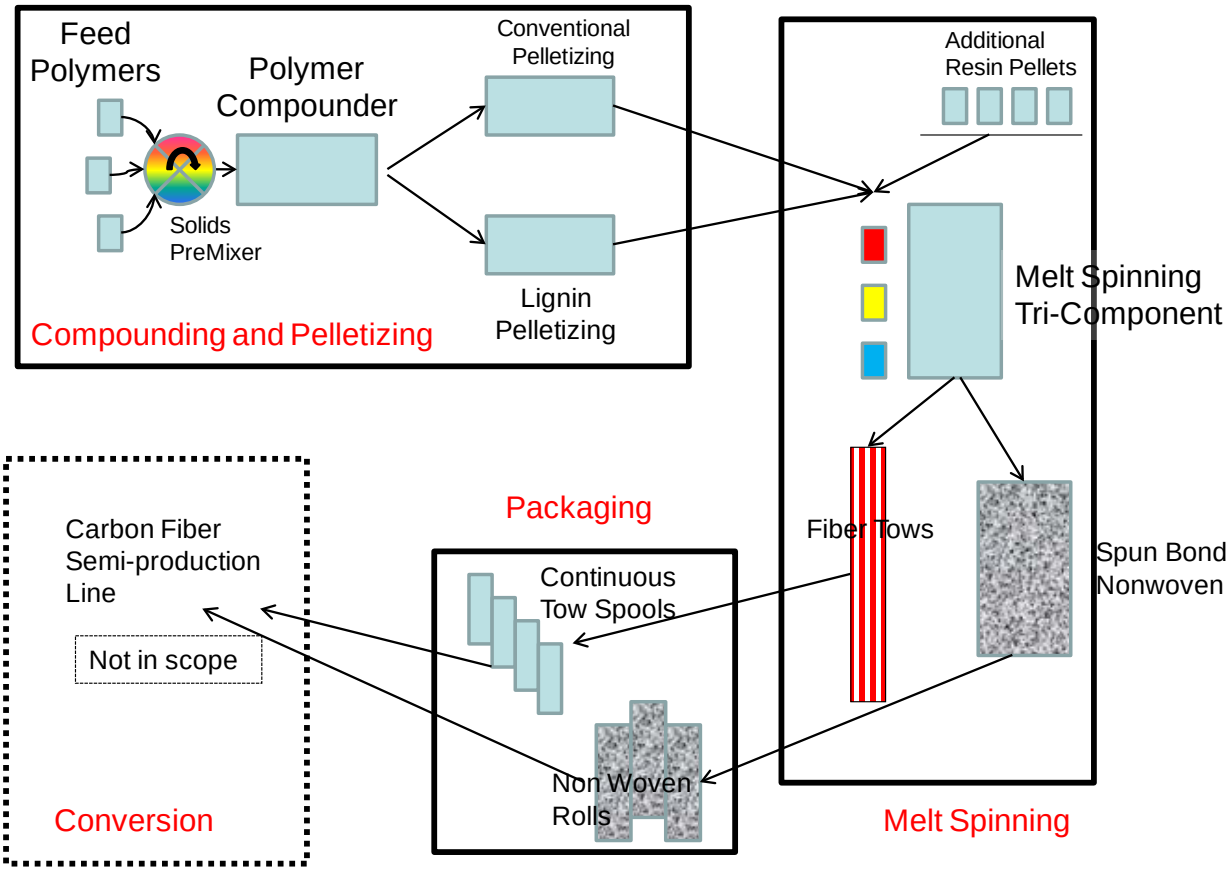

Figure 1. General Configuration of the MSSL.

List of Major Equipment

Polymer Compounding and Pelletizing

1. Dehumidifying dryers – three (3)
2. Feedstock loaders – three (3)
3. Gravimetric additive feeders – three (3)
4. Ribbon blender
5. Liquid feeders – two (2)
6. Twin screw extruder – including motor, heaters, and controls
7. Gear pump – one (1)
8. Extended (large) area candle filters or screen-changer
9. Water bath and air knife system, and pelletizer
10. Lignin–specific, dry (moisture–free) pelletizer unit
11. Controls and data logging system

Filament Tow Melt Spinning Equipment

12. Polymer drying systems – three (3)
13. Polymer loading devices – three (3)
14. Gravimetric additive feeders – two (2)
15. Primary extruder, 30:1 L/D, rear pull screw, including motor, heaters, and pressure transducers. A minimum of two vents for volatiles removal are required

16. Screen changer with extended (large) area filtration required for primary extruder
17. Secondary extruders, two (2) required, 30:1 L/D, rear pull screw, including motor, drive, heaters, pressure transducers, and two vents for volatiles removal
18. Electrically heated and controlled transfer pipes that are removable
19. Corrosion resistant tri-component spin pack – including heaters and controls
20. Spare filament spin pack assembly (tri-component)
21. Spin pack lift and operator access platform
22. Quench assembly with two sided removable cabinet, blower, and chiller sized for necessary heat removal
23. Removable heated tube assembly capable of 200°C operation
24. Finish application system
25. Three position denier control stands (draw stations). Dual-roll
26. Interlacing stand with variable tension and span control
27. High precision filament winder for fiber tows
28. Main platform with stairs for extruders, feeders, and melt spinning

Spun Bond Equipment

29. Draw slot attenuator
30. Aspirator and ancillary equipment
31. Height adjustable web former
32. Compaction and nonwoven mat winder

Control System and Cabinets

33. Control cabinets for temperature and pressure control and monitoring

3.3 GENERAL LAYOUT

The Seller shall submit with its Proposal a description and footprint layout of the entire MSSL, including plan and elevation layout drawing(s), and the assembled equipment weight as well as the weight of each major component. Updates shall be provided with the Design Approval Data, Advanced Engineering Data, and Certified Data submissions.

3.4 PROCESS EQUIPMENT

All major production line equipment is described in this section. The Seller shall submit with its Proposal a basic description and specification of all equipment. Updates shall be provided with the Design Approval Data and Certified Data submissions.

3.4.1 Compounding and Pelletizing Equipment

A complete compounding and pelletizing system with considerable flexibility is required. See Figure 2. Overall capacity of >= 60 kg/hr is required. Up to three solid components shall be dried, vacuum conveyed, and stored under a nitrogen blanket. A solids premixing unit capable of handling a wide range of polymers and additives while controlling mixing, atmosphere, and temperature shall be supplied. In addition, the capability to feed two (2) liquid ingredients directly into the extruder is required. These liquids are to be transported from manually loaded tanks through metering pumps to the extruder at rates of 1-5% (≤ ± 0.1%) of the pelletizing equipment output (by weight). Each of the three solid feeds shall be fed at 1-100% of output capacity.

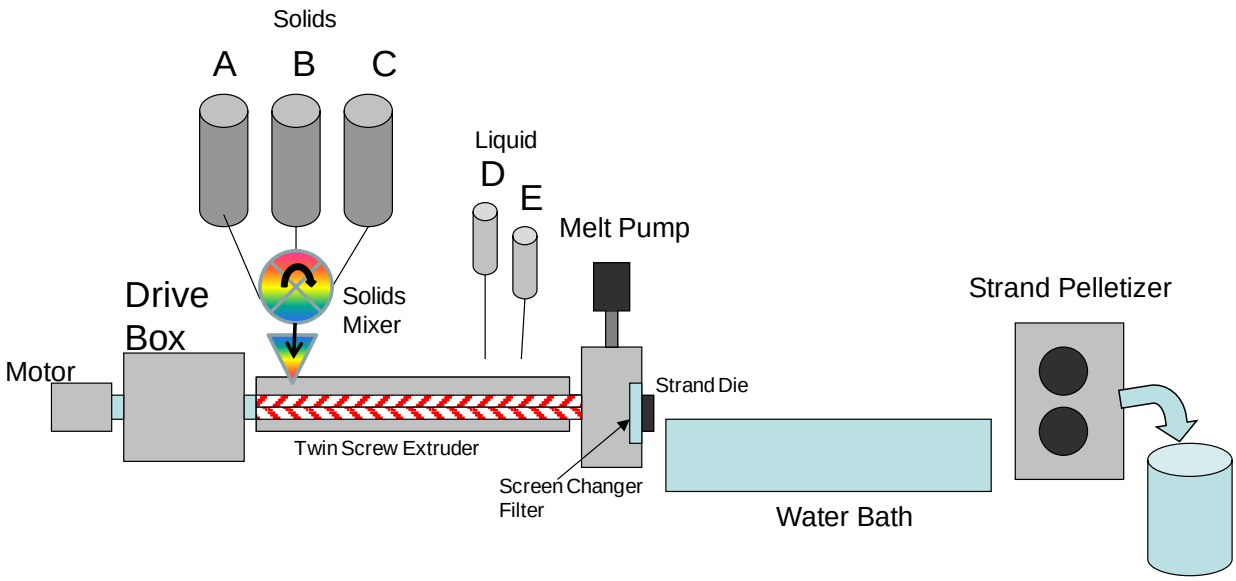

Figure 2. Standard Compounding and Pelletizing Equipment Diagram.

The co-rotating, twin screw compounding extruder shall have a minimum of five (5) heating zones and have a barrel with multiple elements that can be configured to meet the varying requirements of a wide range of polymers and through use of appropriately designed screws (the screw supplied with the equipment shall be suitable for compounding/pelletizing of polyethylene feedstock). Capability to pull the screws from the rear (drive) end of the extruder is required. All wetted parts shall be highly corrosion resistant. It shall operate under a nitrogen atmosphere (blanket). The output of the extruder shall feed a metering pump and incorporate a screen changer or similar device with extended (large) area filtration capable of removing particles >1 micron in size, and then exit through a suitable die to form strands in the range of 0.10 to 0.15 inch diameter. The strands shall then be passed through a water bath and then on to a strand pelletizer with the capability of producing pellets with L/D in the range of 1:1 to 5:1. For most polymers and blends this can be accomplished by using a strand die, water bath and pelletizer equipment typical in the industry (see Figure 2).

Operation with lignin, however, will require special equipment capable of solidifying this natural polymer into controlled size “pellets” in an inert, clean, and moisture-free environment. State of the art pelletizing equipment capable of handling and pelletizing lignin powder under these conditions shall be included in the proposal. California-type pellet mills, rotoformers, or belt flakers should be considered. See Figure 3.

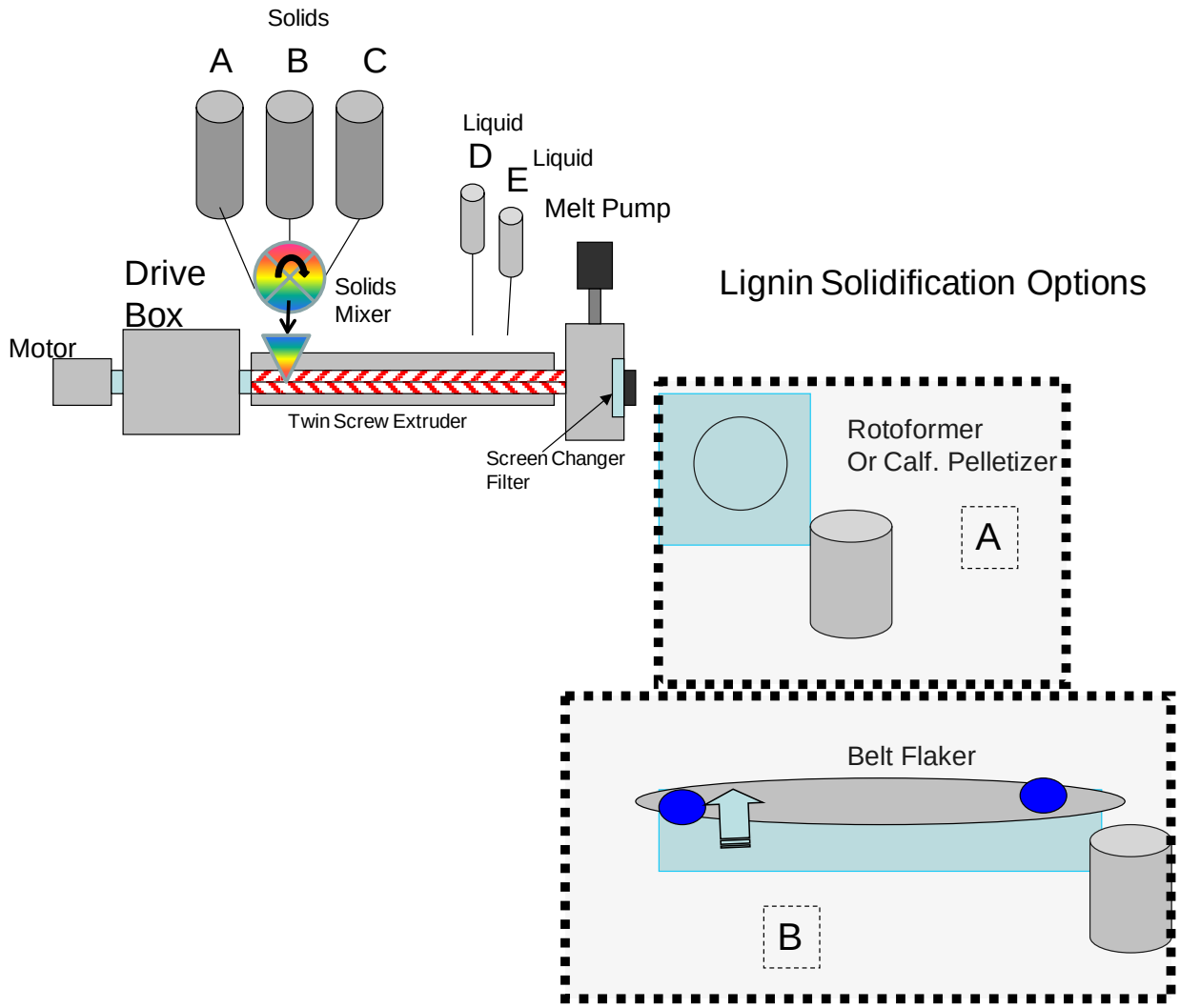

Figure 3. Lignin Compounding and Possible Pelletizing Systems.

3.4.2 Filament Tow Spinning Equipment

A complete filament tow spinning unit is required that provides flexibility without compromising production rates or quality (See Figure 4). It shall have the capability to spin lignin, polyolefin, and pitch precursors at temperatures in the range of 150°–350°C. The line shall have the capability to spin homo, bi, and tri-component fibers with highly controlled, variable morphologies. The melt spinning line shall have a 20 kg/hr capacity and be capable of spinning 0.5–1.5 dpf filaments. All equipment necessary to draw and wind the tows with 3K – 24k filaments shall be supplied. Interchangeable quenching and heating chambers also are required; the exact sizing requirements of the heating chamber are to be defined in consultation with the Company.

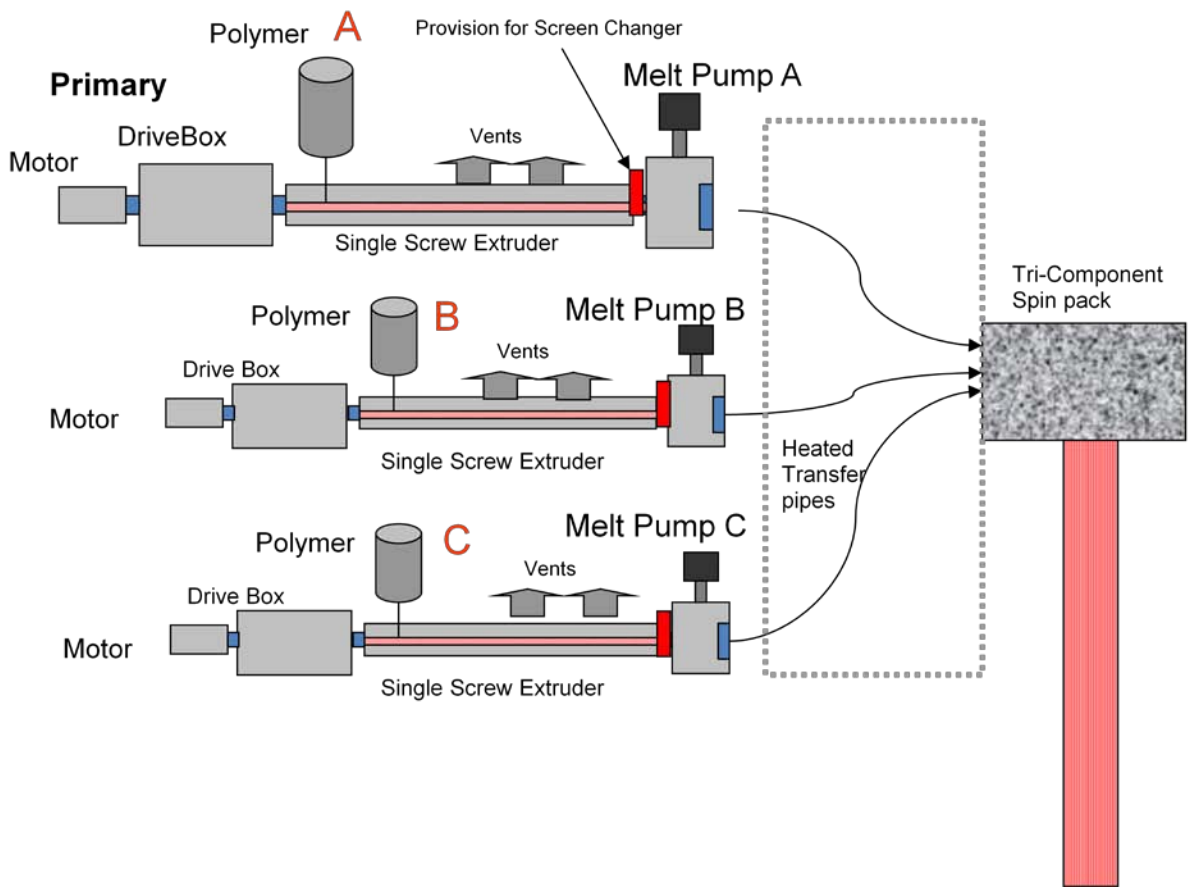

Figure 4. Tri-Component Melt Spin Line.

All components of the equipment that will be wetted by the polymer materials shall resist corrosion from the standard polymers mentioned above, as well as lignin and additives that may present corrosion concerns. Hastelloy X or an alloy with equivalent corrosion resistance will be required. Corrosion-resistant materials and design features shall be specifically identified in the Proposal.

Suitable multiple polymer handling systems with dryers, inert gas blanketing, feed chutes, vacuum loading, feed systems, and gravimetric loaders shall be required.

The three (3) 30:1 L/D extruders shall feature rear pull screws for easy maintenance, a temperature range capability of 150°–350ºC, ventilation ports (2), heated transfer pipes, and all necessary temperature controls. The pump drive motors shall feature over-torque protection and shutdown to prevent screw breakage under extreme conditions, including excessively high pressure.

The system shall also feature a screen changer with extended (large) area filter, corrosion resistant tri-component spin head assembly with pump block, pack adaptors, wear and purge plates, heating jackets, pump well extensions and covers, and temperature and pressure control systems.

A removable quench assembly with air control valves, feed and return ducts, and all associated hardware is required. An appropriately sized air handler with filter, coils, fan, controls, and associated hardware is required. (See Figure 5.) A lifting/removal system is also a requirement.

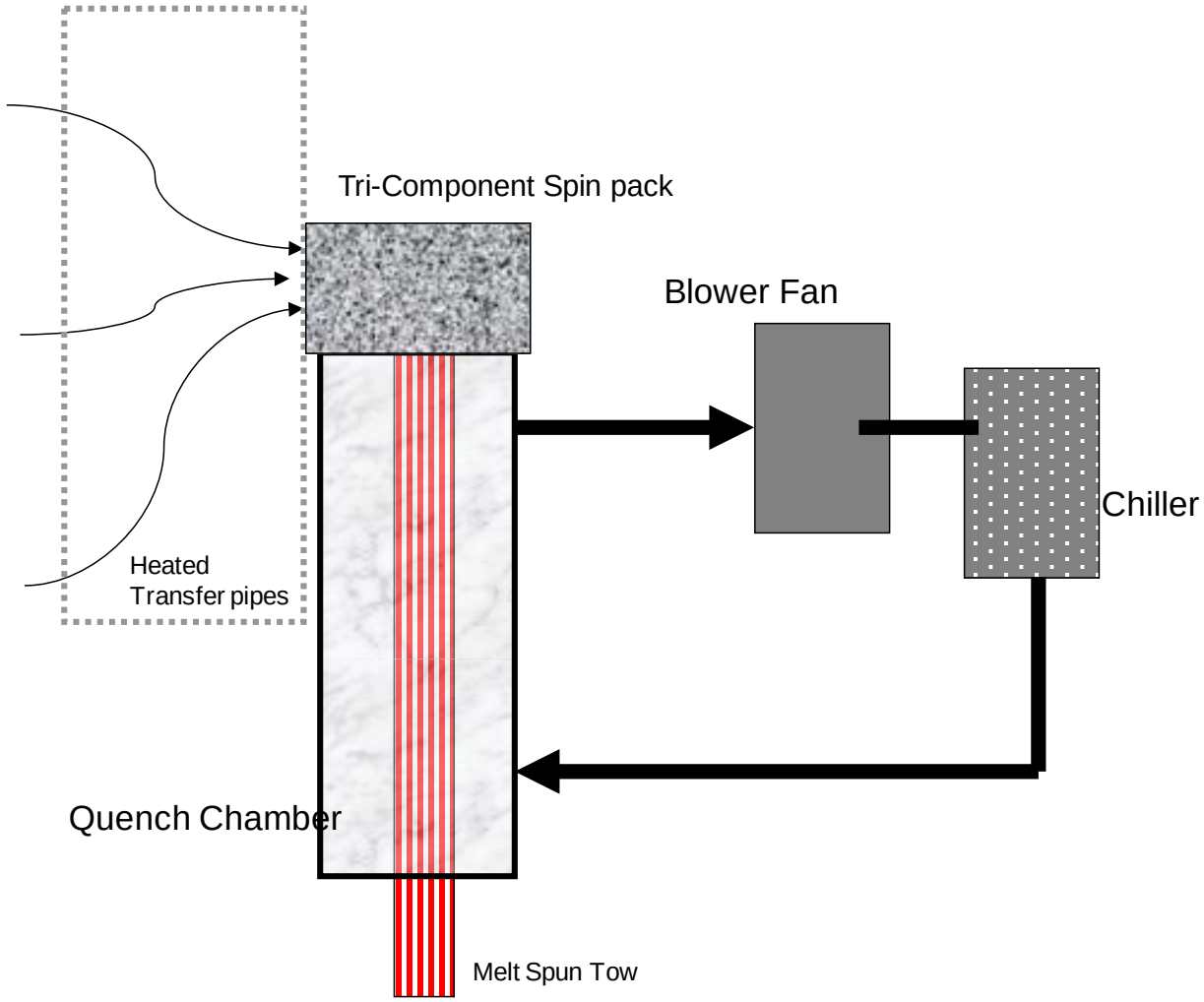

Figure 5. Quench System for Melt Spin Line.

A separate, removable heated tubular chamber for operation up to 200ºC is required and will replace the quench system for heat treatment of lignin fibers. (See Figure 6.) The exact sizing requirements of the heating tubular chamber are to be defined in consultation with the Company.

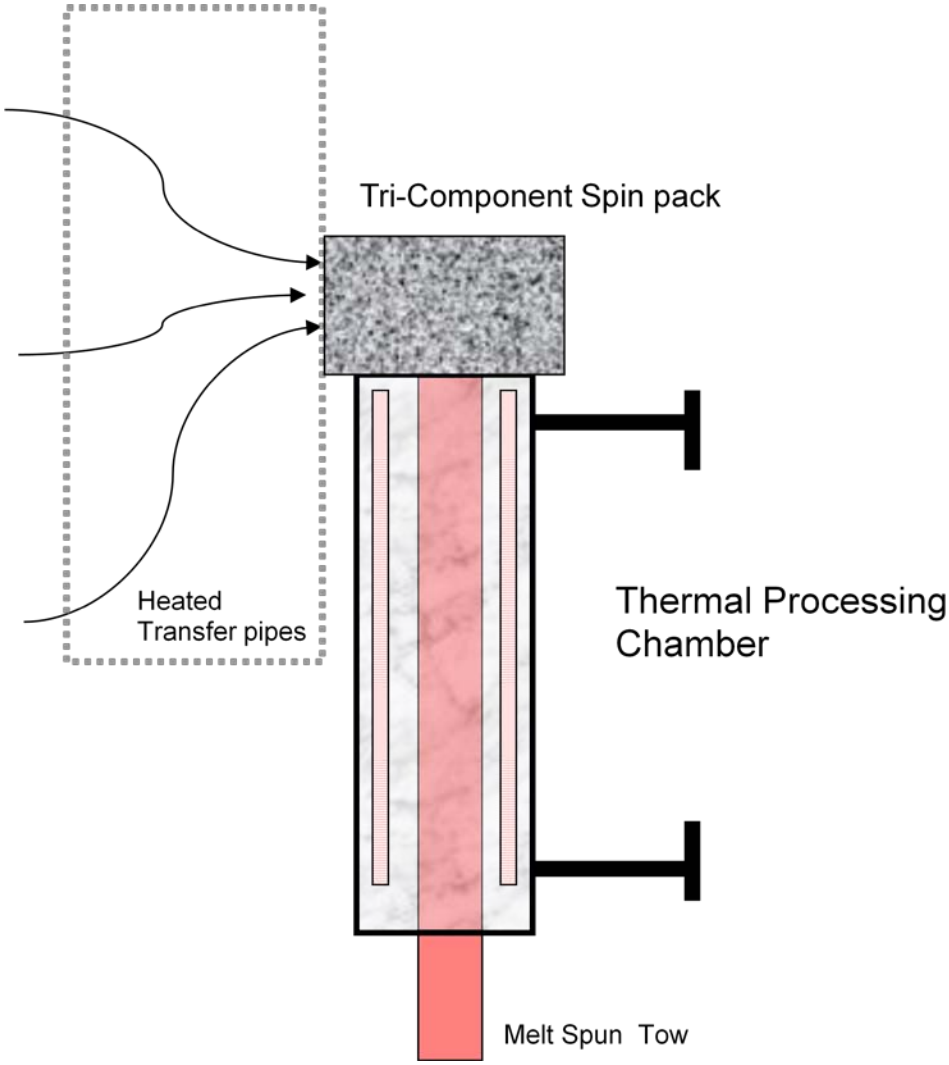

Figure 6. Removable Thermal Processing Chamber.

A filament tow, three (3)-stage denier stand with induction heated dual-rolls, variable precision speed control suitable for controlled drawing, and a temperature limit of 200ºC is required. A metered spin finish system and separate interlacing stand with span and tension control are required. (See Figure 7A.)

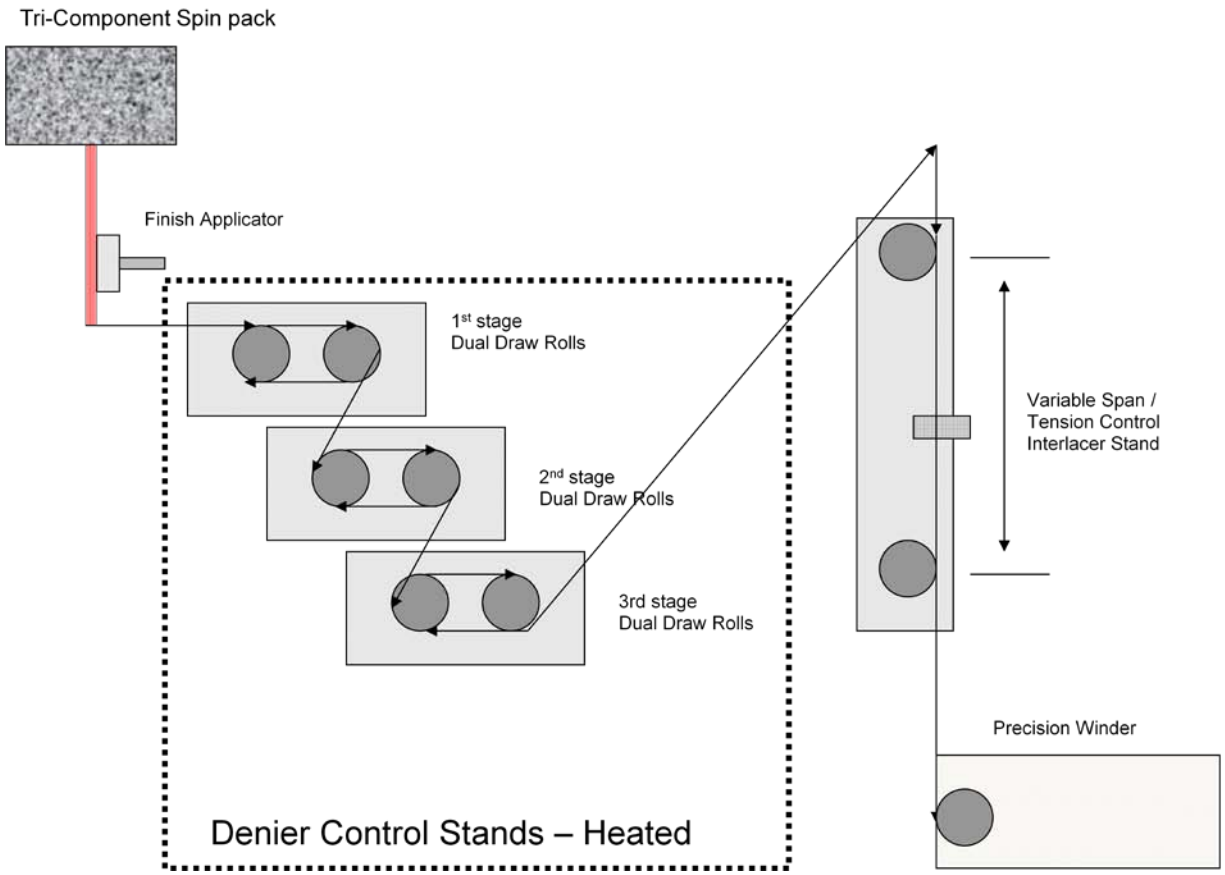

Figure 7A. Melt Spin Line with Tow Capability – Denier Control and Interlacing.

Precision winder(s) capable of handling tows with filament counts in the range of 1k to 24k and filament deniers of 0.5–1.5 dpf is (are) required, as well as any string-up aspirator devices needed for operation. All rollers shall have hard surfaces and mirror finish. Tow or fiber abrasion and pinch points shall be minimized.

A central vacuum system designed to collect and store scrap fiber during startup and purging shall be included.

A pyrolysis oven and ultrasonic bath are required for cleaning equipment, particularly the spinnerets.

3.4.3 Spun Bond Equipment

The tri-component spin line shall also feature the capability of producing spun bond filaments as a non-woven mat. The system shall be capable of forming a 600 mm (24”) wide web at spin speeds of 200 m/min (approx. 600 ft/min). A suitable draw slot attenuator, aspirator, and height adjustable web former shall be configured and supplied to permit interchange between fiber tow and spun bond spinning operations. Provision for easy re-configuration from the tow draw and winding equipment to the spun bond web forming equipment (and vice-versa) is a key operational requirement; i.e., two-person teams sequentially working for three (3) eight (8) hour shifts. Power, water, and temperature and pressure measurement connections, etc., shall be configured with this in mind. Compaction rolls, and non-woven product take-up winder featuring interleaf capability, are required. (See Figure 7B.)

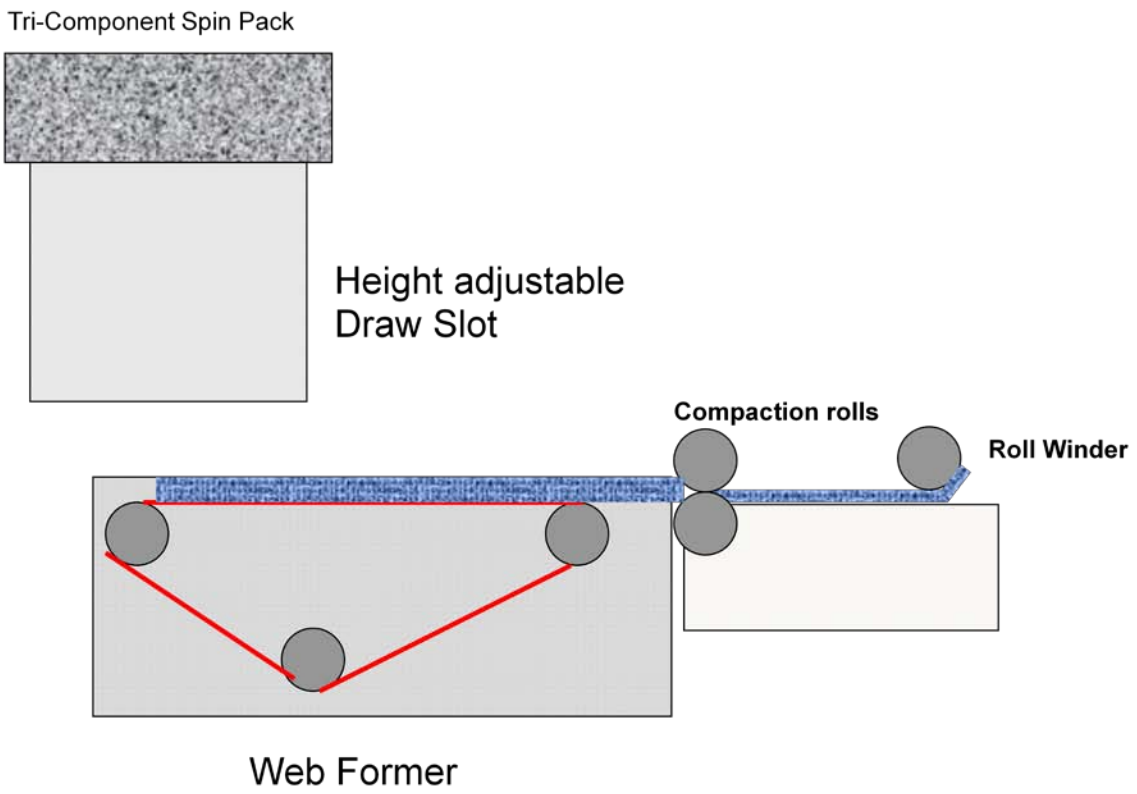

Figure 7B. Melt Spin Line with Spun Bond Capability - Equipment Diagram.

3.4.4 Spinning Platform

Permanent platforms, ladders, etc., needed for routine operation and maintenance of the process equipment, as described in Section 3.4, shall be supplied by the Seller. A list of access equipment and the process equipment for which it provides access shall be submitted in the Proposal, and its preliminary design shall be submitted with the Design Approval Data.

The spinning system shall be mounted to a suitable main platform with stairs, landing, and shall incorporate all necessary bracing, equipment sleds, and associated hardware and fasteners. The platform shall be designed to accommodate normal operator access as well as frequent cleaning of hoppers, feed lines, spin packs, and heaters. In addition, ample space shall be provided for easy and safe removal of the rear pull extruder screws (at operating temperature). Also, a key design feature is a deployable platform and lift system to facilitate the moving of the (heavy) spin packs.

3.4.5 Interconnecting Hardware

The Seller shall design and/or specify all hardware for interconnecting utility distribution points, production line equipment, instrumentation, control and data acquisition system, effluent treatment equipment, and effluent discharge points. This includes all process and utility piping; electrical wiring and cabling; and instrument wiring, cabling, and tubing. The Seller shall also design and/or specify all structures required to support the aforementioned interconnecting hardware. A summary list of interconnecting hardware and associated support structures shall be submitted in the Proposal. Preliminary design data shall be submitted with the Design Approval Data, and final design documentation with the Advanced Engineering Data and Certified Data.

3.5 INSTRUMENTATION

Instrumentation details are listed in Table 1, Table 2, Table 3, and Table 4.

Table 1. General Instrument Listing – Compounding And Pelletizing

Unit Operation	Temp °C	Flow rate	Rotational Speed	Weight (Gravimetric Feeder)	Purge gas flows & vacuum	% Moisture	Polymer Pressure	Power
Solid Feed A B C	 Y Y Y	 Y Y Y		 Y Y Y	Nitrogen Y Y Y	 Y Y Y	Storage Vessel Pressure	
Liquid E F	 Y Y	 Y Y	 Y Y	Fluid level			 Y Y	
Extruder All Zones	Separate TCs Y		Y				Y	Y
Vent Ports (Instrumentation Undefined)					Y			
Metering Pump	Y	Y	Y				Y	Y
Screen changer	Y						Y	
Filter	Y						Y	
Die plate	Y						Y	
Water bath Inc. heat exchanger	Y Y	Y						
Cutter			Y					Y
Lignin Pelletizer (Instrumentation not defined)	Y	Y coolant						Y

Table 2. General Instrument Listing – Melt Spinning Equipment

Unit Operation	Temp °C	Polymer Flowrate	Rotational Speed	Weight GRAVIMETRIC FEED	Gas flow rate	Pressure	Power
Solids A B C	 Y Y Y	 Y Y Y	 Y Y Y	 Y Y Y	Nitrogen Y Y Y	 Storage Vessel Pressure	
1-primary extruder 2-secondary extruder 3-tertiary extruder	Y-all zones Y-all zones Y-all zones	Y Y Y	Y Y Y			Y Y Y	Y Y Y
Screen changer	Y					Y	
Filter	Y					Y	
Transfer Pipes	Y					Y	
Spin Pack	Y					Y	
Thermal treatment Chamber	Y# of points undefined	Y			Air Y		
Quench Chamber	Y# of points undefined	Y			Y		
Pyrolysis & Preheat Oven	Y				Y		

Table 3. General Instrument Listing – Draw Stands And Winding

Unit Operation	Temp	Flow rate	Lineal Speed	Draw ratio	Interlacer air flow	Pressure	Power
Finish Application		Ymetering punp					
Draw Stand 1	Y		Y	Y			Y
Draw Stand 2	Y		Y	Y			Y
Draw Stand 3	Y		Y	Y			Y
Interlacer Stand			Y	Y Tow Tension	Y	Y	
Winder Station			Y	Tow Tension			

Table 4. General Instrument Listing- Melt Blown

Unit Operation	Temp	Flow rate	Lineal Speed	Draw ratio	Vacuum	Pressure	Power
Aspirator	Y	Y				Y	
Web Former	Y		Y		Y		
Winder			Y			Compaction pressure/ thickness	

Temperature monitors are assumed to be thermocouples unless otherwise specified by the Seller. All thermocouples shall be mounted in thermocouple wells and connected to instrument ports or similar fixtures which enable quick and easy replacement by one person. Separate monitoring thermocouples (i.e., other than those used for heater control) shall be installed on the extruders and all components of the equipment where both temperature control and measurement are required.

The Seller shall include in its Proposal a complete list of instruments, including type and accuracy data for each instrument. Instrument specifications shall be included in the Design Approval Data. Piping and instrumentation diagrams (PIDs) shall be included in the Advanced Engineering Data, including the dimensioned interface locations in plan and elevation. All final instrument design information shall be documented in the Certified Data.

3.6 DATA ACQUISITION AND CONTROL SYSTEM

The Seller shall supply all data acquisition and control capabilities for the entire operation of the equipment. The Seller shall submit in its Proposal a description of data acquisition and control hardware, software, capabilities, features, operational modes, and options.

3.6.1 Control Systems and Cabinets

Sensitive electronics, motors, and computer devices shall be sealed or protected from exposure to electrically-conductive carbon filaments generated in an adjoining facility. Controls, pressure and temperature readouts, and alarms shall be placed in suitable cabinets that are placed within easy reach of the MSSL unit and shall also feature protection from airborne carbon fibers. Prewired supplementary temperature input jacks near the spin pack area shall be provided in the design to allow future addition of at least ten (10) temperature probes.

3.6.2 Operator Interface

The operator interface shall be a digital computing platform with user-friendly Graphical User Interface (GUI) and data acquisition/control software. A common GUI and code shall be used for every control station, enabling operators to control all hardware and access all data with knowledge of only one interface protocol. The operator interface shall require minimal training for operators that are moderately proficient users of Mac or IBM-compatible computers. The control and data acquisition system shall communicate with operators via English language and Arabic numerals.

3.6.2.1 Control Hardware

The control system shall utilize current state-of-the-art control hardware with large, flicker-free displays. It shall include sufficient data storage capacity to store at least a 30-day data log for the system, with capability to regularly backup the data to a secure, remote data storage center. It shall have USB ports and DVD-ROM drives that are accessible only to authorized system administrators.

Input devices shall include keyboard, mouse, touchpad, and/or joystick, all of which shall be ergonomically designed.

Output devices shall include high resolution digital printers with photographic image quality.

All computer hardware shall be readily upgradeable.

An operator console shall be provided on the process floor adjacent and within the designated footprint for the MSSL. Authorized personnel shall be able to access all control functions and data for which they are authorized.

The Seller shall provide a summary specification of the computer hardware in its Proposal and in the Design Approval Data. The Seller shall describe the process floor console and location in its Proposal and in the Design Approval Data.

3.6.2.2 Computer Software

Control software, together with the operating system, shall provide the following capabilities:

- Controlled access to control functions and data, limited to authorized personnel only, with different access levels for different personnel
- Fast entry to “sleep” mode upon operator command (rapidly terminates data display)
- Resume data display mode upon command by authorized personnel
- Automated start-up and shutdown of all equipment
- Programmable or manual control of all controlled process parameters in all MSSL equipment, including scram, constant rate of change, and defined time-parameter profiles
- Select displayed units (e.g., meters-kilograms-seconds, feet-pounds-seconds, etc.)

Data acquisition software, together with the operating system, shall provide the following capabilities:

- Store run ID, precursor data, etc.
- Store operator ID’s
- Log operator inquiries and commands
- Log specific measured parameter data at specified time intervals
- Log all measured parameter data at specified time intervals >= 10 seconds
- File password protection
- Data compression
- Network connection with password-protected web interface for system monitoring by authorized personnel; NO ability to control via web interface
- System alarm remote notification (e.g. call one or more designated phone numbers)
- Backup of specified data at specified time intervals

The Seller shall include in its Proposal and in the Design Approval Data a tabulated description of data acquisition and control functions.

3.6.3 Data Security

See Section 3.7.

3.6.4 Diagnostics

The data acquisition and control system shall be furnished with maintenance test circuits that will assist in isolating any failure to a particular system function. The test circuits can be any combination of switches, diagnostic boards, visual indicators, and/or test programs. All test circuits and test programs shall be documented in the Certified Data.

3.6.5 Operator Messages

The data acquisition and control system shall display prompts and error messages at the operator’s control panel. The system shall enable printing and electronic storage of displayed messages. A list of prompts and error messages with definitions shall be included in the operation and maintenance manuals.

3.6.6 Low-Power Mode

The facility will be equipped with uninterruptible power. The data acquisition and control system shall have a low-power mode that engages when it is on backup power. When on backup

power, the system shall perform only the essential control and data acquisition functions that are necessary to conduct a safe shutdown, and to log and maintain critical data until the equipment is safely shut down.

3.7 SECURITY

Operator access to control functions, data displays, and display controls shall require a Company-issued password. The operator consoles shall be normally in “sleep mode” such that the screens are blank or display a “screen saver” but can be “awakened” in seconds by authorized personnel who can then access the console’s operator interface by entering their Company-issued password. The operator interface shall allow operators to return the consoles to secure sleep mode upon command. The consoles shall further have a timeout function that returns them to secure sleep mode after a specified (programmable) period of inactivity.

Process data shall be accessible over the internet only to authorized persons who are logged into the Company’s secure web portal and who have been granted access by the Company’s system administrator.

3.8 OPERATING ENVIRONMENT

The MSSL will be installed in or near Oak Ridge, Tennessee at an elevation of between 200 to 300 m. All the equipment, including control and computer systems, shall be qualified to operate at rated capacity within the following ranges of environmental conditions:

3.8.1 Process Floor Environment

Temperature: 10° – 45°C

Relative humidity: up to 98%

Dust and particulate: typical carbon fiber production process space

Electromagnetic and acoustic backgrounds are negligible.

3.9 HEALTH AND SAFETY

The equipment shall be furnished with safety devices and shall meet or exceed the applicable safety requirements in 29 CFR 1910. All equipment shall be guarded to prevent personnel injury during automatic operation.

The Seller shall provide a list of Hazardous Materials and associated Material Safety Data Sheets for any hazardous materials incorporated into the equipment, in compliance with the requirements of OSHA 29 CFR 1910.1200, Hazard Communication.

The equipment shall comply with the requirements of NFPA 70E, Standard for Electrical Safety in the Workplace.

The equipment shall comply with the requirements of 29 CFR 1910, Subpart O – Machinery and Machine Guarding.

The equipment shall consist of components meeting the requirements of OSHA 29 CFR 1910 Subpart S, Electrical.

Maximum equipment surface temperature shall be limited in accordance with ASTM C1055. All hot (>= 45ºC) surfaces shall be labeled with warning signs.

The maximum equipment noise level shall not exceed 70 decibels (dBA) measured at the operators’ floor consoles, and 80 dBA at one meter from equipment enclosures or external surfaces.

The Seller shall identify and describe any breathing hazards posed by the MSSL, including upgrades identified in Section 5, in the Design Approval Data.

All piping shall comply with ASME B31 Code for Pressure Piping as applicable and shall be labeled in accordance with ANSI A13.1.

Flow diagrams shall show system designations, line numbers, line sizes, and piping specification number. System designations shall be defined on the drawings and may be the Seller's standard designations. Valves shall be identified by a standard valve number and unique valve identifier. Valve identification numbers (VINs) will be provided by the Company. The following information shall be tabulated on the piping drawings:

- Service, designation, and specification subsection
- Service design pressure, design temperature, test pressure, test type, and test media
- Valve information including VIN, standard valve number, type, and (if applicable) instrument number
- Pressure reducing and relieving devices indicating type, size, pressure setting and capacity
- Insulation type and thickness
- Backflow protection devices including location and backflow preventer device type

All pressure containment structures that are addressed within the mandatory scope of the ASME Boiler and Pressure Vessel Code shall be ASME code-stamped pressure vessels, and shall be described in the Design Approval Data.

3.10 INTERFACES

3.10.1 Facility Constraints

The MSSL will be installed in a new building that is specified in detail in Company Specification for Special Project 017144.

The MSSL shall fit within a footprint of 24' x 60' with a maximum height of 32' to the crane hook. No pipes, ducts, wires, or other structures may protrude vertically outside this envelope; all pass-throughs shall be horizontal. The equipment components and subassemblies shall be transportable through a 3.6 m wide x 4.8 m tall doorway during installation. The heaviest equipment lift shall not exceed 89 kN (10 tons). Floor loads shall not exceed 12 kPa (250 psf).

The control center shall fit within the footprint described above of the MSSL.

The Seller shall submit in its Proposal a schedule of utility requirements and preliminary guidance on their interconnecting hardware. Maximum allowable utility demands by the MSSL are shown in Table 5. Piped utilities will be available from manifolds running parallel to the line along the nearest wall. The main electrical distribution point will be located in the motor control center. Details on utility provisions and distribution are detailed in Company Specification for Special Project 017144.

Table 5. Utility Allowances

Utility	Specification	Maximum allowable demand
Electricity	480 V, 3-phase	<100 kW- steady state max 250 kW during start-up
Process water	Demineralized	1 kg/min
Cooling water	33ºC maximum supply temperature	150 kg/min (40 gal/min) max
Process Air	690 kPa (100psi) gage, 5ºC dewpoint	24 m^3/min (825 cfm) peak
Nitrogen gas	-67ºC dewpoint, <= 10 ppm oxygen, 100 kPa gage	10 Nm^3/hr
Exhaust	Conditioned makeup air	1.13 m^3/min (40 cfm)

3.10.2 Power

3.10.2.1 Electrical Systems

Electrical equipment and wiring shall be standardized by the Seller to comply with NFPA 70-2008, the National Electrical Code. All electrical equipment, components, and assemblies shall be listed and labeled by a Nationally Recognized Testing Laboratory (NRTL). Control panels shall be UL 508A listed. Exceptions shall be indicated to the Company. After Subcontract award, shop drawings for non-listed control panels shall be provided to the Company for preliminary acceptance. Non-listed control panels shall be made available to the Company for factory inspection at no additional cost.

An insulated equipment grounding conductor shall be provided in all electrical raceways. The Seller shall furnish power conditioning and isolation equipment required to allow electromagnetic interference sensitive electrical systems to operate correctly. All electrical enclosures for equipment located in a process area shall be rated NEMA 12. Conductor splices shall only be performed on terminal strips or at device terminals. All conductors entering or exiting enclosures shall be terminated on a terminal strip. All wiring shall be identified with wiring numbers.

3.10.2.2 Electrical Documentation

The Seller shall specify electrical requirements in its Proposal. The Seller shall submit electrical schematics, wiring diagrams, interconnection diagrams, and control panel layouts in the Design Approval Data. The Seller shall provide in the Advanced Engineering Data detailed drawings for electrical services required, including the dimensioned equipment supply entry location in plan and elevation and indicating the voltage, phases, and current kilovolt-ampere (KVA) load at the supply location. All of the aforementioned documentation shall be submitted as-built in the Certified Data package.

3.10.3 Cooling Water

The Seller shall specify cooling water requirements in its Proposal. Cooling shall not require deionized water. The Seller shall provide in the Advanced Engineering Data detailed drawings for coolant piping, including the dimensioned equipment supply entry and exit locations in plan and elevation and indicating the pipe sizes and materials at all interface locations. The Seller shall provide schematics and piping diagrams with its Certified Data package.

3.10.4 Nitrogen Purge

The Seller shall specify nitrogen purge gas requirements in its Proposal. The Seller shall provide in the Advanced Engineering Data detailed drawings for nitrogen purge gas piping, including the dimensioned equipment supply entry locations in plan and elevation and indicating the pipe sizes and materials at all interface locations. The Seller shall provide schematics and piping diagrams with its Certified Data package.

3.10.5 HVAC

The Seller shall specify HVAC requirements in its Proposal. The Seller shall provide in the Advanced Engineering Data detailed drawings for concentrated HVAC requirements, if any, including the dimensioned equipment supply entry locations in plan and elevation. The Seller shall provide schematics and diagrams with its Certified Data package.

3.10.6 Structural

The Seller shall submit in its Proposal, confirmed in the Design Approval Data, a floor loading diagram and estimated loads imposed on building structures by equipment, piping, cable trays, etc; and the weights of all equipment components and assemblies. A schedule of floor penetrations required for equipment installation, indicating penetration location, size, and depth shall be submitted in the Advanced Engineering Data. All final structural data shall be delivered in the Certified Data package.

3.10.7 Miscellaneous Utilities

Requirements for compressed air or gas, deionized water, vacuum, and any other miscellaneous utilities shall be described in the Seller's Proposal. The description shall include compositions, demand rates, temperatures, pressures, cleanliness, and all other relevant parameters. The Seller shall provide in the Advanced Engineering Data detailed drawings for piping or other means of conveyance, including the dimensioned equipment supply entry locations in plan and elevation and indicating the conveyance sizes and materials at all interface locations. The Seller shall provide schematics and conveyance diagrams with its Certified Data package.

3.11 SPARE PARTS

The Seller shall provide in the Certified Data a recommended spare parts list in which each part is described, identified, and priced. The list shall identify the original manufacturer and manufacturer's part number. This listing shall include the recommended spare parts for a period of one year. The Company may, at its discretion, purchase any or all of these listed spare parts. Each spare parts package shall be priced separately.

3.12 OPERATION AND MAINTENANCE MANUALS

The Seller shall submit in the Advanced Engineering Data manuals for operation and maintenance of all equipment supplied by the Seller, as well as a detailed replacement parts manual. The replacement parts manual shall include (an) exploded view(s) with each item identified such that it may be obtained from either the Seller or the original manufacturer. The part number and serial or lot control number shall be provided for each replacement part that may be necessary to maintain the system in a fully functioning condition. The operation manuals and replacement part manuals should also contain the following information for the major equipment assemblies:

- Equipment identification number, model number, etc.
- Equipment serial number

- Seller name
- Manufacturer name (if different from Seller)
- Manufacturing plant address
- Seller product designation
- Manufacturer product designation (if different from Seller)
- Date of manufacture (month and year)
- Materials safety data sheets (MSDS)

The Seller shall include in its Proposal a summary operations manual briefly describing key features and operational procedures, specifically including start-up and shutdown procedures and times. It shall also tabulate estimated annual maintenance costs for the first ten years of operations, based on 500 hours of continuous operation every month and shutdown for the remainder of each month.

4. QUALITY CONTROL (QC) REQUIREMENTS

4.1 GENERAL QC REQUIREMENTS

All technical requirements in this specification are classified as acceptance requirements.

The Seller shall submit with its Proposal a copy of its general Quality Control Program (QCP) description, with documented evidence showing how the Seller intends to comply with all requirements of this specification. This QCP shall provide sufficient detail and scope to allow the Company to determine the quality control that can be expected from the Seller. This QCP shall describe quality control policies and practices that shall be used to ensure that the proposed equipment shall meet the requirements in this specification.

The Seller shall identify in its Proposal any requirement(s) of this specification that are not satisfied by its Proposal. Any deviation from specified requirements must be approved by the Company. A Company Request for Deviation form may be submitted to initiate this process.

The Certified Data package shall include the rated capacities and capabilities, accuracy, and uncertainty performance specifications of each component, device, or system. It shall also include the Seller's certification that the products ordered by the Company based on the stated specifications have been supplied and conform to the requirements of this specification (Certificate of Conformity), with supporting test and inspection documentation.

Equipment and products not conforming to this specification and the applicable detail specifications, or to modifications authorized by the Company, are subject to rejection.

4.2 QC PLAN

The Seller shall submit in the Design Approval Data a detailed QC Plan that is specific for this equipment. It shall encompass the manufacturing process from raw materials receiving to final product shipment and shall specifically define the tests and inspections to be performed to verify that the hardware and software meet the requirements. The Design Approval Data shall also include a detailed schedule of milestones for meeting delivery dates.

In its QC Plan, the Seller shall establish control factors, processes, and performance indices to meet this specification's technical and operational requirements.

The QC Plan shall include statistical process control (SPC). The Seller shall establish and maintain procedures and requirements for an SPC system based on key characteristics (KC) of each equipment unit and sub-unit. The Seller shall conduct SPC analysis of the KC's. If statistical analysis determines that a KC is out of control, the Seller shall:

- Investigate the cause(s),
- Eliminate special causes of variation and reestablish statistical control, and
- If a KC is not capable, the Seller shall take corrective action to reestablish capability.

The Seller shall document all corrective actions affecting the process and assure the effectiveness of the actions. The Company reserves the right to review the results of all SPC analyses, capability calculations, and corrective actions.

4.3 QUALIFICATION

4.3.1 Product Qualification

This specification requires qualified products, design, manufacturing installation, and operation procedures. The MSSL equipment design, fabrication, installation, and operation should be supported by design calculations, drawings, process control documents (PCD), material specifications, and MSDS. The MSSL design, manufacturing, installation and operations shall fully comply with government safety and health regulations.

4.3.2 Audits

The Company reserves the right to audit equipment manufacturing operations, process records, quality assurance and certification systems, raw material traceability, test procedures, and test data.

4.3.3 Approvals

The Company reserves the right for the final qualification approval of the MSSL design, manufacturing, installation, and operational procedures for successful completion of both base and detail specification requirements.

4.4 CHANGE CONTROL AND NONCONFORMANCE

Formal notification of design or manufacturing changes is required. Company approval is required for major changes and will be granted through Advance Change Notices (ACNs). Prior to implementing a major change, the Seller shall contact the Company with the following information:

a. A detailed description of the change and
b. A draft of the change

The Seller may proceed with the proposed change only after receipt of written authorization by the Company’s subcontract administrator.

If it is necessary to make any change in the QC Plan’s control factors, the Seller shall request an ACN to revise the PCDs and maintenance manual. The change shall not be incorporated prior to the receipt of a signed ACN.

All deviations from the technical specifications that were not approved prior to conducting activities associated with these deviating conditions shall be classified as nonconformance. All nonconformance documentation shall be provided to the Company's subcontract administrator two weeks prior to shipment of the system. Shipment shall not take place until all nonconformances have been approved by the Company's subcontract administrator.

Suspect/counterfeit products or materials are prohibited. The Seller’s Proposal constitutes a certification by the Seller that no suspect/counterfeit items shall be supplied.

The Company's goods recipient will verify that the correct quantity meeting the stated specification, catalogue or related model number, and/or Seller quote is received. Subsequent

determination that the incorrect product was provided or that any product fails to function as specified shall be documented as a nonconforming condition and shall be returned to the Seller for reimbursement.

4.5 INSPECTION AND TESTING

The Seller shall submit in its Proposal a Test Matrix listing the proposed performance acceptance tests, and national approved standards for which they apply, if applicable. The Test Matrix shall include an explanation of each test listed along with methods of inspection.

The Seller shall submit in the Design Approval Data a Test Plan outlining how testing and verification will be performed, and standards to be utilized in conducting measurements. This Test Plan shall demonstrate that the installed equipment satisfies requirements and shall include performance testing as described in Section 4.5.2. An Inspection and Test Report documenting the results of all inspection and testing shall be submitted with the Certified Data. The Test Plan shall be a part of the detailed QC Plan and shall, at a minimum, describe the tests listed in Table 5. All tests require Company approval.

Table 6. Minimum Required Acceptance Tests

Hardware or Function	Test
Compounder feed system - solids	Dryers, vacuum and purging, transfer from drums, nitrogen purge , gravimetric wt. loss system, moisture meters
Compounder feed System – liquids	Filling system operation , metering pump accuracy, purge system, high/low alarms, Spill control
Compounder Twin Screw Extruder	Operation and stability, temperature zone control, over-torque system, alarms, instrumentation, full rotational speed range
Compounder screen changer and die	Leakage and sealing, removal and installation operation, pressure monitoring
Conventional strand pelletizer and water bath	Die operation, strand diameters and uniformity, bath operation (leakage, flow), die cutter operation –uniformity and speed adjustment
Lignin pelletizing System	Operation with Lignin compounds – pellet shape, fines and uniformity, atmosphere free from moisture & air, clogging (strongly suggest this be tested with actual lignin)
Polymer Feed Systems	Dryers, vacuum and purging, transfer from drums, nitrogen purge, gravimetric wt. loss system
Three Single Screw Feed Extruders	Operation and stability, temperature zone control, over-torque system, instrumentation, full rotational speed range, removal of rear pull screw, emergency stop- overpressure- or from operator
Spin Metering Pumps	Operation and instrumentation, over-torque protection, leakage
Transfer Pipes	Temperature and uniformity, removal(if practical)
Spin Pack Assembly including heaters	Heating uniformity and temp control, pressure transducers, alarms
Tow Thermal treatment system	Temperature control and uniformity, Highest sustainable temperature, gas flow uniformity, installation and removal
Tow Quenching System	Temperature control and uniformity, temperature range, gas flow uniformity, installation and removal,
Operator platform and spin	Safety and ease of deployment and storage, demonstration

pack lift system	of spin pack installation lift
Spin Finish System	Pump operation and range of flow rates, alignment system
Melt Spin Tow draw stands	Temperature range and roll uniformity, speed control- vibration and runout, readouts of speed, draw ratio, emergency stop, operation with actual tow feed- through all three draw stands, string-up gun operation
Interlacing Stands	Speed control- vibration and runout, readouts of speed, draw ratio, emergency stop, operation with actual tow feed, string-up, span adjustment
Tow Winder	operation with actual tow feed of appropriate denier, string up tension adjustment, speed readout, package build and stability and doff gun operation
Central Vacuum System	Use of vacuum system with simulated scrap fiber – including range of deniers
Melt Blown Spin assembly	Temperature control and uniformity, Highest sustainable temperature, installation and removal
Aspirator /Attenuator	Liquid or gas flow uniformity, demonstrate full design air flow capability
Web Former	Demonstration with actual nonwoven fibers if possible
Non woven web winder with interleaf	Demonstration with actual nonwoven fibers and suitable interleaf if possible
Interconnect piping and ductwork	Leakage, noise/vibration, delivery of expected gas or liquid rates,
Instrumentation	Functionality and accuracy of all instruments
Data acquisition and control	Essential control functions, common control functions, data acquisition from all instruments, operation of main operator control console and remote panel if approved
Security	Correct operation of all security interlocks

4.5.1 Factory Acceptance Testing

The equipment shall be pre-assembled and inspected at the Seller's facility. Inspection and tests to be performed at the Seller's facility shall be identified in the Test Plan. The Seller shall supply all tools and materials required to conduct inspection and testing at its facility. The Company may, at its discretion, witness any or all of the final performance verification inspection and testing performed at the Seller's facility. The Seller shall notify the Company's Technical Project Officer (TPO) at least 30 days in advance of such tests. Results of this testing shall comprise part of the equipment acceptance for shipment.

4.5.2 Equipment Commissioning

The equipment shall be inspected, tested, and commissioned, under the Seller's supervision, after installation to demonstrate full compliance with the specified requirements. These tests shall be conducted in accordance with the Test Plan, subject to Company approval of the Test Plan. The results of post-installation testing shall be documented in an Acceptance Document, fully endorsed by both the Company and the Seller, and shall be the basis for final acceptance.

The equipment shall be commissioned by at least 12 hours of continuous operation of the compounder/pelletizer and melt spin line, satisfying performance requirements for each of the following materials:

1. Maximum width tow band of 24k polyethylene tows;

2. Maximum number of 3k polyethylene tows;
3. Maximum width mat of polyethylene, lignin, or pitch-based fibers.

The precursor fibers used for commissioning shall be selected and provided by the Company.

The Seller shall supervise commencement of operations.

4.5.3 Calibration

The Certified Data package shall indicate the equipment calibration status (calibrated or not calibrated) of each device and - if shipped in a calibrated condition - a description or reference to the method used to perform the calibrations at the time of shipment including the reference standard(s) used for this purpose.

Where applicable, the Certified Data package shall include instructions concerning the calibration of associated devices, instruments, or components to fully ensure the stated operating capabilities based on methods traceable to the US National Institutes for Standards and Technology.

4.6 INSTALLATION

The Seller shall install the equipment in a building to be provided by the Company. The Seller shall provide an installation plan including preliminary installation procedures in the Design Approval Data. A final installation plan with detailed installation procedures shall be provided with the Advanced Engineering Data package. The Seller shall furnish tools and equipment required for installation and alignment, as well as material handling. The Seller shall coordinate rigging and installation requirements with the Company; some equipment such as fork trucks may be provided by the Company, depending on the required capacity and availability of such equipment.

For installation planning purposes, the Seller may assume that utility manifolds will be provided along the nearest wall of the building, at elevations to be provided by the Company during preliminary engineering. The building's main motor control center will be adjacent to the equipment high-bay, adjoining the side wall farthest from the melt spin equipment location. All interconnecting piping, ductwork, wiring, cabling, and their associated structural supports, from the main distribution points to the equipment, between the equipment components, and to/from the equipment control center, shall be designed, furnished, and installed by the Seller.

4.7 TRAINING

The Seller shall provide operator training for four (4) complete shifts of operators during equipment installation, testing and commissioning. Operator instruction shall include an in-depth classroom lecture and actual operational demonstration of start-up, turn-down, and maintenance procedures.

The Seller shall submit a written training program with its Proposal to include the following elements:

- Equipment included in each training session;
- Trainer's names, qualifications and contact information;
- Anticipated duration of each training session; and,
- Topics and learning objectives, such as:
    - Equipment function;
    - Safe and effective operation of the equipment;

- o Manual and automatic modes of operation for the overall system and each major component; and,
- o Operator cleaning and maintenance tasks.

The Seller shall describe how training will be accomplished so as to safely train the operators during testing and commissioning, without incurring excessive schedule delays. The Seller shall professionally video tape and edit the training sessions. Prior to recording the first training session, the Seller shall submit samples of video/audio quality for approval by the TPO. Video Tape or Digital Video Disc (DVDs) shall be cataloged and added to the O&M Manual deliverables.

4.8 SOFTWARE SUPPORT AND BACK-UP

The Seller shall submit in its Proposal an itemized list of all software included with this equipment. This list shall include a description of the software, what feature(s) this software will enable, a statement addressing who will be responsible for supporting this software, and the software support provider's qualifications. This information shall be updated in the Design Approval Data.

The software shall be validated and verified for correctness prior to release to the Company. The Seller shall include, with the Certified Data shipment, one complete system software backup copy (with offline media capabilities) on Company approved media. The backup software media and backup procedures shall be described in the Design Approval Data. The Seller shall also provide with the Certified Data one complete set of software documentation.

4.9 WARRANTY

The Seller shall submit a detailed warranty description with its Proposal and in the Certified Data Package. It shall also describe any optional Service and Maintenance programs in its Proposal.

4.10 RECORD-KEEPING

The manufacturer shall keep the following records on file for a period of at least 5 years from the date of manufacture, unless otherwise specified on the purchase order.

- Traceability
- All records pertaining to raw material receiving inspection and certification, in-process records, and product testing specified in the manufacturer's Quality System and this specification
- All records pertaining to the SPC requirements specified in the manufacturer's Quality System

5. OPTIONS AND UPGRADES

The Seller shall offer certain equipment as options. Additionally, certain anticipated future upgrades shall be considered in the instant equipment design and configuration.

5.1 OPTIONAL EQUIPMENT AND SERVICES

The Seller shall include in its Proposal the following listed equipment and services. If the Company exercises any Option(s), at its sole discretion, the Seller shall submit preliminary equipment designs with the Design Approval Data and detailed designs with the Advanced

Engineering Data. Unless otherwise stated, the state-of-the-art quantity shall be determined and justified by the Seller.

1. Additional spin packs for back-up and long spinning campaigns (per each).
2. Prewired supplementary temperature input jacks (total of 10) in the control system shall be incorporated in the design to allow future addition of temperature probes as needed.
3. Upgrading of all necessary components of the spinning equipment to raise the maximum operating temperature from 350° to 450°C.
4. Autodoffing winders for the fiber tow line (per each).
5. Break detectors and alarms for the fiber tow line.
6. Electronic “yield” measuring device for the fiber tow line.
7. Passive or active (ionization) antistatic devices for tow handling without spin finishes
8. Equipment for rewinding of fiber tow of desired lengths onto separate spools
9. Additional feed port on the compounding extruder
10. Additional operator console to be located near the spin pack assembly for electronic access to the main control console on the floor
11. Upgrading of all necessary components of the equipment to spin and wind 80,000 (80k) filament tow
12. Two-year Extended Warranty
13. Extended on-site assistance beyond start-up period (per day), one person full-time for up to the duration of the Extended Warranty
14. Service and Maintenance program(s) offered by the Seller

5.2 PLANNED UPGRADES

The Seller’s design shall enable upgrading the necessary components of the spinning equipment to raise the maximum operating temperature from 350°– 450°C.

6. SCOPE OF SUPPLY

The Seller shall provide preliminary engineering, detailed engineering, equipment manufacturing, standard operational procedures, and initial operator training. The Seller shall also provide installation. The Seller shall supervise the equipment commissioning and commencement of operations.

6.1 PRELIMINARY ENGINEERING

The primary focus of preliminary engineering will be defining the process and project parameters while also moving the project and equipment integration to an advanced stage to develop project details. During this phase, efforts will concentrate on the selection of sub-suppliers and the refinement of the schedule for project execution, based on detailed input from material and technology sub-suppliers. Long lead-time purchases that may impact final delivery

are identified and accelerated for early release if necessary to meet the project schedule. Key technical milestones such as PIDs, bills of materials, hazardous operations analysis (HAZOP), risk assessment, and operational review of the design, etc. are developed to finalize the required scope of supply and ensure a successful project.

Completion of this phase of the project allows the Company and the Seller to review the proposed scope of supply and associated costs, to ensure equitable and complete definition of the requirements, and to ensure project success. Each party is given the opportunity to ensure that their responsibilities are clearly understood. The Seller shall perform engineering to design, identify, evaluate, select candidate materials and equipment, and perform process integration required to deliver a successful project.

The deliverables of this phase shall include the following, with all resulting documentation submitted with the Design Approval Data:

- Definition of the project team and issuance of subcontracts, if necessary, to ensure proper development by discipline
- Kick-off meeting with the Company's key representatives
- Development of preliminary process flow diagrams
- Development of PID's
- Development of system general assembly and layout diagrams, with recommended design loads
- Confirmation of a detailed equipment list by unit operation
- First revision of basic electrical engineering, including:
  - Single line power and control diagrams
  - Termination drawings
  - Instrumentation list
  - Wiring schematics
- First revision of the conceptual layout of interconnecting pipes
- Development of equipment drawings and design details for core technologies
- Identification and qualification of sub-suppliers
- Refinement of technical specifications for the major sub-assemblies and materials packages, preparation for the release of sub-supplier purchase orders
- Definition of battery limits, calculation of utilities and definition of connected loads
- Refinement of the project schedule with critical path analysis
- Identification of potential long lead-time purchases that could negatively impact the project schedule, and preliminary negotiations with suppliers of those items
- Completion of HAZOP and risk assessment for the equipment operation
- Revision of the major engineering documents (PIDs, layout, etc.) to include the incorporation of the results from the HAZOP
- Revision of the scope of supply and the generation of a scope of responsibilities
- Seismic and civil review, if required

6.2 DETAILED ENGINEERING

After the Company's authorized contract representative issues written approval of the Design Approval Data, the Seller shall conduct detailed engineering to finalize all aspects of the preliminary engineering and release design documents for manufacture. The detailed design shall in every respect conform to the requirements of this specification, except if an exception has been granted in writing by the Company's authorized contract representative. Detailed engineering documents, after final revisions, shall be delivered in the Certified Data package.

6.3 EQUIPMENT MANUFACTURING

The Seller shall fabricate and assemble the equipment in accordance with its detailed design, and deliver the equipment to the Oak Ridge, Tennessee site designated by the Company.

6.4 INSTALLATION

The Seller shall install the equipment at the site.

6.5 COMMISSIONING AND TRAINING

The Seller shall provide technically competent staff to supervise the equipment start-up, acceptance testing, commissioning, and commencement of operations. Equipment testing, commissioning, and operator training shall be conducted as described in Sections 4.5 and 4.6.

6.5.1 Commissioning Acceptance Criteria

The Seller's Test Plan and final acceptance criteria shall be developed from the plans, specifications, and equipment manufacturer's operating criteria. The Seller is responsible for meeting contractual requirements found in the plans and specifications. The Seller is responsible for furnishing a working system. All items logged as deficient shall be corrected per the plans and specifications.

6.5.2 Final Commissioning Report Requirements

The Company will utilize a disinterested 3rd party Commissioning Agent (CA), skilled in carbon fiber manufacturing and operation, to assure that the Seller's test plan and commissioning acceptance criteria are achieved. Along with Seller input and coordination, the Company's CA shall submit a final report to the Company which includes a statement that the project meets the Company's performance requirements, and includes a narrative of the results of the completed inspections, operational and functional testing. The final report shall include an outline of the deficiency list and dates identifying items found and dates items corrected. All open items will be identified in the report. Technical data from the equipment shall be included as well as all test results, manufacturer's start-up sheets, and testing adjusting & balancing (TAB) reports when possible. The Company's CA shall also furnish an electronic copy of the final report on Compact Disc (CD) to the Company and Seller; and the CD shall be menu-driven and include all documentation possible from the final report.

At the conclusion of the commissioning process and after the final summary has been completed, the Company's CA shall formally recommend system and equipment performance acceptance to the Company's TPO. The final commissioning report shall include:

1. Summary
2. Commissioning plan
3. Commissioning site visit reports
4. Submittal reviews
5. O&M data reviews

7. PREPARATION AND DELIVERY

7.1 LABELING

A corrosion resistant, metal nameplate shall be attached to each major equipment item. This nameplate shall be plainly and permanently marked with the following information:

Equipment identification number, model number, etc.
Equipment serial number
Seller name
Manufacturer name (if different from Seller)
Manufacturing plant address
Seller product designation
Manufacturer product designation (if different from Seller)
Date of manufacture (month and year)

Separately packaged equipment subassemblies and/or components shall be marked to provide positive identification to the equipment. When such markings impair proper functioning of the equipment, a metal tag shall be used.

7.2 PACKING AND SKIDDING

All the components shall be packaged and skidded to provide protection against deterioration and damage during shipment.

7.3 SHIPPING PLAN

The Seller shall submit in the Design Approval Data, with an update in the Advanced Engineering Data, a shipping plan that shall include a description of methods to be used to preserve, package, skid, and identify equipment. Ground transport shall be by air-ride equipped vehicle(s). After the equipment is loaded at the Seller's facility, unloading and reloading operations shall be limited to those required at terminals where the transport mode is changed (e.g., from ground transport to marine transport). The Seller shall contact the Company ten business days prior to shipment of the equipment to confirm shipping method and route.

7.4 MARKING

Each shipping skid shall be marked with the Seller’s name; Company name; Company purchase order number; Seller’s model number; equipment, sub-assembly or component identification; and gross weight. Boxes containing loose parts, attachments, and accessories shall be marked for identification with the equipment to which they belong, and where possible, boxes are to be secured to the skid of the basic unit.

7.5 SHIPPING

The Seller shall provide for transport of the equipment from the Seller’s facility to the designated site in Oak Ridge, Tennessee, USA. The Seller shall be liable for any damages to the equipment until it is received at the designated site.

7.6 DOCUMENTATION

The Seller shall submit the following Certified Data under a separate cover upon shipment of the equipment:

Complete Bills of Material for all components
Copies of the packing list

8. MANUFACTURERS DATA

Manufacturer’s data itemized on attachments ORNL-CFTC-2010MSL01-1, -2, -3, and -4 shall be furnished and transmitted by the Seller to the Company by the dates specified. These data sheets list the information required for the Company to adequately evaluate the Seller’s

Proposal, approve preliminary engineering and commencement of detailed engineering, obtain engineering requirements for equipment installation, and obtain Certified Data for operating and maintaining the instrument in the Company's facility. The Seller shall mark transmitted data as "Proposal Data", "Design Approval Data", "Advanced Engineering", or "Certified Data". The Seller shall grant the Company unlimited rights to copy and internally distribute data (excluding executable code) that is provided on electronic media.

8.1 PROPOSAL DATA

Proposal data is information considered sufficient to allow a technical evaluation of a manufacturer's proposal and/or product. The proposal should address the requirements in each section of this specification. The Seller shall submit with its proposal copies of data as noted in attachment ORNL-CFTC-2010MSL01-1.

8.2 DESIGN APPROVAL DATA

Design approval data is information required to ensure that the manufacturer has an adequate understanding of specified requirements. Design approval data are generally in the form of preliminary or conceptual drawings, sketches, block diagrams, and/or flow charts. The Seller shall submit design approval data for Company approval within 90 days after award, as noted in attachment ORNL-CFTC-2010MSL01-2.

8.3 ADVANCED ENGINEERING DATA

Advanced engineering data is design information that is sufficient to enable installation engineers to complete the equipment installation design or initiate preliminary material processing. The Seller shall submit advanced engineering data at least 180 days before shipment, as noted in attachment ORNL-CFTC-2010MSL01-3.

8.4 CERTIFIED DATA

Certified data is detailed information that allows for complete installation, alignment, operation, maintenance, and repair of equipment or certification of materials for their intended use. The Seller shall submit certified data upon shipment as noted in attachment ORNL-CFTC-2010MSL01-4.

ATTACHMENT 1. ORNL-CFTC-2010MSL01-1 PROPOSAL DATA

EQUIPMENT SPECIFICATION	Specification Number ORNL-CFTC-2010MSL01-1	Revision 0
	Issue Date	Revision Date
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MANUFACTURER'S DATA REQUIREMENTS

Item No.	DATA SUBMITTAL—PURPOSE AND DESCRIPTION	Specification or Reference	Number of Copies	Form[a]	Date[b]
	Proposal Data				
	The Seller shall submit the following information with its Proposal				
1	Summary of overall system design and performance parameters	3.1	6	E	
2	Description and footprint layout of entire MSSL	3.3	6	E	
3	Basic description and specification of all process equipment	3.4	6	E	
4	Identify corrosion-resistant materials and design features	3.4.2	6	E	
5	Access equipment listing	3.4.2	6	E	
6	Summary list of interconnecting hardware	3.4.5	6	E	
7	Complete list of instruments	3.5	6	E	
8	Data acquisition and control	3.6	6	E	
9	Summary specification of computer hardware	3.6.2.1	6	E	
10	Describe process floor consoles and locations	3.6.2.1	6	E	
11	Data acquisition and control functions	3.6.2.2	6	E	
12	Schedule of utility requirements	3.10.1	6	E	
13	Specify electrical requirements	3.10.2	6	E	
14	Specify water cooling requirements	3.10.3	6	E	
15	Specify nitrogen purge gas requirements	3.10.4	6	E	
16	Specify HVAC requirements	3.10.5	6	E	
17	Floor loading documentation	3.10.6	6	E	
18	Miscellaneous utilities requirements	3.10.7	6	E	
19	Operations manual summary	3.12	6	E	
20	General QCP description	4.1	6	E	
21	QCP requirements not satisfied by proposal	4.1	6	E	
22	Suspect/counterfeit items	4.4	6	E	
23	Test matrix	4.5	6	E	
24	Training program	4.7	6	E	
26	Itemized list of all software	4.8	6	E	
27	Detailed warranty description	4.9	6	E	
28	Optional equipment and services description and pricing	5.1	6	E	

[a]Indicate the following:

A—Full size prints
B—Full size reproducibles
C—Microfilm aperture card
D—Manual (booklet, brochure, report, etc.)
E—Other (Specify) Seller's standard form
F—Other (Specify) Standard AWS or ASME forms
G—Other (Specify) Electronic media

[b]To be completed by the contract administrator at the time of award.

ATTACHMENT 2. ORNL-CFTC-2010MSL01-2 DESIGN APPROVAL DATA

EQUIPMENT SPECIFICATION	Specification Number ORNL-CFTC-2010MSL01-2	Revision 0
	Issue Date	Revision Date
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MANUFACTURER'S DATA REQUIREMENTS

Item No.	DATA SUBMITTAL—PURPOSE AND DESCRIPTION	Specification or Reference	Number of Copies	Form[a]	Date[b]
	Design Approval Data The Seller shall submit Design Approval Data within 90 days after award of contract unless otherwise noted. This data will be used as part of Company Acceptance.				
1	Updated description and footprint layout of entire MSSL	3.3	6	E	
2	Updated description and specification of all process equipment	3.4	6	E	
3	Spinning platform preliminary design	3.4.4	6	E	
4	Interconnecting hardware preliminary design	3.4.5	6	E	
5	Instrument specifications	3.5	6	E	
6	Control center hardware summary specifications	3.6.2.1	6	E	
7	Process floor console(s) description and location	3.6.2.1	6	E	
8	Data acquisition and control functions	3.6.2.2	6	E	
9	Summary specifications of security equipment		6	E	
10	Breathing hazards	3.9	6	E	
11	Pressure containment code-stamp	3.9	6	E	
12	Electrical documentation	3.10.2.2	6	E	
13	Floor loading documentation	3.10.6	6	E	
14	Detailed QA plan	4.2	6	E	
15	Detailed schedule of milestones	4.2	6	E	
16	Inspection and testing plan	4.5	6	E	
17	Inspection and testing results	4.5	6	E	
18	Installation plan	4.6	6	E	
19	Software support and back-up	4.8	6	E	
20	Back-up software media and procedures	4.8	6	E	
21	Option equipment preliminary designs	5.1	6	E	
22	Preliminary engineering documents	6.1	6	E	
23	Finalize all aspects of preliminary engineering	6.2	6	E	
24	Shipping plan	7.3	6	E	

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[b]To be completed by the contract administrator at the time of award.

ATTACHMENT 3. ORNL-CFTC-2010MSL01-3 ADVANCED ENGINEERING DATA

EQUIPMENT SPECIFICATION	Specification Number ORNL-CFTC-2010MSL01-3	Revision 0
	Issue Date	Revision Date
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MANUFACTURER'S DATA REQUIREMENTS

Item No.	DATA SUBMITTAL—PURPOSE AND DESCRIPTION	Specification or Reference	Number of Copies	Form[a]	Date[b]
	Advanced Engineering Data The Seller shall submit Advanced Engineering Data 180 days before shipment. The Company will use this data to perform the installation engineering.				
1	Description and footprint layout of the entire MSSL	3.2	6	A	
2	Interconnecting hardware final design documentation		6	E	
3	Piping and instrumentation diagrams for interlocking hardware		6	A	
4	Detailed drawings for electrical services	3.9	6	A	
5	Detailed drawings for coolant pipes	3.9	6	E	
6	Detailed drawings for nitrogen purge gas piping	3.9	6	E	
7	Detailed drawings for concentrated HVAC requirements	3.9	6	E	
8	Schedule of floor penetrations	3.9	6	E	
9	Miscellaneous utilities detailed drawings	3.9	6	E	
10	Operation and maintenance manuals	3.12	6	E	
11	Final installation plan	4.6	6	E	
12	Detailed designs for optional equipment	5.1	6	E	
13	Shipping plan updates	7.3	6	E	

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ATTACHMENT 4. ORNL-CFTC-2010MSL01-4 CERTIFIED DATA

EQUIPMENT SPECIFICATION	Specification Number ORNL-CFTC-2010MSL01-4	Revision 0
	Issue Date	Revision Date
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MANUFACTURER'S DATA REQUIREMENTS

Item No.	DATA SUBMITTAL—PURPOSE AND DESCRIPTION	Specification or Reference	Number of Copies	Form[a]	Date[b]
	Certified Data The Seller shall submit the following Certified Data under a separate cover upon shipment of the equipment				
1	Certified correct copies of all Proposal Data items		4 1	E G*	
2	Certified correct copies of all Design Approval Data items		4 1	E G*	
3	Certified correct copies of all Advanced Engineering Data items		4 1	E G*	
4	Description and footprint layout of entire MSSL	3.3	4 1	E G*	
5	Process equipment specifications	3.4	4 1	E G*	
6	Final documentation for interconnecting hardware	3.4.5	4 1	E G	
7	Final instrument designs	3.5	4 1	E G	
8	Documentation of all diagnostic test circuits and test programs	3.9	4 1	E G	
9	Final schematics and wiring diagrams	3.9	4 1	E G	
10	Final schematics and piping diagrams for cooling water	3.9	4 1	E G	
11	Final schematics and piping diagrams for nitrogen purge system	3.9	4 1	E G	
12	Final HVAC schematics and diagrams	3.9	4 1	E G	
13	Final structural data	3.9	4 1	E G	
14	Final schematics and conveyance diagrams for miscellaneous utilities	3.9	4 1	E G	
15	Spare parts list	3.11	4 1	E G	
16	Rated capacities and capabilities, accuracy, and uncertainty performance specifications	4.1	4 1	E G	
17	Backup software with documentation	4.8	4 1	E G	
18	Warranty description	4.9	4 1	E G	
19	Final engineering documentation	6.2	4 1	E G	
20	Bills of materials and packing lists	7.6	4 1	E G	

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[b]To be completed by the contract administrator at the time of award.

ABBREVIATIONS AND ACRONYMS

ACN	Advance Change Notice
ANSI	American National Standards Institute
ASME	American Society Of Mechanical Engineers
ASTM	American Society For Testing And Materials
CD	Compact Disk
cfm	Cubic feet per minute (standard)
CFR	Code Of Federal Regulations
dBA	Decibels Adjusted
dpf	Denier per filament
DVD-ROM	Digital Video Disc – Read Only Memory
GUI	Graphical User Interface
HAZOP	Hazardous Operations Analysis
hr or hrs	Hour or hours
HVAC	Heating Ventilation and Air Conditioning
IBM	International Business Machines
KVA	Kilovolt-Amperes
k or K	Kilo (1000)
KC	Key Characteristics
MSDS	Materials Safety Data Sheet
MSSL	Melt Spinning Semi-Production Line
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association; also National Fluid Power Association
NRTL	Nationally Recognized Testing Laboratory
O&M	Operations and Maintenance
PAN	Polyacrylonitrile
PCD	Process Control Document
PE	Polyethylene
PID	Piping and Instrumentation Diagram
QA	Quality Assurance
QC	Quality Control
QCP	Quality Control Program
SPC	Statistical Process Control
TPO	Technical Project Officer
UL	Underwriters' Laboratories
USB	Universal Serial Bus
VIN or VINS	Valve identification number(s)