

Chapter I: General Specifications for Biomass Gasification System

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1 General data

1.1 Introduction of the project

In order to improve the rural energy structure in Jilin, to reduce the waste in energy by burning stalk directly, and eliminate the environmental pollution a CHP demonstration site, sponsored by UNDP, will be established in Hechengli village, Guangxin County, Longjin City, which will apply modernized biomass energy technology and be operating on agricultural residues that are abundant in the local area. After the establishment of the demonstration site, it will supply gas for 224-household, and electricity to village enterprises. According to the Feasibility Study Report, the capacity of the CHP system is 11,169,000 Nm³ producer gas per year, 1,241,000 kWh electricity per year, by use of 3 units of 600-Nm³ gasifier, 1 unit of 200 kW engine-generator. In the past one year, the project inception, investigation and feasibility study report have been accomplished. At this time, the project is in a stage of equipment procurement and design and construction. Based on the requirement of the project design, the equipment procured is grouped into 3 equipment bidding packages (the detailed division of packages is shown in section 1.4.3 in Chapter I).

1.2 Brief introduction of the project

1.2.1 Supply and transport of raw material

The raw material is the crop stalk and corncob generated in the surrounding area centered in Hechengli village with a radius of 7 km. The vehicle of the CHP demonstration site will transport the raw material from the off-site storage to the on-site storage.

1.2.2 Water source

The water for living and production in the gasifier-generation workplace is mainly from ground water. The annual consumption is about 3,000 tonnes. The water supply system inside the demonstration site will be the responsibility of the Engineering and Management unit.

1.2.3 Ash storage

All the ash generated will be utilized comprehensively, therefore, there is no ash storage inside the CHP demo site.

1.2.4 Overall layout and transport in the demo site

1.2.4.1 Overall layout of the demo site

Since the demo site is located between two high-voltage grid lines, based on the safety requirement, the gasifier-generator workplace should be in the center of the demo site, and

is connected to the storage by a corridor. Inside the demo site, the office building is at the main entrance, and the assistant workplace is in the west, and the gas storage tank is located in the north. The main entrance is situated in the south of the demo site, and the second entrance for transport is in the southeast of the demo site.

1.2.4.2 Vertical layout of the demo site

The principle of the vertical design of the demo site is to remove rainwater, to reduce the undulated ground surface and slope to a great extent when the technical condition is satisfied. The one-way drainage in the demo site is to discharge the rainwater to the drains, and the smallest slope is 3‰.

1.2.4.3 Transport in the demo site

Through the main roads, each major building could be reached.

1.2.5 Style and major parameters of gasification

1.2.5.1 Gasifier and gas clean-up system

Table 1-1 Major parameters of gasifier

No	Items	Technical indexes	Note
1	Gas output	□1800 Nm ³ /h	Gas output per unit □600 N m ³ /h
2	Gasification efficiency	□70%	
3	Producer gas low heat value	□4600kJ/ Nm ³	
4	Producer gas tar and ash	□30mg/ Nm ³	

1.2.5.2 Generator

- 1) Capacity: 200 kW
- 2) Voltage in the outlet: 0.4 kV
- 3) Frequency: 50 HZ
- 4) Rotation speed of rotator: 750 r/min
- 5) Cooling method: air cooling

1.2.5.3 Gas storage tank

- 1) Gas pressure in the inlet of gas storage tank: 3432.3 – 3922.7 Pa
- 2) Gas pressure in the outlet of gas storage tank: 3432.3 Pa
- 3) Type of gas storage tank: dry storage tank with a movable top
- 4) Active volume: VN = 500 m³
- 5) Total volume: V = 570 m³
- 6) Highest working pressure: P □6 kPa
- 7) Working temperature: 20□
- 8) Pressure decline in the trunk pipe: 1078.7 Pa
- 9) Pressure decline in the indoor pipe: 274.6 Pa
- 10) Pressure decline in the gas meter: 117.7 Pa
- 11) Rated pressure of stove (pressure on the meter): 1961.3 Pa

1.2.5.4 Layout of the major workplace - gasifier-generator workplace

The layout of the gasifier-generator workplace is based on the requirement of the plant design, i.e. gasification system – engine-generator system.

1.2.6 Raw material feeding

1.2.6.1 Raw material consumption

The annual consumption of crop stalk is around 4100 tonnes.

1.2.6.2 Unload equipment

Auto will be applied to transport raw material to the off-site storage, so unload equipment is not necessary.

1.2.6.3 Off-site storage

Off-site storage will be outside of the demo site, its capacity is 1700 tonnes that could satisfy the consumption of crop stalks for 180 days. The on-site storage's capacity is about 200 tonnes.

1.2.6.4 Crushing equipment

In order to meet the requirement of the gasifier, the crop stalks should be cut into 10 to 20 – mm pieces, and the capacity of the crashing equipment should be around 2500 kg/hr.

1.2.6.5 Conveyor system

The capacity of stalk feeding equipment should be 1000 kg/hr/unit, and the capacity of conveyor equipment is 5000 kg/hr.

1.2.7 Ash removal system

Since the ash production of 3-unit gasifier is 70 kg/hr, it is suggested to adopt dry method to remove ash.

1.2.8 Electric system

1.2.8.1 Captive electricity system

The scope of the captive electricity is the start-up control, protection, illumination etc. For the generator, the 0.4-kV side will adopt single generator for connection. The start-up power supply is from the 10-kV grid line near the demo site, and sent to electric equipment after the adjustment of transformer. When the generator runs steadily, the subsection switch will be shut, and the demo site will use captive electricity. The electricity is introduced from the main receiving cabinet to low-voltage mate electricity cabinet, then to the electric equipment through 3-phase 4-line armoured cable. The workplace and raw material storage will apply wide-spread factory lamp, the office and watchman room will adopt fluorescence, and the demo site will set up illumination facilities.

The start-up of gasifier-generator system and auxiliary equipment will adopt AC method.

1.2.9 Water supply system

A deep well is for water supply in the demo site, and the 60-tonne water storage is for production, living and fire control.

1.2.10 Construction structure

Table 1-2 Structure of facilities in the demo site

Name	Structure
Gasifier-generator workplace	Frame structure, independent base
Raw material storage	Mix-brick structure, rubble base
Office	Mix-brick structure, rubble base
Assistant workplace	Mix-brick structure, rubble base
water storage in the demo site	Rubble layer construction, waterproof treatment
Tar-washing tank	Rubble layer construction, waterproof treatment
Tar-washing comprehensive treatment tank	Rubble layer construction, waterproof treatment
Water circulating tank	Rubble layer construction, waterproof treatment
Septic tank	Based on criteria 92S213(I)

1.3 Major original material

1.3.1 Hydrologic and meteorological material

Meteorological data:

Average ambient temperature:

Highest annual average ambient temperature: 6.5℃

Lowest annual average ambient temperature: 4.1℃

Extreme lowest ambient temperature: -32.7℃

Extreme highest ambient temperature: 37.7℃

Sea level: average 270 – 280 m

Annual average relative humidity: 65%

Average relative humidity in winter (December, January, February): 58%

Average relative humidity in summer (June, July, August): 78%

Annual average precipitation: 517.1 mm

Max. annual precipitation: 735 mm

Min. annual precipitation: 308.5 mm

Average wind velocity: 2.7 m/s

Dominant wind direction: WNW

Dominant wind direction in summer: NE

Dominant wind direction in winter: WNW

1.3.2 Geology

The types of soil are dark brown soil, white plasm soil, meadow soil and river silt, in which the dark brown soil and white plasm soil are rich in organic matter.

According to “Report on the rock engineering survey in the CHP demo site in Longjing City” (No. 200048) prepared by Yianbian Geological Engineering Survey Bureau, the general situation of engineering hydrology and geology is:

Description of soil layers: First layer powder clay: thickness is 0 – 3 m, $f_k=125\text{Kp}$

Second layer sand rock: thickness is 2.5 – 4.3 m, $f_k=300\text{Kp}$

Ground water level and frozen depth: there is groundwater in the depth of 7.3 m.

Standard frozen depth of groundwork: 1.7 m

1.3.3 Earthquake data

Earthquake intensity: Degree 6

1.3.4 Major data adopted in the design

- 1) Basic wind pressure 0.55KN/m^2
- 2) Basic snow pressure: 0.35KN/m^2

1.3.5 Raw material for gasification

Corn stalk and soybean stalk

1.3.6 Fuel for power generation

Producer gas.

1.4 Overview of work scope

The project will be coordinated by Engineering & Management Unit led by Project Manager; qualified construction unit will be selected to undertake the capital construction and auxiliary facility construction; the equipment bidding will determine the contractor for each equipment package.

1.4.1 Work scope of Project Engineering & Construction Management contractor

1.4.1.1 Detail engineering and construction management inside the demo site

The design of the main workplace, raw material storage, assistant workplace, office, walls of the demo site, gate, and other building. Power, illumination, water supply and drain, pipeline layout for fire control, general layout of the demo site, the ventilation of the gasifier-generator workplace, heating by utilizing circulating cooling water.

1.4.1.2 Design of general layout and design of the capital construction and auxiliary engineering in the demo site

1.4.2 Work scope of other contractor

1.4.2.1 Equipment contractors are responsible for supplying the equipment and instrument control and electric equipment in the 3 bidding packages (see section 1.4.3), and related system function design.

1.4.2.2 For the bidding packages mentioned above, the Project Engineering & Management Unit will be responsible for submitting the technical requirement of each system and the technical specification of the major equipment. The contractor should be in charge of the accomplishment of system function design, and the selection and supply of major and auxiliary equipment.

1.4.2.3 Contractors should participate in the construction supervision of all equipment, the operation test of each sector of CHP system, and the united operation of the whole CHP system. Also they are responsible for solving all the problems related to equipment.

1.4.2.4 Contractors should supply training to local personnel in the aspects of equipment operation.

1.4.3 Sub-contract

There are 3 bidding packages.

1.4.3.1 Gas production and clean-up package

1.4.3.2 Power generation and distribution package

1.4.3.3 Gas storage and distribution package

2 Time schedule

2.1 Time table of the project

Engineering & Management Unit made suggestions on the timetable of the project (see section 2.3), and the deadline of each phase's target. The explanations are as follows:

In December 2001, the CHP system should be checked and accepted and put into operation. The system adjustment and trial production should be finished within 3 months since the beginning of trial production, i.e. the end of February 2002.

2.2 Schedule of technical document and drawing delivery

2.2.1 Document and drawing supplied with equipment

The contractors should supply three sets of document and drawings with equipment. In addition, the contractor will submit documents and drawings for review purposes as defined in the following sections. It is requested that one set of document and drawings

should be submitted to Engineering & Management Unit 60 days before equipment delivery.

2.2.2 Document and drawings for 1st design communication meeting

During the first design communication meeting (see section 3.3.2.2), the contractors should supply following document and drawings to Engineering & Management Unit:

2.2.2.1 List of document and drawing for identification (the detailed requirement is shown in section 3.3 in Chapter I)

2.2.2.2 Technical document and drawing, including function data and curve, drawing of appearance, base size and weight, size of interface. These document and drawing are for the purpose of correcting the preliminary design and construction drawing design of CHP demo site in Hechengli village. The contractor should submit an overview of the check and control points for related equipment and systems' key items, so that the Project Engineering & Management Unit could review it.

2.2.3 Document and drawing for 2nd design communication meeting

One week before the 2nd design communication meeting (see section 3.4.2.3), the contractor should submit the following document to Engineering & Management Unit.

2.2.3.1 Function design of gas production package, gas distribution and gas storage package, power generation and connection to grid, and all monitoring and control parts related to each package.

2.2.3.2 Final technical document and drawing for the equipment the contractor would supply, so that the Engineering & Management Unit could check and apply them during the construction drawing design.

2.2.4 Document and drawing for 3rd design communication meeting

During the 3rd design communication meeting (see section 3.4.2.4), the contractors should submit the following document and drawing to the Engineering & Management Unit:

2.2.4.1 Final technical document and drawing of each equipment bidding package, and the final revision materials for the previous two sets of materials

2.2.4.2 Within the scope of contract, the integrated equipment, system, list of material, plan for equipment delivery. The lists should include the table for assemble pieces and 2nd assemble pieces, accordingly the Engineering & Management Unit could make the installation plan and timetable.

2.2.4.3 Final draft for the function design of gas production and clean-up, gas distribution and storage, power generation and connect to grid, and the monitoring and control part.

2.3 Timetable

Table 2-1 Timetable for the project

Activity \ months	1	2	3	4	5	6	7	8	9	10	11	12
1. Preparation												
2. Construction design												
3. Construction												
4. Equipment installation												
5. Adjustment of CHP system												
6. Trial production												
7. Check and accept												

3 Explanation of the general principles and evaluation guide lines

3.1 General explanation

3.1.1 The equipment supplier should review all the terms in the bidding document issued by CICETE, including the technical specification.

3.1.2 The technical specification of products that equipment supplier would supply should meeting the requirement in the bidding document. The equipment supplier could recommend the design-finalized product with similar specification, however, the equipment supplier must submit the detailed specification deviation table.

3.1.3 The equipment procured should be advanced in technology, should adopt approved new technique and new technology. The equipment supplier should submit the material related to the experience in equipment manufacture gained by the manufacturer.

3.1.4 According to the comments of CICETE, if a reasonable price for an equipment bidding could not be accepted, CICETE will reserve the right to re-evaluate the price and scope-of-supply relative to the project budget, and could delete one or several items from the whole original bidding package, or one or several parts from the original sections, or evaluate the price per unit.

3.1.5 The bidding evaluation should be based on the price of the equipment, including the discount if it is available. However, the bidder should list the price per unit and the total price for the whole bidding package. In case the total price is wrong, the buyer could correct the total price based on the price per unit.

3.2 General requirement

The contractors should meet all the requirements mentioned in the technical specification. In case contradict occurs, a more strict requirement should be met.

3.2.1 Definition and terms

3.2.1.1 Performance check test refers to the test done for the purpose of checking the function guarantee of each technical system and equipment stated in the contract.

3.2.1.2 Accept means the Engineering & Management Unit accepts all the equipment included in the equipment supply contract, i.e. the set of equipment and its auxiliary equipment. Based on the results of check and accept test on the performance of each equipment in the testing operation, all the guarantee indexes stated in the contract could be reached, then “accept” could be carried out by Engineering & Management Unit.

3.2.1.3 Final accept means the accept after the guarantee period in case the equipment could meet the requirement of the equipment supply contract.

3.2.1.4 Set of equipment refers to the gas production system, engine-generator system and their auxiliary equipment.

3.2.1.5 Boundary refers to the interface between the Engineering & Management Unit and contractors or equipment bidding package in terms of design scope and/or equipment supply scope. In other words, the “boundary” means the interface of design and/or equipment supply.

3.2.1.6 “Assemble of single unit of equipment” means the equipment package consisting of several independent equipment with determined parameters.

3.2.1.7 “Group of system equipment” (integrated package) refers to the equipment package containing major equipment with determined parameters and auxiliary equipment suited to the major equipment. The auxiliary equipment is selected based on the system function design.

3.2.2 Criterion and standard

Except the explanation in related chapters, the applicable scope and standard of equipment and material procured should be on a basis of IEC, ISO or GB in China, or other equivalent standards.

The detailed standards adopted is in related sections, and the followings are American standards:

IEEE	AISC	ANSI	ASA	ASHRAE
ASME	ASNT	ASTM	AWC	AWS
AWWA	HI	ICEA	ISA	MSS
SAE	UL	NEMA	NFPA	NEC
SSPC	TEMA	SAMA	UBC	CMMA

IEC

3.2.2.1 Suitable conditions for the criterion and standards

- 1) The function test of the equipment should follow the criterion of ASME.
- 2) Following environmental protection standards should be abided:

- a) “Environmental Quality Standard for Atmosphere” (GB3095-1996), Grade II.
 - b) “Comprehensive discharge standard for wastewater” (GB8978-1996), Grade II newly extended and revised.
 - c) “Standard for noise in factories” (GB12348-90), Class II for mixed zone.
- 3) When the contract is approved, the contractor should submit the latest edition of all the criterion and standards applied in design, techniques, equipment and material to the Engineering & Management Unit.

3.2.3 Basic requirement for CHP system design

General principles

The techniques and equipment should be new, the quality should be reliable, and the technology should be advanced, so that it could be guaranteed that the system could be of high applicability, high gasification efficiency, low fuel consumption and could meet the requirement of related environmental protection regulations. The adopted system and equipment should be matured, and only proved system and equipment could be included in the bidding. The equipment, design and document supplied by the contractors should satisfy the technical requirement in the following sections.

3.2.4 General requirement for the equipment supplied by the contractors

3.2.4.1 Major requirement

- 1) All the equipment should be designed and manufactured correctly. For the sake of safety and continuous operation, the equipment should satisfy the requirement under various working conditions, and there is no problem related to extensive stress, vibration, erosion and aging. Also the equipment should be equipped with hook and ring-shape bolt, so that the equipment could be hanged or removed during installation or maintenance.
- 2) All the material should meet the requirement of related criterion, and should be new and in good quality, so that the maintenance could be reduced to a great extent. Casting and forging pieces should satisfy related criterion, and there is no crack and harmful flaw.
- 3) Strict quality management should be carried out during the manufacture process, including necessary treatment, test and check.
- 4) For running machine, the rotor or impeller should have safe natural frequency.
- 5) The machine or other pieces should be exchangeable.
- 6) During manufacture, the contractor should pay attention to the interface among equipment, especially the interface between purchased equipment and manufactured equipment. The equipment suppliers are responsible for solving the problems of interface.
- 7) The contractors are responsible for the on-site installation and test. After the installation, no problem in interface would be found.

- 8) The equipment suppliers should follow the requirement in section 3.3, submit complete technical material, and the international equipment supplier should submit materials in Chinese as much as they can.

3.2.4.2 General requirement for the system

The equipment should run normally under the geological situation in Yanbian area (supplied by the users). In case the equipment could not meet these requirements, the bidder should inform the error.

1) Expected life-span of the system

The expected life span of the gasification system should be 15 years.

The expected life span of the power generation system should be 30 years, and all the major and auxiliary equipment should meet the requirement of safe and economic operation.

The expected life span of the gas storage tank and gas distribution pipes should be 15 years respectively.

2) Life-span deletion for start-up mode

Within the expected life span, at least the system should undertake the stress caused by different start-up modes, and enough capacity could be reserved for emergency.

The contractor should list the max. life span deletion of each cycle according to above situation.

3.2.4.3 Frozen-proof and dew-proof

Based on the local environmental condition and layout circumstance, the measures should be adopted to prevent the pipelines from frozen and dew, and to keep warm.

3.2.4.4 Preservation

The contractor should supply preservation for the pipelines (including accessories) and underground pipes, so that the expected life span could be reached.

3.3 Technical document and drawing

3.3.1 General principles

The contractors should submit the technical document and drawing mentioned in this section, i.e. technical material (equipment data/drawing). The technical material includes: technical data and specification and drawing and other necessary data gained in the process of check, test, installation, operation and maintenance.

3.3.2 Requirement

Since Engineering & Management Unit will be responsible for the design of capital construction in the demo site, and the selection of qualified construction unit to undertake the capital construction, the technical document and drawing supplied by contractors in every construction period should satisfy the process requirement in design and construction.

3.3.3 Additional data

Unless there is other criterion in the technical specification, “approximate” or “about” means the scope of error is 10%.

Unless there is other criterion in the technical specification, SI units should be adopted to measure all the equipment and instrument.

In case the Engineering & Management Unit is not satisfied with the drawing and data supplied by the contractors, the Engineering & Management Unit reserves the right to ask for the supplement and revision from the contractors.

3.3.4 Special requirement: the details for the technical document and drawing supplied by the contractors are listed in related sections.

3.3.5 Data and drawing needed after the approval of the contract

3.3.5.1 Drawing

- 1) After the approval of the contract, the contractors should prepare revised and reliable bidding document and submit to the Engineering & Management Unit. The document and drawing include all the drawing and data listed in the data/drawing term in the bidding paper. All the improvements, changes, increase and deletion should be indicated and every detail should be revised.

Scope of the data and drawing submitted is (but not limited to): all the data and drawing regulated. Sufficient generalization should be done to determine all the pieces and steps in the actual work to ensure the target and requirement for installation and operation and maintenance could be satisfied. Engineering & Management Unit reserves the right to ask for additional materials from the contractors based on reasonable requirement.

- 2) The contractor should submit the data and materials for the purpose of civil engineering design to the Engineering & Management Unit.
- 3) Countersign of the civil engineering drawing (limited to construction package)

In order to be identical between the civil engineering drawing and the machine and electric and control equipment, the contractors should participate in the countersign of overall layout drawing and other necessary detailed construction drawing supplied by E&MC. The contractors should indicate each error or contradict, mark, signature and date clearly on the civil engineering drawing, and return these drawing within two weeks to the Engineering & Management Unit. The contractors have no obligation in the problems in civil engineering design.

- 4) The contractors should supply the lists for indoor-storage equipment and outdoor-storage equipment.
- 5) The contractors should submit the model and general technical requirement for all the major pieces.

- 6) The contractors should submit a complete on-site installation drawing, and list the location and installation and connection of all pieces that are not assembled in the factory. Each on-site installation item should have the same identification requirement both in the drawing and item itself.
- 7) The contractors should submit the calculation of all flux elements, and the material should include the data for design and operation condition. The permanent pressure decrease of the element should be included, too.
- 8) Before the manufacture of the equipment, the contractors should submit the general layout and installation drawing and any other necessary drawing for examination in order to determine the target suitable for all elements.
- 9) The contractors should submit the detailed start-up and operation steps, and the preferred installation steps.
- 10) All the drawings from Engineering & Management Unit and contractors should adopt the rule of international unit.
- 11) The contractors should submit detailed material list and accessory list for each equipment.

3.3.5.2 Table

1) General principles

The contractors should submit all the following tables. In addition, in case the Engineering & Management Unit requests, the contractors should supply all these tables as soon as possible till Engineering & Management Unit is satisfied.

2) Table for equipment

The contractors should prepare a comprehensive table for equipment, including all identified equipment in the equipment package. The table should consist of following parts:

- a. Model
- b. Name
- c. Manufacturer
- d. Serial number of the bidding sheet

3) List of instrument

The contractors should supply a complete computerized table for all the instrument and control system within their equipment supply scope. The Engineering & Management Unit should adopt measures to incorporate contractors' instrument list to his list, so that a complete instrument list could be formed. The recording sheet of the instrument list should be regarded as the standard drawing and submitted to Engineering & Management Unit. The contractors should apply same format to prepare the instrument list.

4) List of drawing

A complete classified drawing/material list prepared by the contractors should be submitted to Engineering & Management Unit within one month following the approval of the contract.

3.4 Technical services and personnel dispatch

3.4.1 Function design and overall coordination

This section will determine the outline for the contractors and Engineering & Management Unit in terms of function design and techniques for gasifier and its auxiliary equipment, gas distribution and storage equipment, generator and its auxiliary equipment and all the monitoring and control equipment. The contractors should ensure that the function design of the integrated equipment package supplied by them is complete, advance, reasonable in terms of technology and economy, and is in harmony with other related technique system. The contractors should work together to be responsible for the whole system's start-up, operation and check.

3.4.2 Design communication meeting

3.4.2.1 Function of design communication meeting

The design communication meeting is to ensure the design of each technique system could be done smoothly, to solve the technical problems timely, and to solve the problems of interface among each technique systems. For the time, duration, location and personnel of the design communication meeting, the following proposal is submitted for equipment suppliers' review. With the comments from equipment suppliers, the proposal for the meeting could be finalized through negotiation. For the cost of design communication meeting, the equipment suppliers and Engineering & Management Unit will pay for themselves. However, the cost for Engineering & Management Unit to participate in the design communication meeting should be included in the quoted price. Based on the actual situation, for example, in case some topics request for additional meeting held at home or abroad, the contractors should participate in the meeting and pay for themselves.

3.4.2.2 1st design communication meeting

Time: 1 weeks after the contract goes into effect;

Duration: Not yet available;

Location: Changchun, China;

Participants: Engineering & Management Unit, the commercial and technical personnel from each equipment supplier who has signed contracts.

Contents:

- 1) The contractors should introduce the equipment information, including the system, layout, function parameters, requirement on measurement and control, balance data of various medium, capacity of the generator, interface and requirement on equipment and design etc.
- 2) Engineering & Management Unit and its design personnel should introduce the general design principle of the demo site, including the design principles of each system, major system drawing, general layout, layout of the major workplace, construction

structure, electric system, monitoring instrument and control principles etc.

Meanwhile, the Engineering & Management Unit should organize the discussion with the contractors on the topics of technical condition related to the general design principles of the demo site, the parameter and location of each interface item.

- 3) Engineering & Management Unit and the contractors should discuss and identify the applicability of drawing and technical material for bidding.
- 4) The general layout of the demo site, layout of the major workplace and each technique system should be determined, so that Engineering & Management Unit and the contractors could be aware of the original condition further.
- 5) Coordinate to perfect the function design for gas production and clean-up, gas distribution and storage, power generation and connect to grid and monitoring, and determine the cooperation items and process among each equipment package during the period of function design.
- 6) The contractors investigate the demo site.

3.4.2.3 2nd design communication meeting

Time: one week after the 1st design communication meeting;

Duration: Not available;

Location: Changchun, China;

Participants: Engineering & Management Unit and design engineers, commercial and technical chiefs of the contractors (gas production and clean-up, gas distribution and storage, power generation and other equipment package)

Content:

- 1) The contractors for gas production and clean-up, gas distribution and storage, power generation and monitoring should introduce their function design, and Engineering & Management Unit should check and identify the function design.
- 2) Engineering & Management Unit checks and identifies the design for the major equipment in each equipment package.
- 3) The contractors should submit the final materials of the equipment supplied, including equipment's shape, weight, size of base, location and size of interface, function parameters, calculation results, characteristic curves etc.
- 4) Coordinate in each equipment package.
- 5) Coordinate the process of equipment supply and construction.
- 6) Visit/consult CHP plant and related manufacturers. In case the plant is outside of China, the visit should be carried out after the 2nd design communication meeting, and the contractor should pay for Engineering & Management Unit and its representatives, the total number should be 3.

Note: at least one week before the meeting, the contractor should send the finished product of function design to Engineering & Management Unit and its design engineers for review.

3.4.2.4 3rd design communication meeting

Time: Not available;

Duration: Not available;

Location: Changchun, China

Participants: commercial and technical chiefs from 3 equipment supply contractors (gas production and clean-up, gas distribution and storage, and power generation and distribution), electric and monitoring, other related personnel, Engineering & Management Unit and its design engineers.

Content:

- 1) Engineering & Management Unit should organize the examination of the preliminary design, determine the principle of the construction drawing design.
- 2) Coordination and identification among general design and gas production, gas distribution and storage, monitoring, and electric.
- 3) The contractors should supplement equipment information.
- 4) Related commercial issues.

3.4.2.5 Memorandum

After each design communication meeting, a memorandum should be signed by each participating organization.

3.4.2.6 Communication with other contractors

Since the interface is quite complicated, besides above design communication meetings, if it is necessary, Engineering & Management Unit should contact the contractors through mail or contact person at any time, the related contractors should respond in a timely fashion.

3.4.2.7 Representatives

During each design communication meeting, the related personnel of each equipment package must attend the meeting and join the discussion.

3.4.3 Installation monitoring and monthly report

3.4.3.1 Technical services

During the installation, start-up and trial production, qualified representatives from the contractors should supply on-site technical service. Meanwhile, the contractors should dispatch experts from equipment manufacturers to supply on-site technical services.

3.4.3.2 Permanent representatives

The permanent representatives should assist Engineering & Management Unit in checking and testing the equipment during the transportation and installation, solving the problems in interfaces with other contractors or Engineering & Management Unit, preparing a monthly report on the process of the work and existing problems and suggestions starting from 2nd design communication meeting.

3.4.4 Test

3.4.4.1 Technical instruction

The contractors are responsible for the technical instruction during the system test, start-up and function test. Engineering & Management Unit will undertake the actual test and operation.

A combination of Engineering & Management Unit personnel and operating personnel from the village O&M company will participate in the training, and the actual number of attendees are equipment procurement package depended. Engineering & Management Unit should make the final name list for the training.

3.4.4.2 Important items

For that critical work, the representatives of the contractors should attend in person.

3.4.4.3 Timetable for specification delivery

3 months before the test, the contractors should submit the operation specification for equipment operation and maintenance.

3.4.4.4 Responsibility

The contractors are responsible for the preparation work of test and start-up for the equipment within the supply scope. In order to arrange the testing steps, the contractors should consultant all the sections in the specification.

- 1) The responsibility of the contracts includes the design and manufacture and delivery and normal operation of the whole set of equipment. During the installation and delivery, the equipment supplier should dispatch suitable technical personnel to supply on-site technical instruction, and be responsible for the operation of each equipment package.
- 2) Based on the complicated procedure of the equipment, the contractor should supply service time and personnel for on-site installation and adjustment. The equipment supplier could suggest and declare the price per unit. The cost will be included in the cost estimation.
- 3) When bidding, the contractors should identify the guarantee period clearly. Within the guarantee period, the contractors should supply maintenance services within 7 days after the construction unit gives notices, adjust or replace un-qualified pieces or equipment for free to ensure the smooth operation of the system.

3.4.4.5 Based on the complexity of the equipment, the contractors should supply sound technical training to the construction unit to ensure that the construction unit could master the technology, including operation and maintenance. The bidding paper should suggest the training time and training personnel. The price for the training course will be quoted separately. The quoted price will not be included in the basic price for the equipment and the estimated price.

During manufacture, the contractors should pay attention to the interface, especially the interface between booked equipment and existing equipment, and the equipment suppliers are responsible for the problems of interface. The contractors will be in charge of on-site installation and adjustment. After the installation, no interface problem could be found.

All the procured equipment should be proved, and have effective test report and certificate. The content of the test should be determined by equipment suppliers and buyers, however, the suppliers should suggest the test items and standards first. The test before check and accept should be carried out in the demo site.

Limits on equipment load

Size of the vehicle and permitted load should be determined upon the sign up of the contract.

Other special situations will be regulated in the bidding paper.

3.5 Expendable, such as spare part, tools for special purpose and lubricant.

3.5.1 Spare part

3.5.1.1 Necessary spare part refers to the spare part that the contractors supplies with equipment without any additional cost, and the spare part prepared for emergency and first overhaul. The price mentioned in this item will be included in the basic price of the bidding equipment. The contractor should list the name, model, size, amount and price per unit for the instrument and tools for special purpose and accessories or expendable in detail. Before the contractors signs the contract, the buyer reserves the right to submit supplement requirement to the type and amount of the product mentioned above. Once the two sides confirm, this item should be included in the contract.

3.5.1.2 Besides the necessary spare part supplied with the equipment, the contractors should submit a list of spare part and expendable for 3-year use (since the day of commercial operation) in order to establish a basis for future purchase. This part will not be included in the total price.

3.5.1.3 The model and size of the spare part and the actual installed equipment should be the same.

3.5.1.4 The machining drawing for the spare part should be submitted. The drawing should include the explanation of material, technical requirement and machining.

3.5.1.5 In case the equipment applies other materials (water, oil, and electricity) as medium, the contractors should submit related parameters, such as consumption.

3.5.2 Tools for special purpose

3.5.2.1 The tools for special purpose supplied by the contractors should be necessary and sufficient.

⌘ The pieces and components could be uninstalled safely and effectively during the maintenance.

⌘ Special requirement for maintenance and overhaul could be met.

3.5.2.2 Considering the life span and frequency, the contractors should leave some space when they supply tools for special purpose.

3.5.2.3 Necessary technical specification and user manual for the tools for special purpose should be supplied by the contractors.

3.5.3 Installation materiald

The contractors should supply the special materials of the equipment installation, including the necessary material for construction and trial production.

3.5.4 Lubricant filled before the commercial operation

The contractors should supply the lubricant applied before the commercial operation. For the sake of commercial operation, the contractors should submit the list of lubricant, and quality and amount of the lubricant, and lubricant filling station, so that the Engineering & Management Unit could make selection.

4.Training

4.1 Training before operation

The contractors should train operators initially to make them know about the common sense of operation before trial production.

4.2 Training during operation

The contractors should train operators finally to make them understand all operation methods during trial production. Additionally, the contractors should train the checker and repairman to grasp the way to repair important parts of all equipment.

4.3 Training method

Training consists of lectures in classroom, and practical operation. The contractors should provide the training materials. Chinese should be used during training.

4.4 Training procedure

The bid document should include the training plan such as times and locations for training. The total price for bidding includes the training cost.

4.5 Evaluation for training

Engineering & Management Unit and the contractors should determine the objectives and time and training methods for each training together. The contractors are responsible for managing the training and making changes upon the request from Engineering & Management Unit. However, the Engineering & Management Unit should not interfere with the training once this review is complete and the training plan is being properly implemented.