NASIR ABSAR
CONSULTING

Ref. No.: NACL/NEPRA/15(16)-08/01

SCHEDULE 1
(REGULATION 3(1)
FORM OF APPLICATION

The Registrar,
National Electric Power Regulatory Authority

Subject: **APPLICATION FOR A GENERATION LICENSE.**

I, Syed Ibrahim Ahmad, Executive Director of M/S Nasir Absar Consulting, being duly authorize representative of M/S Bulleh Shah Packaging (Private) Limited by virtue of Board Resolution, hereby apply to the National Electric Power Regulatory Authority for the grant of a Generation License to the Bulleh Shah Packaging (Private) Limited pursuant to section 15 of the Regulation of Generation, Transmission and Distribution of Electric Power Act 1997.

I certify that the documents-in-support attached with this application are prepared and submitted in conformity with the provisions of the National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulations, 1999, and undertake to abide by the terms and provisions of the above-said regulations further undertake and confirm that the information provided in the attached documents-in-support is true and correct to the best of my knowledge and belief.

A Pay Order No. 3610636 dated 28-02-2018 amounting PKR-305,856/- (Rupee Three Hundred Five Thousand Eight Hundred and Fifty-Six Only), being the non-refundable license application fee calculated in accordance with Schedule II to the National Electric Power Regulation Authority Licensing (Application and Modification Procedure) Regulations, 1999, is also attached herewith.

Date: March 9, 2018

Syed Ibrahim Ahmad,
Executive Director

NASIR ABSAR CONSULTING (PRIVATE) LIMITED
Office # 1, Second Floor, VIP Square, I-8 Markaz, Islamabad, Pakistan
Tel: +92 51 486 1322-3, +92 51 835 1186-7 Fax: +92 51 486 1324

March 9, 2018

Name of Company: Bulleh Shah Packaging (Private) Limited

Plant Capacity: 41 MW

Project Location: Factory & Plant: Bulleh Shah Packaging (Private) Limited, Kasur- 7 Km, Kot Radha Kishan Road, Off 4 Km Kasur Raiwind Road, District Kasur – 55050. Phone No. 049-2717335-45

Head Office: Bulleh Shah Packaging (Private) Limited, Shahrah-E-Roomi P.O, Amer Sidhu, Lahore – 54760. Phone No. 042-35811541-46

Contact Details: Abdul Samad Goraya, Bulleh Shah Packaging (Private) Limited, Shahrah-E-Roomi P.O, Amer Sidhu, Lahore – 54760. Phone No. 042-35811541-46

PROSPECTUS PURSUANT TO REGULATION 3(5)(I)

1. BRIEF INTRODUCCTION OF THE APPLICANT

Bulleh Shah Packaging, a Packages Group Company, aims to provide responsible packaging solutions for brands in Pakistan.

Bulleh Shah Packaging works with all kinds of industries; ranging from Textiles, Dairy, Snacks, Electronics and many more. Today, 80% of our portfolio includes some of the top local and international brands operating in Pakistan. Our team of over 1,000 employees is spread between offices in Karachi, Lahore, Islamabad and Kasur.

Bulleh Shah Packaging's parent company, Packages Limited, has been in the Paper and Board business since 1968. Over the years, it has continued to enhance its capacities and capabilities to meet the growing demand of Paper and Board products in Pakistan. In 2005, Packages Limited invested in a Green Field Project in Kasur by the name of Bulleh Shah Paper Mills. The plant, spread over 225 acres of land expanded its product lines to Liquid Packaging Board, Folding Box Board, White Line Chip Board, Writing Paper and Photocopy Paper, Test Liner and Fluting/Corrugated medium paper. The current plant has the capacity to produce 240,000 tons of paper and board and 210 million corrugated boxes annually.

PRODUCTS

A. PAPER AND BOARD

Great packaging begins with the right material. BSP is known to deliver performance, quality and reliability for the product it houses. The company ensures conformance by strictly adhering to product specifications and delivering high quality results. The distinction of product experience is warranted by BSP's continuous investment in modern technology for its Paper & Board and Corrugator plants.

BSP's Paper and Board business unit specializes in fulfilling the need to securely and responsibly provide reliable packaging services to its customers.

1. Consumer Board

These boards are used for packaging purposes such as Confectionery Cartons, Food Cartons, Ice-cream cartons, Book Titles, Matchboxes, Tea Cartons, Paper Cups, Paper Plates, Cigarette Packaging, Pharmaceutical Packaging, and Liquid Packaging.

- Folding Box Board
- Liquid Packaging Board
- Soap Stiffener
- White Line Chip Board

2. Container Board

Bulleh Shah Packaging is the major producer of high quality liner and fluting in Pakistan. These different types of liner and fluting are primarily used by demanding producers of high quality Corrugated Boxes. Bulleh Shah Packaging has developed special, high performance fluting with moisture barrier for packaging of fruit and other similar end-uses.

- Liner
- Fluting
- White Test Liner

3. Paper

For BSP, customer satisfaction – together with environmental and social responsibility – is the highest priority. Therefore, Bulleh Shah Packaging uses 100% fine quality imported wood pulp in order to provide premium quality paper products to its customers. In addition to this, BSP utilizes updated technology and the most modern equipment to produce outstanding output.

- Copymate Plus
- Writing, Printing & Publishing Paper

B. Corrugated Packaging

Corrugated material is made up of three layers of paper – inside liner, outside liner and fluting which runs in between. The material gets its name from the corrugated medium which signifies its strength. Extensive investment in research and development along with the successful utilization of customer feedback has enabled BSP to develop special liner and fluting in-house that provides the strength and durability needed to pack and transport valuable customer products.

Thus, BSP's value proposition is to deliver high-quality corrugated containers while setting new standards in customer service, product development and tailor-made problem-solving to meet customers' unique packaging needs. This is made possible through:

State of the art machinery

Multi-color print designs

Flexibility in choosing from:

- Regular Slotted Glued Containers (RSC)

- RSC-stitched trays and shelves
- Die-cut containers

Detail profile of Applicant is appended as Annexure-D.

2. **SALIENT FEATURES OF THE FACILITY OR THE SYSTEM IN RESPECT OF WHICH THE LICENSE IS SOUGHT**

- **Regulation No. 3(5)-A(i) - Certificate of Incorporation:**

  Appended as Annexure-A

- **Regulation No. 3(5)-A(ii) – Memorandum and Articles of Association:**

  Appended as Annexure-B.

- **Regulation No. 3(5)-A(iii) – Latest financial statement:**

  Financial statements, Bank Certificate and Income Tax Return for the Year 2017 are appended as Annexure-C.

- **Regulation No. 3(5)-A(iv) and Schedule III-Regulation 3(6)A-(b)-1– Location (location map, site map):**

  The project is located at Bulleh Shah Packaging (Private) Limited, Kasur- 7 Km, Kot Radha Kishan Road Off 4 Km Kasur Raiwind Road, District Kasur – 55050.

  The Coordinates of the area are: 31.1417458, 74.3593049

  The location is accessible from Allama Iqbal International Airport Lahore through Lahore Ring Rd/L-20 to Kot Arian - Jia Bagga Rd., Kasur – Raiwind Road. Total Distance is 62.9 Km. The distances are:

Allama Iqbal International Airport Lahore through Lahore Ring Rd/L-20 to Kot Arian - Jia Bagga Rd.	31 km
Kasur – Raiwind Road to Packages Factory	31.9 Km

  The google map of the location has been attached as an Annexure-F.

- **Regulation No. 3(5)-A(v) and Schedule III-Regulation 3(6)A-(b)-2 – Type of Technology:**

  - Production capacity of the power plant electricity output from Generator: 1 * 41 MW.
  - Biomass Boiler, Vibrating Grate: 150 t/h Boiler; Steam Pressure: 128 bar(g); Steam Pressure after super heater 98 bar(a); Normal working pressure, boiler drum 115.8 bar(a); Steam Temperature: 530 Celsius; Feed water temperature 180 °C; Flue gas flow 175000 Nm^3/h.

- Conventional Boiler: 200 t/h Boiler; Nominal main steam pressure: 96 bar(g); Main steam temperature: 528 °C; Feed Water Operating pressure: 134 bar(g); HP Boiler (Furnace + Superheaters): 2400 m^2 ; Flue gas pre-heater: 4078 m^2.
- Steam Turbine: 1 * 41 MW, 525 Celsius.
- Generator: 1 * 41 MW generator, 1500rpm, 48 235 kVA.
- Circulating Cooling Water: Fresh water circulating water system
- The power plant is currently using Natural Gas and Biomass as fuel.

- **Regulation No. 3(5)-A(vi) – Number of Units (No.)/Size (MW):**

  A unit with the plant capacity of 41 MW is under operation.

- **Regulation No. 3(5)-A(vii) – Year Make/Model, Operation Date and expected remaining life:**

  Biomass Boiler: 150 TPH - Descon, EDDW-SH-200120, Vibrating Grate, HFO/Gas 2009, Operation Date: Dec 2015, Life: 30 years.

  Conventional Boiler: 200 TPH - BWV, PP-7578, Vibrating Grate, 2016, Operation Date: Oct 2009, Life: 30 Years

  Steam Turbine: Siemens, 2006, SST 300, Operation Date: Nov 2009, Life: 30 Years

- **Regulation No. 3(5)-A(viii) and Schedule III-Regulation 3(6)A-(b)-7 – Installed Capacity, de-rated capacity, Auxiliary Consumption, Net Capacity:**
  - Installed Capacity: 41 MW
  - Auxiliary Consumption: 4 MW
  - Net Capacity: 37 MW
- **Regulation No. 3(5)-A(ix) and Schedule III-Regulation 3(6)A(b)-3 – Fuel: type, imported/indigenous, supplier, etc.**
  - Bulleh Shah Packaging is operating a plant using Biomass (Wheat Straw, Corn Stovers, Brassica) and Natural Gas or HFO as supporting Fuel.
  - Fuel is supplied by Local Suppliers through local transport. Gas is provided by SNGPL as per the Contract (Attached as Annexure-O).
- **Regulation No. 3(5)-A(x) – Supply Voltage (11kV/132 kV), in case of 132 kV voltage distance and name of nearest grid (Signle Line Diagram):**

  Medium voltage (11kV) electricity from generator outgoing feeder panel; Single Line Diagram has been provided as Annexure-G.

- **Regulation No. 3(5)-A(xi) and Schedule III-Regulation 3(6)A(b)-13– Plant Characteristics: Generation voltage, frequency, power factor, automatic generation control, ramping rate, alternative fuel, time(s) required to synchronize to grid:**

  Steam Turbine:

  - Generation voltage: 11 kV
  - Frequency: 50 Hz
  - Power Factor: 0.85
  - Automatic Generation Control: Yes
  - Ramping Rate: 3 hours on cold /1 hour on Warm/ 30 minutes on hot.

  Biomass Boiler, Vibrating Grate

  - Automatic Generation Control: Yes
  - Ramping Rate: 5 hours on cold /2 hours on Warm/ 1 hour on hot.
  - Alternative Fuel: Corn

  Conventional Boiler

  - Automatic Generation Control: Yes
  - Ramping Rate: 5 hours on cold /2 hours on Warm/ 1 hour on hot.
  - Alternative Fuel: HFO
- Time(s) required to synchronize to grid: Not applicable
- **Regulation No. 3(5)-A(xii) Provision of Metering, Instrumentation, Protection and Control arrangement:**

  Control, Metering, Instrumentation and protection will be in accordance with ISA (The International Society of Automation) standards. Detail Short Circuit Calculations and Load Flow Analysis Report has been provided in the Annexure-H

3. PROJECT COST

The cost incurred for the turbine and boiler was PKR 1,294,169,079.

4. SOCIAL AND ENVIRONMENTAL IMPACT OF THE PLANT

The environmental approval has been issued by the Environmental Protection Agency for the project. The detail environmental report along with the approval is appended as Annexure-M.

5. **EFFICIENY PARAMETERS UNDER REGULATION 3(6) SCHEDULE-III PART A(a)**

	GROSS EFFICIENCY	NET EFFICIENCY
200 TPH BOILER	90%	85%
150 TPH BOILER	85%	80%
TURBINE	93%	90%

- **SCHEDULE-III Regulation 3(6)-A(b) EXISTING GENERATION FACILITIES (THERMAL)**

1. Emission Values:

Parameters	NEQS/MIGA	Dec17	Jan 18
SOx mg/NM^3	1700	14.3	0
NOx mg/Nm^3	600	89.9	84.4
CO mg/Nm^3	800	67.5	715
PM mg/Nm^3	300	134.8	48.2
Fuel		Biomass + Gas	Natural gas

Details monitoring reports are attached as Annexure-L.

2. **Cooling Water Source:**

Tube well

3. **Interconnection:**

The power generation unit will not be connected to the National Grid. However, Single Line Diagram and Detail Study Report provided is in Annexure-G & H.

4. **Project Cost:**

The total project cost incurred was PKR 1,294,169,079.

5. **Environmental Study Report:**

Environmental study report has been attached as Annexure – M along with the submission letter to EPA Punjab.

6. **Training and Development:**

Training Manuals and Training Certificate of employees are appended as Annexure-N.

BRIEF OF THE APPLICATION

Bulleh Shah Packaging, a Packages Group Company, aims to provide responsible packaging solutions for brands in Pakistan.

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Project

To meet the electricity demand, Bulleh Shah Packaging established its own Captive Power Project with the installed capacity of 41 MW using biomass as primary fuel and Gas/HFO as secondary fuel. The project has been in operation since 2009.

Consumer

Bulle Shah Packaging (Pvt.) Ltd. is to sole consumer of the electricity produced through this Captive Power Plant.

Premises

The Power Plant is within the premises of Bulleh Shah Packaging factory area. The total land is 229.95 Acre. No public property is passed/disturber.

Supply

The electricity is been supplied through 11kV line which was been build and are been maintained by the company itself.

NASIR ABSAR
CONSULTING

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
GOVERNMENT OF PAKISTAN

Dated: April 9, 2018
Ref. No. NACL/NEPRA/15(16)-08/05
Pages: 1

Address: NEPRA Tower, Attaturk Avenue (East),
G-5/1, Islamabad

Attention: Iftikhar Ali Khan
Director (Registrar Office)

Subject: **APPLICATION OF BULLEH SHAH PACKAGING (PRIVATE) LIMITED FOR GRANT OF GENERATION LICENSE IN RESPECT OF 41 MW THERMAL POWER PLANT, DISTRICT KASUR**

Reference:

i. NACL Letter No. NACL/NEPRA/15(16)/08/01 dated 09-03-2018
ii. NEPRA Letter No. NEPRA/R/LAG-30/4206 dated 15-03-2018 received on 16-03-2018
iii. NACL Letter No. NACL/NEPRA/15(16)-08/02 dated 22-03-2018
iv. NEPRA Letter No. NEPRA/R/LAG-30/4934 dated 28-03-2018 received on 29-03-2018
v. NACL Letter No. NACL/NEPRA/15(16)-08/03 dated March 30, 2018
vi. NACL Letter No. NACL/NEPRA/16(16)-08/04 dated April 4, 2018

Respected,

Pursuant to the Application submitted through Letter referred at (i), certain clarifications are essential to be submitted to the Authority.

The premises shown in the Location Map is 100% owned by the Bulleh Shah Packages (Pvt.) Ltd. and the Power Plant is also 100% owned, operated and maintained by Bulleh Shah. however, a portion of the premises is rented to one of the sister concern company namely Omya Pack (Pvt.) Ltd. furthermore, the energy produced is also consumed by the Omya Pack (Pvt.) Ltd. The energy consumed by Omya Pack (Pvt.) Ltd. is being charged by Bulleh Shah (Pvt.) Ltd. on the basis of units consumed (PKR/KWh) at a manufacturing cost settled between the companies. Since, Omya is a sister-concern of Bulleh Shah therefore, no profit is being charged on the provision of electricity. The location map of the area showing the Power Plant and the Consumers are annexed with the letter.

Looking forward for the best of the cooperation, as always.

For

Syed Ibrahim Ahmad
Executive Director

Dy No. 8656
Dated 10-04-18

CC:

1. Abdul Samad Goraya, Bulleh Shah Packaging (Pvt.) Ltd. Shahrah-e-Roomi, P.O. Amer Sidhu, Lahore – 65760.

NASIR ABSAR CONSULTING (PRIVATE) LIMITED
Office # 1, Second Floor, VIP Square, I-8 Markaz, Islamabad, Pakistan
Tel: +92 51 486 1322-3, +92 51 835 1186-7 Fax: +92 51 486 1324
E-mail: info@nasirabsar.com Web: www.nasirabsar.com

Location Map

	Latitude	Longitude
Bulleh Shah Packaging	31.1417458	74.359304
Power Plant	31.130329	74.358208
Omya Pack (Pvt.) Ltd.	31.134108	74.360634

Lahore-54760
Ref: AG/ 462
Feb 28, 2018

AUTHORITY LETTER

It is to authorize **M/S NASIR ABSAR CONSULTING (PVT.) LTD.** through its **EXECUTIVE DIRECTOR, SYED IBRAHIM AHMAD,** to represent the Company, for the purpose of conduction and submission of Generation License Application for Bulleh Shah Packaging (Pvt) Limited to National Electric Power Regulatory Authority "NEPRA", Islamabad. The representative is authorized to correspond with all stakeholders including NEPRA, attend any/ all meeting(s) and discussions related to any matter of the project in this regard.

Yours faithfully,
For BULLEH SHAH PACKAGING (PVT) LTD

BULLEH SHAH PACKAGING (PRIVATE) LIMITED
A Packages Group Company

Lahore Office
Shahrah-E-Roomi P.O. Amer Sidhu, Lahore – 54760,
Ph: 042-35811541-46

Kasur Factory
Kasur – 7 KM, Kot Radha Kishan Road
Off 4 KM Kasur-Raiwind Road,
District Kasur - 55050
Ph: 049-2717335-45

Karachi Office
416-422, G-20, The Forum,
Block – 9, Khayaban-e-Jami,
Clifton, Karachi
Ph: 021-35869417

SECURITIES AND EXCHANGE COMMISSION OF PAKISTAN

CERTIFICATE OF INCORPORATION

(Under section 32 of the Companies Ordinance, 1984 (XLVII of 1984)

Company Registration No. 00000011656/20050907

I hereby certify that BULLEH SHAH PAPER MILL (PRIVATE) LIMITED is this day incorporated under the Companies Ordinance, 1984 (XLVII of 1984) and that the company is limited by Shares.

Given under my hand at Karachi this 16th day of September two thousand and five.

Fee Rs. 2,500/- (Two Thousand Five Hundred Only)

Company Registration Office Karachi Securities & Exchange Commission of Pakistan

(TAHIR MAHMOOD)
ADDITIONAL REGISTRAR OF COMPANIES

S No. 72123 dt. 10-04-13
Certified to be True Copy
11.04.2013
Asstt. Deputy Registrar of Companies

S. No. 3519. dt 19/9/2005.

SECURITIES & EXCHANGE COMMISSION OF PAKISTAN

CERTIFICATE OF INCORPORATION ON CHANGE OF NAME

[Under section 40 of the Companies Ordinance, 1984 (XLVII of 1984)]

Company Registration No: 0052465

I hereby certify that pursuant to the provisions of section 39 of the Companies Ordinance, 1984 (XLVII of 1984), the name of BULLEH SHAH PAPER MILL (PRIVATE) LIMITED has been changed to BULLEH SHAH PACKAGING (PRIVATE) LIMITED and that the said company has been duly incorporated as a company limited by shares as a private company under the provisions of the said Ordinance.

This change is subject to the condition that for period of one year from the date of issue of this certificate, the company shall continue to mention its former name along with its new name on the outside of every office or place in which its business is carried on and in every document or notice referred to in clauses (a) and (c) of section 143.

Given under my hand at Karachi this 03rd day of October Two Thousand and Twelve.

Company Registration Office * Karachi * Securities and Exchange Commission of Pakistan

(SIDNEY C. PEREIRA)
Joint Registrar/Incharge
Company Registration Office,
Karachi

Rs. 5000/-

Diary No. 19046(1) dtd. 03/10/2012

THE COMPANIES ORDINANCE, 1984

(PRIVATE COMPANY LIMITED BY SHARES)

MEMORANDUM

AND

ARTICLES OF ASSOCIATION

OF

BULLEH SHAH PACKAGING (PRIVATE) LIMITED

THE COMPANIES ORDINANCE, 1984

(PRIVATE COMPANY LIMITED BY SHARES)

MEMORANDUM OF ASSOCIATION

OF

BULLEH SHAH PACKAGING (PRIVATE) LIMITED

I. The name of the company is BULLEH SHAH PACKAGING (PRIVATE) LIMITED.

II. The registered office of the company will be situated in the province of Sindh, Pakistan.

III. The objects for which the company is established are:

1. To carry on all or any of the businesses of manufacturers of and dealers in paper and board of all kinds, and Tetra paper for making Tetra Pak of any type, description and dimension, straw board, plain and corrugated, duplex board, chip board, card board, box board, veneer board, mill board, wall and ceiling paper, greaseproof paper and articles made of paper, pulp, paper board specialities and board in all their branches.

2. To carry on all or any of the business of manufacturing and printing of cartons, packages, specialised containers for various commodities, utensils and other articles; printers, lithographers, type founders, stereotypers, electrotypers, photographic printers, photo-lithographers, chromo-lithographers, engravers, die-sinkers, book binders, designers, draughtsmen, paper and ink manufacturers and dealers in or manufacturers of any other articles or things of a character similar or analogous to the foregoing or any of them or connecting therewith; manufacturers, importers, exporters and dealers in raw materials, articles and things required for purposes of manufacture and printing of cartons, packages, specialised containers for various commodities, utensils and other articles in which the company is interested or any other marketable commodities, and to establish and maintain showrooms for this purpose; and of distributors, suppliers and sellers of the said articles and contractors for supplying them.

3. To acquire, deal, purchase, import, sale, supply and export any thing whatsoever.

4. To acquire agencies except managing agent of any person, firms or companies and to act as agents, manufacturer's representatives, personal agents, selling agents, buying agents, consultants, technical agents to and for any undertaking or enterprise whatsoever.

5. To do business of contractors, tenders, stockists, distributors, market surveyors, dealers and suppliers of variety of things which the company may consider beneficial.

6. To acquire, establish and carry on stores, depots and factories etc in Pakistan or elsewhere and maintain stalls, booths, godowns and warehouses required for the benefit and promotion of the products or business of the company.

7. To apply for tender, purchase or otherwise acquire contracts, subcontracts, licenses and concessions for or in relation to the objects of business herein mentioned or any of them and to undertake, execute, carry out, dispose of or otherwise turn to account the same. To sublet all or any contracts from time to time and upon such terms and conditions as may be thought expedient.

8. To guarantee the performance of contracts, agreements, obligations of the company and to give any guarantee in relation to the execution of jobs, contracts, payment of securities, deposits, loans, debenture stocks, bonds and also for discharge of the obligations of the company.

9. To establish, participate in or promote commercial, mercantile and industrial enterprises and operation and enter into joint ventures, partnerships or other collaborations and arrangements with any undertaking or company whether local or foreign for the achievement of the company's objects and business.

10. To appoint contractors, except managing agent, brokers, canvasses, agents and other persons to establish and maintain agencies or branches in any part of Pakistan or else where for the purpose of the company and to discharge and discontinue the same.

11. To apply for purchase or otherwise acquire and register any patent or patent rights, licenses, concessions or privileges, trade marks or designs and the like conferring to any exclusive or non-exclusive or limited right to use or any secret or other information as to any invention of which may seem calculated directly or indirectly to benefit the company, and use, exercise, develop or grant license in respect of or otherwise turn to account the property rights or information so acquired.

12. To enter into any arrangements and contracts with any government or authority, supreme, municipal, local or other firms, companies and corporate bodies etc., that may seem conducive to the company's objects or any one of them and to obtain from government or authority any rights, privileges, options, concessions and licenses, and to carry out, exercise or comply with any such agreements, arrangements, rights, privileges, concessions and licenses and to procure the company to be registered or recognized.

13. To amalgamate with any other company in Pakistan or elsewhere established with objects similar or identical to those for which this company is established.

14. To purchase, take on lease or in exchange, hire or otherwise acquire any immovable or movable property, and any rights or privileges which the company may think necessary or convenient for the purpose of its business, and in particular any land, buildings, easements, machinery, plant and stock-in-trade; and either to retain any property so acquired for the purpose of the company's business or to turn the same to account as may seem expedient.

15. To let out on hire, mortgage, sell or otherwise dispose off or deal with whole or any part of the undertaking of the company to any lands, business, property, rights or assets of any kind belonging to the company or any share or interest thereon respectively in such manner and for such consideration as the company may think fit, in the event of winding up of the company.

16. To create and issue different classes of shares, debenture or stock debenture and redeem, cancel or accept surrender thereof; and to issue its members any dividends, bonuses, shares, or distribute amongst them any other property of the company provided that any such issue or distribution of dividends, bonuses, bonus shares or other property does not amount to reduction of share-capital of the company.

17. To borrow money by the issue of debenture stock (perpetual or otherwise) and to secure the repayment of any money borrowed, or owing to mortgage, charge or lien upon all or any of the property or assets of the company (both present and future) and also by a similar mortgage, charge or lien to secure and guarantee the performance by the company of any obligation undertaken by the company.

18. To pay all costs, expenses, liabilities and obligations incurred or sustained in or in respect of the promotion, floatation, registration and establishment of the company, or in connection with the establishment and inauguration of any of its branches or business, and also to pay or adjust advocate's fees, brokerage, commission, bonuses, printing charges, or any other preliminary expenditure, which in the opinion of the Directors, may have properly been incurred by any member, advocate or agent, in connection with the aforesaid.

19. To open an account or accounts with any bank or banks and to draw and endorse cheques and to withdraw money from such accounts

20. To draw, make, accept, endorse, execute and issue promissory notes, bills of exchange, bills of lading and other negotiable or transferable securities and to advance, deposit money, securities or property to such persons, firm or company and on such terms with or without security as the company deem fit.

21. And generally to do and to perform all such other things and acts as may appear to be incidental or conducive to the attainment of the above objects or any of them.

22. It is expressly declared that the several sub-clauses of this Clause and all the powers expressed therein are to be construed as cumulative and independent and in no case unless the context expressly so requires is the generality of any one sub-clause to be narrowed or restricted by the name of the Company or by the particularity of expression in the same sub-clause or by the application of any rule of construction such as the ejusdem generis rule, and accordingly none of such sub-clauses or the objects therein specified or the power thereby conferred shall be deemed subsidiary or auxiliary merely to the objects mentioned in any other sub-clause of this clause, and the Company shall have full power to exercise all or any of the powers conferred by any part of this Clause in any part of the world.

23. It is hereby undertaken that the company shall not engage in banking business or in investment company or in any unlawful business and that nothing in object clauses shall be construed to entitle it to engage in such business

24. "Notwithstanding anything stated in any object clause, the company shall obtain such other approval or license from the competent authority, as may be required under any law for the time being in force, to undertake a particular business."

25. The company shall not engage in banking, business of an investment company, leasing company and insurance or any unlawful business and that nothing in object clauses shall be construed to entitle it to engage in such business, directly or indirectly. The company shall not launch multilevel, pyramid and ponzi scheme.

IV. The liability of the members is limited.

V. The Authorized Share Capital of the Company is Rs.15,000,000,000 (Rupees Fifteen Billion) divided into 1,500,000,000 ordinary shares of PKR 10/- each with powers to the Company to increase, reduce, reorganize, consolidate or subdivide the share capital on such terms as the Company in General Meeting may deem appropriate in the capital of various classes from time to time in accordance with the provisions of the Articles of Association of the Company and the Companies Ordinance, 1984.

We, the several persons, whose names and address as are subscribed hereunto are desirous of being formed into a Company in pursuance of these Memorandum of Association, and we respectively agree to take the number of shares in the capital of the Company set opposite to our respective names.

Name & Surname (Present & Former) in full (in Block Letters)	Father's/Husband's Name in full	Nationality with any former Nationality	N.I.C. No.	Occupation	Residential address in full	Number of shares taken by each subscriber	Signature
SYED HYDER ALI	Syed Babar Ali	Pakistani	35201-1655225-1	Professional Manager	70-F.C.C., Gulberg, Lahore	(500) Five Hundred	Sd/-
MUJEEB RASHID	Chaudhry Abdul Rashid	Pakistani	35201-5296887-7	Professional Manager	House No.54, Block L, Phase I, D.H.A., Lahore Cantt., Lahore	(200) Two Hundred	Sd/-
KHALID YACOB	Omar Yacob	Pakistani	35202-2337385-9	Professional Manager	304-Upper Mall, Lahore	(200) Two Hundred	Sd/-

Sd/-

Dated this 9th day of September 2005

Witness to the above signatures: Adi J. Cawasji
Father's name: Mr. Jehangir N. Cawasji
Occupation: Service
Nationality: Pakistani
N.I.C. number: 42000-0524360-9
Full address: 66 B, South Circular Avenue, D.H.A., Phase-2, Karachi-75500

THE COMPANIES ORDINANCE, 1984

PRIVATE LIMITED COMPANY LIMITED BY SHARES

ARTICLES OF ASSOCIATION

OF

BULLEH SHAH PACKAGING (PRIVATE) LIMITED

1. TABLE 'A' NOT TO APPLY

The regulations contained in table "A" in the first Schedule to the Companies Ordinance, 1984, shall not apply to the Company except to the extent and as hereinafter expressly incorporated.

2. DEFINITIONS

Words or expressions contained in these Articles shall, unless otherwise defined herein or unless inconsistent with the subject or context, have the same meaning as ascribed thereto in the Companies Ordinance, 1984. In these Articles, unless there is something in the subject or context inconsistent therewith:

(a) "**Affiliate**" means a person or an entity (other than the Company) which Controls any of the Shareholders or is Controlled by a Shareholder by virtue of shareholding, composition of the principal management body of the entity, contract or any other means;

(b) "**Articles**" means these Articles of Association as originally framed or as altered from time to time in accordance with the terms of these Articles;

(c) "**Board**" means the Board of Directors of the Company for the time being;

(d) "**Business Day**" means any day (other than Saturday or Sunday) when banks in Pakistan are open for the transaction of normal business;

(e) "**Chief Executive**" means the Chief Executive Officer of the Company appointed from time to time in accordance with these Articles;

(f) "**Company**" means Bulleh Shah Packaging (Private) Limited;

(g) "**Control**" (including, with its correlative meanings, the terms "Controlling", "Controlled by") means the possession, directly or indirectly, including together with their Affiliates, of the power to direct or cause the direction of the management or policies of a Shareholder, whether through the ownership of voting rights, by agreement or otherwise;

(h) "**Dividend**" means the distribution of profits of the Company to its Shareholders;

(i) "**Memorandum**" means the Memorandum of Association of the Company as originally framed or as altered from time to time in accordance with the provisions of the Ordinance and these Articles;

(j) "**Month**" means a calendar month according to the Gregorian calendar;

(k) "**Ordinance**" means the Companies Ordinance, 1984;

(l) "**Packages**" means Packages Limited, a company incorporated in Pakistan (registered No. KAR No. 396 of 1955-1956), whose registered office is located at 4th Floor, The Forum, Suite No. 416-422, G-20, Block 9, Khayaban-e-Jami, Clifton, Karachi 75600, Pakistan;

(m) "**Register**" means the Register of Members / Shareholders to be kept pursuant to Section 147 of the Ordinance;

(n) "**Registered Office**" means the registered office of the Company for the time being;

(o) "**Registrar**" has the same meaning as ascribed thereto in clause (31) of sub-section (1) of Section 2 of the Ordinance;

(p) "**Reserved Matters**" has the same meaning as ascribed thereto in Article 18 (*Reserved Matters*);

(q) "**SE**" means Stora Enso South Asia Holding AB, a company incorporated in Sweden (registered No. 556900-1638), whose registered office is at c/o Stora Enso AB, 79180 Falun, Sweden;

(r) "**Seal**" or "**seal**" means the common seal of the Company;

(s) "**Section**" or "**section**" means sections of the Ordinance;

(t) "**Shareholders Agreement**" means the agreement titled the "Shareholders Agreement" dated September 17, 2012 entered into between SE, Packages and the Company, as may be amended , restated or replaced from time to time;

(u) "**Shareholder Loan**" means, with respect to each Shareholder, a shareholder loan given by that Shareholder or by any of its Affiliates to the Company;

(v) "**Shares**" means shares in the share capital of the Company;

(w) "**Special Resolution**" has the same meaning as ascribed thereto in clause 36 of sub-section 1 of Section 2 of the Ordinance.

3. BUSINESS OF THE COMPANY AND REGISTERED OFFICE

3.1 The business of the Company shall include the objects expressed in the Memorandum of Association.

3.2 The Registered Office of the Company will be situated in the province of Sindh.

4. PRIVATE COMPANY

The Company is a private limited company and accordingly:

(a) the number of Shareholders of the Company shall (exclusive of persons in the employment of the Company), shall be limited to fifty, provided that for the purposes of this provision, where two or more persons hold one or more shares in the Company jointly, they shall be treated as a single member;

(b) no invitation shall be made to the public to subscribe for the shares or debentures of the Company;

(c) the right to transfer Shares of the Company is restricted in the manner and to the extent specified in these Articles and the Shareholders Agreement.

5. CHANGES TO THE MEMORANDUM AND ARTICLES OF ASSOCIATION

No Changes shall be made to the Memorandum and Articles of Association of the Company, except without the unanimous approval of all the Shareholders of the Company (including SE and Packages) in a duly convened General Meeting of the Company.

6. AUTHORISED CAPITAL

6.1 The Authorised Share Capital of the Company is the amount set out in Clause V of the Memorandum divided into the number of ordinary shares of PKR 10/- each as set out in the said clause with powers to the Company to increase, reduce, reorganize, consolidate or subdivide the share capital on such terms as the Shareholders may deem appropriate in the capital of various classes from time to time in accordance with the provisions of these Articles and the Ordinance.

6.2 Except as may be set out in these Articles, the holders of Shares of the Company are entitled to receive notice(s) of general meetings of the Company and to vote at such general meetings and shall have one vote for each share.

7. SHARES

7.1 **Issuance of Shares Controlled by the Board**

Subject to the provisions of the Ordinance and these Articles, the Shares of the Company shall be under the control of the Board. The Board shall, as regards any issuance or allotment of shares, duly comply with the provisions of these Articles and Sections 67 to 73 and Section 86 of the Ordinance as may be applicable.

7.2 **Parity of Initial Shares**

All shares issued pursuant to these Articles shall have a par value of PKR 10/- each per share and except to the extent stated in these Articles, shall rank pari passu in all respects, including voting rights, dividends, return on capital and otherwise.

7.3 **Further Issue of Shares**

The Board may, subject to the provisions of the Shareholders Agreement, these Articles and Section 86 of the Ordinance, allot or otherwise dispose of any shares of the Company to such persons, on such terms and conditions and at such times as the Board thinks fit, and at a premium or at par or at a discount (subject to the provisions of the Ordinance) and for such consideration as the Board thinks fit, PROVIDED THAT, where at any time the Board decides to increase the issued capital of the Company by issuing any further shares, such shares shall be offered to the existing Shareholders in proportion to the existing shares held by each Shareholder and such an offer shall be made by a notice specifying the number of shares to which the Shareholder is entitled, and limiting a time within which the offer, if not accepted, will be deemed to be declined, and on expiration of such time, or on receipt of information from the Shareholder to whom such notice is given that he declines to accept the shares offered, the Board may, subject to the provisions of Section 86(7) of the Ordinance, dispose of the same in such manner as it may consider most beneficial to the Company or decide not to allot such shares to any person.

7.4 **Issuance of Shares for consideration other than cash**

Subject to the provisions of the Ordinance, these Articles and any applicable laws, rules and regulations, the Board may allot and issue shares in the capital of the Company as payment for any property (tangible or intangible) sold or transferred, goods or machinery supplied, or for services rendered to the Company or expenses incurred on behalf of the Company or in conduct of its business or affairs and any shares which may be so allotted shall be issued as fully paid up shares.

8. SHARE CERTIFICATES

8.1 Certificates

The certificates of title to the shares shall be issued under the Seal of the Company and signed by two (2) directors (comprising of at least one (1) nominee director of Packages and one (1) nominee director of SE). Every certificate of Shares shall bear the following legend thereon, unless some other legend or notation is agreed by the Shareholders in the Shareholders Agreement:

"Any disposition, transfer, charge, sale, pledge, hypothecation, assignment of or dealing in any other manner in the Shares represented by this certificate is restricted by a Shareholders' Agreement dated September 17, 2012 and made between Packages Limited, Stora Enso South Asia Holdings AB and Bulleh Shah Packaging (Private) Limited. Copies of such agreement are available in the custody of the company."

8.2 Shareholders' Right to Certificates

Every Shareholder shall be entitled, within ninety (90) Days of the allotment of Shares, without payment, to one (1) certificate for all the shares registered in his name, or upon paying such fee as the Board may from time to time determine, to several certificates, each for one or more shares. Every certificate of shares shall specify and denote the number of shares in respect of which it is issued, and the amount paid thereof. In respect of a share or shares held jointly by several persons, the Company shall not be bound to issue more than one certificate and delivery of the share certificate to anyone of the joint holders shall be sufficient delivery to all.

8.3 Issue of Duplicate Certificates

If any certificate is worn-out, defaced or rendered useless, then upon production thereof to the Board, the Board may order the same to be cancelled and may issue a new certificate in lieu thereof, and if any certificate is lost or destroyed, then on proof to the satisfaction of the Board, and on such indemnity as the Board deems adequate being given, a new certificate in lieu thereof may be issued on such terms and fee as may be prescribed by the Board including payment of expenses incurred by the Company in investigating title.

9. TRANSFER OF SHARES

9.1 Lock-in Period

Except as provided in this Article 9 (*Transfer of Shares*), no Shareholder (including Packages and SE) shall without the prior permission of the other Shareholder, for a period of six (6) calendar years be entitled to transfer, or agree to undertake or transfer, directly or indirectly, any Shares or any right in or attaching to any of its Shares ("**Lock-in Period**").

9.2 Expiry of Lock-in Period

Except as allowed under these Articles, no Shareholder shall without the prior written consent of the other Shareholders, be entitled, following the expiry of the Lock-in Period, to transfer or agree to undertake to transfer, directly or indirectly, any Shares or any right in or attaching to any of its Shares.

9.3 Validity of Transfer

Any transfer or attempted transfer of shares by a Shareholder (either directly or indirectly) which is not in accordance with the requirements set out in these Articles, shall be void and of no force or effect and the Board shall not be required to register any such transfer or attempted transfer.

9.4 **Transfer to Affiliates and to a Nominee Director**

(a) A Shareholder may, at any time, transfer all (but not less than all) of its shares (**"Relevant Shares"**) to an Affiliate of that Shareholder and such Affiliate may at any time transfer all of the Relevant Shares back to the original Shareholder or to another Affiliate of the original Shareholder. The right of first refusal restriction as contained in Article 9.6 (*Right of First Refusal*) shall not apply to the transfer of any Relevant Shares pursuant to this Article 9.4(a). Likewise, a Shareholder may transfer one (1) share to its each of its nominee Directors for providing such nominee Director with the requisite share qualification in terms of Section 187 (h) of the Ordinance. The said right of first refusal restriction will not apply to such transfer of shares, or to further transfer of such shares back to the original Shareholder or to other new nominee Director.

(b) If the Relevant Shares have been transferred under Article 9.4(a) (whether directly or by a series of transfers) by a Shareholder (the **"Transferor"**, which expression shall not include a second or subsequent transferor in a series of transfers) to its Affiliate or nominee Director (the **"Transferee"**) and subsequently the Transferee ceases to be an Affiliate or nominee Director of the Transferor, then the Transferee shall forthwith transfer the Relevant Shares to the Transferor or at the Transferor's option to an Affiliate or a new nominee Director of the Transferor.

(c) Prior to transferring the Relevant Shares to a Transferee under this Article 9.4 (*Transfer to Affiliates and to a Nominee Director*), the Transferor shall provide to the Board and the Company such information as may be reasonably required by the Board for the purposes of ensuring that the proposed transfer of the Relevant Shares is in accordance with the requirements set out in this Article 9.4 (*Transfer to Affiliates and to a Nominee Director*). If the said information is not provided within twenty eight (28) days of the request made by the Company, the Board shall refuse to register the transfer of the Relevant Shares in the name of the Transferee.

9.5 **Right of First Refusal**

(a) Following the expiry of the Lock-in Period, if a Shareholder (**"Proposed Transferor"**) receives an offer from an identified third party (**"Third Party Offeror"**) (whether through a single transaction or a series of related transactions) to transfer the legal and / or beneficial title to all (but not some only) of its Shares to the Third Party Offeror (**"Pre-Emption Transfer"**), then prior to entering into a binding agreement in relation to the Pre-Emption Transfer, the Proposed Transferor must give notice in writing (**"Pre-Emption Notice"**) to the Company, as agent for and on behalf of the Shareholder(s) other than the Proposed Transferor (**"Other Shareholder(s)"**):

(i) stating that the Proposed Transferor wishes to transfer all (but not less than all) of its Shares (**"Pre-Emption Shares"**);

(ii) setting out the identity of the Third Party Offeror;

(iii) setting out the price per Pre-Emption Share (**"Pre-Emption Price"**) and any other key terms (**"Pre-Emption Terms"**) on which the Proposed Transferor proposes to transfer the Pre-Emption Shares to the Third Party Offeror; and

(iv) stating that the Proposed Transferor wishes to transfer the Pre-Emption Shares to the Third Party Offeror pursuant to the Pre-Emption Transfer.

(b) Within five (5) Business Days of the receipt by the Company of a Pre-Emption Notice, the Company shall send to the Other Shareholder(s), a copy of the Pre-Emption Notice. Within twenty (20) Business Days of the date of the Pre-Emption Notice or such other date and time as is agreed between the Proposed Transferor and the Other Shareholder(s) ("**Pre-Emption Right Closing Date**"), the Other Shareholder(s) may by notice in writing to the Company and the Proposed Transferor ("**Pre-Emption Right Exercise Notice**") exercise the right, to acquire all (but not less than all) of the Pre-Emption Shares at the Pre-Emption Price and on the Pre-Emption Terms. Once given, a Pre-Emption Right Exercise Notice shall be irrevocable and binding.

(c) If the Other Shareholder(s) fails to submit a Pre-Emption Right Exercise Notice by the Pre-Emption Right Closing Date for any reason whatsoever or has suffered an Insolvency Event (as defined in the Shareholders Agreement), the Other Shareholder(s) shall be deemed to have declined to take up its pre-emption rights pursuant to the Pre-Emption Notice and shall have no further rights under this Article 9 (*Transfer of Shares*) in relation to the Pre-Emption Shares.

(d) If the Other Shareholder(s) submits a Pre-Emption Right Exercise Notice on or before the Pre-Emption Right Closing Date, then within 5 Business Days of the Pre-Emption Right Closing Date, the Other Shareholder(s) shall give notice in writing to the Proposed Transferor, of a date, place and time ("**Pre-Emption Completion Date**") between 10 and 30 Business Days after the Pre-Emption Right Closing Date (or such other date, place and time as the Proposed Transferor and the Other Shareholder(s) may agree), on which the sale and purchase of the Pre-Emption Shares to the Other Shareholder(s) is to be completed.

(e) On or before the Pre-Emption Completion Date, (a) the Proposed Transferor shall transfer the legal and beneficial title to all (but not less than all) of the Pre-Emption Shares to the Other Shareholder(s) with full title guarantee and free from all Encumbrances by delivering the share certificates relating to the Pre-Emption Shares along with the duly executed transfer deed(s) in relation thereto and shall take all such actions and deliver all such documents as may be required under the Shareholders Agreement for the transfer of the Pre-Emption Shares; and (b) the Other Shareholder(s) shall make payment of the Pre-Emption Price to the Proposed Transferor.

(f) Upon completion of the abovementioned requirements and such other requirements as may be set out in the Shareholders Agreement, the Board shall authorise the registration and the Company shall register the transfer of the Pre-Emption Shares in favour of the Other Shareholder(s), subject to due stamping (if required).

(g) If, by the Pre-Emption Completion Date, the Other Shareholder(s) fails to pay (or procure payment of) the aggregate Pre-Emption Price in respect of the Pre-Emption Shares pursuant to Article 9.5(e) ("**Defaulting Other Shareholder(s)**"), the Proposed Transferor, shall without prejudice to any other rights which it may have against the Defaulting Other Shareholder(s) and subject to the tag-along rights as specified in Article 9.6 (*Tag Along Right*), be entitled to transfer the legal and beneficial title to such Pre-Emption Shares in accordance with Article 9.5(j), as if the Other Shareholder(s) had failed to submit a Pre-Emption Right Exercise Notice in relation to the Pre-Emption Shares and the Defaulting Other Shareholder(s) shall have no claim for damages or compensation (or otherwise) against the Proposed Transferor in respect of such Pre-Emption Shares.

(h) If, by the Pre-Emption Completion Date, the Proposed Transferor ("**Defaulting Proposed Transferor**") fails to comply with its obligation to transfer the Pre-Emption Shares to the Other Shareholder(s), the Defaulting Proposed Transferor hereby authorises any director of the Company to execute, complete and deliver as agent for the Defaulting Proposed Transferor the share certificates and the transfer deeds in respect of the Pre-Emption Shares and to further execute all other requisite documents on behalf of the Defaulting Proposed Transferor in terms of this Article and the Shareholders Agreement. Following the transfer of the Pre-Emption Shares, the Other Shareholder(s) shall make payment of the aggregate price in respect of the Pre-Emption Shares to the Defaulting Proposed Transferor and the Board shall authorise the registration and the Company shall register the transfer of the Pre-Emption Shares in favour of the Other Shareholder(s).

(i) With effect from the Pre-Emption Completion Date, to the extent legally permissible under the Ordinance, the Pre-Emption Shares shall automatically cease to confer the right to the Defaulting Proposed Transferor to receive notice of or to attend or vote at any general meeting of the Company or (subject to the Ordinance) at any meeting of the holders of any class of shares in the capital of the Company or for the purposes of a resolution of the Company and the Pre-Emption Shares shall not be counted in determining the total number of votes which may be cast at any such meeting or required for the purposes of a resolution or for the purposes of any other consent required under these Articles, till such time as the Pre-Emption Shares are transferred and registered in the name of the Other Shareholder(s).

(j) Subject to the Tag Along Rights as specified in Article 9.6 (*Tag Along Rights*), the Proposed Transferor may, within a period of six (6) months following the Pre-Emption Right Closing Date, transfer the legal and beneficial title to:

(i) those Pre-Emption Shares in respect of which no Pre-Emption Right Exercise Notices were received; and

(ii) those Pre-Emption Shares for which the Other Shareholder(s) shall be deemed to have declined to take-up (by issuance of Pre-Emption Right Exercises Notices) under Article 9.5(c).

to the Third Party Offeror (i) at a price per Share which is not less than the Pre-Emption Price and (ii) on terms no more favourable to the Third Party Offeror than the Pre-Emption Terms, without following the pre-emption procedure set out in this Article 9.5 (*Right of First Refusal*).

(k) Each Shareholder shall be responsible for ensuring that any transfer of shares under this Article 9.5 (*Right of First Refusal*) complies with all legal requirements including, without limitation, securities laws and regulations and is not subject to, or is exempt from, registration and similar requirements under applicable securities law.

(l) If the Other Shareholder(s) has submitted a Pre-Emption Right Exercise Notice but completion of the transfer of the Pre-Emption Shares to the Other Shareholder(s) cannot occur, by reason of a delay in the obtaining of any Government Authorisation for the completion of such transfer, then the Pre-Emption Completion Date shall be deemed to be deferred until the earlier of:

(i) three months following the original Pre-Emption Completion Date; and

(ii) ten (10) Business Days following the date that all of the required Government Authorisations are obtained for that transfer.

(the "**Extended Pre-Emption Completion Date**")

(m) If the required Government Authorisations are not obtained by the Extended Pre-Emption Completion Date, then the Proposed Transferor shall be released from its obligations to make the transfer set out in this Article 9.5 (*Right of First Refusal*), which resulted from the original Pre-Emption Right Exercise Notice, it being clarified that if the Pre-Emption Shares are not transferred to the Other Shareholder as a result of the Government Authorisations, then the Proposed Transferor shall not be authorised to transfer the Pre-Emption Shares to the Third Party Offeror.

(n) Any transfer of the Pre-Emption Shares which is not in accordance with the provisions of this Article 9.5 (*Right of First Refusal*) shall not be made or registered by the Board and the Company and shall be void and of no legal effect.

9.6 **Tag-Along Right**

(a) If the Proposed Transferor wishes to transfer all its Shares to the Third Party Offeror in accordance with Article 9.5(j) and has otherwise complied with the requirements of Article 9.5 (*Right of First Refusal*) in connection with such proposed transfer, before making the proposed transfer, the Proposed Transferor shall procure that the Third Party Offeror makes an offer ("**Tag Offer**") to the Other Shareholder(s) ("**Tag Shareholder**") to purchase all of the Shares held by the Tag Shareholder for a consideration in cash for each Share, at a price that is at least equal to the highest price per Share offered or paid by the Third Party Offeror, or any person acting in concert with the Third Party Offeror, in the proposed transfer or in any related previous transaction in the six months preceding the date of the proposed transfer ("**Specified Price**").

(b) The Tag Offer shall be given by written notice ("**Tag Notice**"), at least ten (10) Business Days before the proposed sale date ("**Tag Sale Date**"). To the extent not described in any accompanying documents, the Tag Notice shall set out:

(i) the identity of the Third Party Offeror;

(ii) the Specified Price and other terms and conditions of payment;

(iii) the Tag Sale Date; and

(iv) the number of Shares to be purchased by the Third Party Offeror (which shall not be less than all the Shares held by the Tag Shareholder).

(c) If the Third Party Offeror fails to make the Tag Offer to the Tag Shareholder in accordance with Article 9.6(a)and Article 9.6(b), the Proposed Transferor shall not be entitled to complete the proposed transfer and the Board and the Company shall not register any transfer of Shares effected in accordance with the proposed transfer.

(d) If the Tag Offer is accepted by the Tag Shareholders by no later than five (5) Business Days prior to the Tag Sale Date, the completion of the proposed transfer shall be conditions on the completion of the purchase of all the Shares held by the Proposed Transferor.

9.7 **Transfer upon Default of Shareholders Agreement or Deadlock Provisions**

Notwithstanding anything contained herein in respect of the transfer of shares, Packages and SE have entered into the Shareholders Agreement for the purposes of governing the transfer of shares in the event of any default or deadlock under the Shareholders Agreement. The provisions of the Shareholders Agreement with respect to the transfer of shares upon the occurrence of a deadlock or default under the Shareholders Agreement are incorporated in these Articles by reference and shall be binding on all Shareholders and the Company.

9.8 **Refusal to Transfer Shares**

(a) The Directors shall refuse to transfer any Shares of the Company if the provisions of these Articles are not complied with. The Directors shall also refuse to transfer any shares if the transfer deed is for any reason defective or invalid, provided that the Company shall, within thirty (30) days from the date on which the instrument of transfer was lodged with it, notify the transferor and transferee of the defect or invalidity, either of whom shall, after removal of such defect or invalidity, be entitled to re-lodge the transfer deed with the Company.

(b) If the Company refuses to register the transfer of any shares, the Company shall, within thirty (30) days after the instrument of transfer was lodged with it, send to the transferor and transferee notice of the refusal indicating the reason for such refusal.

10. ALTERATION OF CAPITAL

10.1 **Power to Increase Authorised Capital**

Subject to the provisions of Article 18 (*Reserved Matters*), the Company may from time to time by way of a resolution passed and approved by the Shareholders of the Company (in a duly convened General Meeting), increase its authorised share capital by such sum as the resolution shall prescribe, provided that the nominal value of the Shares remains to be PKR 10/- each.

10.2 **Condition of Creation of New Shares**

Any capital raised by the creation of new shares shall be considered part of the authorised capital and the new shares shall be subject to the provisions herein contained with reference to transfer, transmission, voting and otherwise.

10.3 **Shareholders Rights to New Shares**

(a) Subject to the provisions of Article 18 (*Reserved Matters*), any new shares shall, before issue, be offered to the Shareholders of the Company in proportion, to the amount of the existing shares to which they are entitled. The offer shall be made, following approval of the issuance of the new shares by the Board (subject to quorum requirements being met) by notice specifying the number of shares offered and limiting a time within which the offer, if not accepted, will be deemed to be declined, and after the expiration of that time, or on receipt of an intimation from the person to whom the offer is made, that it declines to accept the shares offered, the Directors shall, subject to Section 86(7) of the Ordinance and in accordance with the provisions contained in the Shareholders Agreement, dispose of the same in such manner as they think most beneficial to the Company, provided however, that the percentage of ownership of the issued share capital of the Company by Packages and SE remains as follows unless otherwise agreed between Packages and SE:

(i) Packages holding 65% of the issued and paid up capital of the Company; and

(ii) SE holding 35% of the issued and paid up capital of the Company.

10.4 **Power to Reduce Share Capital**

Subject to the provisions of Article 18 (*Reserved Matters*), the Company may by way of a resolution passed and approved by the Shareholders of the Company (in a duly convened General Meeting), reduce its share capital in any manner and with and subject to any incidental authorisation and consent required by law.

10.5 **Power to Cancel Shares**

Subject to the provisions appearing after clause (d) of sub-section 1 of Section 92 of the Ordinance and Article 18 (*Reserved Matters*), the Company may by way of a resolution passed by the Shareholders of the Company (in a duly convened General Meeting), alter the conditions of the Memorandum as to cancel any shares which at the date of passing of the resolution in that respect have not been taken or agreed to be taken by any person, and diminish the amount of its share capital by the amount of shares so cancelled.

11. GENERAL MEETINGS

11.1 **Holding of Annual General Meeting**

An Annual General Meeting of the Company shall be held in accordance with the provisions of Section 158 of the Ordinance once atleast in every calendar year within a period of four (4) months following the close of its financial year at such time and place as may be determined by the Board, provided that no greater interval than fifteen (15) months shall be allowed to elapse between two such General Meetings. All such General Meetings shall be called "Annual General Meetings" and all other General Meetings shall be called "Extraordinary General Meetings".

11.2 **Extraordinary General Meetings**

Subject to the provisions of Section 159 of the Ordinance and these Articles, the Directors may at any time call an Extraordinary General Meeting of the Company to consider any matters which require the approval of the Company in a General Meeting and shall, on the requisition of Shareholders representing not less than 100% of the voting power on the date of the deposit of the requisition less any voting power attached to the shares held by persons other than Packages and SE, forthwith proceed to call an Extraordinary General Meeting.

11.3 **Notice of Meetings**

Twenty one (21) days notice at the least (exclusive of the day on which the notice is served or deemed to be served, but inclusive of the day for which the notice is given) specifying the agenda, place, the day and the hour of meeting and, in case of special business, the general nature of that business, shall be given in the manner provided by Section 160 of the Ordinance for the General Meetings to such persons as are under the Ordinance or these Articles, entitled to receive such notices from the Company.

11.4 **Special Business**

All business shall be deemed special that is transacted at an Extraordinary General Meeting, and also business that is transacted at an Annual General Meeting with the exception of (i) declaring dividends; (ii) the consideration of accounts, balance sheet and reports of Directors and Auditors; (iii) the election and appointment of Directors; and (iv) the appointment, and the fixing of the remuneration of, the Auditors.

11.5 **Shorter Notice**

In the event of an emergency affecting the business of the Company, the Board may, in accordance with the provisions of Section 159(7) of the Ordinance, make application to the Registrar for a shorter notice period, and, if the Registrar authorises a shorter notice period, then an Extraordinary General Meeting may be convened upon such shorter notice as authorised by the Registrar. Notwithstanding the foregoing, where a Special Resolution is to be passed at an Extraordinary General Meeting, the Board may call such Extraordinary General Meeting by such less than twenty one (21) days notice as is acceptable to all the Shareholders.

11.6 **Omission to give Notice of General Meeting**

Except to the extent notice is not given in accordance with Article 9.5(i) (*Transfer of Shares*), the omission (either accidental or otherwise) to give notice to any Shareholder of the Company or the non-receipt of notice (either accidental or otherwise) by any Shareholder shall invalidate the proceedings at any such General Meeting called by such notice unless all the Shareholders attend such General Meeting.

11.7 **Waiver of Notice**

A Shareholder who does not timely receive notice of a General Meeting, but attends and participates in such General Meeting, shall be deemed to have waived timely receipt of such notice.

11.8 **Quorum and Decision at General Meetings**

(a) Subject to Article 11.10 (*Adjournment of Meeting for Lack of Quorum*), the quorum for any General Meeting of the Shareholders (be it the Annual General Meeting or an Extraordinary General Meeting) shall be at least two (2) Shareholders representing not less than one hundred percent (100%) voting power in the Company (less the voting power attached to the shares held by any persons other than Packages and SE), either of their own account or as proxies, including one (1) authorised representative or proxy representing each of Packages and SE.

(b) Any business (other than Reserved Matters which will be decided by unanimous approval in accordance with Article 11.8(c) and Article 18 (*Reserved Matters*)) to be transacted at any General Meeting shall be decided by a simple majority of the Shareholders' votes (present in person or by proxy) in its favour at a General Meeting properly convened and held.

(c) If a General Meeting has been convened for the purposes of considering and approving a Reserved Matter or if a decision on a matter which is a Reserved Matter is part of the agenda in any General Meeting, then any decision relating to the Reserved Matter will be approved with the unanimous approval of all Shareholders (including Packages and SE) who are present at a General Meeting of the Shareholders (either in person or by proxy).

(d) No action shall be taken by the Company which is required under the Ordinance or these Articles to be approved by the Shareholders of the Company, unless consent or approval for such action is given at a General Meeting of the Shareholders duly convened and held.

11.9 **Who is to preside at General Meetings**

The Chairman of the Board of Directors shall also be the Chairman of the General Meetings, but if there is no such Chairman, or and if at any meeting the Chairman is not present within fifteen (15) minutes after the time appointed for holding the Meeting or if the Chairman is not willing to take the Chair, the Shareholders present may choose one of the Directors to be the Chairman of the General Meeting, and if none of the Directors being present or, being present, is unwilling to act as the Chairman, the Shareholders present shall choose one of their number to be the Chairman, provided that the representatives or proxies of Packages and SE have both voted in favor of the resolution appointing the Chairman.

11.10 **Adjournment of Meeting for Lack of Quorum**

If within thirty (30) minutes after the time prescribed for a General Meeting a quorum is not present or ceases to exist, the meeting, if called upon the requisition of the Shareholders shall be dissolved, and in any other case, the meeting shall be adjourned to the same day in the next week at the same time and place and for that adjourned meeting the Shareholders present, being not less than two, shall form the quorum.

11.11 **Voting on Resolution by Show of Hands and When Poll Demanded**

At any General Meeting a resolution put to the vote of the General Meeting shall be decided by a show of hands, unless a poll is demanded (before or on the declaration of the results of the show of hands) on a unanimous basis by Shareholders present (subject to the quorum requirements being met) in person or by proxy or by the Chairman of the General Meeting and unless a poll is so demanded, a declaration by the Chairman that a resolution has been carried or lost and an entry to that effect in the books of the proceedings of the Company which is approved by the Shareholders, shall be conclusive evidence of the fact without further proof of the number or proportion of votes recorded in favour of or against such resolution. The demand for a poll may be withdrawn at any time by the person or persons who made the demand.

11.12 **Poll**

If a poll is demanded as aforesaid it shall be taken (subject to Section 168 of the Ordinance) in such manner and at such time and place as the Chairman of the General Meeting directs, and either at once or after an interval or adjournment of not more than fourteen (14) days from the day on which the poll is demanded and the result of the poll shall be deemed to be the resolution of the General Meeting at which the poll was held.

11.13 **Poll on Election of Chairman and Adjournment**

Any poll demanded on the election of a Chairman of a General Meeting or on any question of adjournment shall be taken at the General Meeting and without adjournment.

11.14 **Effect of Demand for Poll**

The demand for a poll shall not prevent the continuation of a General Meeting for the transaction of any business, other than the question on which the poll was demanded.

11.15 **Minutes**

Minutes shall be made in books provided by the Board pursuant to Section 173 of the Ordinance for the purposes of all resolutions and proceedings at the General Meetings, and any such Minutes if signed by the Chairman of the General Meeting or of the next following General Meeting and approved by the Shareholders shall constitute sufficient evidence on the facts therein stated without further proof.

11.16 **Inspection of Minute Books**

The books containing Minutes of proceedings of General Meeting of the Company shall be kept at the Registered Office and shall, during business hours (subject to reasonable restrictions as the Board may from time to time impose but so that not less than two (2) hours each day is allowed for inspection), be open to the inspection of any Shareholder.

12. VOTING

12.1 **Votes of Shareholders**

Except as to voting for the election of the Directors as provided in Section 178 of the Ordinance, every Shareholder entitled to vote may vote, either in person or by proxy, and upon a poll every Shareholder entitled to vote and present in person or by proxy shall have one (1) vote for every share conferring voting rights as aforesaid held by him.

12.2 **Voting by Joint Shareholders**

In case of joint holders, the vote of the senior who tenders a vote, whether in person or by proxy, shall be accepted to the exclusion of the votes of other joint holders, and for this purpose seniority shall be determined by the order in which their names stand in the Register.

12.3 **Representative of Corporate Shareholders**

A corporation, foundation or a company being a Shareholder may by a resolution of its directors authorise any of its officers or any other person to act as its authorised representative at any General Meeting and the person so authorised shall be entitled to exercise the same powers on behalf of the Shareholder which he represents as if he were an individual Shareholder.

12.4 **Poll by Proxy**

On a poll, votes may be given either personally or by proxy, provided that no corporate body shall vote by proxy as long as a resolution of its directors in accordance with the provisions contained in Article 12.3 (*Representative of Corporate Shareholder*) is in force.

12.5 **Proxy**

Every proxy shall be appointed in writing under the hand of the appointer or by an agent duly authorised under a power of attorney. A proxy holder need not be a Shareholder of the Company.

12.6 **Filing of Instrument of Proxy**

No person shall act as proxy unless the instrument of his appointment, duly executed, or other authority (if any) under which it is signed, or a notarially certified copy thereof, shall be deposited at the Registered Office of the Company at least 48 hours before the time appointed for holding the General Meeting at which the person named in the proxy proposes to vote.

12.7 **Instrument of Proxy**

An instrument of proxy shall be in the form specified in Regulation 39 of Table A in the First Schedule to the Ordinance, or in any other form as the Board may approve.

12.8 **Validity of Proxy**

A vote given in accordance with the terms of an instrument of proxy shall be valid notwithstanding the previous death of the principal or revocation (where permissible) of the proxy or of any power of attorney or the other authority under which such proxy was signed, provided that no intimation in writing of the death or revocation shall have been received at the Registered Office before the General Meeting or the adjourned General Meeting at which the proxy is used.

12.9 **Validity of the Vote**

No objection shall be made to the validity of any vote except at the General Meeting or at the poll at which such vote shall be tendered, and every vote whether given personally or by proxy not disallowed at such General Meeting or poll shall be deemed valid for all purposes of such General Meeting or poll.

12.10 **Chairman to Decide**

If any question is raised, the Chairman of the General Meeting shall decide the validity of every vote tendered at such General Meeting in accordance with the Ordinance and these Articles.

12.11 **Chairman not to have Casting Vote**

The Chairman shall not have a casting vote.

13. DIRECTORS

13.1 First Directors **As of the Adoption of these Articles**

As of the date of adoption of these Articles or as soon as practically possible thereafter, the Company shall have six (6) Directors consisting of four (4) Packages Nominee Directors and Two (2) SE Nominee Directors. These Directors will hold office upto the next election of Directors of the Company after adoption of these Articles.

(a) **Packages Nominee Directors**

(i) Syed Hyder Ali;
(ii) Syed Aslam Mehdi;
(iii) Khalid Yacob;
(iv) Khurram Raza Bakhtayari

(b) **SE Nominee Directors**

(i) Veli-Jussi Potka;
(ii) Martin Schotten;

13.2 **Appointment of Chairman**

(a) The Directors shall appoint a nominee Director of Packages as the Chairman of the Company. The Board may remove the Chairman at any time by unanimous vote (except the vote of the Chairman to be removed) and appoint a new Chairman and such Chairman shall be appointed from amongst the nominee Directors of Packages on the Board. The Chairman shall at all times be one of the six (6) Directors. The term of the Chairman shall be co-terminus with the tenure of the Board. A retiring Chairman shall be eligible for reappointment and shall preside over the General Meeting at which an election of Directors shall be held. Syed Hyder Ali shall be appointed by the Board as the Chairman as of the date of adoption of these Articles or as soon as practically possible thereafter. Syed Hyder Ali shall hold the office of the Chairman till the next election of Directors held after the adoption of these Articles or as soon as practically possible thereafter and shall be eligible for re-appointment after such election if elected as a Director.

(b) The Chairman shall preside over the meetings of the Board, but shall not have a casting vote. If the Chairman for the time being is unable to attend any meeting of the Board, a nominee Director of Packages shall be entitled to appoint another nominee Director of Packages to act as chairman of that meeting.

13.3 **Number of Directors**

(a) Subject to the provisions of Article 13.3(b), the total number of the Directors shall be six (6). The six (6) Directors on the Board shall be elected by the Shareholders (including Packages and SE) as follows:

(i) Packages shall have the right to nominate for election (and require removal after election) four (4) Directors; and

(ii) SE shall have the right to nominate for election (and require removal after election) two (2) Directors.

(b) If at any time:

(i) the shareholding of SE in the Company increases to fifty percent (50%) of the total issued and paid up capital of the Company, then at all following elections of Directors or during any existing term of the Board, as the case may be, the Shareholders (including Packages and SE) representation on the Board (which shall comprise of six (6) Directors) shall be as follows:

(A) Packages shall have the right to nominate for election (and require removal after election) three (3) Directors; and

(B) SE shall have the right to nominate for election (and require removal after election) three (3) Directors.

In order to comply with the provisions of Article 13.3(b)(i), Packages shall ensure that one of its nominated Directors tenders his resignation from the Board, in order for SE to appoint its nominee on the Board.

(ii) the shareholding of SE in the Company decreases below twenty percent (20%) of the total issued and paid up capital of the Company, then at all following elections of Directors or during any existing term of the Board, as the case may be, the Shareholders (including Packages and SE) representation on the Board (which shall comprise of six (6) Directors) shall be as follows:

(A) Packages shall have the right to nominate for election (and require removal after election) five (5) Directors; and

(B) SE shall have the right to nominate for election (and require removal after election) one (1) Director.

In order to comply with the provisions of Article 13.3(b)(ii), SE shall ensure that such number of its nominated Directors tender their resignation from the Board, in order for Packages to appoint its nominee(s) on the Board.

(c) The Board shall fix the number of Directors of the Company to be elected not later than thirty (35) days before convening the General Meeting at which the Directors are to be elected, and the number so fixed shall not be changed except with the prior approval of the Company in a General Meeting. It is clarified that in no event shall the number of Directors increase beyond or fall below six (6) until the same has been unanimously approved by the Shareholders in a General Meeting.

13.4 **Election of Directors**

(a) After the expiry of the term of office of the existing Directors of the Company as at the date of adoption of these Articles and at each subsequent election of Directors and subject to the provisions of Article 13.3 (*Number of Directors*), the number of Directors fixed by the Board (and such number shall not be less or more than six (6)) shall be elected by the Shareholders in a General Meeting, unless the number of the candidates is not more than the number of Directors to be elected, in the following manner, namely:

(i) a Shareholder shall have such number of votes as is equal to the product of the voting shares held by him and the number of Directors to be elected.

(ii) a Shareholder may give all his votes to a single candidate or divide them between more than one of the candidates in such manner as he may choose.

(iii) the candidate who gets the highest number of votes shall be declared elected as Director and then the candidate who gets the next highest number of votes shall be so declared, and so on until the total number of Directors to be elected has been so elected.

(b) No person, whether a retiring director or otherwise, shall be eligible for election as Director unless notice of his candidature for election has been lodged in writing at the Registered Office not less than fourteen (14) days before the date of the General Meeting at which the election of Directors is to take place.

(c) Where the number of candidates is equal to or less than the number of Directors to be elected, it will not be necessary to hold an election as laid down in Article 13.4(a) above and all candidates shall be deemed to have been elected under this Article.

(d) Notwithstanding anything contained in these Articles, it is hereby agreed that the Shareholders shall vote in the General Meeting in such a manner so as to ensure that the Directors to be elected on the Board are in accordance with the provisions contained in Article 13.3 (*Number of Directors*).

13.5 **Term of Office**

An elected Director shall hold office for a period of three (3) years, unless he resigns, or becomes disqualified from being a Director or otherwise ceases to hold office earlier under these Articles. An election of Directors in the manner prescribed by the preceding Articles shall be held once in every three (3) years. A retiring Director shall be eligible for re-election.

13.6 **Removal of Director**

The Company may by resolution in a General Meeting remove an elected Director in accordance with the provisions of Section 181 of the Ordinance.

13.7 **Continuing Directors to Act**

The continuing Directors may act notwithstanding any vacancy in the Board, but if the number falls below the minimum fixed, the Directors shall not, except for the purposes of filling a casual vacancy in their number or for convening a General Meeting, act so long as the number remains below the minimum.

13.8 **Filling of Casual Vacancy**

If any Director resigns or becomes disqualified or otherwise ceases to hold office for any reason whatsoever prior to the expiry of a three (3) year term, then the Board shall appoint any person to be a Director to fill such casual vacancy in the Board, provided that the casual vacancy shall be filled through appointment of a nominee of the same Shareholder whose nominee has created such vacancy as a consequence of ceasing to be a Director before the expiry of the three (3) years term for any reason whatsoever, as referred to above. Any Director so appointed shall hold office for the remainder of the term of the Director in whose place he is appointed.

The Shareholder whose nominee has resigned as a Director of the Company shall indemnify and keep indemnified the Company on demand against all losses, liabilities and costs which the Company may incur arising out of, or in connection with, any claim by such Director for wrongful or unfair dismissal or redundancy or other compensation arising out of such Director's resignation or loss of office.

13.9 **Remuneration**

Subject to any approval or limits required by law, the terms and conditions and remuneration of:

(a) a Director (including each alternate Director) for performing extra services, including holding office of the Chairman;

(b) the Chief Executive Officer; and

(c) any Director (including each alternate Director) for attending meetings of the Board or a Committee of the Directors;

shall be determined by the Board, provided that unless otherwise agreed by the Board, neither the nominee Directors of Packages nor the nominee Directors of SE shall be entitled to any remuneration in their capacity as Directors of the Company.

A Director may also be reimbursed all reasonable travelling, hotel and other expenses properly incurred by him/her in attending and returning from meetings of the Directors or any committee of the Directors or General Meetings of the Company or in connection with the discharge of their duties as Directors of the Company.

13.10 **General Management Powers**

(a) The Board shall be responsible for the overall direction, supervision and management of the Company. The Board may pay all expenses incurred in promoting and registering the Company, and may exercise all such powers of the Company as are not by the Ordinance or by these Articles or by a Special Resolution, required to be exercised by the Company in General Meetings, subject nevertheless to the provisions of the Ordinance or to any of these Articles, and such regulations (being not inconsistent with the aforesaid provisions) as may be prescribed by the Company in General Meeting but no regulations made by the Company in General Meeting shall invalidate any prior act of the Directors which would have been valid if such regulations had not been made.

(b) A resolution at a meeting of the Directors duly convened and held shall be necessary for exercising the powers of the Company specified in Section 196(2) of the Ordinance.

(c) The Board shall not take any decision in relation to any matter which is within the competency of the Shareholders under the Ordinance, other applicable laws and these Articles and regulations as referred to in Article 13.10 (a), unless and to the extent permitted by the Ordinance, other applicable laws and these Articles and the regulations referred to above and the relevant consent is given by all Shareholders at a General Meeting, properly convened and held.

13.11 **Power to Obtain Finances and Giving of Securities**

(a) For the purposes of the Company only, the Board may obtain finance or borrow moneys from third party financiers, including (without limitation) banks, development financial institutions, other financial institutions and / or the Shareholders and secure payment of such sum or sums of money in such manner and upon such terms and conditions as it may think fit and in particular by the creation of mortgages and / or charges on the property, assets (movable and immovable) and / or on book debts / receivables of the Company and by the issue of bonds, perpetual or redeemable Debentures or Redeemable Capital, or by mortgage or charge or other security on the whole or any part of the property, assets and rights of the Company (both present and future), and the undertaking of the Company, provided however, that the above power of the Board shall not entitle the Company to carry on the business of banking/finance/investment company;

(b) any bonds, Debentures, Redeemable Capital or other securities issued or to be issued by the Company shall be under the control of the Board which may issue them on such terms and conditions and in such manner and for such consideration as shall be considered by the Board to be for the benefit of the Company.

13.12 **Minute Books**

(a) The Board shall cause minutes to be made in the books provided for the purposes:

(i) of the names of Directors (including Alternate Directors) present in person, at each meeting of the Board or any Committee of the Directors;

(ii) of all resolutions and proceedings at all meetings of the Company and the Board, and of any Committees of the Directors; and

(iii) of appointment of officers made by the Directors.

(b) Any such minutes of any meeting of the Board or of a Committee of Directors or of the Company, if signed by the Chairman of such meeting or of the next succeeding meeting and approved by the Board or the Shareholders (as the case may be), shall be receivable as evidence of the matters stated in such minutes.

(c) Every Director (including an Alternate Director) present in person at any meeting of the Directors shall sign his name in a book to be kept for that purpose and a list of the Directors present in person shall be listed as such in that book by the Chairman of the meeting.

14. PROCEEDING OF DIRECTORS

14.1 **Meeting of Directors**

(a) The Directors of the Company may meet together for the dispatch of business, adjourn, and otherwise regulate meetings of the Board as they think fit.

(b) The Board shall at a minimum meet at least meet four (4) times annually at the Registered Office of the Company or at such other location as may be approved by the Board from time to time.

(c) A Director may, by written notice, summon a meeting of the Board. In respect of any meeting of the Board, at least fourteen (14) days notice will be given to all Directors, unless at least two (2) nominee Directors of Packages (or their alternates) and at least two (2) Directors nominee Directors of SE (or their alternates) approve a shorter notice period.

(d) Any notice shall include an agenda identifying in reasonable detail the matters to be discussed at the meeting and such notice shall be sent by registered air mail or telexed or emailed to any Director residing outside Pakistan. At least seven (7) days prior to the proposed meeting, copies of any relevant papers to be discussed at the meeting shall be given to each Director. Any Director (or its alternate) is entitled to add matters to the agenda to be discussed at a meeting by serving notice together with the list of the matters and copies of any relevant papers to each other Director not less than four (4) days prior to the meeting. If any matter is not identified in reasonable detail, the Board shall not decide on it, unless all Directors present at the meeting agree.

(e) A Director's attendance at a meeting shall constitute a waiver of notice of that meeting except when the Director attends a meeting for the express purpose of objecting, at the beginning of the meeting, to the transaction of any business because the meeting is not properly called or convened.

(f) The meeting of the Board may take place in person or by telephone conference call or video conference, if permitted under the applicable law. Subject to the Ordinance, all business transacted by the Directors by telephone conference or video conference for the purposes of the Articles shall be deemed to be validly and effectively transacted at a meeting of the Directors.

14.2 Quorum of **Directors' Meeting**

(a) A meeting of the Board, at which quorum is present, shall be competent to exercise all or any of the authorities, powers and discretion by or under these Articles or by or under any law vested in or exercisable by the Board generally. For the purposes of any Board meeting (other than an adjourned meeting), the quorum shall be no less than three (3) Directors, which Directors shall comprise of at least two (2) Packages nominee Directors and one (1) SE nominee Director.

(b) If a quorum is not present within thirty (30) minutes from the time when the meeting should have begun or if during the meeting there is no longer a quorum, the meeting shall be adjourned for seven (7) Business Days and at that first adjourned meeting at least three (3) Directors, which Directors shall comprise of at least two (2) Packages nominee Directors and one (1) SE nominee Director (or their alternates) present shall be a quorum. If quorum for the first adjourned meeting is not present within thirty (30) minutes from the time when the meeting should have begun or if during the meeting there is no longer quorum present, the meeting shall be adjourned for another three (3) Business Days, provided however, that the quorum requirements specified in Article 14.2(c) shall apply in respect of such second adjourned meeting.

(c) At the second adjourned meeting at least two (2) Packages nominee Directors (or their alternates) and one (1) SE nominee Director (or his alternate) present shall form a quorum. If that quorum is not present within thirty (30) minutes from the time when the meeting should have begun or if during the meeting there is no longer a quorum, the meeting shall be adjourned for four (4) hours.

(d) At the third adjourned meeting the Director(s) (or their alternates) present shall be a quorum.

(e) A Director shall be regarded as present for the purposes of quorum if represented by an alternate Director in accordance with Article 15 (*Alternate Directors*).

14.3 **Who to preside at Directors' Meetings**

The Chairman of the Board of Directors shall preside at Directors' meetings.

14.4 **Approval of Actions by Directors**

(a) No resolution (other than resolutions relating to Reserved Matters which will be decided by unanimous approval in accordance with Article 14.4(b) and Article 18 (*Reserved Matters*)) will be passed and no action will be taken at a Board meeting, unless a majority of the Directors vote in favour of such resolution.

(b) If a Board meeting has been convened for the purposes of considering and approving a Reserved Matter or if a decision on a matter which is a Reserved Matter is part of the agenda in any General Meeting or tabled before the Directors for approval, then any decision relating to the Reserved Matter will be taken by the unanimous approval of all the Directors present at a Board meeting properly convened and held.

The approval of a resolution in accordance with the provisions of this Article 14.4 (*Approval of Actions by Directors*) by the Directors at a meeting of the Board at which quorum is present, by telephone conference call or by video device shall be sufficient for constituting such action as the decision of the Board. It is clarified that for purposes of deciding the matters specified in Section 196(2) of the Ordinance, a duly convened physical meeting of the Board at which quorum is present will be required.

14.5 **When acts of Meetings of the Board or a Committee Valid – Defective Appointment**

All acts done by any meeting of the Board or of a Committee of the Directors, or by any person acting as Director or alternate Director shall, notwithstanding that it be afterwards discovered that there was some defect in the appointment of any such Directors or persons acting as aforesaid, or that they or any of them were disqualified, be as valid as if every such Director or person had been duly appointed and was qualified to act, provided that as soon as any such defect has come to notice, the Director or other person concerned shall not exercise the right of his office till the defect has been rectified.

14.6 **Resolution by Circulation**

Except for resolutions relating to matters contained in Section 196(2) of the Ordinance, a resolution which is circulated together with the necessary papers, if any, to all Directors and signed by all the Directors entitled to vote thereon shall be as valid and effectual as if it has been passed at a meeting of the Directors duly convened and held. Transmission of documents and signature of resolutions by facsimile or other electronic transmission shall be effective for the purpose of circulating and executing documents and resolution. A resolution may consist of several documents in the like form each signed by one or more Directors. A resolution signed by an Alternate Director need not also be signed by his appointer and, if it is signed by a Director who has appointed an Alternate Director, it need not be signed by the Alternate Director in that capacity.

15. ALTERNATE DIRECTORS

Subject to the approval by the Board, any Director not permanently resident in Pakistan or any Director so resident but intending to be absent from Pakistan for a period of not less than three (3) months may appoint any person acceptable to the Board to be an alternate Director of the Company to act for him. Every such appointment shall be made by notice to the Board in writing under the hand of the Director making the appointment (with a copy to the Shareholders). An alternate Director so appointed shall not be entitled to appoint another Director, but shall otherwise be subject to the provisions of the Articles with regard to the Directors. An alternate Director shall be entitled to receive notice of all meetings of the Board, and to attend and vote as a Director at any such meeting at which the Director appointing him is not personally present, and generally to perform all the functions of his appointer as a Director in the absence of such appointer, including approving and signing Board resolutions by circulation under Article 14.6 (*Resolution by Circulation*). An alternate Director shall *ipso facto* cease to be an alternate Director if his appointer for any reason ceases to be a Director or if and when his appointer returns to Pakistan or if the appointee is removed from office by notice in writing under the hand of the appointer.

16. COMMITTEES OF DIRECTORS

Subject to Section 196(2) of the Ordinance, the Board may from time to time delegate all or any of its powers to a committee or committees, as it thinks fit. Any committee so formed shall conform to any regulations that may be imposed upon it by the Board and shall have such quorum as prescribed by the Board.

17. CHIEF EXECUTIVE

17.1 Appointment of Chief Executive

(a) Subject to Article 18 (*Reserved Matters*), the Board shall appoint, from amongst the Directors, the Chief Executive for a term as is determined by the Board, and at such remuneration as is determined in accordance with Article 17.1(b), and his appointment shall be subject to determination *ipso facto* in accordance with Article 17.2 (*Removal of Chief Executive*) or if he ceases from any cause to be a Director. It is clarified that the Chief Executive of the Company shall at all times be appointed from amongst the existing Directors of the Company.

(b) The remuneration of a Chief Executive shall from time to time be fixed by the Directors and may be by way of fixed salary, or commission or dividends, profits on turnover of the Company or of any other company which is a Company is interested, or by participation in any such profits, or by any, or all these modes.

17.2 Removal of Chief Executive

The Board may, by resolution passed on a unanimous basis (subject to quorum being met) or the Company may by unanimous approval of all Shareholders in a General Meeting remove a Chief Executive before the expiration of his term of office notwithstanding anything contained in these Articles or in any agreement between the Company and the Chief Executive.

17.3 Filling Vacancy in Position of Chief Executive

In case of a vacancy in the office of the Chief Executive, the Board may select another Director to be Chief Executive, provided that the term of such replacement shall not be for longer than the remaining term of the Chief Executive being replaced.

17.4 Power of the Chief Executive and Management Committee of Directors

Except for matters stated in Section 196(2) of the Ordinance, the Board may delegate to the Chief Executive such of its powers, authorities and discretion as are necessary for and consistent with the effective management of the Company, and as are not required to be exercised by the Directors at their meetings, upon such terms and conditions and with such restrictions as they may think fit, and either collaterally with or to the exclusion of their own powers, and, may from time to time, render, withdraw, alter or vary any such powers.

18. RESERVED MATTERS

18.1 Notwithstanding anything contained in these Articles and unless otherwise agreed between Packages and SE, the following matters, whether required to be approved or decided by the Board or the Shareholders under the Ordinance, shall constitute "Reserved Matters" and will require: (i) in case the matter is required to be approved by the Board, the unanimous approval of all the Directors of the Company present in a meeting of the Board duly convened and held; and (ii) in case the matter is required to be approved by the Shareholders, the unanimous approval of all the Shareholders (including SE and Packages) present at a General Meeting (either in person or proxy) duly convened and held:

(a) any change in these Articles or any change in the capital structure of the Company or the issue of further Shares or the creation of any options to subscribe for or acquire Shares or purchase by the Company of its own shares or reduction of the share capital, other than as expressly contemplated in business plan or investment plan that has been approved by the Directors and/or Shareholders in accordance with the Shareholders Agreement;

(b) any prepayment of any Shareholders Loans, other than prepayment of all outstanding First Ranking Shareholder Loans as described in the Shareholders Agreement (or, if there are no such loans, of all the other outstanding Shareholder Loans) on a *pari passu* basis;

(c) any debt-to-equity swap arrangements, other than as expressly contemplated in a business plan or investment plan that has been approved by the Directors and/or Shareholders with respect to the Company in accordance with the Shareholders Agreement;

(d) any changes or alteration of the name of the Company;

(e) the issue by the Company (other than liens arising in the ordinary course of business) of any debenture or loan stock (whether secured or unsecured) or the creation of any mortgage, charge, lien, encumbrance or other third party right over any of the Company's material assets or the giving by the Company of any guarantee or indemnity to or becoming surety for any third party, other than as expressly contemplated in a business plan, annual budget or investment plan that has been approved by the Directors and/or Shareholders in accordance with the Shareholders Agreement;

(f) any arrangement for any joint venture or partnership or for the acquisition of the whole or substantially the whole of the assets and undertaking of the Company or an acquisition by the Company of any part of the issued share capital or of the assets and undertaking of another company, other than as expressly contemplated in a business plan, annual budget or investment plan that has been approved by the Directors and/or Shareholders in accordance with the Shareholders Agreement;

(g) approval or amendment of the business plan, annual budget or investment plan that has been approved by the Directors and/or Shareholders;

(h) any change in the nature of the business of the Company;

(i) a merger, acquisition, spin-off or other corporate reorganisation of the Company;

(j) the making of any loan by the Company or the creation, renewal or extension of any borrowings by the Company, other than as expressly contemplated in a business plan, annual budget or investment plan that has been approved by the Directors and/or Shareholders in accordance with the Shareholders' Agreement;

(k) the acquisition or construction or lease of items of tangible or intangible property (other than real estate) or the entering into the occupation, purchase, sale, transfer, acquisition, lease or licence of any freehold or leasehold real estate, other than as expressly contemplated in a business plan, annual budget or investment plan that has been approved by the Directors and/or Shareholders in accordance with the Shareholders Agreement;

(l) any transaction by the Company with any Shareholder or Affiliate of the Shareholder or any associated company of the Shareholder, other than in the ordinary course of business and on an arm's length basis;

(m) any transaction by the Company, either alone or jointly with, through (which includes by ownership of any shares, direct or indirect control) or on behalf of (whether as director, partner, consultant, manager, employee, agent or otherwise) any person, directly or indirectly, to carry on or be engaged or concerned or interested in any business which is in competition with the business activities of any Shareholder (including SE and Packages) as carried on at any time;

(n) any obligation of the Company outside the normal course of trading, other than as expressly contemplated in a business plan, annual budget or investment plan that has been approved by the Directors and/or Shareholders in accordance with the Shareholders Agreement;

(o) the assignment, sale or other disposal of any undertaking, asset or related group of assets of the Company, other than in the ordinary course of trading or of obsolete or redundant assets (and verified as such by the Auditors);

(p) any change in the accounting policies or Auditors of the Company, accounting reference date or the company secretary;

(q) the establishment of any retirement benefit scheme in relation to the Company's employees, or the making of any contribution to any third party scheme for the provision of retirement benefits;

(r) the granting or entering into any licence, agreement or arrangement concerning any part of the name of the Company or any of its intellectual property rights or those of the Shareholders;

(s) the making of any investment (whether through debt or equity), or the liquidation or disposition of any investment made by the Company, in any other person or business, other than as expressly contemplated in a business plan, annual budget or investment plan that has been approved by the Directors and/or Shareholders in accordance with the Shareholders Agreement;

(t) the making, granting or allowing of any claim, disclaimer, surrender, election or consent for taxation purposes;

(u) the appointment of any committee of the Board or delegating any of the powers of the Board to any committee;

(v) establishing any bonus, profit sharing, share option or other incentive scheme for any director or employee of the Company;

(w) the conversion of the form of the Company into anything other than a private company limited by shares or, a change in the jurisdiction of the seat of the Company;

(x) any application for the listing of any shares or other securities of the Company on any stock exchange or for permission for dealings in any shares or other securities of the Company in any securities market;

(y) any resolution for winding up of the Company or taking of any analogous proceedings;

(z) appointment of, or removal before the expiration of his/her term of office of, the Chief Executive, Chief Financial Officer, Head of Treasury, Head of Packaging Business Unit and Head of Paper and Board Business Unit;

(aa) application for the appointment of a receiver or an administrator over assets of the Company;

(bb) incurring any capital expenditure (in any one transaction or series of transactions) , other than as expressly contemplated in a business plan, annual budget or investment plan that has been approved by the Directors and/or Shareholders in accordance with the Shareholders Agreement;

(cc) the commencing or settling by the Company of any litigation, arbitration or other dispute or the admission of fault or liability with respect thereto which has or is reasonably likely to have a material adverse affect on the business or reputation of the Company;

(dd) the entering into or early termination of any material contract with a supplier or customer of the Company and / or the business of the Company;

(ee) any matters connected with the Company's compliance with Stora Enso Oyj's sustainability policy; and

(ff) entering into an agreement that may result in, or for the purpose of, any of the foregoing.

Except for the Reserved Matters stated above, if any matter is required to be approved by the Shareholders by way of a Special Resolution, then such matter shall only be approved once the same has been approved by way of a Special Resolution passed by the Shareholders at a duly convened General Meeting. It is clarified that in respect of Reserved Matters, all such matters (even if the same do not require unanimous approval under the Ordinance) shall be approved by the unanimous approval of the Board and/or the Shareholders, as the case may be.

18.2 It is clarified that the Reserved Matters shall be applicable till such time as the shareholding of SE in the Company is twenty percent (20%) of the issued and paid up share capital of the Company. In the event, the shareholding of SE falls below twenty percent (20%) of the issued and paid up share capital of the Company, the Reserved Matters shall no longer be applicable and all decisions whether to be taken at a meeting of the Board or at a General Meeting shall be decided in accordance with the requirements of the Ordinance.

19. DISQUALIFICATION OF DIRECTORS

19.1 **Automatic Vacation of Office of Directors**

The office of a Director shall *ipso facto* be vacated if:

(a) he becomes ineligible to be appointed a Director on anyone or more of the grounds enumerated as follows, that is to say, he:

(i) is a minor;

(ii) is of unsound mind;

(iii) has applied to be adjudicated as an insolvent and his application is pending;

(iv) is an undercharged insolvent;

(v) has been convicted by a Court of Law for an offence involving moral turpitude;

(vi) has been debarred from holding such office under any provision of the Ordinance;

(vii) has betrayed lack of fiduciary behavior and declaration to this effect has been made by the court under Section 217 of the Ordinance at any time during the preceding five (5) years;

(viii) is not a Shareholder, provided that this Article 19.1(a) (viii) shall not apply in case of:

(A) a person representing the Government of Pakistan or an institution (including a multinational company, such as SE) or authority which is a Shareholder;

(B) a whole time Director who is an employee of the Company;

(C) the Chief Executive;

(D) a person representing a creditor.

(ix) is a defaulter in repayment of loan amounts of PKR 1,000,000/- or more as adjudicated by a court or tribunal of competent jurisdiction, provided that this shall not apply to a person representing the Government, a bank or a financial institution;

(x) he absents himself from three consecutive meetings of the Directors or from all the meetings of the Directors for a continuous period of three (3) months, whichever is longer, without leave of absence from the Directors.;

(xi) he or any firm of which he is a partner or any private company of which he is a director without the sanction of the Company in General Meeting accepts or holds any office of profit under the Company other than that of chief executive or a legal or technical advisor or a banker; or

(xii) accepts a loan or guarantee from the Company in contravention of Section 195 of the Ordinance (if applicable in terms of this Section.

(b) he resigns his office by notice in writing to the Company;

(c) being a nominee Director of Packages on the Board, his nomination is withdrawn by Packages;

(d) being an employee or Director of Packages or of an Affiliate of Packages, he ceases to be the employee or Director of Packages, or its Affiliate;

(e) being a nominee Director of SE on the Board, his nomination is withdrawn by SE; and

(f) being an employee or Director of SE or an Affiliate of SE, he ceases to be the employee or Director of SE or of its Affiliate.

The appointment of an alternate Director will constitute leave of absence from the Board of Directors for whom such alternate is appointed during such Director's absence.

19.2 **Interest of Directors**

Subject to the provisions of Section 196(2)(g), Section 214, Section 216 and Section 219 of the Ordinance, the Directors shall not be disqualified from contracting with the Company as vendor, purchaser or otherwise, but in respect of any such contract or arrangement entered into by or on behalf of the Company with any company or partnership of or in which any director shall be a director or Shareholder or interested, the nature of his interest must be disclosed by him at the meeting of the Directors at which the contract or arrangement is determined, if the interest then exists, or in any other case at the meeting of the Directors after the acquisition of the interest. No Director shall vote as a Director in respect of any contract or arrangement in which he is so interested as aforesaid, and if he does so vote, his vote shall not be counted but he shall be entitled to be present at the meeting during the transaction of the business in relation to which he is precluded from voting, although he shall not be reckoned for the purpose of ascertaining whether there is a quorum of Directors present. These provisions shall not apply to any contract by or on behalf of the Company to give to Directors or any one of them any security for advances or by way of indemnity against any loss which they or any of them may suffer by reason of becoming or being sureties for the Company. A general notice that any Director is a shareholder of any specified company or is a partner of any specified firm and is to be regarded as interested in any subsequent transaction with such firm or company shall be given for purposes of disclosure under this Article, and any such general notice shall expire at the end of the financial year in which it was given but it may be renewed for a further period of one financial year by giving fresh notice in the last month of the financial year in which it would otherwise expire. A register shall be kept by the Directors in which shall be entered particulars of all contracts or arrangements to which this Article applies.

20. CONFLICT OF INTEREST

20.1 Each Shareholder hereby agrees that where it becomes aware that its interests (or those of an Affiliate of such Shareholder) in relation to any matter conflict or are reasonably likely to conflict with the interests of the Company in any material respect, each such Shareholder shall immediately give notice to the Company, the Board and the other Shareholder or such conflict or potential conflict.

20.2 All matters, agreements and transactions of the Company which are with a Shareholder or its Affiliates or other related parties will only be entered into by the Company with the unanimous approval of the Shareholders in a General Meeting.

20.3 If a Shareholder (an "**Interested Shareholder**") or its Affiliates or related parties is a party or proposed party to any agreement or proposed agreement to be entered into by the Company, other than those non-material transactions carried out in the ordinary course of business and on an arm's-length basis, all matters relating to such transaction, including the exercise of rights and / or compliance with its obligations by the Company, shall be dealt with by the other Shareholder(s) (or if the other Shareholder(s) so direct, the Company) and, accordingly, the Interested Shareholder (and / or any nominee Director of such Shareholder) shall in relation to such matters, be bound by and subject to the following conflict restrictions principals which are to apply only to the specific circumstances and matters and to the relevant Shareholder (and / or nominee Directors of such Shareholder), unless the other Shareholder(s) otherwise agrees in writing:

(a) exclusion from all decisions directly relating to such circumstance or matter;

(b) complete disentitlement and disenfranchisement from exercising any consent or any votes on any resolutions proposed directly in connection with such circumstance or matter; and

(c) disentitlement and disenfranchisement from:

(i) receiving or being provided with information from or by the Company directly in connection with such circumstance or matter; and / or

(ii) attending, speaking at and / or receiving any notice of any part of any Board meeting at which such circumstance or matter is to be considered (and, to such extent, the requirements as to quorum as specified in these Articles shall be amended so that a quorum may be present notwithstanding the relevant Director may not be in attendance or notified thereof).

21. OFFICIAL SEAL

The Board shall provide a Seal for the purposes of the Company and shall provide for the safe custody of the Seal. The Seal shall never be used except by the authority of the Board, and at least two (2) Directors (one being a nominee of Packages and one being a nominee of SE) shall sign every instrument to which the Seal is affixed, provided, nevertheless, that any instrument bearing the Seal of the Company and issued for valuable consideration shall be binding on the Company notwithstanding any irregularity.

22. DIVIDENDS AND RESERVES

22.1 Declaration of Dividends and Restrictions on Amount Thereof

The Company in General Meetings may declare dividends, but no dividend shall exceed the amount recommended by the Board.

22.2 Interim Dividends

The Board may from time to time pay to the Shareholders such interim dividends as appear to be justified by the profits of the Company.

22.3 Distribution of Dividends

The profits undistributed as dividends shall be declared and paid according to the amounts paid on the shares and the number of shares themselves.

22.4 Form of Payment

Any payment may be made by cheque sent through the post to the registered address of the Shareholder or person entitled thereto, or in case of joint holders to any one of such joint holders at his registered address, or to such person and at such address as the Shareholder or the person entitled or such joint holders, as the case may be, may direct. Every such cheque shall be made payable to the order of the person to whom it is sent, or to the order of such other person as the Shareholder or person entitled or such joint holders, as the case may be, may direct.

In case of payment of dividend to any non-resident Shareholder, such dividend shall be remitted from the account of the Company to the designated account of such non-resident Shareholder in accordance with applicable law.

22.5 Power of Board to create Reserve

The Board before recommending any dividend, may set aside out of the profits of the Company such sum as they think proper as a reserve or reserves, which shall, at the discretion of the Board, be applicable for meeting debt obligations or contingencies, or for equalizing dividends, or for any other purpose to which the profits of the Company may properly be applied, and pending such application may, in the like discretion, either be employed in the business of the Company or be invested in such investments (other than the shares of the Company), as the Board may from time to time think fit.

22.6 **Receipt for Dividends by Joint Holders**

If several persons are registered as joint holders of any share, any one of them may give effectual receipts for any dividends payable on the shares.

22.7 **No interest on Dividends**

No dividend shall bear interest or mark-up against the Company. The dividend shall be paid within the period laid down in the Ordinance.

22.8 **Carrying forward of Profits**

The Directors may carry forward any profits which they may think prudent non to distribute, without setting them aside as a reserve.

22.9 **Unclaimed Dividends**

Unclaimed dividends may be invested or otherwise used by the Board for the benefit of the Company until claimed.

23. CAPITALISATION

Any General Meeting may, upon recommendation of the Board, by unanimous approval of the Shareholders present in such General Meeting (either in person or proxy), resolve that any undistributed profits of the Company (including profits carried and standing to the credit of any reserves or other special accounts or representing premiums received on the issue of shares and standing to the credit of the share premium account and capital reserves arising from realized or unrealized appreciation of the assets or goodwill of the Company or from any acquisition / sale of interests in other undertakings) be capitalised. Such capitalised undistributed profits and reserves shall be distributed amongst such of the Shareholders as would be entitled to receive the same if distributed by way of dividend, and in the same proportions, on the footing that they become entitled thereto as capital. All or any part of such capitalised fund may be applied on behalf of such Shareholders for payment in full or in part either at par or at such premium as the resolution may provide, for any unissued shares or debentures of the Company which shall be distributed accordingly and such distributions or payment shall be accepted by such Shareholders in full satisfaction of their interest in the said capitalised sum.

24. ACCOUNTS

24.1 **Books of Accounts to be Kept**

The Board shall cause to be kept proper books of accounts and to be maintained detailed, complete, accurate and itemized accounts of the Company in accordance with the generally accepted accounting principles in Pakistan and, to the extent possible, in accordance with the International Financial Reporting Standards and the procedures of the International Accounting Standards Board.

24.2 **Where to be Kept**

The books of accounts shall be kept at the Registered Office or at such other place as the Board thinks fit and shall be open to inspection by the Directors during business hours.

24.3 **Inspection by Shareholders**

Each Shareholder will have the right, exercisable by providing at least seven (7) days prior written notice to the Company, at all reasonable times during the Company's normal business hours and at the sole expense of that Shareholder and with the assistance of the Shareholder's employees, consultants and / or representatives, to examine all or any portion of the Company's books and accounts including, without limitation the generality of the foregoing, all records, invoices, and the contracts and agreements of the Company.

24.4 **Profit and Loss Account and Balance Sheet**

Once at least in every year, the Directors shall cause to be prepared and laid before the Company in a General Meeting a Balance Sheet and Profit and Loss Account, both made up in accordance with the Ordinance and to a date not more than three (3) months before the date of the General Meeting. Every such balance sheet shall be accompanied by an Auditor's Certificate and the Directors report in accordance with the provisions of the Ordinance in that respect.

24.5 **Copies of Directors' Report and Balance Sheet to be sent to Shareholders**

A copy of the report of the Directors and of the Balance Sheet (including a report of the Auditors and every document required by law to be annexed thereto), and of the Profit and Loss Account shall be sent to all Shareholders along with the notice convening the General Meeting before which the same are required to be laid at least twenty one (21) days preceding the General Meeting.

24.6 **Compliance with Ordinance**

The Directors shall in all respects comply with the provisions of Section 230 to Section 247 of the Ordinance, as applicable, in relation to the accounts of the Company.

25. AUDIT

25.1 **Appointment of Auditors and their Duties**

Auditors shall be appointed and their duties regulated in accordance with Section 252 and Section 260 of the Ordinance. The auditors shall have access to all books of accounts, records, invoices, cheques, vouchers, papers and documents relating to the business of the Company.

It is clarified that the Auditors of the Company shall only be appointed from amongst the PricewaterhouseCoopers, Deloitte Touch Tohmatsu, Ernst & Young or KPMG (or their affiliate firms in Pakistan).

25.2 **Unaudited Accounts**

(a) The Company shall prepare and provide to all the Shareholders:

(i) as soon as they are available, but in no event later than fifteen (15) Business Days of the end of each calendar month, financial statements and unaudited management accounts of the Company made upto and as at the end of the calendar month containing such information as the Shareholders may agree from time to time;

(ii) as soon as it is available, but in any event within thirty (30) Business Days after the end of each calendar quarter, a report from the Board on the financial position and affairs of the Company and unaudited financial statements in respect of such calendar quarter;

(iii) as soon as they are available, but in any event within eight (8) weeks from the end of the financial year to which they relate, draft annual accounts of the Company in a form substantially approved by the Auditors.

(b) In addition to the above, the Company shall provide to all the Shareholders:

(i) as soon they are available, full details of any actual or prospective material change in the business or the financial position or affairs of the Company;

(ii) as soon as they are available, details of any matters which might have a material adverse impact on the business or the financial position or affairs of the Company, including material litigation affecting the business;

(iii) promptly, any information relating to the financial position and affairs of the Company as the Shareholders may from time to time reasonably require.

25.3 **Bank Account and Use of Funds**

The Company shall keep its funds in one or more bank accounts, in the sole name of the Company, with banks approved by the Board. Such funds shall be used in connection with the business of the Company (in accordance with the Shareholders Agreement) or as may be otherwise provided in the Memorandum.

26. NOTICES

26.1 **How Notices to be Served**

A notice may be given by the Company to any Shareholder or Director either personally or by sending it to them by mail, prepaid postage, electronic message or by facsimile, at their registered address, or if they have no registered address in Pakistan, to the address supplied to the Company for the giving of notices to them. Notwithstanding the foregoing, notices to Shareholders and Directors that are located outside Pakistan shall be sent by facsimile and electronic message.

26.2 **Personal Delivery of Notice**

Where a notice is delivered personally, the recipient shall sign a receipt in such form as the Board shall determine.

26.3 **Service by Post**

Where a notice is sent by post, service of the notice shall be deemed to be made by properly addressing pre-paying and posting a letter containing the notice and unless the contrary is proved, to have been effected at the time at which the letter would be delivered in the ordinary course of post.

26.4 **Notice of Joint Holders**

A notice may be given by the Company to the joint holders of a share by giving the notice to the joint holder named first in the register in respect of the share.

26.5 **Notice of General Meetings**

Subject to the requirements of these Articles, notice of every General Meeting shall be given in the same manner herein authorised to (a) every Shareholder, and also to (b) every person entitled to a share in consequence of the death or insolvency of Shareholder, who but for his death or insolvency would be entitled to receive notice of the General Meeting; and (c) to the Auditors of the Company for the time being.

27. SECRECY

27.1 Secrecy

Every Director, Chairman, Chief Executive, Auditor, Trustee, Shareholder, officer, servant, agent, accountant or other person employed in the business of the Company shall, if so required by the Board before entering upon his duties, sign a declaration in the form approved by the Board pledging himself to observe strict secrecy representing the business and affairs of the Company and all transactions of the Company with the customers and state of the accounts with individuals and in matters relating thereto, and shall by declaration pledge himself not to reveal any of the matters which may come to his knowledge in the discharge of his duties except when required so to do by the Board, or by any General Meeting, or by a court of law or by competent authority, and except so far as may be necessary in order to comply with any provisions in these Articles.

27.2 Restriction on Inspection of Books of Account of Company or on entering into the property of the Company

No person other than Shareholders or Directors or the person authorised by the Company shall be entitled to enter the property of the Company, or inspect any account or books of accounts or document of the Company or properties of the Company, without permission of the Board and to require disclosure of any information relating to the Company's trading, or any matter which is or may be in the nature of a trade secret, mystery of trade, or secret to the conduct of the business of the Company and which in the opinion of the Board will be expedient in the interest of the Company not to communicate.

28. DISTRIBUTION OF ASSETS ON WINDING UP

28.1 If the Company shall be wound up (whether voluntarily or otherwise), the Liquidator may, with the unanimous approval of the Shareholders present in a General Meeting (in person or proxy) and any other sanction required by the Ordinance, divide amongst the Shareholders in specie or kind, the whole or any part of the assets of the Company, whether they consist or property of the same kind or not.

28.2 For the purpose of aforesaid, the Liquidator may set such value as it may deem fair (with the unanimous approval of the Shareholders in a General Meeting) upon any property to be divided as aforesaid and may determine how such division shall be carried out as between the Shareholders or different classes of Shareholders.

28.3 The Liquidator may, within the like sanction, vest the whole or any part of such assets in trustees upon such trust for the benefit of the contributors as the Liquidator, with the like sanction, think fit, but so that no Shareholder shall be compelled to accept any shares for securities whereupon there is any liability.

29. INDEMNITY

29.1 Indemnity of Officers of the Company

Every Director, Chairman, Chief Executive or officer of the Company or any person employed by the Company as Auditors or advisor, shall be indemnified out of the funds of the Company against any liability incurred by him or her as such Director, Chairman, Chief Executive, officer, Auditor or advisor, in defending any proceedings, whether civil or criminal, in which judgments given in his favour or in which he is acquitted, or in connection with any application under Section 488 of the Ordinance in which relief is granted to him by court.

29.2 **Individual Responsibility of Directors, etc.**

No Director, Chairman, Chief Executive, Secretary, legal advisor, attorney or other officer or employee of the Company will be liable for the acts, receipts, neglects or default of any other Director or office or for any loss or expenses happening to the Company through the insufficiency or deficiency of title to any property acquired by order of the Board, or other officer for and on behalf of the Company, or for the insufficiency or deficiency of any security in or upon which any of the moneys of the Company shall be invested, or for any loss or damage arising from the bankruptcy, insolvency, or tortuous acts of any persons or institutions with whom any money, securities or effects shall be deposited, or for any loss associated by any error of judgment or oversight on his part, or for any other loss, damage, or misfortune whether which may happen in the execution of the duties of his office or in relation thereto, unless the same happens through his own willful act or negligent breach of duty or breach of trust in relation to the Company.

30. PROVISIONS OF THE SHAREHOLDERS AGREEMENT

30.1 Notwithstanding anything contained in these Articles, if the provisions of the Memorandum or these Articles at any time conflict with any provision of the Shareholders Agreement, the Shareholders Agreement shall, to the extent legally possible, prevail and the Articles shall, with the unanimous approval of the Shareholders in a General Meeting, be amended to such an extent so as to ensure that there is no conflict between the terms of the Shareholders Agreement and these Articles.

30.2 The Shareholders shall at all times ensure compliance with and abide with all terms, conditions and provisions of the Shareholders Agreement.

30.3 The provisions of the Shareholders Agreement shall stand and be deemed to be incorporated in these Articles by reference.

30.4 The Company shall, at all times, ensure compliance with the provisions of the Shareholders Agreement.

We, the several persons, whose names and address as are subscribed hereunto are desirous of being formed into a Company in pursuance of these Articles of Association, and we respectively agree to take the number of shares in the capital of the Company set opposite to our respective names.

Name & Surname (Present & Former) in full (in Block Letters)	Father's/Husband's Name in full	Nationality with any former Nationality	N.I.C. No.	Occupation	Residential address in full	Number of shares taken by each subscriber	Signature
SYED HYDER ALI	Syed Babar Ali	Pakistani	35201-1655225-1	Professional Manager	70-F.C.C., Gulberg, Lahore	(500) Five Hundred	Sd/-
MUJEEB RASHID	Chaudhry Abdul Rashid	Pakistani	35201-5296887-7	Professional Manager	House No.54, Block L, Phase I, D.H.A., Lahore Cantt., Lahore	(200) Two Hundred	Sd/-
KHALID YACOB	Omar Yacob	Pakistani	35202-2337385-9	Professional Manager	304-Upper Mall, Lahore	(200) Two Hundred	Sd/-

Sd/-

Dated this 9th day of September 2005

Witness to the above signatures: Adi J. Cawasji
Father's name: Mr. Jehangir N. Cawasji
Occupation: Service
Nationality: Pakistani
N.I.C. number: 42000-0524360-9
Full address: 66 B, South Circular Avenue, D.H.A., Phase-2, Karachi-75500

ANNEXURE F - LOCATION MAP

Project Location:

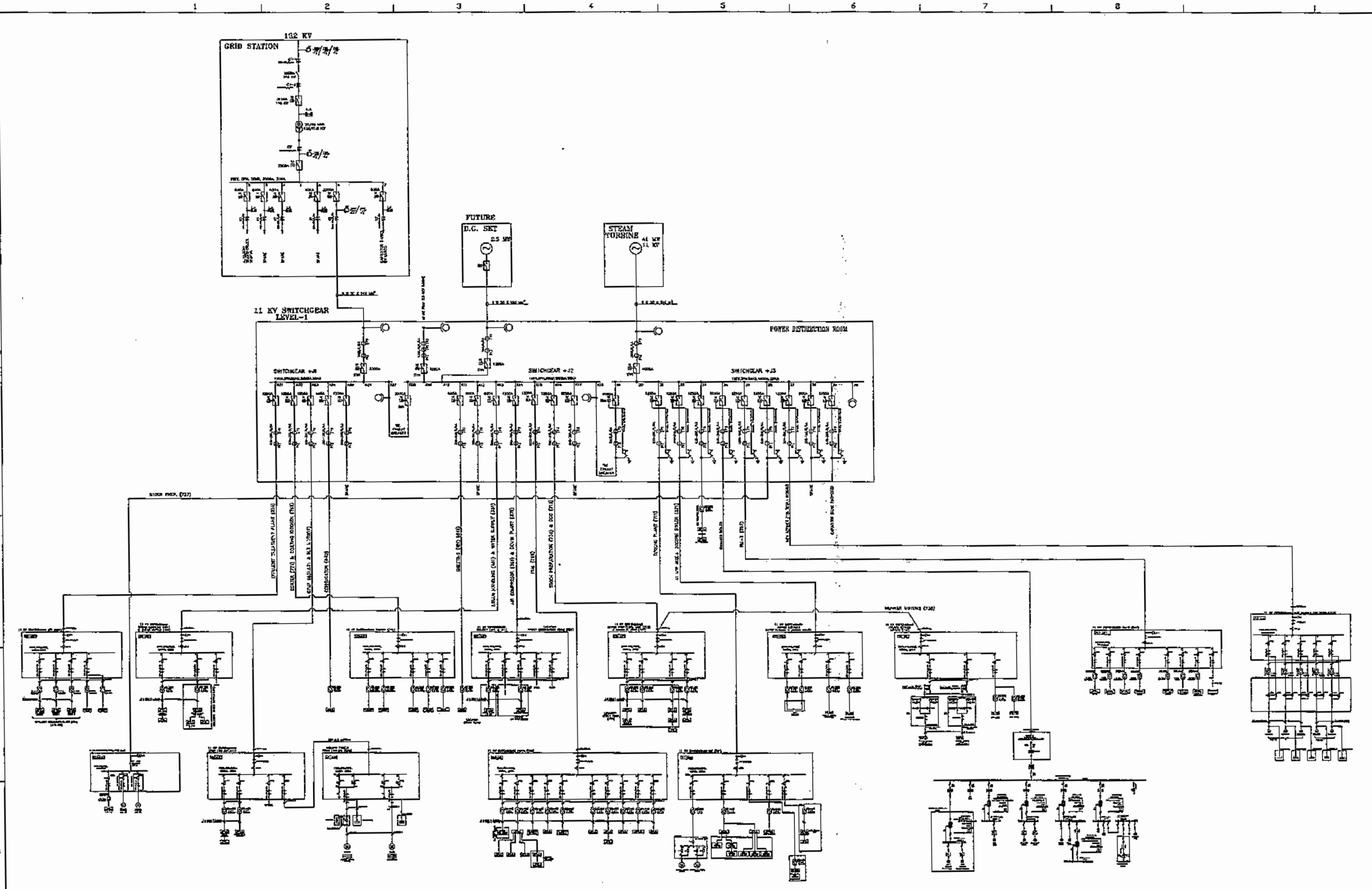
Bulleh Shah Packaging
A Packages group company

Bulleh Shah Packaging
A Packages group company

Head Office:
Shahrah-e-Roomi, P.O Amer Sidhu,
Lahore-54760, Punjab, Pakistan

Kasur Factory:
7 km, Kot Radha Kishen Road, Off 4 KM,
Kasur-Raiwind Road, District Kasur-55050,
Punjab Pakistan.
Latitude: 34.1417
Longitude: 74.359

ANNEXURE G - SINGLE LINE DIAGRAM



LEGEND

SYMBOL	DESCRIPTION
	11KV CIRCUIT BREAKER
	MOTORIZED 11 KV CIRCUIT BREAKER
SYN	MOTORIZED 11 KV CIRCUIT BREAKER WITH SYNCHRONIZING PROVISION
	L.V CIRCUIT BREAKER
	PT $11000/\sqrt{3}$ /$110/\sqrt{3}$ V
CABLE A	15KV, 3Cx240MM^2 CU/XLPE/PVC/SWA/PVC
CABLE B	15KV, 3Cx120MM^2 CU/XLPE/PVC/SWA/PVC
CABLE C	LT, 1Cx300MM^2 CU/PVC/PVC

REFRENCE DRAWINGS

1- JP. NLK DWG NO. AO-300246-381-3811 (REV-3)
2- UPDATE OF HT ARRANGMENT (REV-4)

NOTES

REV.	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
4	12.04.11	GENERAL REVISION	MT	MZ	JZK
3	07.06.11	GENERAL REVISION	RA	MA	IH
2	07.01.10	GENERAL REVISION	NA	MA	IH
1	08.09.10	GENERAL REVISION	RA	MA	IH
0	08.05.08	ISSUED FOR CONSTRUCTION	MS	HR	IH

NOTE: ALL PREVIOUS REVISIONS CONSIDER AS SUPERCEDED

FLOWTRONIX (PVT) LTD
73-C/K, MODEL TOWN LAHORE-PAKISTAN
UAN: 111 355 355 Fax : 5885733

PACKAGES LIMITED

PROJECT: BULLEH SHAH PAPER MILL

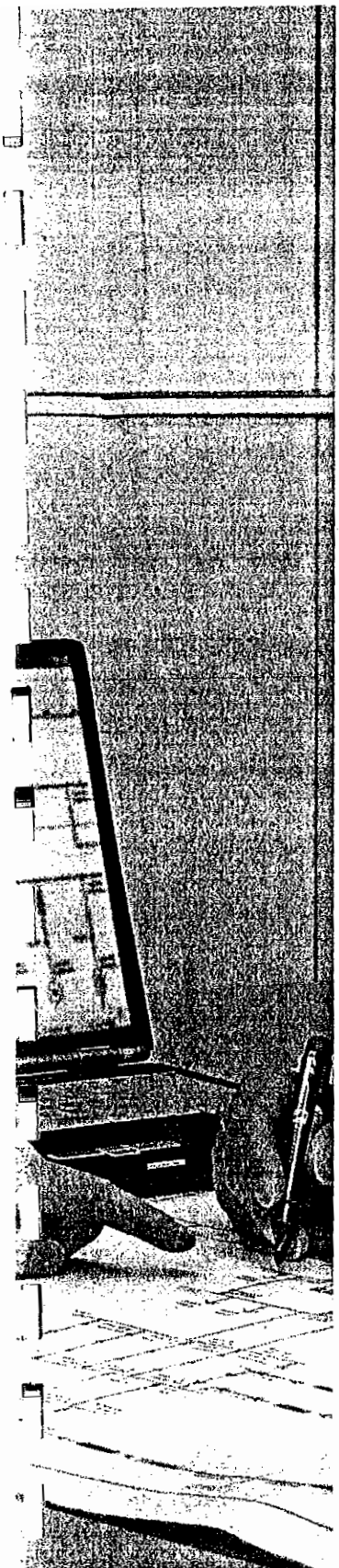
TITLE: 11 KV SINGLE LINE DIAGRAM MILL GENERAL AREA

DRAWING NO. AO-FT290-111-3811

JOB NO. F-290

DESIGNED: FT
DRAWN: M.YOUNIS
CHECKED: M.SIDDIQUE
APPROVED:
DATE: 22/3/2017
ISSUED:
SHT. NO. 1 OF 1
SIZE: A0
REV. 4
SCALE: NTS

ANNEXURE H - LOAD FLOW AND SHORT CIRCUIT ANALYSIS



Bulleh Shah Packaging

Bulleh Shah Packaging

Short Circuit Calculations and Load Flow Analysis

Draft Report V1.0

Siemens Pakistan
Digital Grid
Power Technologies International

Project Reference	3004541342
Date	01.06.2016
Worked By	S.M. Jahangir Haider
Checked By	Syed Farhan Ali
Office Address	B-72, Estate Avenue S.I.T.E. P.O. Box No. 7158, Karachi-75700.
Phone	+92 21 32550010
Fax	+92 21 32567461
E-Mail	jahangir.haider@siemens.com farhan.ali@siemens.com

Siemens PTI – Network Consulting

http://www.siemens.com/power-technologies

SIEMENS

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1. EXECUTIVE SUMMARY

1.1 Job Description

Comprehensive short circuit calculations, load flow analysis of M/s Bulleh Shah Packaging has been carried out to determine short circuit levels on different buses and nodes, determination of electrical equipment loadings, voltage drops on system buses under steady state operation.

The focus of this report is mainly on:

- Short circuit calculations.
- Load flow conditions.

1.2 Network Background

Bulleh Shah Packaging is fed via 01No 132kV over head line from WAPDA grid station. This supply is stepped down to 11kV through 01 No 20/26MVA step down power transformer. The main 132/11 kV transformer is equipped with on load tap changer that maintains constant 11kV supply at the transformer secondary. The 11kV incomer from this power transformer is connected to the main grid station at switchgear +J1. Distribution transformers are installed to feed the LV plant load.

There are 15 MV motors rated at 11kV, 10kV and 6kV in the network ranging from 2500KW to 560KW rating. Motors are equipped with auto transformer for startup while there are few DOL start motors as well.

The main 132kV/6.3kV transformer is solidly grounded. All distribution transformers are solidly grounded.

Bullehshah have also installed a 48MVA steam turbine to meet the power demand for the plant and to become self reliant in power requirement.
The 48MVA steam turbine is grounded through a 127A NGR.

The maximum operating load of the network is around 25 MW.

Short circuit current calculations and load flow analysis are therefore carried out to evaluate the spare capacity and loading of existing system under steady state normal operation.

Please refer Annex A - Case 0 for the network structure / input data model.

1.3 Simulation Cases

As per the discussion with Bulleh Shah Packaging engineers regarding the network operation and loading conditions, following operational cases have been simulated with respect to short circuit and load flow calculations:

1.3.1 3-Phase, 2-Phase, 2-Phase to ground and 1-Phase to ground Maximum Short Circuit Calculations

Cases	41MW Steam Turbine	WAPDA
Case 1	ON	OFF
Case 2	OFF	ON
Case 3	ON	ON
Case 4	ON (J2 + J3)	ON (J1)
Case 5	ON (J3)	ON (J1 + J2)

1.3.2 2 Phase Minimum Short Circuit Calculation

Case 2 is considered for the minimum short circuit case.

1.3.3 1 Phase Minimum Short Circuit Calculation

Case 1 is considered for the minimum short circuit case.

1.3.4 Load Flow Analysis

Cases	41MW Steam Turbine	WAPDA
Case 1	ON	OFF
Case 2	OFF	ON
Case 3	ON	ON
Case 4	ON (J2 + J3)	ON (J1)
Case 5	ON (J3)	ON (J1 + J2)

2. METHODOLOGY

The input data for network was provided by engineers of Bulleh Shah Packaging in the form of single line diagrams, data sheets and load lists. The data was input into the network analysis tool, PSS® SINCAL (Siemens Network Calculation) software.

2.1 Electrical Network Data

The network input model is prepared and modified with the help of data sent via emails and data collected / provided at site.

Please see the input data model in Annex A, Case-0.

2.1.1 Nominal Voltages

Considering the nominal voltages of Bullehshah packaging network at different points, following voltage levels are considered as reference voltages:

- 132 kV
- 11 kV
- 6 kV
- 3.3 kV
- 0.4 kV
- 0.69 kV

2.1.2 Network Infeed Model

The utility connection to the plant is via 01No overhead line from the Kasur grid station. The short circuit power at this connection point is ~ 1355 MVA on the 132kV side. This value has been assumed for maximum condition.

Table 2.1 Specifications of Kasur Grid:

S. No	Element Name	Service Voltage (kV)	Max 3 Phase Short Circuit Current (KA)	Max 1 Phase Short Circuit Current (KA)
1	Kasur Grid	132	5.930	4.813

2.1.3 Transformer Model

- Transformers are modeled as per their name plate data.

- All the no-load tap-changers have been set at 0 positions (Central Point).
- Onload Tap changer of TR1 and TR2 have been modeled.

The details are as follows:

Table 2.2 Specifications of Transformer

S.No	Element Name	Vr1 (kV)	Vr2 (kV)	Sn (MVA)	Vk (%)	Vector Group
1	Grid TR	132	11.5	20	9.83	DYN11
2	842-3351	11	0.4	2.5	6.25	DYN11
3	251-3351	11	0.4	2	6	DYN11
4	251-3352	11	0.4	2	6	DYN11
5	251-3353	11	0.4	2	6	DYN11
6	Tube Well No3	11	0.4	0.25	6	DYN11
7	Tube Well No 4	11	0.4	0.25	6	DYN11
8	771-3351	11	0.52	2.5	6.25	DYN11
9	771-3352	11	0.52	2.5	6.25	DYN11
10	771-3353	11	0.52	2.5	6.25	DYN11
11	771-3354	11	0.4	2.5	6.25	DYN11
12	771-3355	11	0.4	3	6.46	DYN11
13	631-3351	11	0.4	2	6.11	DYN11
14	671-3351	11	0.4	2	6.11	DYN11
15	841-3351	11	0.4	2	6.9	DYN11
16	481-3351	11	0.4	2	6	DYN11
17	351-3351	11	0.4	2	6	DYN11
18	371-3351	11	0.4	2	6.23	DYN11
19	391-3352	11	0.4	2	6.12	DYN11
20	766-3359	11	0.4	2	6.25	DYN11
21	766-3358	11	0.4	2	6.25	DYN11
22	799-3357	11	0.4	2	6.18	DYN11
23	799-3356	11	0.4	2	6.2	DYN11
24	766-3355	11	0.4	2	6.22	DYN11
25	766-3354	11	0.4	2	6.22	DYN11
26	766-3353	11	0.4	2	6.23	DYN11
27	766-3352	11	0.4	2	6.2	DYN11
28	766-3360	11	0.4	2	6.18	DYN11
29	766-3351	11	0.4	2	6.13	DYN11

30	712-3352	11	0.4	2	6.17	DYN11
31	737-3351	11	0.4	2	6.15	DYN11
32	712-3351	11	0.4	2	6.08	DYN11
33	736-3351	11	0.4	2	6.05	DYN11
34	711-3351	11	6	3	10	DYN11
35	711-3352	11	0.4	2	6	DYN11
36	722-3352	11	0.4	2	6	DYN11
37	711-3354	11	0.52	2	6.25	DYN11
38	722-3351	11	0.4	2	6	DYN11
39	371-3352	11	0.69	3	6	DYN11
40	371-3353	11	0.69	3	6	DYN11
41	371-3354	11	0.4	2	6	DYN11
42	391-3351	11	0.4	2	6.12	DYN11
43	767-3351	11	0.52	2	6.25	DYN11
44	767-3352	11	0.52	3	6.25	DYN11
45	767-3353	11	0.52	3	6.25	DYN11
46	767-3354	11	0.4	2	6	DYN11
47	767-3355	11	0.52	2.5	6.25	DYN11
48	767-3356	11	3	3	6.25	DYN11
49	767-3357	11	0.52	2.5	6.25	DYN11
50	737-3352	11	0.52	2	6.25	DYN11
51	713-3355/1610	11	6	2	4.35	YN0
52	713-3356/1620	11	6	2	4.35	YN0
53	713-3357/1630	11	6	2	4.35	YN0
54	713-3353/1640	11	6	3	4.38	YN0
55	713-3354/1650	11	6	3	4.38	YN0
56	736-3352	11	10	2.5	6.05	Y0
57	736-3353	11	10	2.5	6.05	Y0
58	371-3355	11	0.4	2	6	DYN11
59	713-3352	11	0.4	2	7.08	DYN11

* Percentage Impedance

2.1.4 Load Model

- All medium voltage motors are modeled as separate individual motors as per their data sheets / name plate data.
- Starting current (Ia/In) of all medium voltage motors is considered as 5.5 in accordance with the IEC 60909-2 due to unavailability of the data sheets.
- For medium voltage motors with powers per pair of poles greater than or equal to 1MW, R/X = 0.10 is considered as per IEC 60909-0
- For medium voltage motors with powers per pair of poles less than 1MW, R/X = 0.15 is considered as per IEC 60909-0
- For low voltage motors with cable connections, R/X ratio= 0.42 is considered as per IEC 60909-0.
- Starting current (Ia/In) of all low voltage motors is taken as 6.7 as per IEC 60909-2.
- For the VFD motors a reduced starting current ratio of 1.0 has been assumed.

The details are as follows:

Table 2.3 Specifications of Medium Voltage Motors

S.No	Element Name	Rated Power [kW]	Rated Voltage [kV]	cosphi	Ia/In %	EFF (PU)
1	Refiner RG-44 Motor	2500	11	0.85	5.5	0.95
2	Defibrator	710	11	0.85	5.5	0.95
3	Refiner Motor #1	560	11	0.81	5.5	0.95
4	Refiner Motor #2	560	11	0.81	5.5	0.95
5	Refiner Motor # 3	560	11	0.81	5.5	0.95
6	713M1630	1200	11	0.87	6.3	0.95
7	713M16010	1200	11	0.87	6.3	0.95
8	713M1620	1200	11	0.87	6.3	0.95
9	713M1640	1600	11	0.87	5.8	0.95
10	713M1650	1600	11	0.87	5.8	0.95
11	Pulper Refiner Motor 2	1000	10	0.87	5.5	0.95
12	Pulper Refiner Motor 1	1000	10	0.87	5.5	0.95
13	Pulper Motor	560	6	0.85	5.5	0.95
14	Disperger Motor	800	6	0.85	5.5	0.95

15	Vacuum Pump	1430	3.3	0.9	5	0.95

*Efficiency

2.1.5 Modeling of Cables

Cable impedances are chosen from PSS®SINCAL database. The data for cable sizes, lengths and number of parallel systems have been provided by BullehShah Packaging. The permissible maximum continuous load current (Ith) is evaluated by considering the reduction factor i.e. Ith =Irated x Reduction Factor.

Reduction factor of the cables is calculated by considering the following factors:

- Ambient temperature: 45°C.
- Number of parallel system.
- Nature of cable laying.
- Soil thermal resistivity etc.

We have considered an overall reduction factor of 0.7 for all cables laid in the entire BullehShah Packaging. Zero sequence data of the cables was not available. We have therefore considered these values from PSS®SINCAL database.

2.1.6 Annotations:

The short names and their description for different electrical elements used in PSS ®SINCAL are listed below:

Short Names	Unit	Description
GRID		
Sk"	MVA	Short Circuit Power
Transformer		
Vr1	kV	Rated Voltage (Side 1)
Vr2	kV	Rated Voltage (Side 2)
Sn	MVA	Rated Apparent Power
vk	%	Reference Short Circuit Voltage (% impedence)
S/Sb	%	Ratio Apparent Power
BusBars		
V/Vn	%	Actual voltage/Rated Voltage
Ik"	KA	Initial SC Current the maximum of the effective values of the current expected

		at the moment the short circuit occurs
ip	KA	Peak SC Current the peak value of the maximum possible short circuit current in the conductor
IL1a, IL2a, IL3a	KA	Absolute current
3I0a	KA	Absolute return current
Motors		
Pn	MW	rated active power
cosphin		Rated Power Factor
Ia/In	pu	Current Ratio At Start-Up
etan	pu	Rated Efficiency
cosphi		Running Power Factor
Cables		
q	mm^2	Cross Section
l	m	Length
p		No. of Parallel Systems
f		Reduction factor
I/Ib	%	Current Loading
Capacitor Bank		
Qr	Mvar	Rated Reactive Power
General		
+ (P,Q)		Power flow towards the node
- (P,Q)		Power flow away from the node
IK" , ip (For cables)		Depicts the flow towards the respective node.

3. SHORT CIRCUIT STUDY

3.1 Introduction

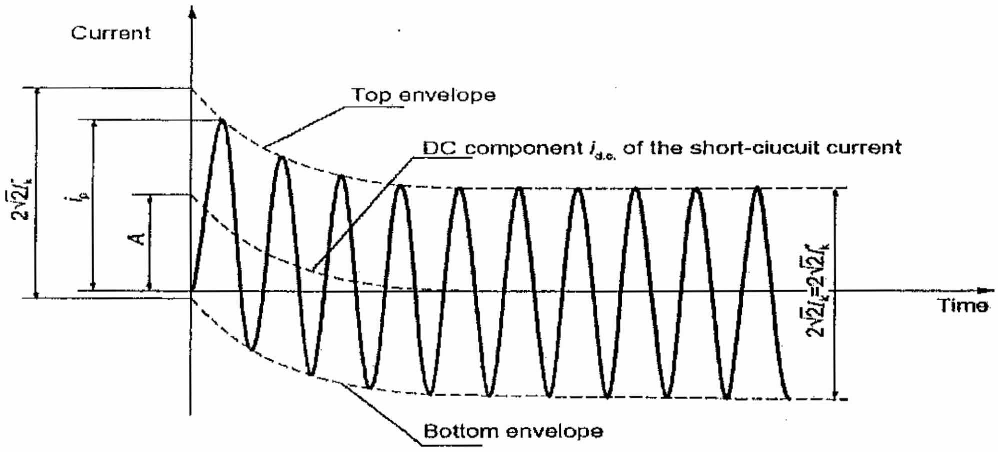
The short circuit calculations are carried out using IEC 60909-0/2001 standard. The initial symmetrical short circuit (Ik") is referred to as the thermal stress of breaker and peak current (ip) will determine the mechanical stresses on the breaker.

2 phase minimum short circuit is used for protection coordination for phase faults while 1 phase minimum short circuit will be used for earth fault settings.

Maximum short circuit current will be calculated when all generating sources & all the load in the network is in operation. The minimum short circuit current will be calculated when all the load is disconnected from the system (system startup from black out).

3.2 Adopted Procedure

The method used for calculation is based on the introduction of an equivalent voltage source at the short-circuit location. The equivalent voltage source is the only active voltage of the system. All network feeders, synchronous and asynchronous machines are replaced by their internal impedances. In all cases it is possible to determine the short-circuit current at the short-circuit location with the help of an equivalent voltage source. Operational data and the load of consumers, tap changer position of transformers, excitation of generators are dispensable. Short circuit current distribution diagram is given below:



I_k'' = initial symmetrical short-circuit current

i_p = peak short-circuit current

I_k = steady-state short-circuit current

$i_{d.c.}$ = d.c. component of short-circuit current

A = initial value of the d.c. component $i_{d.c.}$

Figure 3.1: Short-circuit current distribution in a far from generator short circuit

Initial symmetrical short circuit current (Ik"): RMS value of the ac component of short circuit current applicable at the onset of short circuit.

Peak short circuit current (i_p): The highest possible instantaneous value of the current, following the occurrence of the short circuit. The highest value of ip depends on the time constant of the decaying aperiodic component i.e on the X/R or R/X of the short circuit impedance and is reached if the short circuit starts at zero voltage. ip also depends on the decay of the symmetrical ac component of the short circuit current.

Steady state short circuit current (Ik): RMS value of the short circuit current which remains after the decay of the transient phenomenon.

DC component of short circuit current (i_{dc}): Mean value between the top and bottom envelope of a short circuit current, decaying from an initial value A to zero.

Table 3.1 Voltage Factors according to IEC-60909-0

<table>
<tr><th rowspan="2">Nominal Voltage
Un</th><th colspan="2">Voltage factor c for the calculation of</th></tr>
<tr><th>Maximum Short-Circuit Currents
c_{max}[1]</th><th>Minimum Short-Circuit Currents
c_{min}</th></tr>
<tr><td>Low Voltage
100V to 1000V
(IEC 60038)</td><td>1.05[3]
1.04[4]</td><td>0.95</td></tr>
<tr><td>Medium Voltage
>1kV to 35 kV
(IEC 60038)</td><td rowspan="2">1.10</td><td rowspan="2">1.00</td></tr>
<tr><td>High Voltage[2]
>35 kV
(IEC 60038)</td></tr>
<tr><td colspan="3">1) $c_{max}U_n$ should not exceed the highest voltage Um for equipment of power systems.
2) If no nominal voltage is defined $c_{max}U_n = U_m$ or $c_{max}U_n = 0.90 \times U_m$ should be applied.
3) For low-voltage systems with a tolerance of +6 %, for example systems renamed from 380V to 400V.
4) For low-voltage systems with a tolerance of +10 %.</td></tr>
</table>

When calculating maximum short circuits, it is necessary to introduce the following conditions as per IEC 60909-0:

- Voltage factor c_{max} according to table 3.1 shall be used for the calculation of short circuit currents.
- Choose the system configuration and the maximum contribution from the power plants and the network feeders which lead to the maximum short circuit current at the short circuit location.
- When equivalent impedances are used to represent the external networks, the minimum equivalent impedance shall be used which corresponds to the maximum short circuit contribution from the network feeders.
- Motors shall be included in accordance with their appropriate reactance by resistance ratios.
- Resistance of line (overhead lines and cables) is to be introduced at a temperature of 20 degree centigrade.

When calculating minimum short circuits, it is necessary to introduce the following conditions as per IEC 60909-0:

- Voltage factor c_{min} according to table 3.1 shall be used for the calculation of short circuit currents.

- Choose the system configuration and the minimum contribution from the power plants and the network feeders which lead to the minimum short circuit current at the short circuit location.
- Motors shall be neglected.
- Resistance of line (overhead lines, cables and neutral conductors) is to be introduced at a higher temperature of 90 degree centigrade.

3.3 3 Phase Maximum Short Circuit Cases

For 3 phase maximum short circuit calculations, the following color coding have been used to check the switchgear thermal withstand capability (ik"),

Green: OK

Red: Switchgear exposed to 100% of its rated limit under 3 phase fault condition.

All MV buses are rated at Ik" = 25KA and Ip = 62.5KA

3-phase maximum short circuit results at different bus bars are given below:

For detailed results please refer Annex-A.

Following operating scenarios have been simulated for 3 phase short circuit calculations:

Cases	41MW Steam Turbine	WAPDA
Case 1	ON	OFF
Case 2	OFF	ON
Case 3	ON	ON
Case 4	ON (J2 + J3)	ON (J1)
Case 5	ON (J3)	ON (J1 + J2)

Case – 1

Results of MV Buses:

Table 3.2 3-Phase Maximum Short Circuit Levels – Case 1

S.No	Bus Name	Voltage Level (KV)	Ik (KA)	Ip (KA)	Rated Capacity	
					Ik (KA)	Ip (KA)
1	Grid Station Bus	11KV	33.65	76.96	25	62.5
2	SW +J2	11KV	37.30	91.20	25	62.5
3	SW +J1	11KV	37.30	91.20	25	62.5
4	SW +J3	11KV	37.30	91.20	25	62.5
5	ETP 251 - 3311	11KV	29.07	61.97	25	62.5
6	CTMP (621,631,671)	11KV	33.13	75.11	25	62.5
7	Coater 771 - 3311	11KV	33.48	76.36	25	62.5
8	Straw handling and Water Supply	11KV	32.55	73.12	25	62.5
9	Utilities (371 391)	11KV	36.83	89.06	25	62.5
10	PM-6 766	11KV	33.32	75.79	25	62.5
11	Stock Prep 736 OCC 712 and Chem prep 737	11KV	31.92	71.02	25	62.5
12	631-3312	11KV	32.95	74.47	25	62.5
13	DIP 711	11KV	32.66	73.51	25	62.5
14	PM-7 (767)	11KV	35.04	82.04	25	62.5
15	41MW Turbine + 200TPH Boiler	11KV	36.87	89.17	25	62.5
16	New Refiner for Tetra 713	11KV	29.15	62.00	25	62.5
17	Stock Prep	11KV	32.10	71.61	25	62.5
18	Pulper Refiner Motors 736	11KV	31.91	70.99	25	62.5
19	HT Room DIP	6KV	4.01	10.66	NA	NA

Case – 2

Results of MV Buses:

Table 3.3 3-Phase Maximum Short Circuit Levels – Case 2

S No	Bus Name	Voltage Level (KV)	Ik (KA)	Ip (KA)	Rated Capacity	
					Ik (KA)	Ip (KA)
1	Grid Station Bus	11KV	26.96	64.51	25	62.5
2	SW +J2	11KV	27.74	67.04	25	62.5
3	SW +J1	11KV	27.74	67.04	25	62.5
4	SW +J3	11KV	27.74	67.04	25	62.5
5	ETP 251 - 3311	11KV	23.00	50.00	25	62.5
6	CTMP (621,631,671)	11KV	25.45	58.19	25	62.5
7	Coater 771 - 3311	11KV	25.62	58.81	25	62.5
8	Straw handling and Water Supply	11KV	25.04	56.74	25	62.5
9	Utilities (371 391)	11KV	27.48	65.83	25	62.5
10	PM-6 766	11KV	25.57	58.64	25	62.5
11	Stock Prep 736 OCC 712 and Chem prep 737	11KV	24.77	55.82	25	62.5
12	631-3312	11KV	25.35	57.81	25	62.5
13	DIP 711	11KV	25.21	57.34	25	62.5
14	PM-7 (767)	11KV	26.52	62.12	25	62.5
15	41MW Turbine + 200TPH Boiler	11KV	27.51	65.90	25	62.5
16	New Refiner for Tetra 713	11KV	23.22	50.56	25	62.5
17	Stock Prep	11KV	24.81	55.93	25	62.5
18	Pulper Refiner Motors 736	11KV	24.76	55.80	25	62.5
19	HT Room DIP	6KV	3.97	10.51	NA	NA

Case – 3

Results of MV Buses:

Table 3.4 3-Phase Maximum Short Circuit Levels – Case 3

S.No	Bus Name	Voltage Level (KV)	Ik" (KA)	Ip (KA)	Rated Capacity	
					Ik (KA)	Ip (KA)
1	Grid Station Bus	11KV	42.79	101.09	25	62.5
2	SW +J2	11KV	46.25	114.32	25	62.5
3	SW +J1	11KV	46.25	114.32	25	62.5
4	SW +J3	11KV	46.25	114.32	25	62.5
5	ETP 251 - 3311	11KV	34.11	71.56	25	62.5
6	CTMP (621,631,671)	11KV	39.88	89.73	25	62.5
7	Coater 771 - 3311	11KV	40.45	91.71	25	62.5
8	Straw handling and Water Supply	11KV	39.15	87.24	25	62.5
9	Utilities (371 391)	11KV	45.53	111.02	25	62.5
10	PM-6 766	11KV	40.14	90.65	25	62.5
11	Stock Prep 736 OCC 712 and Chem prep 737	11KV	38.10	83.81	25	62.5
12	631-3312	11KV	39.62	88.82	25	62.5
13	DIP 711	11KV	39.17	87.32	25	62.5
14	PM-7 (767)	11KV	42.75	100.03	25	62.5
15	41MW Turbine + 200TPH Boiler	11KV	45.59	111.18	25	62.5
16	New Refiner for Tetra 713	11KV	34.01	71.00	25	62.5
17	Stock Prep	11KV	38.46	84.96	25	62.5
18	Pulper Refiner Motors 736	11KV	38.08	83.77	25	62.5
19	HT Room DIP	6KV	4.04	10.75	NA	NA

Case – 4

Results of MV Buses:

Table 3.5 3-Phase Maximum Short Circuit Levels – Case 4

S No	Bus Name	Voltage Level (KV)	Ik" (KA)	Ip (KA)	Rated Capacity	
					Ik" (KA)	Ip (KA)
1	Grid Station Bus	11KV	13.64	34.56	25	62.5
2	SW +J2	11KV	32.78	80.63	25	62.5
3	SW +J1	11KV	13.47	33.69	25	62.5
4	SW +J3	11KV	32.78	80.63	25	62.5
5	ETP 251 - 3311	11KV	12.37	29.10	25	62.5
6	CTMP (621,631,671)	11KV	13.01	31.64	25	62.5
7	Coater 771 - 3311	11KV	13.02	31.68	25	62.5
8	Straw handling and Water Supply	11KV	29.08	66.20	25	62.5
9	Utilities (371 391)	11KV	32.42	78.94	25	62.5
10	PM-6 766	11KV	29.73	68.53	25	62.5
11	Stock Prep 736 OCC 712 and Chem prep 737	11KV	28.63	64.65	25	62.5
12	631-3312	11KV	12.99	31.54	25	62.5
13	DIP 711	11KV	29.22	66.71	25	62.5
14	PM-7 (767)	11KV	31.06	73.49	25	62.5
15	41MW Turbine + 200TPH Boiler	11KV	32.45	79.04	25	62.5
16	New Refiner for Tetra 713	11KV	26.47	57.32	25	62.5
17	Stock Prep	11KV	28.74	65.01	25	62.5
18	Pulper Refiner Motors 736	11KV	28.62	64.63	25	62.5
19	HT Room DIP	6KV	3.99	10.61	NA	NA

Case – 5

Results of MV Buses:

Table 3.6 3-Phase Maximum Short Circuit Levels – Case 5

S.No	Bus Name	Voltage Level (KV)	Ik'' (KA)	Ip (KA)	Rated Capacity	
					Ik'' (KA)	Ip (KA)
1	Grid Station Bus	11KV	18.60	46.00	25	62.5
2	SW +J2	11KV	18.65	45.92	25	62.5
3	SW +J1	11KV	18.65	45.92	25	62.5
4	SW +J3	11KV	27.60	68.40	25	62.5
5	ETP 251 - 3311	11KV	16.49	37.49	25	62.5
6	CTMP (621,631,671)	11KV	17.68	41.87	25	62.5
7	Coater 771 - 3311	11KV	17.73	42.07	25	62.5
8	Straw handling and Water Supply	11KV	17.42	40.88	25	62.5
9	Utilities (371 391)	11KV	18.53	45.32	25	62.5
10	PM-6 766	11KV	17.75	42.14	25	62.5
11	Stock Prep 736 OCC 712 and Chem prep 737	11KV	17.38	40.74	25	62.5
12	631-3312	11KV	17.63	41.68	25	62.5
13	DIP 711	11KV	25.12	58.36	25	62.5
14	PM-7 (767)	11KV	26.41	63.31	25	62.5
15	41MW Turbine + 200TPH Boiler	11KV	27.37	67.23	25	62.5
16	New Refiner for Tetra 713	11KV	23.18	51.34	25	62.5
17	Stock Prep	11KV	24.72	56.91	25	62.5
18	Pulper Refiner Motors 736	11KV	17.38	40.73	25	62.5
19	HT Room DIP	6KV	3.97	10.52	NA	NA

3.4 2 Phase Maximum Short Circuit Calculation

2 phase maximum short circuit has been calculated only for case 3 which depicts the normal plant operating conditions.

Table 3.7 2-Phase Maximum Short Circuit Levels – Case 3

S.No	Bus Name	Voltage Level (kV)	Ib (KA)	Ia (KA)	Rated Capacity Ik (KA)
1	Grid Station Bus	11KV	35.95	35.95	25
2	SW +J2	11KV	38.71	38.71	25
3	SW +J1	11KV	38.71	38.71	25
4	SW +J3	11KV	38.71	38.71	25
5	ETP 251 - 3311	11KV	28.81	28.81	25
6	CTMP (621,631,671)	11KV	33.54	33.54	25
7	Coater 771 - 3311	11KV	34.00	34.00	25
8	Straw handling and Water Supply	11KV	32.93	32.93	25
9	Utilities (371 391)	11KV	38.13	38.13	25
10	PM-6 766	11KV	33.75	33.75	25
11	Stock Prep 736 OCC 712 and Chem prep 737	11KV	32.08	32.08	25
12	631-3312	11KV	33.32	33.32	25
13	DIP 711	11KV	32.96	32.96	25
14	PM-7 (767)	11KV	35.87	35.87	25
15	41MW Turbine + 200TPH Boiler	11KV	38.18	38.18	25
16	New Refiner for Tetra 713	11KV	28.74	28.74	25
17	Stock Prep	11KV	32.37	32.37	25
18	Pulper Refiner Motors 736	11KV	32.07	32.07	25
19	HT Room DIP	6KV	3.49	3.49	NA

3.5 2 Phase to Ground Maximum Short Circuit Calculation

Maximum 2 phase to ground short circuit has been calculated only for case 3 which depicts the normal plant operating conditions.

Table 3.8 2-Phase to Ground Maximum Short Circuit Levels – Case 3

S.No	Bus Name	Voltage Level (kV)	Ilb (KA)	Ilc (KA)	3Ioa (KA)	Rated Capacity Ik (KA)
1	Grid Station Bus	11KV	36.22	37.46	14.63	25
2	SW +J2	11KV	40.14	38.77	13.49	25
3	SW +J1	11KV	40.14	38.77	13.49	25
4	SW +J3	11KV	40.14	38.77	13.49	25
5	ETP 251 - 3311	11KV	30.59	28.01	10.04	25
6	CTMP (621,631,671)	11KV	35.27	33.03	11.72	25
7	Coater 771 - 3311	11KV	35.70	33.56	11.93	25
8	Straw handling and Water Supply	11KV	34.64	32.44	11.63	25
9	Utilities (371 391)	11KV	39.60	38.13	13.31	25
10	PM-6 766	11KV	35.49	33.25	11.78	25
11	Stock Prep 736 OCC 712 and Chem prep 737	11KV	33.86	31.45	11.17	25
12	631-3312	11KV	35.06	32.80	11.64	25
13	DIP 711	11KV	34.72	32.39	11.48	25
14	PM-7 (767)	11KV	37.50	35.59	12.54	25
15	41MW Turbine + 200TPH Boiler	11KV	39.65	38.17	13.32	25
16	New Refiner for Tetra 713	11KV	30.31	28.37	10.95	25
17	Stock Prep	11KV	34.11	31.81	11.38	25
18	Pulper Refiner Motors 736	11KV	33.85	31.43	11.17	25
19	HT Room DIP	6KV	3.91	3.92	3.52	NA

3.6 2 Phase Minimum Short Circuit Calculation

Following operating scenario has been simulated for 2 phase minimum short circuit calculations:

Case	41MW Steam Turbine	WAPDA
Case 2	OFF	ON

Results of MV Buses:

Table 3.9 2-Phase Minimum Short Circuit Levels

S.No	Bus Name	Voltage Level (kV)	Ib (KA)	Ik (KA)	Rated Capacity Ir (KA)
1	Grid Station Bus	11KV	7.00	7.00	25
2	SW +J2	11KV	6.83	6.83	25
3	SW +J1	11KV	6.83	6.83	25
4	SW +J3	11KV	6.83	6.83	25
5	ETP 251 - 3311	11KV	6.40	6.40	25
6	CTMP (621,631,671)	11KV	6.62	6.62	25
7	Coater 771 - 3311	11KV	6.65	6.65	25
8	Straw handling and Water Supply	11KV	6.61	6.61	25
9	Utilities (371 391)	11KV	6.81	6.81	25
10	PM-6 766	11KV	6.62	6.62	25
11	Stock Prep 736 OCC 712 and Chem prep 737	11KV	6.55	6.55	25
12	631-3312	11KV	6.61	6.61	25
13	DIP 711	11KV	6.59	6.59	25
14	PM-7 (767)	11KV	6.72	6.72	25
15	41MW Turbine + 200TPH Boiler	11KV	6.81	6.81	25
16	New Refiner for Tetra 713	11KV	6.35	6.35	25
17	Stock Prep	11KV	6.58	6.58	25
18	Pulper Refiner Motors 736	11KV	6.55	6.55	25
19	HT Room DIP	6KV	2.09	2.09	NA

3.7 1 Phase Maximum Short Circuit Calculation

Following operating scenarios have been simulated for 3 phase short circuit calculations:

Cases	41MW Steam Turbine	WAPDA
Case 1	ON	OFF
Case 2	OFF	ON
Case 3	ON	ON
Case 4	ON (J2 + J3)	ON (J1)
Case 5	ON (J3)	ON (J1 + J2)

Results of MV Buses:

Table 3.10 1-Phase Maximum Short Circuit Levels – Case 1

S No	Bus Name	Voltage Level (KV)	I"k (KA)	Ip (KA)	Rated Capacity Ik (KA)
1	Grid Station Bus	11KV	0.146	0.146	25
2	SW +J2	11KV	0.146	0.146	25
3	SW +J1	11KV	0.146	0.146	25
4	SW +J3	11KV	0.146	0.146	25
5	ETP 251 - 3311	11KV	0.146	0.146	25
6	CTMP (621,631,671)	11KV	0.146	0.146	25
7	Coater 771 - 3311	11KV	0.146	0.146	25
8	Straw handling and Water Supply	11KV	0.146	0.146	25
9	Utilities (371 391)	11KV	0.146	0.146	25
10	PM-6 766	11KV	0.146	0.146	25
11	Stock Prep 736 OCC 712 and Chem prep 737	11KV	0.146	0.146	25
12	631-3312	11KV	0.146	0.146	25
13	DIP 711	11KV	0.146	0.146	25
14	PM-7 (767)	11KV	0.146	0.146	25
15	41MW Turbine + 200TPH Boiler	11KV	0.146	0.146	25
16	New Refiner for Tetra 713	11KV	0.146	0.146	25
17	Stock Prep	11KV	0.146	0.146	25
18	Pulper Refiner Motors 736	11KV	0.146	0.146	25
19	HT Room DIP	6KV	3.748	3.748	NA

Case – 2

Results of MV Buses:

Table 3.11 1-Phase Maximum Short Circuit Levels – Case 2

S.No	Bus Name	Voltage Level (kV)	I1a (KA)	3I0a (KA)	Rated Capacity Ik (KA)
1	Grid Station Bus	11KV	18.68	18.68	25
2	SW +J2	11KV	17.93	17.93	25
3	SW +J1	11KV	17.93	17.93	25
4	SW +J3	11KV	17.93	17.93	25
5	ETP 251 - 3311	11KV	13.99	13.99	25
6	CTMP (621,631,671)	11KV	15.96	15.96	25
7	Coater 771 - 3311	11KV	16.17	16.17	25
8	Straw handling and Water Supply	11KV	15.78	15.78	25
9	Utilities (371 391)	11KV	17.73	17.73	25
10	PM-6 766	11KV	16.03	16.03	25
11	Stock Prep 736 OCC 712 and Chem prep 737	11KV	15.34	15.34	25
12	631-3312	11KV	15.87	15.87	25
13	DIP 711	11KV	15.70	15.70	25
14	PM-7 (767)	11KV	16.88	16.88	25
15	41MW Turbine + 200TPH Boiler	11KV	17.74	17.74	25
16	New Refiner for Tetra 713	11KV	14.81	14.81	25
17	Stock Prep	11KV	15.53	15.53	25
18	Pulper Refiner Motors 736	11KV	15.34	15.34	25
19	HT Room DIP	6KV	3.72	3.72	NA

Case – 3

Results of MV Buses:

Table 3.12 1-Phase Maximum Short Circuit Levels – Case 3

S.No	Bus Name	Voltage Level (kV)	Ith (KA)	3I0a (KA)	Rated Capacity Ik (KA)
1	Grid Station Bus	11KV	22.20	22.20	25
2	SW +J2	11KV	21.35	21.35	25
3	SW +J1	11KV	21.35	21.35	25
4	SW +J3	11KV	21.35	21.35	25
5	ETP 251 - 3311	11KV	15.85	15.85	25
6	CTMP (621,631,671)	11KV	18.51	18.51	25
7	Coater 771 - 3311	11KV	18.82	18.82	25
8	Straw handling and Water Supply	11KV	18.31	18.31	25
9	Utilities (371 391)	11KV	21.06	21.06	25
10	PM-6 766	11KV	18.60	18.60	25
11	Stock Prep 736 OCC 712 and Chem prep 737	11KV	17.65	17.65	25
12	631-3312	11KV	18.39	18.39	25
13	DIP 711	11KV	18.13	18.13	25
14	PM-7 (767)	11KV	19.82	19.82	25
15	41MW Turbine + 200TPH Boiler	11KV	21.07	21.07	25
16	New Refiner for Tetra 713	11KV	16.86	16.86	25
17	Stock Prep	11KV	17.94	17.94	25
18	Pulper Refiner Motors 736	11KV	17.64	17.64	25
19	HT Room DIP	6KV	3.76	3.76	NA

Case – 4

Results of MV Buses:

Table 3.13 1-Phase Maximum Short Circuit Levels – Case 4

S.No	Bus Name	Voltage Level (KV)	Ik'' (KA)	Ip (KA)	Rated Capacity Ik'' (KA)
1	Grid Station Bus	11KV	12.646	12.646	25
2	SW +J2	11KV	0.142	0.142	25
3	SW +J1	11KV	12.119	12.119	25
4	SW +J3	11KV	0.142	0.142	25
5	ETP 251 - 3311	11KV	10.335	10.335	25
6	CTMP (621,631,671)	11KV	11.286	11.286	25
7	Coater 771 - 3311	11KV	11.362	11.362	25
8	Straw handling and Water Supply	11KV	0.142	0.142	25
9	Utilities (371 391)	11KV	0.142	0.142	25
10	PM-6 766	11KV	0.142	0.142	25
11	Stock Prep 736 OCC 712 and Chem prep 737	11KV	0.142	0.142	25
12	631-3312	11KV	11.246	11.246	25
13	DIP 711	11KV	0.142	0.142	25
14	PM-7 (767)	11KV	0.142	0.142	25
15	41MW Turbine + 200TPH Boiler	11KV	0.142	0.142	25
16	New Refiner for Tetra 713	11KV	0.142	0.142	25
17	Stock Prep	11KV	0.142	0.142	25
18	Pulper Refiner Motors 736	11KV	0.142	0.142	25
19	HT Room DIP	6KV	3.737	3.737	NA

Case – 5

Results of MV Buses:

Table 3.14 1-Phase Maximum Short Circuit Levels – Case 5

S.No	Bus Name	Voltage Level (kV)	I"k (KA)	3I0k (KA)	Rated Capacity Ik (KA)
1	Grid Station Bus	11KV	15.393	15.393	25
2	SW +J2	11KV	14.750	14.750	25
3	SW +J1	11KV	14.750	14.750	25
4	SW +J3	11KV	0.140	0.140	25
5	ETP 251 - 3311	11KV	12.082	12.082	25
6	CTMP (621,631,671)	11KV	13.459	13.459	25
7	Coater 771 - 3311	11KV	13.590	13.590	25
8	Straw handling and Water Supply	11KV	13.312	13.312	25
9	Utilities (371 391)	11KV	14.618	14.618	25
10	PM-6 766	11KV	13.514	13.514	25
11	Stock Prep 736 OCC 712 and Chem prep 737	11KV	13.048	13.048	25
12	631-3312	11KV	13.400	13.400	25
13	DIP 711	11KV	0.140	0.140	25
14	PM-7 (767)	11KV	0.140	0.140	25
15	41MW Turbine + 200TPH Boiler	11KV	0.140	0.140	25
16	New Refiner for Tetra 713	11KV	0.140	0.140	25
17	Stock Prep	11KV	0.140	0.140	25
18	Pulper Refiner Motors 736	11KV	13.045	13.045	25
19	HT Room DIP	6KV	3.716	3.716	NA

3.8 1 Phase Minimum Short Circuit Calculation

Following operating scenarios have been simulated for 1 phase minimum short circuit calculations:

Cases	41MW Steam Turbine	WAPDA
Case 1	ON	OFF

Results of MV Buses:

Table 3.15 1-Phase Minimum Short Circuit Levels

S.No	Bus Name	Voltage Level (KV)	Ia (KA)	3I0 (KA)	Rated Capacity Ir (KA)
1	Grid Station Bus	11KV	0.132	0.132	25
2	SW +J2	11KV	0.133	0.133	25
3	SW +J1	11KV	0.133	0.133	25
4	SW +J3	11KV	0.133	0.133	25
5	ETP 251 - 3311	11KV	0.132	0.132	25
6	CTMP (621,631,671)	11KV	0.132	0.132	25
7	Coater 771 - 3311	11KV	0.132	0.132	25
8	Straw handling and Water Supply	11KV	0.132	0.132	25
9	Utilities (371 391)	11KV	0.133	0.133	25
10	PM-6 766	11KV	0.132	0.132	25
11	Stock Prep 736 OCC 712 and Chem prep 737	11KV	0.132	0.132	25
12	631-3312	11KV	0.132	0.132	25
13	DIP 711	11KV	0.132	0.132	25
14	PM-7 (767)	11KV	0.132	0.132	25
15	41MW Turbine + 200TPH Boiler	11KV	0.133	0.133	25
16	New Refiner for Tetra 713	11KV	0.132	0.132	25
17	Stock Prep	11KV	0.132	0.132	25
18	Pulper Refiner Motors 736	11KV	0.132	0.132	25
19	HT Room DIP	6KV	2.747	2.747	NA

4. LOAD FLOW ANALYSIS

4.1 Introduction

Every load flow problem specifies a system of non-linear equations with no direct solution. Iterative methods, such as current iteration or the Newton-Raphson method, are the only methods that remain. With PSS® SINCAL, either of these procedures can be used.

Newtonian procedures solve problems through iteration by beginning with an initial solution to the desired solution. This solution is improved step by step in order to obtain a linearized statement. Corrections to the voltage rate and the voltage angle are calculated from the active and reactive power still at variance with the prescribed values.

In the normal operation scenario, the load shall be fed by the power transformer from the grid and the 41MW steam turbine. The total load requirement of network is of about 25 MW. All the continuous running motors are considered in load flow study. However, the standby load is disconnected from the system to achieve the real loading of the network. The onload tap changer of the power transformers are modeled to keep the voltages within 99% to 101% at the main 11kV busbars.

Load flow study has been carried out to verify:

- The voltage drops at all main LV bus-bars.
- Loading of generator, transformers, cables etc.
- Active and reactive power flow in the network.

4.2 Load Flow Scenarios and Results

The voltage profiles results from load flow results are tabulated below. For detailed results at each node, active and reactive power flow and percentage current loadings of MV cables in the branches and motor power consumptions, please refers Annex-A.

For load flow analysis the following color coding have been used to check the components loadings and voltage profile on buses.

Black: OK.

Red: Network element exposed to heavy loading based on its rated capacity / Voltages on the network buses drop to less than 95% of the rated values.

- For Transformer loading

S/Sb < 90[%]

S/Sb > = 90[%]

- For Cables with applied derating factors

I/Ib < 95[%]

I/Ib ≥ 95[%]

- For Bus Bar Voltages

V/Vn < 95[%]

V/Vn ≥ 95[%]

The voltage and the voltage profile of the network at specified locations are shown in the table below.

Following cases have been simulated for load flow calculations

Following operating scenarios have been simulated for 3 phase short circuit calculations:

Cases	41MW Steam Turbine	WAPDA
Case 1	ON	OFF
Case 2	OFF	ON
Case 3	ON	ON
Case 4	ON (J2 + J3)	ON (J1)
Case 5	ON (J3)	ON (J1 + J2)

Case – 1

Table 4.1 Voltage Profile at all Main Buses Case 1

No	Name of Bus / Node	Network Voltage Level [kV]	V/Vn(%)
1	Grid Station Bus	11KV	99.98
2	SW +J2	11KV	99.94
3	SW +J1	11KV	99.94
4	SW +J3	11KV	99.94
5	ETP 251 - 3311	11KV	99.91
6	CTMP (621,631,671)	11KV	99.93
7	Coater 771 - 3311	11KV	99.93
8	Straw handling and Water Supply	11KV	99.93
9	Utilities (371 391)	11KV	99.94
10	PM-6 766	11KV	99.81
11	Stock Prep 736 OCC 712 and Chem prep 737	11KV	99.78
12	631-3312	11KV	99.93
13	DIP 711	11KV	99.91
14	PM-7 (767)	11KV	99.84
15	41MW Turbine + 200TPH Boiler	11KV	99.94
16	New Refiner for Tetra 713	11KV	99.87
17	Stock Prep	11KV	99.93
18	Pulper Refiner Motors 736	11KV	99.78
19	HT Room DIP	6KV	99.64

*V/Vn = Node Voltage / Rated Node Voltage

For detailed results, please refer Annex A.

The power loading for all the transformers for Case 1 is as follows:

Table 4.2 Transformer loading Case 1

S.No	Element Name	Sb (KVA)	S/Sb (%)	Active Power P (KW)	Reactive power Q (KVAR)
1	842-3351	2.5	23.36	0.49	0.31
2	251-3351	2	13.20	223.41	140.61
3	251-3352	2	9.41	159.55	99.97
4	251-3353	2	11.07	187.48	117.71
5	Tube Well No3	0.25	5.64	11.96	7.46
6	Tube Well No 4	0.25	5.64	11.96	7.46
7	771-3351	2.5	5.21	110.54	68.94
8	771-3352	2.5	5.21	110.55	68.94
9	771-3353	2.5	6.78	143.74	89.82
10	771-3354	2.5	9.35	198.01	124.16
11	771-3355	3	8.17	207.80	130.22
12	631-3351	2	10.73	132.37	168.90
13	671-3351	2	8.32	102.71	130.81
14	841-3351	2	7.06	122.46	70.10
15	481-3351	2	28.04	518.08	214.46
16	351-3351	2	14.11	261.55	105.81
17	371-3351	2	5.14	89.23	50.90
18	391-3352	2	36.97	635.78	377.47
19	766-3359	2	22.11	395.51	197.91
20	766-3358	2	18.00	322.37	160.31
21	799-3357	2	71.56	1261.51	675.92
22	799-3356	2	5.89	105.82	51.69
23	766-3355	2	49.82	884.06	459.62
24	766-3354	2	40.05	712.74	365.52
25	766-3353	2	19.74	353.25	176.13
26	766-3352	2	24.91	445.26	223.49
27	766-3360	2	41.67	741.28	380.89
28	766-3351	2	26.01	464.80	233.50
29	712-3352	2	42.49	694.57	489.64
30	737-3351	2	16.41	270.89	185.41
31	712-3351	2	64.00	1038.58	748.05

32	736-3351	2	37.09	607.82	425.40
33	711-3351	3	6.81	187.39	81.07
34	711-3352	2	14.71	269.74	117.57
35	722-3352	2	10.62	195.00	84.43
36	711-3354	2	17.30	316.87	138.76
37	722-3351	2	15.07	276.36	120.51
38	371-3352	3	24.57	658.95	330.04
39	371-3353	3	22.78	611.40	305.52
40	371-3354	2	27.56	492.30	247.83
41	391-3351	2	18.93	331.25	183.32
42	767-3351	2	36.94	464.58	574.57
43	767-3352	3	62.21	1158.94	1462.96
44	767-3353	3	56.52	1055.93	1326.84
45	767-3354	2	40.97	514.54	637.59
46	767-3355	2.5	46.64	729.53	909.47
47	767-3356	3	24.57	466.35	570.67
48	767-3357	2.5	37.38	587.36	726.75
49	737-3352	2	21.42	387.64	182.50
50	736-3352	2.5	26.32	541.44	374.02
51	736-3353	2.5	26.32	541.44	374.02
52	371-3355	2	21.28	380.75	189.97
53	713-3352	2	35.15	575.10	404.44

*S/Sb = MVA Loading

For detailed results, please refer Annex A.

The power loading of the steam turbine is as follows:

S. No	Element Name	Sb (MVA)	*S/Sb (%)	Active Power P (MW)	Reactive power Q (MVAR)	PF
1	Steam Turbine	48.235	59.78	24.94	14.48	0.86

For detailed results, please refer Annex A.

Case – 2

Table 4.3 Voltage Profile at all Main Buses Case 2

S.No	Name of Bus / Node	Network Voltage Level [kV]	V/Vn(%)
1	Grid Station Bus	11KV	99.82
2	SW +J2	11KV	99.28
3	SW +J1	11KV	99.28
4	SW +J3	11KV	99.28
5	ETP 251 - 3311	11KV	99.25
6	CTMP (621,631,671)	11KV	99.26
7	Coater 771 - 3311	11KV	99.26
8	Straw handling and Water Supply	11KV	99.26
9	Utilities (371 391)	11KV	99.28
10	PM-6 766	11KV	99.14
11	Stock Prep 736 OCC 712 and Chem prep 737	11KV	99.11
12	631-3312	11KV	99.26
13	DIP 711	11KV	99.25
14	PM-7 (767)	11KV	99.17
15	41MW Turbine + 200TPH Boiler	11KV	99.27
16	New Refiner for Tetra 713	11KV	99.20
17	Stock Prep	11KV	99.26
18	Pulper Refiner Motors 736	11KV	99.11
19	HT Room DIP	6KV	98.97

*V/Vn = Node Voltage / Rated Node Voltage

For detailed results, please refer Annex A.

The power loading of power transformers is as follows:

S. No	Element Name	Sb (MVA)	*S/Sb (%)	Active Power P (MW)	Reactive power Q (MVAR)	PF
1	Grid TR	26	122.32	25.21	19.39	0.79

For detailed results, please refer Annex A.

Case – 3

Table 4.4 Voltage Profile at all Main Buses Case 3

S.No.	Name of Bus/ Node	Network Voltage Level [kV]	V/Vn(%)
1	Grid Station Bus	11KV	100.95
2	SW +J2	11KV	100.91
3	SW +J1	11KV	100.91
4	SW +J3	11KV	100.91
5	ETP 251 - 3311	11KV	100.88
6	CTMP (621,631,671)	11KV	100.89
7	Coater 771 - 3311	11KV	100.89
8	Straw handling and Water Supply	11KV	100.89
9	Utilities (371 391)	11KV	100.91
10	PM-6 766	11KV	100.77
11	Stock Prep 736 OCC 712 and Chem prep 737	11KV	100.75
12	631-3312	11KV	100.89
13	DIP 711	11KV	100.88
14	PM-7 (767)	11KV	100.81
15	41MW Turbine + 200TPH Boiler	11KV	100.90
16	New Refiner for Tetra 713	11KV	100.84
17	Stock Prep	11KV	100.89
18	Pulper Refiner Motors 736	11KV	100.75
19	HT Room DIP	6KV	100.60

*V/Vn = Node Voltage / Rated Node Voltage

The power loading of power transformers and the steam turbine is as follows:

S.No.	Element Name	Sb (MVA)	*S/Sb (%)	Active Power P (MW)	Reactive power Q (MVAR)	PF
1	Grid TR	26	1.83	0.45	-0.13	-0.96
2	Steam Turbine	48.24	59.1	24.5	14.54	0.86

For detailed results, please refer Annex A.

Case – 4

Table 4.5 Voltage Profile at all Main Buses Case 4

S No.	Name of Bus / Node	Network Voltage Level (kV)	V/Vn(%)
1	Grid Station Bus	11KV	100.43
2	SW +J2	11KV	99.95
3	SW +J1	11KV	100.38
4	SW +J3	11KV	99.95
5	ETP 251 - 3311	11KV	100.35
6	CTMP (621,631,671)	11KV	100.37
7	Coater 771 - 3311	11KV	100.36
8	Straw handling and Water Supply	11KV	99.93
9	Utilities (371 391)	11KV	99.94
10	PM-6 766	11KV	99.81
11	Stock Prep 736 OCC 712 and Chem prep 737	11KV	99.78
12	631-3312	11KV	100.37
13	DIP 711	11KV	99.91
14	PM-7 (767)	11KV	99.84
15	41MW Turbine + 200TPH Boiler	11KV	99.94
16	New Refiner for Tetra 713	11KV	99.87
17	Stock Prep	11KV	99.93
18	Pulper Refiner Motors 736	11KV	99.78
19	HT Room DIP	6KV	99.64

*V/Vn = Node Voltage / Rated Node Voltage

The power loading of power transformers and the steam turbine is as follows:

S No.	Element Name	Sb (MVA)	S/Sb (%)	Active Power P (MW)	Reactive Power Q (MVAR)	PF
1	Grid TR	26	9.74	2.38	-0.86	0.94
2	Steam Turbine	48.24	56.65	22.58	15.39	0.83

For detailed results, please refer Annex A.

Case – 5

Table 4.6 Voltage Profile at all Main Buses Case 5

S.No.	Name of Bus / Node	Network Voltage Level (kV)	V/Vn(%)*
1	Grid Station Bus	11KV	100.83
2	SW +J2	11KV	100.55
3	SW +J1	11KV	100.55
4	SW +J3	11KV	99.97
5	ETP 251 - 3311	11KV	100.51
6	CTMP (621,631,671)	11KV	100.53
7	Coater 771 - 3311	11KV	100.53
8	Straw handling and Water Supply	11KV	100.53
9	Utilities (371 391)	11KV	100.54
10	PM-6 766	11KV	100.41
11	Stock Prep 736 OCC 712 and Chem prep 737	11KV	100.38
12	631-3312	11KV	100.53
13	DIP 711	11KV	99.94
14	PM-7 (767)	11KV	99.87
15	41MW Turbine + 200TPH Boiler	11KV	99.97
16	New Refiner for Tetra 713	11KV	99.90
17	Stock Prep	11KV	99.95
18	Pulper Refiner Motors 736	11KV	100.38
19	HT Room DIP	6KV	99.66

*V/Vn = Node Voltage / Rated Node Voltage

The power loading of power transformers and the steam turbine is as follows:

S. No.	Element Name	Sb (MVA)	S/Sb (%)	Active Power P (MW)	Reactive power Q (MVAR)	PF
1	Grid TR	26	60.43	14.05	7.04	0.89
2	Steam Turbine	48.24	28.99	10.97	8.67	0.78

For detailed results, please refer Annex A.

5. OBSERVATIONS & RECOMMENDATIONS

5.1 Observations

The electrical network of Bulleh Shah Packaging has been evaluated for different operational scenarios for breach in the short circuit ratings as well as the continuous ratings of the network elements.

Following are our observations and recommendations with respect to Short Circuit and load flow Calculations:

Short circuit Calculations

Short circuit results show that for 3 phase and 2phase faults, the initial symmetrical short circuit current as well as the peak fault current will exceed the rated capacity of the MV bus bars in all cases.

It is also observed that all LV switchgears are adequately sized with respect to the short circuit levels except the LV substation of transformer 771-3354. The maximum short circuit levels on this switchgear are about 55KA.

It is observed that by dividing the network into two islands, the fault levels on the MV switchgears supplied by WAPDA (J1 in case 4 and J1 and J2 in case 5) are under the permissible range.

The existing fault level on the switchgears necessitates measures to mitigate the short circuit levels.

Load Flow Analysis:

Load flow conditions show that the voltage profile on all bus bars is within the permissible range (95% to 105%). Equipment loadings are also within permissible range.

However it is observed that the main grid transformer can not supply the load for the whole plant (case 2).

The load flow conditions are found acceptable in general. All system components loadings and voltage profiles are observed to be within permissible operating ranges.

5.2 Recommendations

It is observed that by operating the plant in two islands as in case 3, switchgear J1 and J2 are safe with respect to the maximum fault levels. However under this scheme the full capacity of the steam turbine cannot be utilized and the fault levels on switchgear J3 are not under the safe limits.

It is recommended to install a fast current limiting device on the coupler of J2 and J3 and further shift Dinking Plant 711 and Stock Prep (737) to switchgear J2. Under the short circuit conditions the limiter will operate and divide the network into two islands. The power sources on both the islands are sufficient to supply the load in post fault conditions.

However it is to be noted that as the fault levels on all the substations are exceeding the rated values, the limiter would need to trip on all MV Faults.

It is also recommended to upgrade the LV switchgear for 771-3354 to at least 65KA.

ANNEXURE M (i) - ENVIRONMENTAL APPROVAL

ENVIRONMENT PROTECTION DEPARTMENT

Government of the Punjab
National Hocky Stadium, Lahore.

TO BE SUBSTITUTED WITH LETTER BEARING SAME NUMBER & DATE

NO. DD(EIA)/EPA/F-127(IEE)/1412/2012/337
Dated: 06 / 04 / 2017

To

Syed Aslam Mehdi,
Chief Executive Officer,
Bulleh Shah Packaging (Pvt.) Limited,
7-KM, Kot Radha Kishan Road,
District Kasur.

Subject: **APPROVAL FOR OPERATIONAL PHASE / CONFIRMATION OF COMPLIANCE UNDER REGULATION 14 OF IEE/EIA REGULATIONS, 2000 FOR THE PROJET "30 MW BIOMASS FIRED BOILER, BULLEH SHAH PAPER MILLS, KASUR"**

1. Description of Project: Operational Phase of 30 MW Bio Mass Fired Boiler.
2. Location of Project: Bulleh Shah Packaging (Pvt.) Limited (Paper Mill), 7-KM, Kot Radha Kishan Road, District Kasur.

3. EPA Punjab has reviewed the Compliance Status Report of Environmental Approval issued vide letter No. DD(EIA)/EPA/F-127(IEE)/2012/1506/401 dated 27.06.2012 and considered the Site Inspection Report received from Assistant Director (Field), Kasur vide letter No. 528/DOE/KSR dated 27.10.2016. EPA Punjab has also considered the recommendations of **EA Committee** (Meeting dated 22.03.2017) and other relevant record, before taking decision regarding issuance of "Confirmation of Compliance" / approval for operational phase.

4. **EPA, Punjab accords Confirmation of Compliance / Approval for operational phase of the said project / unit.** The proponent of the project shall follow the following conditions during the **"Operational Phase"** of the project.

i. The proponent shall ensure compliance of Punjab Environmental Quality Standards (PEQS) during operation of the project / unit.
ii. The proponent shall ensure the compliance of conditions contained in the Environmental Approval issued vide letter No. DD(EIA)/EPA/F-127(IEE)/2012/1506/401 dated 27.06.2012 and applicable to the operational phase of the project.
iii. Mitigation Measures suggested in the IEE report and Environmental Management & Monitoring Plan (EMMP) shall be strictly adhered to minimize any negative impacts on soil, ground water, air and biological resources of the project area.
iv. Monitoring shall be carried out regularly and Monitoring Reports shall be submitted to EPA Field office on quarterly basis.
v. The proponent shall ensure that strict and efficient health and safety measures are in place for protection of workers backed by a comprehensive emergency response system.
vi. The proponent shall be responsible for adopting appropriate mitigation measures for controlling anticipated environmental hazards.
vii. The solid waste shall be retained within the unit boundary / premises and shall be disposed of in an environmental friendly way at a suitable disposal facility.
viii. The proponent shall install Ambient Air Quality Monitoring Station within 6 months with online access to EPA Punjab.
ix. The proponent shall install SCADA and maintain record for verification by EPA.
x. Proper system for covering of biomass shall be devised.
xi. Proper storage place shall by devised for storage of full material.

ASSISTANT DIRECTOR (EIA)
for Director General, EPA, Punjab
Ph: (042)99232285

CC

A copy is forwarded to Assistant Director (Field), Kasur w.r.t. letter No. 528/DOE/KSR dated 27.10.2016. He is requested to ensure compliance of the conditions mentioned in the Environmental Approval and maintain the file / record of correspondence with the project proponent properly.

ANNEXURE M (ii)- ENVIRONMENTAL REPORT

Executive Summary

EXECUTIVE SUMMARY:

1. PROJECT DESCRIPTION

1.1 Introduction

As a result of serious power shortage of electric power, load sheddings are so frequent in Pakistan. The gap between power supply and demand is further on the increase. Consequently, all walks of life are being adversely affected. Pakistan has an installed electric generating capacity of about 19,400 MW. Projection for the demand in year 2030 is forecasted to be 100,000 MW.

Pakistan is energy deficit country. Fossil fuels are already in short supply, and their local availability is fastly depleting alongwith price hike taking place during very short intervals of time. On the other hand, their industrial, domestic and other multifarious usages are also fast on the increase. Import bills of the fossil fuels are swelling at a very fast rate due to their fast increasing demand in the country.

In 2005, Packages Limited, Lahore initiated a new project under the name Bulleh Shah Pulp and Paper Mill **(BSPPM)** in Kasur, located 50 km south of Lahore which later on became Bulleh Shah Packaging Private Limited (BSPPL) after joint venture with Stora Enso (Finnish pulp and paper manufacturer). BSPPL site spreads over 300 acres and consists of two paper machines PM-6 and PM-7 enabling to increase paper and paperboard production from 100,000 to 300,000 tones per year.

Operation of BSPPL is contingent on reliable supply of electricity from Water and Power Development Authority (**WAPDA**) and gas fuel supply from Sui Northern Gas Pipe Lines (**SNGPL**) limited.

Currently, BSPPL is equipped with one gas / Heavy Furnace Oil (HFO) fired 200 tph steam (about 41-MW) and one smaller gas / Heavy Furnace Oil (HFO) fired boiler (about 65 tph) to meet its internal plant power and steam needs.

The on-going power supply shortage in the country and also compounded by scarcity of natural gas deliveries by SNGPL are causing a significant loss of production at BSPPL resulting in a negative economic impact for the company.

Increase in energy cost i.e. the gas price escalation from Rs. 172.0/mmbtu to Rs.400-/mmbtu during July 2003 to July 2010 and exuberantly price hike in electricity rate besides their acute shortage/non availability, has compelled the management of BSPPL to seek alternative options to be self-sufficient in their present electricity needs.

Bulleh Shah Packaging (BSPPL), with offices located at Packages Lahore and BSPPL Kasur is in the process of installing a BIOMASS BASED BOILER in the vicinity of their Bulleh Shah Packaging near Kasur City, in the Province of Punjab, Pakistan. BSPPL present requirement of steam and electricity is being met through two main boilers:

- 200 tonnes per hour (tph) – high pressure boiler (natural gas and heavy fuel oil fired).
- 65 tph – medium pressure boiler (natural gas & heavy fuel oil fired).

BSPPL is proposing to install a 150 tonnes per hour (tph) biomass based boiler to supply high pressure super-heated steam at 525 °C temperature and 95 bar pressure at turbine inlet. The proposed Biomass Boiler will be using water cooled vibrating grate technology.

New biomass based boiler, to be installed in the vicinity of BSPPL, will be environmentally friendly, replacing the present use of fossil fuels and providing

optimum supply of steam and electricity for BSPPL's two paper & board manufacturing plants.

This SEIA Report has been prepared for the Proposed Project keeping in line with the IFC Guidelines for such SEIA reports.

Project Location

BSPPL is located off Kasur – Madina Town – Raiwind Road. The project site, located in the vicinity of BSPPL, is at an altitude of about 205 meters above mean sea level. The global co-ordinates of the plant is 31° 07'45.12" N (latitude) and 74°21'28.8" E (Longitude)) as indicated in Figure – E.1.

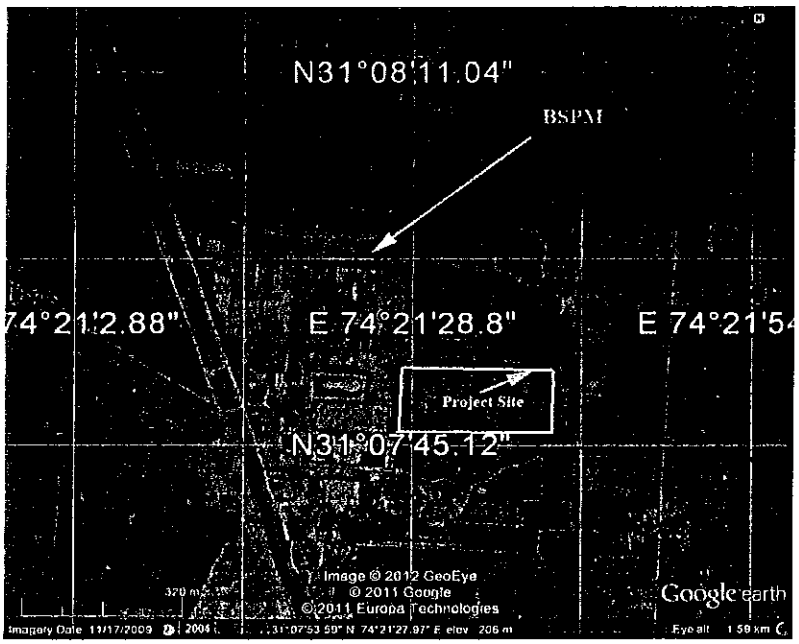


Figure – E.1

[Courtesy: Google Earth]

Sufficient land, owned by Packages Group is available for the Biomass Boiler installation. Proposed Project's layout plan is as below:

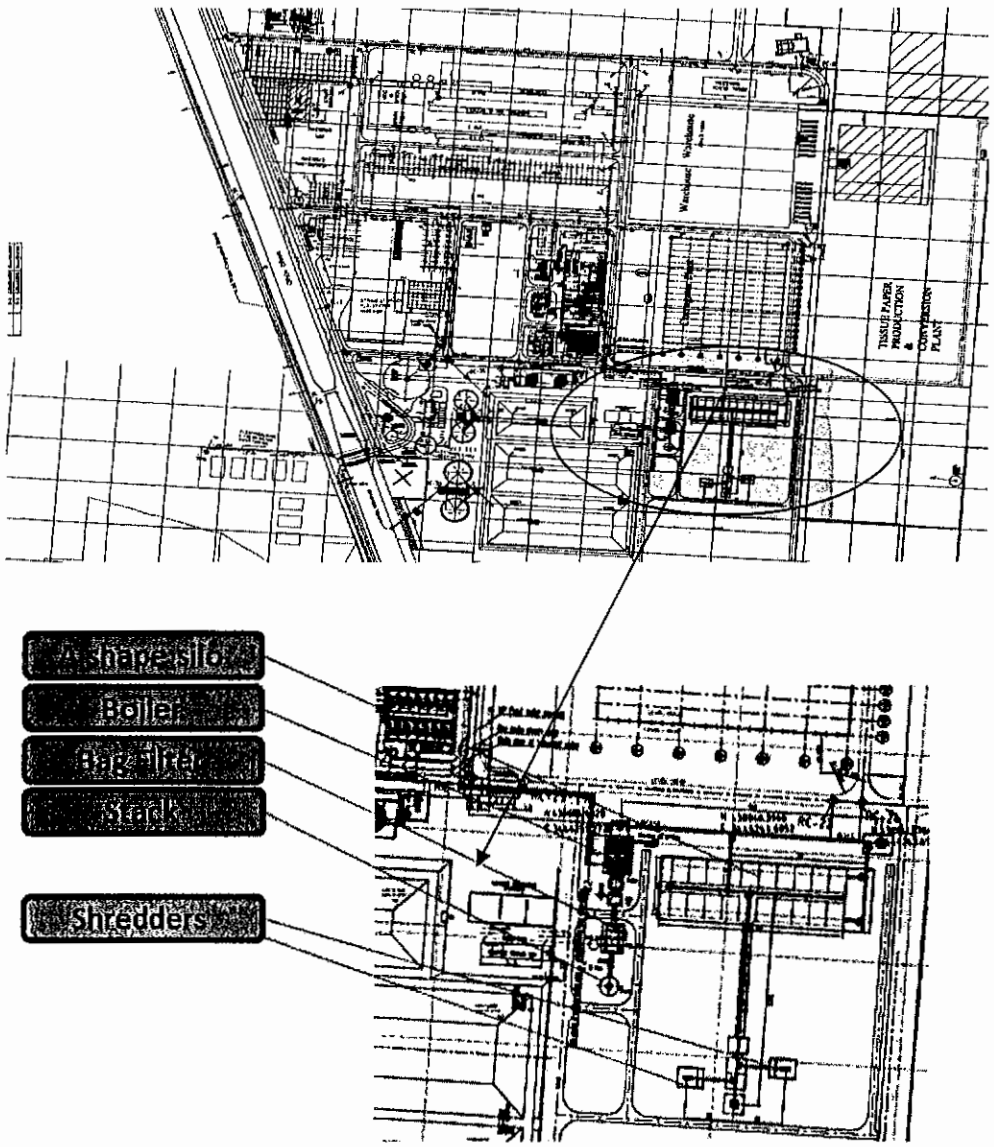


Figure – E.2

[Source: COWI A/S Study]

1.2 Products Processed

The proposed plant has installed capacity to generate 150 tonnes per hour high pressure steam using biomass as fuel. The steam will be supplied to BSPPL for generation of electricity through an existing steam turbine and for process requirements.

Simplified mass balance of the Proposed Project is indicated in Figure – E.3, below:

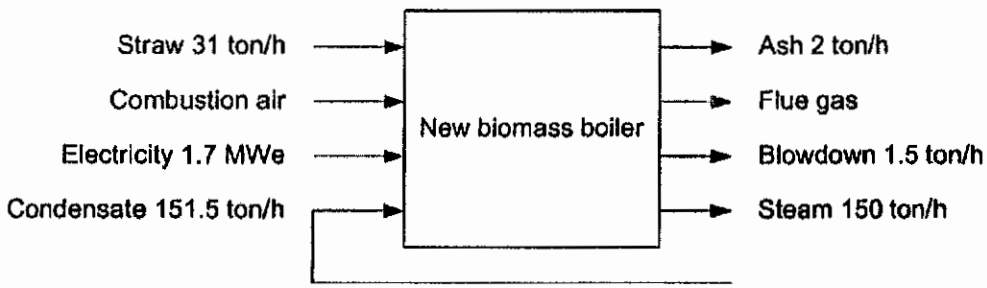


Figure – E.3
Simplified Mass Balance of Biomass Boiler
[Source: COWI A/S]

1.3 Fuel

Project feasibility titled **"Feasibility Study for Biomass Cogeneration at Bulleh Shah Packaging Private Limited (BSPPL)" (December 2011),** prepared by **COWI Consulting Group** has **selected** the following biomasses for use as fuel for the Proposed Project:

- Wheat straw
- Corn Stover
- Cottons stalks

This study has recommended the following requirement of biomass based on harvesting times and minimizations of storage needs as well as transportation distance (based on 100% capacity utilization and 120 MW thermal inputs):

Table – E.1
Residual Biomass and Consumption

Operating year	Feedstock	Amounts (tonnes per year)
1 - 3	Wheat	250,000
4 - rest of planning period	Wheat	48,000
	Corn stover	150,000
	Cotton stalks	52,000
	Total	250,000

[Source: AEIA/COWI Studies]

Packages Group has been using agricultural residual waste (wheat & rice straws) as primary feedstock for their paper & pulp mills at Packages Limited, Lahore and BSPPL (Kasur). The collection of feedstock has been earlier established since inception of Packages Limited plant at Lahore and later on for BSPPL.

Availability of biomass at 100 – 300 kilometers radius from plant site is shown in Table – E.2

Table – E.2

Crop	Distance from BSPPL		
	100 km	200 km	300 km
	Availability of Biomass, Tonnes		
Corn Stovers	566,000	1,762,000	2,148,000
Cotton Stalks	23,000	281,000	909,000
Rice Straw	222,000	666,000	727,000
Wheat Straw	217,000	821,000	1,322,000
Sugar Cane – Trash	87,000	439,000	579,000
TOTAL	**1,115,000**	**3,969,000**	**5,685,000**

[Source: Punjab Agriculture Department]
(70 % biomass residue collection efficiency assumed)

Collection and delivery system for the feedstock has been well established. Biomass deliveries are being made both in bulk and baled form by large and small road trucks as well as tractor trolleys. At present BSPPL consumes about 300,000 tonnes per annum of biomass when operating at 100% capacity.

AEIA Study analysis shows that within a 100 km radius of BSPPL about 1.4 million tonnes/year of agricultural waste is available. At present the biomass in this area is being used for animal fodder, fuel for brick kilns and small scale biomass boilers.

It has been proposed by AEIA and COWI A/S (Project Consultants) that the Proposed Project should establish biomass collection centers, most with baling arrangement at the center for ease of handling and cost of delivery. Such arrangement will also reduce generation of fugitive dust during transportation and will be environmental friendly. Calorific values of various biomass is shown below:

Table – E.3

Calorific Value of Biomasses

Calorific Value		
	HHV(MJ/kg)	**LHV(MJ/kg)**
	Experiment	**Experiment**
Cotton Stalks	16.42	15.01
Corn Straw	16.35	14.96
Cane Trash	15.30	13.92
Rice Straw	14.04	12.86
Wheat Straw	15.5	14.14
Corn Cob	16.66	15.24

[Source: DANAK Study]

Biomass fuel data:	Unit	Data, nominal	Data, worst case
Type:		Wheat straw Corn stover Cotton stalks	Wheat straw Corn stover Cotton stalks
Calorific Value:	MJ/kg	14	11.7
Bale data:			
length:	M	0.6-2.5	0.6-2.5
width:	M	0.5-1.2	0.5-1.2
height:	M	0.5-0.875	0.5-0.875
Bale Volume:	m^3	0.15-2.6	0.15-2.6
Baled Density:	kg/m^3	150-250	150-250
Bale weight:	Kg	30-700	30-700
Loose (bulk) Density:	kg/m^3	55	55
Boiler data:			
Biomass consumption	MW	120	120
Operating hours (fuel handling design)	hours/year	8,000	8,000
Biomass per hour:	Ton	30.9	36.9
Biomass pr. Day	Ton	741	886
Biomass per year	Ton	247,000	295,000
A-shed storage capacity	Days	1.5	1.5
Nearby store capacity	Days	9	9
Shredder capacity	%	2 x 100	
Main conveyor capacity	%	2 x 100	

Source: COWI Feasibility Study

Presently, Packages Group operates seven collection centers and also receives wheat straw directly at both the BSPPL and Packages Limited. This delivered wheat straw is utilized for the pulp & paper production. The collection system is working very well. Packages Group enters into an annual agreement with a farmer's broker to deliver the wheat biomass at a fixed price. This agreement is renewed annually and a fair price for delivery of the wheat straw is negotiated.

1.5 Steam Generation Process

The Proposed Project will install Biomass Fired High Pressure Boilers. Simplified process scheme is presented below:

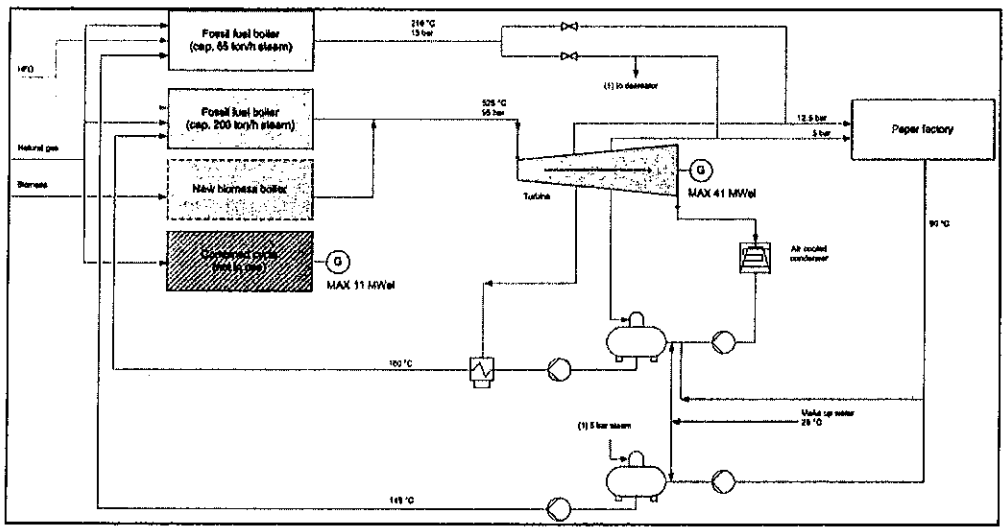


Figure – E.4

The proposed boiler will have a stack with a height of 100 meters. Fabric bag filters will be installed to bring the particulate matter to less than 50 mg/Nm^3 as set by the IFC/World Bank standards. All the ash will be collected in storage silo having a suitable capacity & will be disposed-off by, for use as fertilizer and refractory brick manufacture.

1.6 Water

The site will require make up and cooling water for the operation. The water requirement of the proposed plant is to be met from existing sources as the Biomass Boiler will replacing the operationof existing boilers at BSPPL.

1.7 Waste Water Treatment

Liquid effluents generated in the Biomass Boiler including boiler blowdown water, water from washrooms etc. will be treated in BSPPL existing waste water treatment plant to meet the requirements of IFC and NEQS Pakistan.

2. DESCRIPTION OF THE ENVIRONMENT

2.1 Climate

The climate of the Kasur district area (the project site) experiences the mean monthly temperature 26.80°C (minimum) and 41.0°C (maximum) during hottest month while mean monthly minimum temperature is registered to be 5.10°C and maximum temperature is 19.30°C during the coldest month. The area under reference falls in the tropical arid or desert climate region.

The area receives 250 – 500 mm mean annual rainfall. The rainfall during July to December is registered between 200 – 400 mm and during December to March 50 – 100 mm

2.2 Land Use

Area around the project site is under agriculture use up to over large distances. A few brick kilns operate. A few small scale industries, including cotton yarn manufacturing, exist near the project site. The future trend is showing industrialization as encouraged by the Government also.

2.3 Ecology

There is no endangered species of flora and fauna noticed in this area. The area does not shelter any specific wildlife.

2.4 Hydrological Conditions

2.4.1 Surface water

The run-off during monsoon period contributes to the surface water. There is no perennial stream or river in the surrounding villages. These villages get water from open wells and bore wells which get recharged in rainy season and nearby irrigation canal system.

2.4.2 Ground Water

The proposed Biomass Boiler will be located in the area which is being fed by an elaborate irrigation canal system and rain water, with the result that ground water aquifer is being regularly replenished. Shortage of ground water is not expected. Moreover, the Proposed Project will not be requiring water as it will be replacing existing boilers at BSPPL.

2.5 Ambient Air Quality & Noise Level

The ambient air quality was studied at six locations on and around the BSPPL & Project site. The data is presented below.

Table – E.4

Ambient Monitored Data from Project Site

Range	PM ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	CO (mg/m^3)
Lowest	45.90	15.30	20.30	0.12
Highest	85.40	36.40	48.60	0.42
Average	66.52	26.27	33.83	0.23
NEQS Limits	**550.00**	**120.00**	**80.00**	**10.00**

Noise level data, collected at 26 points at BSPPL and surroundings, ranges at 46.26 to 78.16 dB(A) with an average of 65.15 dB(A). This data is in compliance with the prescribed limit of 85 dB(A) by the National Environment Quality Standards (NEQS), Pakistan and 70 dB(A) by the World Bank.

Air Dispersion Modeling (ADM):

Detailed air dispersion modeling has been undertaken using "SCREEN 3" Model. SCREEN 3 uses a Gaussian plume model that incorporates source related factors and meteorological factors to estimate pollutant concentration from point sources continuously.

Data used for ADM is presented below:

Table – E.5

Fuel	Biomass		
Parameters	PM_{10}	NOx	SO_2
Air Dispersion Model - Input Data			
- Source Type	Point	Point	Point
- Stack Height, meters	100.00	100.00	100.00
- Stack Diameter, meters	2.00	2.00	2.00
- Stack Exit Velocity, m^3/s	42.72	42.72	42.72
- Emission Rate, gm/s	2.14	17.09	10.68
- Stack Gas Temperature, °K	413.15	413.15	413.15
- Rural/Urban Option	Rural	Rural	Rural

The air dispersion model was run using the above mentioned data. A consolidated statement of the results of model run, using various average ambient temperatures, is presented in Table – E.6.

Table – E.6

Summary Results of "AIR DISPERSION MODELLING"

Average Ambient Temperature	30 °C			45 °C			10 °C		
Parameters	PM_{10}	NOx	SO_2	PM_{10}	NOx	SO_2	PM_{10}	NOx	SO_2
A - Air Dispersion Model - Input Data									
- Source Type	Point	Point	Point	Point	Point	Point	Point	Point	Point
- Stack Height, meters	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
- Stack Diameter, meters	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
- Volume Flow Rate, M3/s	42.72	42.72	42.72	42.72	42.72	42.72	42.72	42.72	42.72
- Emission Rate, gm/s	2.14	17.09	10.68	2.14	17.09	10.68	2.14	17.09	10.68
- Stack Gas Temperature, K	413.15	413.15	413.15	413.15	413.15	413.15	413.15	413.15	413.15
- Ambient Air Temperature, K	303.00	303.00	303.00	318.15	318.15	318.15	283.15	283.15	283.15
- Rural/Urban Option	Rural	Rural	Rural	Rural	Rural	Rural	Rural	Rural	Rural
B - Air Dispersion Model - Output Data									
- Final Stable Plume Height, meters	365.50	365.50	365.50	337.61	337.61	337.61	400.63	400.63	400.63
- Distance to Final Rise, Meters	193.67	193.67	193.67	185.23	185.23	185.23	204.26	204.26	204.26
- Stack Velocity, M/S	13.60	13.60	13.60	13.60	13.60	13.60	13.60	13.60	13.60
- Buoyancy Flux, M^4/S^3	35.55	35.55	35.55	30.66	30.66	30.66	41.96	41.96	41.96
- Momentum Flux, M^4/S^2	135.61	135.61	135.61	142.39	142.39	142.39	126.73	126.73	126.73
- Meteorology	Full	Full	Full	Full	Full	Full	Full	Full	Full
- Terrain	Simple	Simple	Simple	Simple	Simple	Simple	Simple	Simple	Simple
- Terrain Height, meters	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
- Max. Concentration, 1-Hour, $\mu g/m^3$	9.76	77.94	48.71	11.03	88.12	55.07	8.46	67.54	42.21
- Max. Concentration, 24-Hour, $\mu g/m^3$	3.90	31.18	19.48	4.41	35.25	22.03	3.38	27.02	16.88
- Distance to Maximum, meters	835.00	835.00	835.00	804.00	804.00	804.00	873.00	873.00	873.00
IFC /WHO Ambient Air Quality Guidelines, 24-Hours, $\mu g/m^3$ (1) (2)	100	(*) 200	50	100	(*) 200	50	100	(*) 200	50
Pakistan - NEQS, at Source, 24-Hours, $\mu g/Nm^3$	550.00	80.00	120.00	550.00	80.00	120.00	550.00	80.00	120.00
Note: (*) NO2, 1-Hour									
Note: (1) Ref: IFC Environmental, Health and Safety Guidelines, "General EHS Guidelines", April 30, 2007									
Note: (2) Ref: WHO Air Quality Guidelines Global Update, 2005									

The air dispersion modeling indicates that the emissions of SO_2, NOx, and Particulate matter in all cases, from the proposed project are in compliance with the requirement of IFC with respect to IFC's Emission Guidelines and Pak-NEQS.

It is worth mentioning here that the project site is located in the "Non-degraded Air Shed" because thre is no industry or any other commercial activity which may pollute the ambient air.

3. PREDICTION OF IMPACTS AND ENVIRONMENT MANAGEMENT PLAN

Prediction of impacts depends on the nature and size of activity being undertaken and also on the type of pollution control measures that are envisaged as part of the project proposal. However, the following management practices would be followed to ensure that the environmental pollutants concentrations remain within the limits. The proposed plant may cause impact on the surrounding environment in two phases.

- During construction phase
- During Operation phase

Mitigations of these likely impacts are described in the following sub-sections.

3.1 Impact on Air Quality and Management

Construction Phase

Increase is likely in PM_{10}, SO_2, NO_x, & CO levels due to construction activities and movement of vehicles. The impact of these activities would be temporary and will be confined within the plant boundary.

Operational Phase

Air pollution generating sources at proposed plant will be due to emissions on account of operation of biomass fired boiler. The important air pollutant to be generated during biomass operation from the proposed plant is mainly particulate matter (PM). Fabric bag filters will be installed to maintain PM below Pak-NEQS and IFC Standards.

3.2 Impact on Water Quality & Management

Construction Phase

The impact on water environment during construction phase is likely to be short term and insignificant.

Operational Phase

All liquid effluents from Proposed Biomass Boiler will treated at BSPPL existing waste water treatment plant. The new Biomass Boiler will be replacing the operationof existing boilers.

3.3 Solid Waste

Construction Phase

Generation of solid waste during this phase shall be controlled by mitigation measures and impact will be insignificant.

Operational Phase

Main solid waste during operation phase shall be fly and bottom ash, which will be properly collected and monitored. Ash will be disposed off as manure/fertilizer and raw material for refractory bricks. However, in case non of the options work, then duly secured landfill, to be constructed and operated in accordance with the internationally accepted practices, will be required for the ultimate disposal of ash.

3.4 Impact on Noise Levels and Management

Construction Phase

The impact of noise due to construction activities are insignificant, reversible and localized in nature and mainly confined to the day hours.

Operational Phase

All rotating items shall be well lubricated and provided with enclosures as far as possible to reduce noise transmission. In general, noise generating items such as fans, blowers, compressors, pumps, motors etc. are so specified as to limit their speeds and reduce noise levels. Operators will be provided with necessary safety and protection equipment such as ear plugs, ear muffs etc.

3.5 Social Aspects

- During construction, the project will provide employment to local personal.
- During the operational phase also, the project will generate employment opportunity.
- Increase in employment opportunities and reduction in migrants to outside for employment, increase in literacy rate, growth in service sectors.
- Improvement in socio-cultural environment of the project area
- Improvement in transport and communication services
- Increase in employment due to increased business, trade commerce and service sector.
- This project does not involve any displacement of local people.
- Some people have concerns about the environmental aspects of the project.
- Public invasion by the outsiders to take place due to the project has also very minor concern for the people.

4. ENVIRONMENTAL MONITORING PROGRAMME

The environment, safety and health-monitoring programme in the factory are as follows:

1. Regular monitoring of stack emissions through on-line instruments.
2. Daily monitoring of water and wastewater
3. Quality monitoring of ambient air, noise and work place air
4. Monitoring of occupational safety

The project management, being aware and conscious of its responsibilities to environemt, is commited that the project operations will be made keeping in line with the internationally accepted sustainable measures/practices and methods thus leaving negligible adverse impacts on any segment of environement due to proposed activity.

5. ENIRONMENTAL MANAGEMENT COSTS

Estimated Environmental Management and Monitoring Cost of the project are described:

- Fly ash cleaning and collection system = US$ 2.0 millions
- Bottom ash collection system = US$ 1.5 millions
- An emission measurement system to check the environmental performance (CEMS) = US$ 0.1 millions
- Operators training for safe and reliable operation = US$ 0.15 million
- Fire fighting system = US$ 1.3 millions
- Equipments for monitoring of emissions, water analysis and personal safety are:
    a. Spectrophotometer
    b. PH meter
    c. Conductivity meter

d. Flue gas analyzer
e. Personal Protective equipment (goggles, face masks, safety shoes and safety helmets)
f. Water treatment lab equipment (burette, pipette, water sampler, glass apparatus, chemicals)

Green House Gases (GHGs), Carbon Dioxide (CO_2), Carbon Credits:

The use of biomass as fuel ensures that overall global mass emissions of CO2 per kWh produced are comparatively low. Furthermore, the relatively low carbon intensity of biomass when compared with fossil fuels reinforces such benefits. The proposed Biomass Boiler being renewable energy project will contribute to Green House Gases (GHGs) avoidance.

The biomass based boiler will result in some carbon emission but in overall terms the plant is carbon neutral. All carbon emitted is effectively reabsorbed within the re-growth of the biomass used as the fuel source.

Categorization of the Project:

With the use of biomass, air pollution will decrease especially with respect to NO_x and SO_2 emissions and can be further reduced very efficiently, conveniently and cost effectively. In the first place, there seems no possibility of NO_x emissions exceeding the IFC/World Bank standards. Secondly, if at all so required then NO_x can be reduced to the desired levels by use of Selective Catalytic Reduction (SCR) or Selective Non-Catalytic Reduction (SNCR). Efficient system of Fiber Filter Bags (FFB) will be used to remove around 99.9 % of the particulate matter. In view of the situation the project merits for its placement in IFC **"Category B"**.

The project, besides many other advantages, will result in:

- Greenhouse gases reduction,
- Reduction in air pollution from the present practices of burning the biomass on the fields,
- Addition to the economic development of farmers through the sale of their agriculture wastes presently either of no use/value or fetching just bare minimum price,

- Creation of more labour jobs in the entire supply chain circuit including also demand for labour around biomass collection stations and on the factory premises,
- Potential for self-employment by way of opening small scale tea stalls, road side autos repair workshops, opening of petrol pumps and gas stations along the routes of the vehicles carrying the biomass from the collection stations to the factory,
- Fly ash being rich in Potassium (K) will be used as K-fertilizer, as partial substitute for synthetic costly K fertilizer, thus reducing cost of production of agriculture products,
- Improvement of existing infrastructure especially roads, development and creation of infrastructure facilities between the biomass collection centres and the factory.
- Development/improvement of social and economic status of the people through addition to their income resulting also in enabling the people to fulfill desire to get their children educated.

The Proposed Project will operate in compliance with IFC's Performance Standards for Environmental and Social Sustainability, effective January 1, 2012.

1

Introduction

SECTION – 1 INTRODUCTION

1.1 INTRODUCTION

Despite severe challenges, economy of Pakistan has shown resilience in the year 2010. Gross Domestic Product (**GDP**) growth for the year 2009-10 was recorded at a provisional 4.1% on an inflation-adjusted basis. The long term forecast for economy are promising through productivity in agriculture and industrial sectors, but the objective of expected developmental growth needs commensurate rise in energy use. Considering the strong correlation between economic growth and energy demand, there is an imperative need for sustained increase in energy supply not only to maintain the growth momentum but also to protect the economy from disruptions, caused by energy deficiency during the years 2008 up to date.

Government of Pakistan (GoP) is making concerted efforts to ensure development of energy resources by encouraging private sector to meet energy demand and has liberalized investment policies. The policy has resulted not only in investments in power production sector from local resources, but also foreign investments are pouring in large amounts.

As a result of serious power shortage, load sheddings are so frequent in Pakistan. The gap between power supply and demand is further on the increase. Consequently, all walks of life are being adversely affected. Pakistan has an installed electric generating capacity of about 19,400 MW. Projection for the demand in year 2030 is forecast to be 100,000 MW.

Pakistan is energy deficit country. Fossil fuels are already in short supply, and their local availability is fastly depleting alongwith price hike taking place during very short intervals of time. On the other hand, their industrial, domestic and other multifarious usages are also fast on the increase. Import bills of the fossil fuels are

swelling at a very fast rate due to their fast increasing demand in the country. Pakistan's fragile economy cannot afford to continue with the present situation. Consequently, the present state demands to explore other fuels which could fully or partially replace the fossil fuels presently in use.

In 2005, Packages Limited, Lahore initiated a new project under the name Bulleh Shah Pulp and Paper Mill **(BSPPL),** which later on became Bulleh Shah Packaging Private Limited (BSPPL) after joint venture with Stora Enso (Finnish pulp and paper manufacturer), located at 50 km south of Lahore in Kasur. BSPPL site spreads over 300 acres and consists of two paper machines PM-6 and PM-7 enabling Packages to increase paper and paperboard production from 100,000 to 300,000 tones per year.

Operation of BSPPL is contingent on reliable supply of electricity from Water and Power Development Authority (**WAPDA**) and gas fuel supply from Sui Northern Gas Pipe Lines (**SNGPL**) limited. However, as mentioned above, since the last two years Pakistan has significant ongoing energy sector challenges including reduction in gas deliveries to industrial units and load shedding of electricity due to lack of power generation capacity in the country.

Packages Ltd. is one of the premier paper mills in the country and its paper production is directly dependent on electricity supply. Currently, BSPPL is equipped with one gas / Heavy Furnace Oil (HFO) fired 200 tph steam (about 41-MW) and one smaller gas / Heavy Furnace Oil (HFO) fired boiler (about 65 tph) to meet its internal plant power and steam needs.

The on-going power supply shortage in the country and also compounded by scarcity of natural gas deliveries by SNGPL are causing a significant loss of production at BSPPL resulting in a negative economic impact for the company.

Increase in energy cost i.e. the gas price escalation from Rs. 172.0/mmbtu to Rs.400-/mmbtu during July 2003 to July 2010 and exuberantly price hike in electricity rate besides their acute shortage/non availability, has compelled the management of BSPPL to seek alternative options to be self-sufficient in their present electricity needs.

Consequently, the management of BSPPL has decided to install boiler to produce 150 tons per hour (tph) steam producing biomass-fired boiler for cogeneration of 30 MW of electricity. This biomass fired boiler will replace existing ones being operated on natural gas and HFO.

Of the targeted bio-mass to be used as alternative fuel include agricultural wastes being produced in the region of the project such as rice hulls and straw, corn husks, wheat stalks/straw, cotton stalks, sugar cane trash etc.
This SEIA report is being prepared alongwith concurrent preparation of the feasibility study of the project.

The spirit of the Equator Principles (EPs) - "seeking to ensure that the projects we finance are developed in a manner that is socially responsible and reflect sound environmental management practices" has been adopted by and large by almost all national and international Development Finance Institutions (DFIs) and as such it has become just an important prerequisite for getting loan for the project from any quarters whatsoever. This spirit has also been kept in mind while preparing this report. This SEIA Report has been prepared for the Proposed Project keeping in line with the IFC Guidelines for such SEIA reports.

1.2 SCOPE OF EIA STUDY

The purpose of this SEIA study is identification of key environmental and social issues which will likely arise during construction and operation of the power plant

along with the assessment of the significant negative impacts and mitigation measures to be adopted for their minimiation.

The ultimate goal of this SEIA report, among others, is also to produce an Environmental Management Plan (EMP) and Environmental Monitoring Plan (EMtP) for the Construction and Operation Stages of the proposed project. Compliance of EMP together with the provisions for mitigation measures for the significant negative impacts will ensure the implementation of this project in an environmentally sustainable manner both at Construction as well as Operation stages of the Project.

The SEIA report ensures compliance to all national and local regulations enforced in Pakistan as well as the IFC/World Bank Guidelines for such report. However, taking into consideration the international requirements due attention has also been given to Equator Principles (EPs) and the International Finance Corporation (IFC) Performance Standards on Environmental and Social Sustainability (effective January 1, 2012). While taking into consideration the EPs, it was further sought to ensure that the project to be financed under reference of this SEIA report, is to be developed in a manner that is socially responsible and reflects sound environmental management practices.

This SEIA report also discusses the legal and administrative framework within which the SEIA is prepared. A brief project description is included in the SEIA report together with a description of the baseline environmental conditions and the actual environmental situation at the proposed site for the project.

The technical section of the report and the environmental baseline situation form the basis for the detailed impact assessment during construction and operation phases of the project. Based on the findings of this report, an environmental

management system has been devised, outlining necessary mitigation and compensation measures together with monitoring practices.

1.3 APPROACH AND METHODOLOGY

This SEIA report has been accomplished after carrying out thorough reconnaissance to identify the following Environmental and Social areas of concern:

- To achieve the desired environmental compliance standards under the IFC Guidelines as applicable to the project.
- Plans and activities to remedy/mitigate any potential adverse impacts and the gaps that could probably remain after implementation.
- Any other points/steps to be taken which could be beneficial to mitigate enviornmental adverse impacts that may accrue both during construction and regular operation of the power plant.

The format/contents of this EIA report are listed as below:

1. Introduction
2. Policy, Legal and Administrative Framework
3. Description of the Project
4. Baseline Conditions & Public Consultations/ Disclosure
5. Social Impacts and Mitigation/Remedial Measures
6. Potential (Unmitigated) Environmental, Health & Safety Impacts
7. Proposed Environmental Prevention and Mitigation Measures
8. Environmental Management & Monitoring Plan
9. Analysis of Alternatives
10. IFC Performance Standards 1 to 8
11. Grievance Redress Mechanism (Formal and Informal Channels)

In addition to the evaluation and review of the available records, data and the facts for the project feasibility studies, detailed discussions were held with the concerned members of the project management as well as other project stakeholders.

Notes and proposals for measures to be taken to mitigate and compensate for any determined/detrimental environmental impacts are contained in the Environmental Management Plan (EMP) as well as a Monitoring Plan, including all parameters that need to be measured, and the frequency of monitoring actions.

A comprehensive qualitative and semi-quantitative methodology was adopted to conduct this study inter-alia in due compliance with the SEIA requirements. The study included collection of both primary and secondary data regarding environmental status and other relevant factors.

1.4 IDENTIFICATION OF THE PROJECT AND THE PROPONENT

- Contact person:

Mr. Azhar Ali,
Project Manger,
Packages Limited,
Shahrah-e- Roomi, P.O. Amer Sidhu,
Lahore 54760.
Phone: 92 42 35811541-46

- Consultants who prepared the report:

ECTECH-Environment Consultants;
Suite 4, 2nd Floor, Link Arcade,
Model Town Link Road, Lahore, Pakistan.
Phone: 92 42 35887517, 35925693;
Fax: 92 42 35855508
Email: ectech_ectech@yahoo.com

The proposed project, belongs to Bulleh Shah Packaging Private Limited, Kasur.

1.5 STUDY TEAM

BSPPL hired services of ECTECH Environmental Consultants, Lahore, Pakistan to undertake preparation of "**Social & Environmental Impact Assessment (SEIA)**" of the proposed project. A brief introduction of the experts who prepared the SEIA report is given in the Annexure – 1.1.

Among others, Dr. Muhammad Hanif and Mr. Aftab Ahmad from ECTECH Environment Consultants team members kept close liaison with the Packages Ltd Corporate Office in Lahore & BSPPL in Kasur through out the preparation of this SEIA report and comprehensively discussed various aspects of the project.

The team members also visited the proposed plant site, carried out environmetal monitoring of the project site, held Public Consultations/ Scoping and attended to various other importantant aspects related to the project for synthesis of a realistic SEIA report of the project.

1.6 IMPORTANCE & BACKGROUND OF THE PROJECT

The on-going power supply shortage in the country besides scarcity of natural gas deliveries by Sui Northern Gas Pipelines Limited (SNGPL) are causing a significant loss of production at BSPPL resulting in negative economic impact for the company. Consequently, the Management of BSPPL has decided to install 150 tons per hour (tph) steam producing biomass-fired boiler for cogeneration of 30 MW of electricity to the meet the power demand of BSPPL.

Increase in energy cost i.e. the gas price escalation from Rs. 172.0/mmbtu to Rs. 400-/mmbtu during July 2003 to July 2010 and exuberantly price hike in

electricity rate besides their acute shortage/non availability, has compelled the BSPPL management to seek alternative options for BSPPL to be self-sufficient in their electricity needs.

The bio-mass to be used as alternative fuel include agricultural wastes/residues being generated in the region of the project such as wheat and rice straw, corn husks, cotton stalks, sugar cane trash etc. The tentative project estimated cost is **US$ 53 million.**

1.7 OBJECTIVES OF THE PROJECT

The main object of the Proposed Project is to generate cleaner, economical and reliable energy from indigenous biomass fuel which will not only provide a better alternate source of energy but also cause a boost to agriculture sector. It will also reduce environmental hazards caused by burning natural gas & furnace oil as fuel for producing electricity.

2

Policy, Legal & Administrative Framework

SECTION 2 - POLICY, LEGAL & ADMINISTRATIVE FRAMEWORK

2.1 - APPLICABLE HOST COUNTRY ENVIRONMENTAL AND OCCUPATIONAL SAFETY AND HEALTH LAWS AND REGULATIONS

A. National Environmental Regulatory/Legal Requirements

After the 18th Amendment to the Constitution of The Islamic Republic of Pakistan-1973, the regulation & management of environment has largely been delegated to the Provinces. The Federal Ministry of Environment has been abolished and instead the Ministry of Climate change has been created under the federal EPA is being operated.

The Pakistan Environmental Protection Agency (Pak EPA) looks after the environment related issues for the federally controlled areas and territories. Lacking laws at the provincial levels; the laws, rules, regulations etc., those already available at the federal level and operational at the provincial levels will continue as such.

A.1 National Conservation Strategy (NCS) - Pakistan

The National Conservation Strategy (NCS) – Pakistan, as approved by the Federal Cabinet in March 1992 is the guiding document on the environmental issues in the country (Ref. EUAD/IUCN, 1992). The NCS outlines the country's primary approach towards encouraging sustainable development, conserving natural resources, and improving efficiency in the use and management of resources.

The NCS has 68 specific programs in 14 core areas in which policy intervention is considered crucial for the preservation of Pakistan's natural and physical environment. The core areas that are relevant in the context of the envisaged

project are pollution prevention and abatement, restoration of supporting forestry and plantations, and preservation of cultural heritage. A mid-term review of the achievements, impacts and prospects of Pakistan's NCS was undertaken between years 1999 - 2000.

The Government of Pakistan promulgated "Pakistan Environmental Protection Act" in 1977. Two organizations, the Pakistan Environmental Protection Council (Pak-EPC) and the Pakistan Environmental Protection Agency (Pak-EPA), are primarily responsible for administering the provisions of the Act. The Pak-EPC oversees the functioning of the Pak-EPA. Among its major members include representatives of the Federal and Provincial Governments especially the Provincial Environmental Protection Agencies, industry, non-governmental organizations, academia, environment experts, Federation of Chamber of Commerce and Industry and the private sector.

The Pak-EPA, through the Provincial EPAs, is required to ensure compliance with the National Environmental Quality Standards (NEQS) and establish monitoring and evaluation systems. As a primary implementing agency in the hierarchy, it is responsible for identifying the need for, as well as initiating legislation whenever necessary. Pak-EPA is also authorized to delegate powers to its provincial counterparts, the provincial EPAs. One of the functions delegated by the Pak-EPA to provincial EPA is the review and approval of Environmental Impact Assessment (EIA) and Initial Environmental Examination (IEE) reports of the projects undertaken in their respective jurisdictions.

A.2 Pakistan Penal Code (1860)

The Pakistan Penal Code usually called PPC is a penal code for all offences charged in Pakistan. It was originally prepared by Lord Macaulay in 1860 on the behalf of the Government of British India as the Indian Penal Code. After the

partition of British India in 1947, Pakistan inherited the same code and subsequently after several amendments [e.g. Protection of Women (Criminal Laws Amendment) Act, 2006, Criminal Laws (Amendment) Act, 2004 (I of 2005), Criminal Law (Amendment) Ordinance (LXXXV of 2002), Criminal Laws (Reforms) Ordinance (LXXXVI of 2002), etc.] it is now mixture of Islamic and English Law.

Pakistan Penal Code is a general criminal law, applies all over the country, and contains specific provisions on the subject. Thus it prohibits mischief by killing or maiming animals, or damaging works of irrigation or a river or a road or a bridge or drain or firing explosive substances with intent to cause damage. The Code also prohibits public nuisance by acting negligently to spread the infection of disease or disobeying quarantine rule or causing adulteration of food or drink or drug, or fouling water or making the atmosphere noxious to health etc.

A.3 Pakistan Environmental Protection Act, 1997 and The Punjab Environmental Protection Act (Amendment) Bill 2011

The promulgation of the **Environmental Protection Ordinance, 1983** was the first codifying legislation to the issue of environmental protection. Later, the Government passed the **Pakistan Environmental Protection Act (PEPA), 1997** [The Punjab Environmental Protection Act (Amendment) Bill 2011], which is the basis of IEE/EIA studies carried out for the projects in Pakistan.

PEPA, 1997 is a fairly comprehensive legislation and provides protection, conservation, rehabilitation and improvement of the environment. It contains concrete action plans and programs for the prevention of pollution and promotes sustainable development. The salient features of the law are:

- It covers the air, water, soil, marine and noise pollution including pollution caused by motor vehicles.
- The Act provides National Environmental Quality Standards (NEQS) for wastewater, air emissions and noise.
- Law provides clear cut guidelines for IEE/EIA for various projects as per their magnitude and anticipated impacts.
- Law also empowers Federal Government to issue notices and to enforce them for the protection of the environment.

For the effective implementation of the provisions of PEPA, 1997, Pakistan Environmental Protection Agency, headed by a Director General was constituted. On the same pattern, Provincial Environmental Protection Agencies (EPA's) were created in all the provinces.

Environmental Tribunals were also constituted according to PEPA, 1997.

A.4 Policy and Procedures for the Filing, Review and Approval of Environmental Assessments

This document sets out the key policies and procedural requirements. It contains a brief policy statement on the purpose of environmental assessment and the goal of sustainable development and requires that environmental assessment be integrated with feasibility studies. It also defines the jurisdiction of the Federal and Provincial EPA's. It lists down the responsibilities of the proponent and states the duties of responsible authorities. It provides schedules of proposals that require either an IEE or EIA.

A.5 Guidelines for the preparation and review of Environmental Reports (November 1997/2000)

These guidelines are descriptive documents regarding the format and content of IEE/EIA reports to be submitted to EPA for "No-Objection Certificate (NOC)/Environmental Approval (EA)". Following are the major areas, which are covered by these guidelines:

- The IEE report (scope, alternatives, site selection, format of IEE report)
- Assessing impacts (identification, analysis and production, baseline data, significance)
- Mitigation and impact management (and preparing an environmental management plan)
- Reporting (drafting style, main features, shortcomings, other forms of presentation)
- Review and decision making (role, steps, remedial options, checks and balances)
- Monitoring and auditing (systematic follow up, purpose, effective data management)
- Project Management (inter-disciplinary teams, programming and budgeting)

A.6 Guidelines for Public Consultations

These guidelines deal with possible approaches to public consultation (PC) and techniques for designing an effective program of consultation that reaches out to all major stakeholders and ensures the incorporation of their legitimate concerns in any impact assessment study. These guidelines cover:

- Consultation, involvement and participation of Stakeholders

- Techniques for public consultation (principles, levels of involvements, tools, building trust)
- Effective public consultation (planning, stages of EIA where consultation is appropriate)
- Consensus building and dispute resolution
- Facilitation involvement (including the poor, women, building community and NGO capacity

A.7 National Environmental Quality Standards (NEQS)-1993, Amended August 2000

The National Environmental Quality Standards (NEQS) were first promulgated in 1993 and have been amended in August, 2000.

The following standards are specified therein:

- Maximum allowable concentrations of pollutants (32 parameters) in municipal and liquid industrial effluents discharged to inland waters, sewage treatment facilities, and the sea (three separate sets of numbers)
- Maximum allowable concentrations of pollutants (16 parameters) in gaseous emissions from the industrial sources

The Guidelines for "Self-Monitoring and Reporting" (SMART) [attached as Annexure– 2.1] for the industry as approved by the Pakistan Environmental Protection Council (PEPC).

A copy of the Government of Pakistan, Gazette Notification dated August 10, 2000 regarding NEQS is attached as Annexure – 2.2.

A.8 National Environmental Quality Standards for Ambient Air- November- 2010

The Ministry of Environment, Government of Pakistan vide its Notification, Islamabad, the 18th October, 2010 under S.R.O. 102 (1)/2010 established standards which provide the maximum allowable limits, in the ambient air, of Sulphur Dioxide (SO_2), Oxides of Nitrogen as (NO_x) and as (NO), Suspended Particulate Matter-(SPM), Respirable Particulate Matter-PM_{10}, Respirable Particulate Matter-$PM_{2.5}$, Lead and Carbon Monoxide (CO) [Annexure-2.2]

A-9 National Standards for Drinking Water Quality - November, 2010

The Ministry of Environment, Government of Pakistan vide its Notification, Islamabad, the 18th October, 2010 under S.R.O. 102(1)/2010 established standards for Drinking Water Quality [Annexure-2.2] The major quality parameters fixed depend upon Bacterial, Physical and Chemical ones.

A-10 National Environmental Quality Standards for Noise - November, 2010

The Ministry of Environment, Government of Pakistan vide its Notification, Islamabad, the 18th October, 2010 under S.R.O. 102(1)/2010 established standards for Noise [Annexure-2.2]. These standards are based on Category/zone i.e. Residential area, Commercial area, Industrial area and Silence zone. The limiting values for day and night have also been fixed for all categories/zones.

A.11 Sectorial Guidelines for Environmental Reports

These guidelines [Annexure-2.3] identify the key environmental issues that need to be assessed as well as mitigation measures and project alternatives to be considered in the actual EIA. These guidelines include:

Sector overview of the industry and the processes

- Potential impacts on the environment
- Mitigation measures
- Monitoring and reporting
- Management and training
- Checklist of likely environmental impacts and mitigation measures

A.12 Guidelines for Sensitive and Critical Areas

These guidelines identify sensitive and critical areas in Pakistan, in relation both to the natural environment and the cultural aspects.

A.13 National Resettlement Policy and Ordinance

At this point, the only legislation relating to land acquisition and compensation is the Land Acquisition Act (LAA) of 1894. Following a national consultative process, a national resettlement policy and a related ordinance were drafted. The draft policy and the ordinance are presently being reviewed by the provinces, and have yet to be approved and notified by the government. The salient applicable features of the Draft Resettlement Policy are given below:

- The Pak-EPA will be responsible for both environment-related as well as resettlement-related matters,
- The responsibilities for implementation at a provincial level are to be delegated to the concerned provincial EPAs with overall control of the provincial Planning and Development (P&D) Departments.
- All categories of 'loss' arising from development projects that entail resettlement, need to be addressed: these include not only loss of land, built-up

property, other infrastructure, and crops and trees, but also loss of income, job opportunities, and access to natural resources, etc.

- Vulnerable groups whose issues need to be addressed in particular include: women, children, destitute persons, tribal communities, squatters, those with usurper rights, and landless groups.
- There should be a special emphasis on consultation with affected groups when preparing a Resettlement Action Plan (RAP).

The provisions of the Draft Resettlement Policy are consistent with the requirements of the World Bank OD 4.30 on involuntary resettlement.

A.14 Forest Act, 1927

All India Forest Act, 1927 was adopted by the Government of Pakistan, which was subsequently implemented by the respective provinces. Basically, the law was enacted to conserve and protect the forest resources of the country for sustainable development. It lays down Rules and Regulations for exploitation of various categories of forests such as reserved, protected or unclassified. Further, the Act spells out the licensing method for timber cutting, grazing, hunting etc. It also gives the details of magisterial powers of Forest Department officers and penalties for offences committed with regard to forest resources and products.

A.15 Industrial Relation Ordinance, 2002

The ordinance has been promulgated to amend, consolidate and rationalize the law relating to formation of trade unions, regulation and improvement of relations between employers and workmen and avoidance and settlement of any differences or disputes arising between them

Pakistan's labour laws trace their origination to legislation inherited from India at the time of partition of the Indo-Pak subcontinent. The laws have evolved through a continuous process of trial to meet the socio-economic conditions, state of industrial development, population and labour force explosion, growth of trade unions, level of literacy, Government's commitment to development and social welfare. To meet the above named objectives, the government of the Islamic Republic of Pakistan has introduced a number of labour policies, since its independence to mirror the shifts in governance from martial law to democratic governance.

While Article 18 of the Constitution affords every citizen with the right to enter upon any lawful profession or occupation, and to conduct any lawful trade or business, the Industrial and Commercial Employment (Standing Orders) Ordinance was enacted in 1968 to address the relationship between employer and employee and the contract of employment. The Ordinance applies to all industrial and commercial establishments throughout the country employing 20 or more workers and provides for security of employment. In the case of workers in other establishments, domestic servants, farm workers or casual labour engaged by contractors, their labour contracts are generally unwritten and can be enforced through the courts on the basis of oral evidence or past practice.

The Constitution of Pakistan contains a range of provisions with regards to labour rights found in Part II: Fundamental Rights and Principles of Policy.

- **Article 11** of the Constitution prohibits all forms of slavery, forced labour and child labour;
- **Article 17** provides for a fundamental right to exercise the freedom of association and the right to form unions;
- **Article 18** proscribes the right of its citizens to enter upon any lawful profession or occupation and to conduct any lawful trade or business;

- **Article 25** lays down the right to equality before the law and prohibition of discrimination on the grounds of sex alone;
- **Article 37(e)** makes provision for securing just and humane conditions of work, ensuring that children and women are not employed in vocations unsuited to their age or sex, and for maternity benefits for women in employment.

A.16 Punjab Industrial Relations Bill 2010

In December 2010 Punjab Assembly passed new legislation that will govern the formation of trade unions, relations between industries and their workers, and the process for the settlement of labour disputes.

A.17 Industrial Relations Ordinance 2011 Promulgation

The Government has promulgated Industrial Relations Ordinance 2011. The Ordinance has been approved by the President on the Advice of the Prime Minister. The Government has promulgated Industrial Relations Ordinance, 2011 in view of the current legal vacuum created due to deletion of the concurrent Legislative List through the 18th Constitutional Amendment. The Industrial Relations has also been transferred to the Provinces which have promulgated provincial laws to regulate industrial relations. However, there is no law in place to deal with Industrial Relations in the Islamabad Capital Territory or in respect of national level trade federations and for resolutions of trans-provincial industrial issues. The Parliament has yet to promulgate the Ordinance as law.

A.18 Other Relevant Laws

Some of the other relevant laws and legislations are listed below:

- Canal and Drainage Act, 1873
- The Explosives Act, 1884
- The Fire Wood and Charcoal (Restriction) Act, 1964
- Motor Vehicles Ordinance, 1965
- The West Pakistan Regulation and Control of Loudspeaker and Sound Amplifier Ordinance, 1965
- Agriculture Pesticides Ordinance, 1971
- The Antiquities Act, 1975

A-19 National Electric Power Regulatory Authority (NEPRA) Act 1997

The NEPRA Act was approved by Parliament and signed into law in December 1997. It seeks to create an autonomous, independent regulatory authority, which will be solely responsible for the power sector. It will be responsible for the oversight of the power sector and will exercise control through its power to license power generation, transmission and distribution. It will regulate tariffs for all these activities. It will perform its functions through transparent processes to be enshrined in rules that are being framed in a transparent manner through appropriate rules.

A-20 Power Policy 1998

The revised power policy was implemented in 1998. The objective and intentions of the Government of Pakistan (GOP) to new policy is to move towards the creation of a competitive power market in Pakistan. It proposes to do so by restructuring and privatizing the existing thermal power generation, the power transmission and distribution functions and assets of existing public sector utilities

(WAPDA/KESC), by the creation of a fully autonomous regulatory authority, the National Electric Power Regulatory Authority (NEPRA), and through its future IPP policy.

The salient features of the Policy are;

- The basis for selection of private power project will be minimum levelized tariff through International Competitive Bidding. Variable tariffs over the life of the project will be permitted under terms specified prior to bidding. The process of selection will involve pre-qualification, issuance of a Request for Proposals (RFP), bidding and evaluation of bids against bid criteria clearly laid out in the RFP.
- It is recognized that without a proper feasibility study for a particular site-specific hydel or indigenous coal based project, it will not be possible to invite competitive bids and receive firm offers. Thus, detailed feasibility studies for such projects will be prepared before bids are invited.
- Hydel projects will be implemented on a Build-Own-Operate-Transfer (BOOT) basis; to be transferred to the province in which it is situated at the end of the concession period, and thermal projects on a Build-Own-Operate (BOO) basis.
- Competitive Tariffs will comprise an Energy Purchase price and a Capacity Purchase Price with adequate provisions for escalation.

A-21 Provincial Local Government Ordinances, 2001

These ordinances, issued following the devolution process, establish regulations for land use, the conservation of natural vegetation, air, water, and land pollution, the disposal of solid waste and wastewater effluents, as well as matters related to public health and safety.

A-22 Factories Act, 1934 (Amended 2012)

There is no independent legislation on occupational safety and health issues in Pakistan. The main law, which governs these issues, is the Chapter 3 of Factories Act, 1934. All the provinces, under this act, have devised Factories Rules. The Hazardous Occupations Rules, 1963 under the authority of Factories Act is another relevant legislation. These rules not only specify some hazardous occupations but also authorize the Chief Inspector of Factories to declare any other process as hazardous.

The other related laws are:

- Workmen Compensation Act, 1923
- Provincial Employees Social Security Ordinance, 1965
- West Pakistan Shops and Establishments Ordinance, 1969
- Boilers and Pressure Vessels Ordinance, 2002

Chapter 3 of the Act has general provisions on health and safety at the workplace. Provincial governments are allowed to make rules under this Act and inspectors under this Act also have discretion in defining the rules. Chapter 3 talks about various safety arrangements. This list is being provided just to show how meticulously labor law covers these issues.

- Cleanliness
- Disposal of wastes and effluents
- Ventilation and temperature
- Dust and fume
- Artificial humidification.
- Overcrowding
- Lighting

- Drinking water
- Latrines and urinals
- Spittoons
- Precautions against contagious or infectious disease
- Compulsory vaccination and inoculation
- Power to make rules for the provision of canteens
- Welfare officer
- Precautions in case of fire
- Fencing of machinery
- Work on or near machinery in motion
- Employment of young persons on dangerous machines
- Striking gear and devices for cutting off power
- Self-acting machines
- Casing of new machinery
- Prohibition of employment of women and children near cotton openers
- Cranes and other lifting machinery
- Hoists and lifts
- Revolving machinery
- Pressure plant
- Floors, stairs and means of access
- Pits, sumps, opening in floors, etc.
- Excessive weights
- Protection of eyes
- Power to require specifications of defective parts or tests of stability
- Safety of building, machinery and manufacturing process
- Precautions against dangerous fumes
- Explosive or inflammable dust, gas, etc.
- Notice of certain accidents

A.23 Land Use

The project site is situated in the area where agriculture and industrial activities are going on side by side. The land from agriculture use is rapidly coming under industry due speedy industrialization of the area.

Government policies for land use encourage industrialization. And permission for installation of the under reference industrial unit is a clear proof of the Government policy of encouraging industrialization of the area.

A-24 Regulatory/ Institutional/Administrative Framework

Government of Pakistan is facilitating investment, both local and foreign, in industrial sector in Pakistan. Liberalization and industrialization in the country, as a policy of the Government are well reflected from her following initiatives:

A-25 Deregulation of the economy

Deregulation is the prioritized policy of the Government of Pakistan. Under same policy there is a systematic movement towards deregulation of the economy and privatization of the state owned companies.

A-26 Import policy

Import policy has been largely liberalized to a great extent through the provision of various incentives. And it is being further liberalized at a quicker pace. There is an increased reliance on development of the industrial sector and enhancement of international trade.

A-27 Infrastructure facilities

In order to facilitate fast industrialization basic infrastructure facilities like roads network, natural gas, water and power supply, means of transportation and communications etc. are available.

A-28 Incentives

In order to maintain Pakistan's competitiveness in international markets and support viability of local and foreign investments in the country, the following incentives are available equally to both the foreign and the local investors:

a- initial depreciation allowance (IDA),
b- amortization and
c- normal tax rates.

The capability of regulatory institutions for environmental management largely, ensures the success of environmental assessment for ensuring that development projects are environmentally sound and sustainable. For decision-making and policy formulation in the environmental and conservation issues, the institutional framework, as it exists in Pakistan, is described below:

2.2 - APPLICABLE INTERNATIONAL ENVIRONMENTAL AND OCCUPATIONAL SAFETY AND HEALTH LAWS AND REGULATIONS

B. International and National Non-Governmental Organizations

International and national Non-Government Organizations (NGOs), such as the International Union for Conservation of Nature and Natural Resources (IUCN) and the World Wide Fund for Nature (WWF), have been active in Pakistan for

some time. Both of these NGOs have worked closely with the governments at the federal as well as provincial levels and have positively contributed to the cause of environment. They have played significant role with regard to the formulation of environmental and conservation policies. And last but not the least, another the most prominent NGO namely "Sustainable Development Policy Institute (SDPI) "has also played very significant role in upholding the cause of environmental protection in Pakistan.

Environmental NGOs have been particularly active in the advocacy for promoting sustainable development approaches. Most of the government's environmental and conservation policies, even at the provincial and federal levels, has been formulated in consultation with these leading NGOs, who have also been involved in drafting new legislation on conservation.

International Framework

For the assessment of the environmental impacts of the proposed project on air, water and noise according to the international legal framework, this report has also incorporated the requirements of the "Pollution Prevention and Abatement Handbook" by the World Bank Group- effective July 1998.

Within this handbook, different guidelines are mentioned for the purpose of assessing industrial facilities with respect to their environmental compliance. In the present case, the guidelines for new thermal power plants are applicable for the preparation of the environmental impact assessment.

C. (ENVIRONMENT) RELATED RELEVANT INTERNATIONAL AGREEMENTS IN PAKISTAN'S CONTEXT

Pakistan is a party to the following treaties and agreements in furtherance of its environmental goals and programme.

Treaty	Pakistan Status
Convention on the Protection of Ozone Layer on Dec 18, 1992.	Ratified
The Amendment to Montreal Protocol on Substance that Depleting Ozone layer	Signed
UN Framework Convention on Climate Change on June 13, 1992	Signed
Convention on the Continental Shelf on October 31, 1958	Signed
The Convention on High Seas on October 31, 1958	Signed
Convention on the Fishing and Conservation of the living Resources of the High Seas on October 1958.	Signed
The UN Convention on Law of the Sea on December 10, 1982	Signed
The Convention on Territorial Sea and the Contagious Zone and the Agreement for the establishment of Network of Aquaculture Centers in Asia and the Pacific	Signed
The Convention on Wetlands of the International Importance on July 23, 1976	Ratified
The Convention on protection of the World Cultural and Natural Heritage on July 23, 1976	Ratified
The Convention on International Trade in Endangers Spice of Wild Fauna and Flora	Signed
The Convention on Conservation of Migratory Specie of Wild Animal on Dec 01, 1987	Signed

The Convention on Biological Diversity in 1994 and became party to the CBD, Convention duly recognizes the intrinsic value of biological diversity, genetic, social, economic, cultural, educationist, recreational and esthetic values of biodiversity and its components	Ratified
The International Plant Protection Convention.	Signed
The Plant Protection Agreement for Area & pacific region	Signed
The Agreement for the establishment of a convention for controlling the desert lost in eastern region of its Distribution Area in South East Asia	Signed
The Treaty Banning Nuclear Weapon Test in the Atmosphere, in Outer Space and under Water on March 3, 1988	Signed
The International Convention on Oil Pollution Preparedness Response and Corporation	Signed
The Convention on prohibition of Military or any other Hostile Use of Environmental Modification Techniques and Accession of Feb 27, 1986	Acceded
Pakistan became a party to Montreal Protocol by Ratifying the protocol and its London amendment on Dec 18, 1982.the subsequent amendments known as Copenhagen Amendment which, accelerate the phase out for rectified in Jan 1995.	Signed
Convention of International trade Endangerous Species (CITS)	Signed
World heritage Convention Ramsar Convention	Signed
United Nation Convention to Combat Ozone Depletion (CCD). The convention signed and ratified in 1996	Signed
Stockholm Convention for Phasing out Persistent Organic pollutants (POPs) in 2001.	Signed

D. Requirements Of Potential Investors, Lenders And Insurers

The client intends to get finances for the project under reference from International Finance Corporation - IFC/WB (World Bank), therefore, requirements of potential investors; lenders and insurers are to be followed as described hereunder:

D-1 International Finance Corporation's (IFC) Policy on Environmental and Social Sustainability, Effective January 1, 2012

International Finance Corporation (IFC) is the private sector arm of the World Bank Group. Summarily, it aims at fighting poverty with passion and professionalism for lasting results and to help people help themselves and their environment by providing resources, sharing knowledge, building capacity, and forging partnerships in the public and private sectors.

International Finance Corporation's (IFC) Policy on Environmental and Social Sustainability, Effective January 1, 2012 supersedes the IFC Disclosure of Information Policy (April 2006) in its entirety. This Policy is not an express or implied waiver of IFC's privileges and immunities under its Articles of Agreement, international conventions, or any applicable law, nor does it provide any contractual or other rights to any party.

At IFC while transparency and accountability are fundamental to fulfilling its development mandate, IFC encourages its clients to be more transparent about their businesses and believes that when clients are committed to transparency and accountability they help promote the long-term profitability of their investments.

IFC strives for positive development outcomes in the activities (including (i) investments financed directly by IFC; (ii) investments implemented through financial intermediaries (FIs) or managed by IFC's Asset Management Company

or any other IFC subsidiary, as well as investments funded in part or in whole by donors; and (iii) advisory services) it supports in developing countries.

IFC believes that an important component of achieving positive development outcomes is the environmental and social sustainability of these activities, which IFC pursues and expects to achieve through the application of this Policy on Environmental and Social Sustainability (the Sustainability Policy or the Policy), and a comprehensive set of environmental and social Performance Standards. Through this Policy, IFC puts into practice its commitments to environmental and social sustainability. Activities supported and financed by IFC include a wide range of investment and advisory products including technical, financial and/or regulatory advice, project structuring as well as training to companies, industries, and governments.

Within the scope of an agreed advisory activity, all advice and training will be consistent with the Performance Standards. The Performance Standards consist of the followings:

Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts
Performance Standard 2: Labor and Working Conditions
Performance Standard 3: Resource Efficiency and Pollution Prevention
Performance Standard 4: Community Health, Safety, and Security
Performance Standard 5: Land Acquisition and Involuntary Resettlement
Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
Performance Standard 7: Indigenous Peoples
Performance Standard 8: Cultural Heritage

These Performance Standards help IFC investment and advisory clients manage and improve their environmental and social performance through a risk and outcomes based approach. While managing environmental and social risks and impacts in a manner consistent with the Performance Standards is the responsibility of the client, IFC seeks to ensure, through its due diligence, monitoring, and supervision efforts, that the business activities it finances are implemented in accordance with the requirements of the Performance Standards. As a result, the outcome of IFC's environmental and social due diligence of a proposed business activity is an important factor in its approval process, and will determine the scope of the environmental and social conditions of IFC financing.

IFC's development mission are its efforts to carry out investment and advisory activities with the intent to "do no harm" to people and the environment, to enhance the sustainability of private sector operations and the markets they work in, and to achieve positive development outcomes. IFC is committed to ensuring that the costs of economic development do not fall disproportionately on those who are poor or vulnerable, that the environment is not degraded in the process, and that renewable natural resources are managed sustainably.

IFC recognizes that climate change is a serious global challenge and that climate-related impacts may impede economic and social well-being and development efforts. Working with the private sector and other parties to address climate change is therefore a strategic priority for IFC. IFC will engage in innovative investments and advisory services to support climate-friendly solutions and opportunities for business.

IFC support for low-carbon economic development is one dimension of a balanced approach to development, including supporting access to modern, clean, and reliable energy services. IFC pursues this objective through the use and development of relevant products, instruments, markets, and advisory services as

well as through the adoption of appropriate technologies, processes, and practices in the activities it supports.

The desired outcomes are very briefly described in the objectives of each Performance Standard as below:

Performance Standard 1

Assessment and Management of Environmental and Social Risks and Impacts

Performance Standard 1 underscores the importance of managing environmental and social performance throughout the life of a project. An effective Environmental and Social Management System (ESMS) is a dynamic and continuous process initiated and supported by management, and involves engagement between the client, its workers, local communities directly affected by the project (the Affected Communities) and, where appropriate, other stakeholders. Drawing on the elements of the established business management process of "plan, do, check, and act," the ESMS entails a methodological approach to managing environmental and social risks and impacts3 in a structured way on an ongoing basis.

Business should respect human rights, which means to avoid infringing on the human rights of others and address adverse human rights impacts business may cause or contribute to. This Performance Standard applies to business activities with environmental and/or social risks and/or impacts.

Performance Standard 2

Labor and Working Conditions Introduction

Performance Standard 2 recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers through a constructive worker-management relationship, and by treating the workers fairly and providing them with safe and

healthy working conditions, clients may create tangible benefits, such as enhancement of the efficiency and productivity of their operations.

Performance Standard 3

Resource Efficiency and Pollution Prevention Introduction

Where on the one hand increased economic activity and urbanization often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels; there on the other hand the current and projected atmospheric concentration of greenhouse gases (GHG) threatens the public health and welfare of current and future generations.

This Performance Standard outlines a project-level approach to resource efficiency and pollution prevention and control in line with internationally disseminated technologies and practices.

Performance Standard 4

Community Health, Safety, and Security Introduction

Performance Standard 4 recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts. In addition, communities that are already subjected to impacts from climate change may also experience an acceleration and/or intensification of impacts due to project activities. While acknowledging the public authorities' role in promoting the health, safety, and security of the public, this Performance Standard addresses the client's responsibility to avoid or minimize the risks and impacts to community health, safety, and security that may arise from project related-activities, with particular attention to vulnerable groups.

This Performance Standard addresses potential risks and impacts to the Affected Communities from project activities.

Performance Standard 5

Land Acquisition and Involuntary Resettlement Introduction

Performance Standard 5 recognizes that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. Involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or other means of livelihood1) as a result of project-related land acquisition2 and/or restrictions on land use.

Unless properly managed, involuntary resettlement may result in long-term hardship and impoverishment for the Affected Communities and persons, as well as environmental damage and adverse socio-economic impacts in areas to which they have been displaced. For these reasons, involuntary resettlement should be avoided and where unavoidable, it should be minimized and appropriate measures to mitigate adverse impacts should be carefully planned and implemented.

Performance Standard 6

Biodiversity Conservation and Sustainable Management of Living Natural Resources I

Performance Standard 6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. The requirements set out in this Performance Standard have been guided by the Convention on Biological Diversity, which defines biodiversity as "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems."

This Performance Standard addresses how clients can sustainably manage and mitigate impacts on biodiversity and ecosystem services throughout the project's lifecycle.

Performance Standard 7

Indigenous Peoples Introduction

Performance Standard 7 recognizes that Indigenous Peoples, as social groups with identities that are distinct from mainstream groups in national societies, are often among the most marginalized and vulnerable segments of the population. In many cases, their economic, social, and legal status limits their capacity to defend their rights to, and interests in, lands and natural and cultural resources, and may restrict their ability to participate in and benefit from development. Indigenous Peoples are particularly vulnerable if their lands and resources are transformed, encroached upon, or significantly degraded. Their languages, cultures, religions, spiritual beliefs, and institutions may also come under threat. As a consequence, Indigenous Peoples may be more vulnerable to the adverse impacts associated with project development than non-indigenous communities. This vulnerability may include loss of identity, culture, and natural resource-based livelihoods, as well as exposure to impoverishment and diseases.

Private sector projects can create opportunities for Indigenous Peoples to participate in, and benefit from project-related activities that may help them fulfill their aspiration for economic and social development. Furthermore, Indigenous Peoples may play a role in sustainable development by promoting and managing activities and enterprises as partners in development. Government often plays a central role in the management of Indigenous Peoples' issues, and clients should collaborate with the responsible authorities in managing the risks and impacts of their activities.

Performance Standard 8

Cultural Heritage Introduction

Performance Standard 8 recognizes the importance of cultural heritage for current and future generations. Consistent with the Convention Concerning the Protection of the World Cultural and Natural Heritage, this Performance Standard aims to

ensure that clients protect cultural heritage in the course of their project activities. In addition, the requirements of this Performance Standard on a project's use of cultural heritage are based in part on standards set by the Convention on Biological Diversity.

Courtsey: IFC

D-2 The World Bank Environmental Assessment Process

The principal international guidance utilized in assessing the significance of impacts from the proposed development, and for determining content and form of reporting from the World Bank was also utilized.

World Bank Operational Policies OP4.01 Environmental Assessment (January 1999):

This sets out the World Bank's policy on projects requiring an EIA and defines what the assessment is designed to achieve and what issues must be considered. It also sets out guidance for screening projects and identifies other World Bank guidance and policies that may be relevant.

World Bank – Pollution Prevention and Abatement Handbook (1998):

This handbook sets out the basic principles that are considered appropriate to evaluating and controlling pollution from any defined project. The handbook provides guidance on pollution management and sets out generic environmental standards for air, water and soil pollution. This handbook also provides sector guidance. Of most significance to this project is the guidance for Thermal Power: Guidelines for new plant (July 1998).

The environmental assessment undertaken in this report also utilizes, as a precautionary measure only, The World Bank guidelines presented in the "Pollution Prevention and Abatement Handbook" effective July 1998.

D-3 International Finance Corporation, Environmental, Health, and Safety (EHS) Guidelines for Thermal Power Plants (2008)

The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment in which site-specific variables, such as hot country context, assimilative capacity of the environment and other project factors, are taken into account.

E- Categorization of the Project

Bulleh Shah Packaging Pvt. Ltd. (BSPPL), the already operational project, is situated in the agriculture land around. The project site is surrounded by populated human settlements in the form of villages. Kasur city, District Headquarter, is situated at about 10 kilometers from distance from the project site with approximate population of **????????????? (Please give here approximate population as to be recorded under Section 4, sub section 4.5.1.3 Population).** There is no element of environmental sensitivity including biodiversity around the project site. With the use of biomass, air pollution will decrease especially with respect to NO_x and SO_2 emissions and can be further reduced very efficiently, conveniently and cost effectively. In the first place, there seems no possibility of NO_x emissions exceeding the IFC/World Bank standards. Secondly, if at all so required then NOx can be reduced to the desired levels by use of Selective Catalytic Reduction (SCR). For, SO_2 removal, a dry or semi-dry scrubber can be used. Efficient system of Fiber Filter Bags (FFB) will be used to remove around 99.9 % of the particulate matter. In view of the situation the project merits for its placement in IFC **"Category B"**.

The project, besides many other advantages, will result in:

- Greenhouse gases reduction,
- Reduction in air pollution from the present practices of burning the biomass on the fields on massive scale,
- Addition to the economic development of farmers through the sale of their agriculture wastes/residues presently either of no use/value or fetching just bare minimum price,
- Creation of more labour jobs in the entire supply chain circuit including also demand for labour around biomass collection stations and on the factory premises,
- Potential for self-employment by way of opening small scale tea stalls, road side autos repair workshops, opening of petrol pumps and gas stations along the routes of the vehicles carrying the biomass from the collection stations to the factory,
- Fly ash for the time being will be land filled for about one to two years, with the ultimate aim of its introduction as being rich in Potassium (K) will be used as K rich-fertilizer, to substitute partially for synthetic costly K fertilizer, thus reducing cost of production of agriculture products,
- Increase in revenue for the Government in the form of additional taxes,
- Improvement of existing infrastructure especially roads, development and creation of infrastructure facilities between the biomass collection centres and the factory,
- Development/improvement of social and economic status of the people through addition to their income resulting also in enabling the people to fulfill desire to get their children educated.

F. Hierarchy of obtaining Environmental Approval (EA) from the EPA, Government of the Punjab, Lahore:

According to The Punjab Environmental Protection Act 1997 (Amendment) Bill 2011 Section 12, sub-section 1&4:

"(1) No proponent of a project shall commence construction or operation unless he has filed with the Government Agency designated by Federal Environmental Protection Agency or Provincial Environmental Protection Agencies, as the case may be, or, where the project is likely to cause an adverse environmental effects an environmental impact assessment, and has obtained from the Government Agency approval in respect thereof."

"(4) The Government Agency shall communicate its approval or otherwise within a period of four months from the date the initial environmental examination or environmental impact assessment is filed complete in all respects in accordance with the prescribed procedure, failing which the initial environmental examination or, as the case may be, the environmental impact assessment shall be deemed to have been approved, to the extent to which it does not contravene the provisions of this Act and the rules and regulations."

For the project falling in "Category A", the hierarchy of obtaining the EA involves submission of EIA report to the EPA. The EIA report is to be examined by the officials of the EPA. In case any further clarification is needed, it will be provided by consultant preparing the report and the project proponent. After satisfying the concerned EPA, the project proponent according to the directions of the EPA, will publish two public notices in two separate daily newspapers of the choice of EPA inviting all concerned and stakeholders to give their written comments on the project while going through the EIA reports to be made public by the EPA. The invitation of comments period will be 30 days as required under the Pakistan Environmental Protection Act- 1997. On the 31st day, Public Hearing (PH) will be

held at a place to be declared by the EPA. The environment consultants are to present the EIA report to the participants of the Public Hearing and reply to their questions. After PH, in case EPA has any objection/question, they will be answered by the environment consultants and the project proponent. And lastly, EA will be issued by the EPA.

For the project falling in "Category B", Initial Environmental Examination (IEE) report is required for getting EA from the EPA. Since the present project falls under this category, therefore, IEE will be submitted to the EPA. The IEE report will be scrutinized at their end and by their panel of experts, after whose satisfaction an internal meeting of the concerned committee of the EPA will further scrutinize the report. And thereafter EA for the construction phase will be awarded.

In either case whether it is Category A or B project, the EA is in the first stage is issued for the construction phase of the project with conditions as required to maintain the environment and other segments of the natural settings unaffected during construction phase. The project proponent is required to submit environmental monitoring reports on monthly basis showing that all the conditions laid down in the EA are being fulfilled. After the construction phase is completed, the project proponent is required to request the EPA for issuance of EA for the operational phase of the project. The concerned EPA official will visit the project site and ascertained if the required conditions as required to be fulfilled have been complied with. In case every thing is in accordance with the requirement of the EA for the Operational Phase then the concerned EPA will issue EA for the regular operation of the project, off course, with various conditions for the environmentally safe operation of the project. In case some conditions are not fulfilled then the project proponent is required to fulfill the condition unfulfilled. Thereafter, EA will be awarded for the operation phase. Of the other conditions to be fulfilled during the regular operation, the most

important one is monthly environment monitoring of the project by a third party and submit the environment monitoring reports regularly to the concerned EPA.

However, the EPA has the right to monitor the project any time of its own choice. In case, the project does not operate in compliance with required national environment quality standards, the concerned EPA will serve a notice under section 16 of the PEPA -1997 to show compliance with in thirty days of the issuance of the notice. In case the project is still found in non-compliance with the NEQS, then the case is refer to the Environment Tribunal (ET) which after satisfaction i.e. the project is not in compliance with the NEQS, will impose a fine of Rupees One Million with the condition that if the project continues in violation of the required standards, then a fine of Rupees Hundred thousand for each day of default will be imposed. After 30 days, in case the project is still operates against the require NEQS, then the project will be closed till the proponent practically demonstrate compliance with the NEQS.

G. Status of the Project Approval for EA from the EPA Punjab

The IEE report prepared according to the required format of the Environmental Protection Agency, Government of Punjab was submitted to the said agency and after its processing No Objection Certificate (NOC)/Environmental Approval (EA) was issued by the said agency.

3

Description of the Project

SECTION – 3 DESCRIPTION OF THE PROJECT

3.1 EXISTING SITUATION AT BSPPL

Packages Limited installed a new pulp and paper mill facility near Kasur previously called Bulley Shah Paper Mills after joint venture with Stora Enso is now renamed as Bulleh Shah Packaging Pvt. Ltd. (BSPPL). This facility consists of two paper machines, PM6 and PM7, able to produce up to 300,000 tonnes of paper and paperboard per year.

BSPPL requirement of steam and electricity is being met through two main boilers:

- 200 tonnes per hour (tph) – high pressure boiler (natural gas & heavy fuel oil fired).
- 65 tph – medium pressure boiler (natural gas & heavy fuel oil fired).

The 200 tph boiler is utilized for generation of electricity and provision of process steam. With operation of 65 tph boiler BSPPL has to import nearly half of its requirement from national grid. BSPPL operation is directly dependent on reliable and continuous supply of natural gas and electricity.

3.2 PROPOSED BIOMASS FIRED BOILER PROJECT

Packages Group is proposing to install, in the vicinity of BSPPL, a 150 tph biomass based boiler to supply high pressure super-heated steam at 525 °C temperature and 95 bar pressure. The proposed Biomass Boiler will be using water cooled vibrating grate technology. At 100% capacity utilization of the boiler the mass and energy balance is presented in Figure 3.1 and 3.2 below:

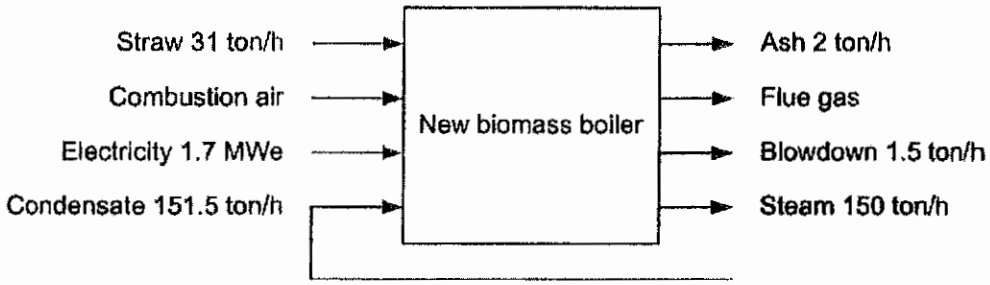


Figure – 3.1

Simplified Mass Balance of Biomass Boiler

[Source: COWI A/S,
"CONCEPTUAL DESIGN STUDY FOR NEW BIOMASS POWER PLANT"]

	Value	Unit
Fuel input	121	MW
Heat load	-109	MW
Heat losses	-12	MW
Own electricity consumption	1.7	MW

	Value	Unit
Fuel input	31	ton/h
Combustion air	200	ton/h
Bottom ash	0.4	ton/h
Fly ash	-1.6	ton/h
Flue gas	229	ton/h
Feedwater flow	151.5	ton/h
Blowdown	-1.5	ton/h
Steam flow	150.0	ton/h

Figure – 3.2

Energy & Mass Balance of New Biomass Boiler

[Source: COWI A/S Study]

New biomass based boiler, to be installed in the vicinity of BSPPL, will be environmentally friendly, replacing the present use of fossil fuels and providing optimum supply of steam and electricity for BSPPL's two paper & board manufacturing plants. BSPPL energy & mass balance diagram is presented as Figure – 3.3.

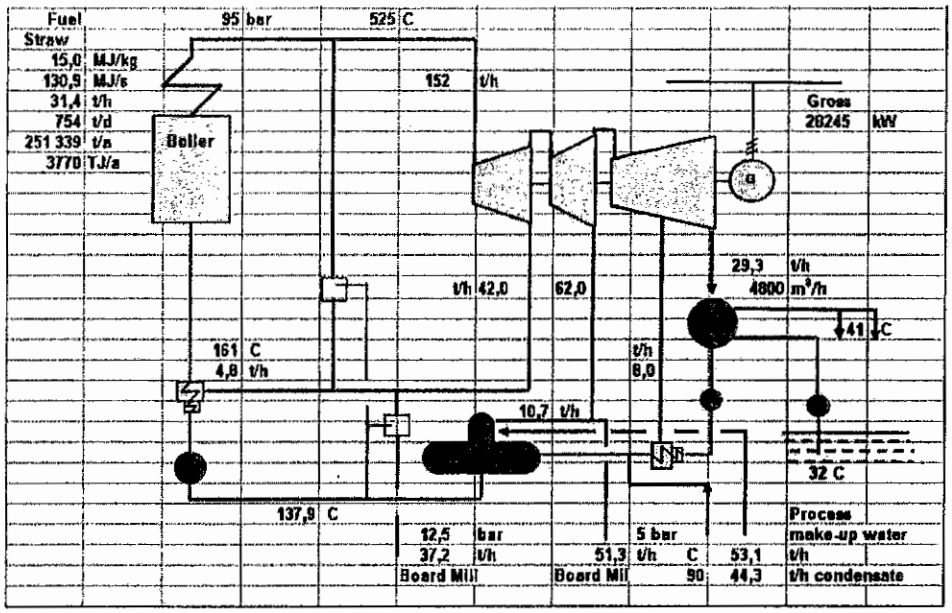


Figure – 3.3

BSPPL - Energy & Mass Balance with 150 TPH New Biomass Boiler
[Source: COWI A/S Study]

The proposed simplified process flow diagram prepared by COWI A/S is presented as Figure-3.4, below:

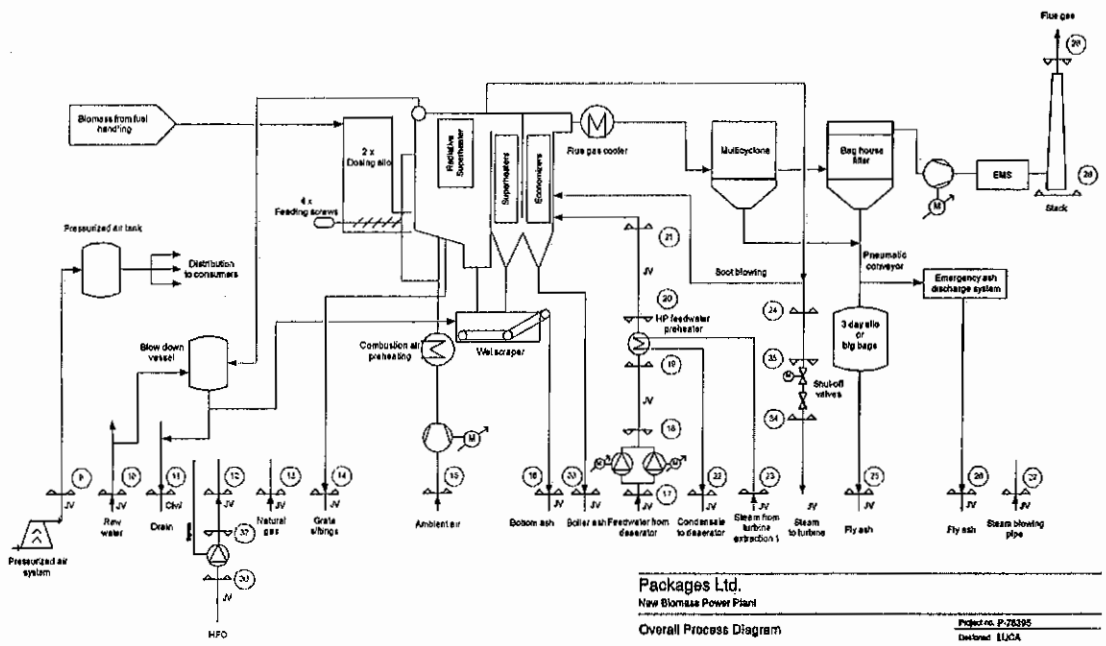


Figure – 3.4, Biomass Boiler – Process Flow

It is proposed to install stack with height of 100 meters and 2 meters diameter. The Biomass Boiler will be equipped with bag filters to remove Particulate Matter (mostly flyash) from the flue gases to less than 50 mg/Nm3 on dry basis. Expected analysis and temperature are as follow:

- Temperature = 130 °C
- Particulate Matter (mostly flyash)= Less than50 mg/Nm^3
- SO_2 = Less than 250 mg/Nm^3
- NO_x (as NO_2) = Below 400 mg/Nm^3
- Carbon Monoxide (CO) = Less than 100 mg/Nm^3
- Carbon Dioxide (CO_2) = 0.1 tonnes per hour

NO_x can be further reduced to 150 mg/Nm^3 with future installation of Selective Non-Catalytic Reduction (SNCR) system.

Table – 3.1 shows the volume of flue gases at 100% capacity utilization of the Biomass Boiler.

Table – 3.1

Biomass Boiler - Flue Gases Volume

	Value	Unit
Thermal fuel input (LHV)	121	MW
Excess air	40	%
Lambda of combustion	1.4	
Oxygen content in the flue gas, wet	5.2	%vol
Oxygen content in the flue gas, dry	6.0	%vol
Flue gas amount, wet	229	ton/h
Flue gas amount, wet	176,800	Nm^3/h
Flue gas amount, dry	153,800	Nm^3/h

[Source: COWI A/S Study]

3.3 SITE FOR THE PROPOSED PROJECT & PLANT LAYOUT

BSPPL is located off Kasur – Madina Town – Raiwind Road. The proposed Biomass Boiler will be located in the vicinity of existing BSPPL. Annexure - 3.1 presents BSPPL location on Google Map, whereas Annexure 3.2 shows BSPPL site on Google Earth picture.

The project site, located in the vicinity of BSPPL, is at an altitude of about 205 meters above mean sea level. The global co-ordinates of the plant is 31° 07'45.12" N (latitude) and 74°21'28.8" E (Longitude) as indicated in Figure – 3.5.

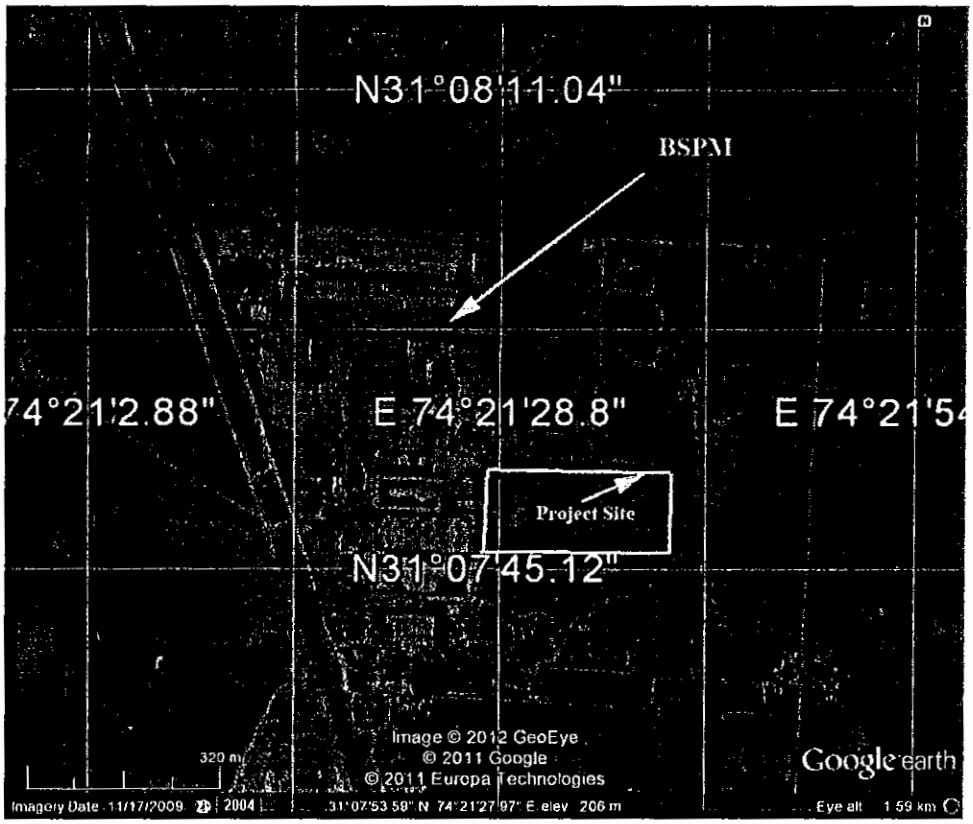
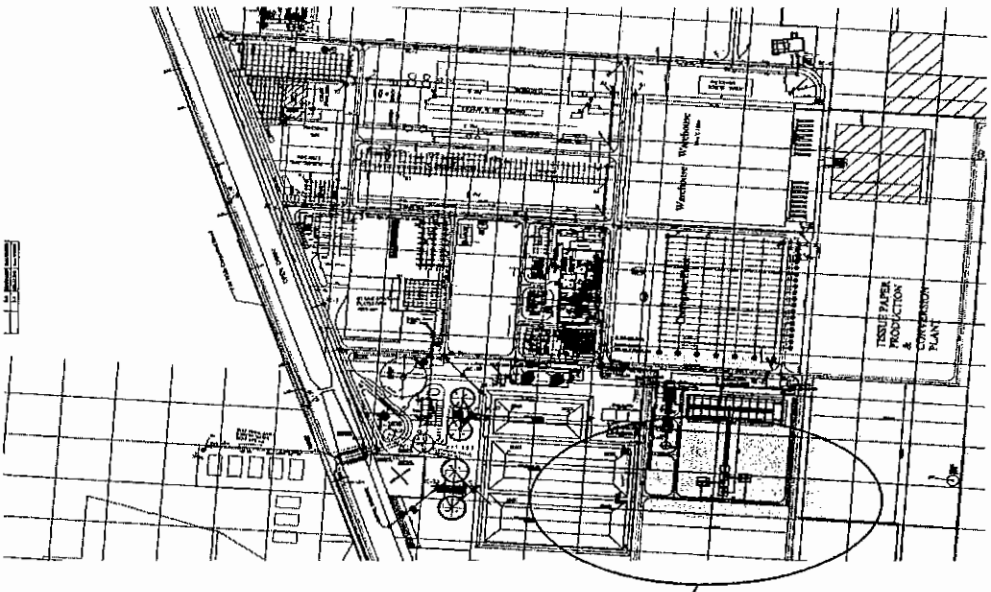


Figure – 3.5 [Courtesy: Google Earth]

The proposed project site is located south-west of the BSPPL operational plant site, but within the folds of the battery limits of the existing plant. Sufficient land, owned by Packages Group is available for the Biomass Boiler installation. The Proposed Project's layout plan is presented as Figure – 3.6



BSPPL Plant Site – Indicating Location of Biomass Boiler Project Site

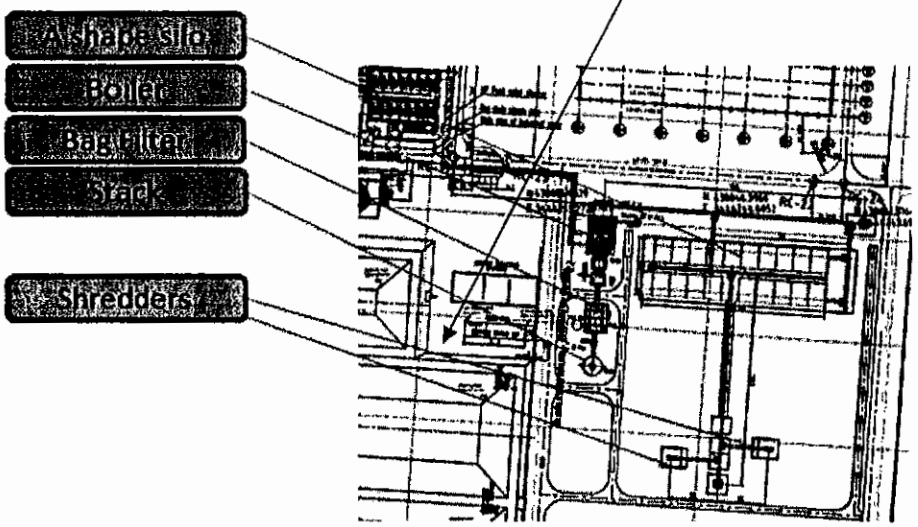


Figure – 3.6 [Source: COWI A/S Study]

Proposed Biomass Project Layout Plan

Above mentioned layout and process details are based on Conception Design Study carried out by COWI A/S, Denmark. The final design of the plant will be determined during the detailed engineering works to be conducted prior to construction. However, the main features will be the biomass bales storage, Biomass handing facilities, conveyors, Biomass bunkers, boiler plant and stack, Biomass shredder, ash handling & bunker facilities, induced draft fan, flue gases

cleaning equipment, boiler feed water facilities, and fire-fighting & safety facilities. The most prominent feature of the site within the surrounding areas is likely to be the boilers chimney (stack).

3.4 BASIC INFRASTRUCTURE AND FACILITIES:

All basic infrastructure like roads; transport; water; repair and maintenance workshops and technicians; communication facilities like telephone, fax and email; utilities required to run the plant smoothly, office buildings, medical facilities, security etc., already exist at BSPPL.

Packages Group is planning to construct a separate link road, from Kasur – Madina Town – Raiwind Road, for the Biomass Boiler Project fuel (biomass) transportation to plant site.

3.5 PROJECT WATER REQUIREMENT AND SUPPLY

The site will require makeup boiler feed water and cooling water for the operation. Water requirement of the proposed Biomass Boiler is to be met from the existing BSPPL facilities. Water requirement for the Biomass Project will be replacing the water requirement of existing BSPPL boilers.

Steam condensate, from power generation steam turbines of BSPPL, will be recycled back to the New Biomass Boiler.

Analyses of ground (raw) and drinking waters at BSPPL have been presented in Section – 4 of this Report.

3.6 WASTEWATER TREATMENT PLANT

Boiler blowdown and other liquid effluents from the Biomass Project will be treated at the existing elaborate waste water treatment facilities of BSPPL.

3.7 FUEL AVAILABILITY, REQUIREMENT & SUPPLY

Project feasibility titled **"Feasibility Study for Biomass Cogeneration at Bulleh Shah Packaging Private Limited (BSPPL)" (December 2011),** prepared by **COWI Consulting Group** has **selected** the following biomasses for use as fuel for the Proposed Project:

- Wheat straw
- Corn Stover
- Cottons stalks

This study has recommended the following requirement of biomass based on harvesting times and minimizations of storage needs as well as transportation distance (based on 100% capacity utilization and 120 MW thermal inputs):

Table – 3.2
Residual Biomass and Consumption

Operating year	Feedstock	Amounts (tonnes per year)
1 - 3	Wheat	250,000
4 - rest of planning period	Wheat	48,000
	Corn stover	150,000
	Cotton stalks	52,000
	Total	250,000

[Source: AEIA/COWI Studies]

The study has considered that during the first three years (2014-2017) of operation, wheat straw will be the sole feed stock. After which period when further biomass collection centers and logistic are developed the shift needs to be

towards use of corn stover and cotton sticks. It is recommended that then corn stover will be the primary residual fuel.

Packages Group has already been using agricultural residues/waste (wheat & rice straws) as primary feedstock for their paper & pulp mills at Packages Limited, Lahore and BSPPL (Kasur). The collection of feedstock system has been earlier established since inception of Packages Limited plant at Lahore and later on for BSPPL.

Collection and delivery system for the feedstock has been well established. Biomass deliveries are being made both in bulk and baled form by large and small road trucks as well as tractor trolleys. At present BSPPL consumes about 300,000 tonnes per annum of biomass when operating at 100% capacity.

Figure – 3.7 shows the potential availability of biomass at 100 and 300 kilometers radius from BSPPL plant site.

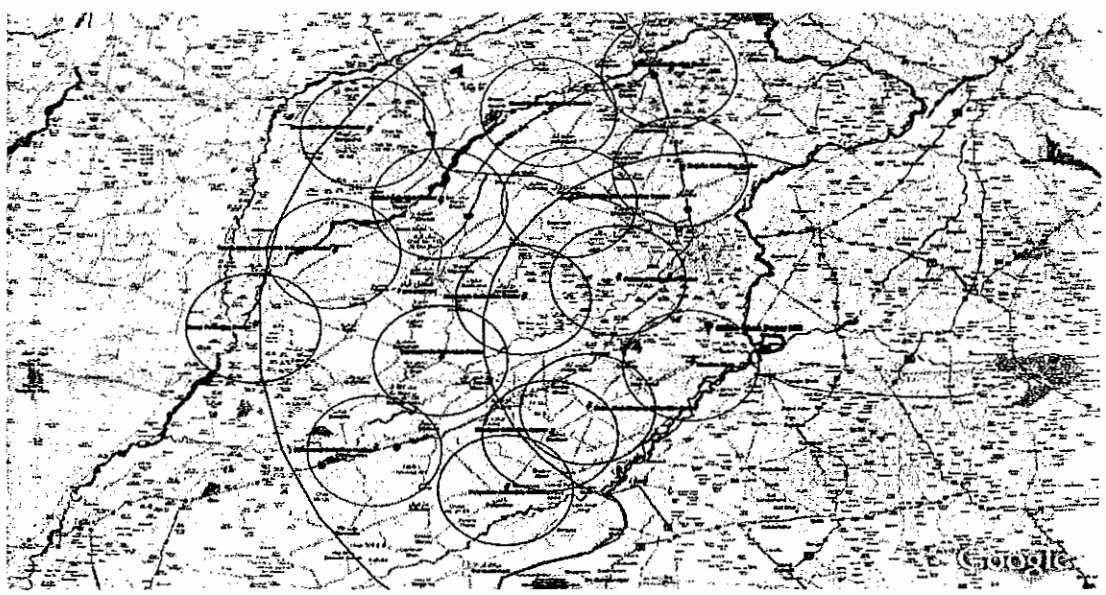


Figure 3.7

Potential Location of Biomass Collection Sites

[Source: AEIA Study]

Availability of biomass at 100 – 300 kilometers radius from plant site is shown in Table – 3.3

Table – 3.3

Crop	Distance from BSPPL		
	100 km	200 km	300 km
	Availability of Biomass, Tonnes		
Corn Stovers	566,000	1,762,000	2,148,000
Cotton Stalks	23,000	281,000	909,000
Rice Straw	222,000	666,000	727,000
Wheat Straw	217,000	821,000	1,322,000
Sugar Cane – Trash	87,000	439,000	579,000
TOTAL	**1,115,000**	**3,969,000**	**5,685,000**

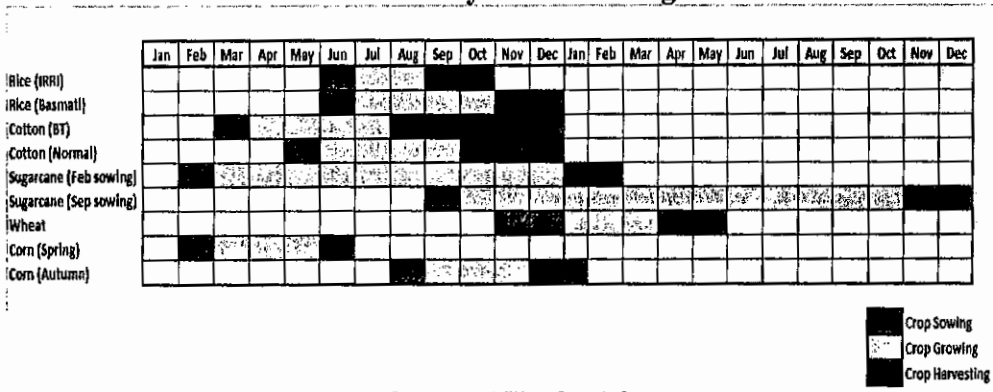
[Source: Punjab Agriculture Department]
(70 % biomass residue collection efficiency assumed)

AEIA Study analysis shows that within a 100 km radius of BSPPL about 1.4 million tonnes/year of agricultural waste is available. At present the biomass in this area is being used for animal fodder, fuel for brick kilns and small scale biomass boilers. Table – 3.3 shows the net availability biomass as future fuel after deduction of present use from total generation.

Table – 3.4 shows the biomass availability schedules for the various crops:

Table – 3.4

Biomass Availability & Harvesting Schedule



[Source: AEIA Study]

It has been proposed by AEIA and COWI A/S that the Proposed Project should establish biomass collection centers, most with baling arrangement at the center for ease of handling and cost of delivery. Such arrangement will also reduce generation of fugitive dust during transportation and will be environmental friendly.

Tables 3.5 and 3.6, below, show the proximate & ultimate analysis of various biomasses:

Table – 3.5

Biomass – Proximate Analysis

Proximate Analysis (Weight %)						
	Corn Straw	**Cane Trash**	**Rice Straw**	**Wheat Straw**	**Corn Cob**	**Cotton Stalks**
Moisture	12.0	13.6	9.4	9.2	11.1	12.6
Volatile Matter	66.7	62.9	58.8	63.6	72.4	65
Ash	4.4	9.5	16.9	11.1	1.4	4.1

[Source: DANAK Study]

Table – 3.6

Biomass – Ultimate Analysis

Ultimate Analysis (Weight %)						
	Corn Straw	**Cane Trash**	**Rice Straw**	**Wheat Straw**	**Corn Cob**	**Cotton Stalks**
C	41.7	38.5	35.9	39.5	42.5	41.5
H	5.0	4.8	4.6	5.0	5.3	5.0
N	0.75	0.63	0.69	0.40	0.29	0.66
O	35.0	32.4	31.4	33.9	39.1	35.6
S	0.06	0.24	00.16	0.11	00.02	0.12

[Source: DANAK Study]

Calorific values of the residual biomass are indicated below in Table – 3.7:

Table – 3.7

Calorific Value of Biomasses

	Calorific Value	
	HHV(MJ/kg)	LHV(MJ/kg)
	Experiment	Experiment
Cotton Stalks	16.42	15.01
Corn Straw	16.35	14.96
Cane Trash	15.30	13.92
Rice Straw	14.04	12.86
Wheat Straw	15.5	14.14
Corn Cob	16.66	15.24

[Source: DANAK Study]

Presently, Packages Group operates seven collection centers and also receives wheat straw directly at both the BSPPL and Packages Limited. This delivered wheat straw is utilized for the pulp & paper production. The collection system is working very well. Packages Group enters into an annual agreement with a farmers' broker to deliver the wheat biomass at a fixed price. This agreement is renewed annually and a fair price for delivery of the wheat straw is negotiated.

Tables 3.8 indicates the existing operational biomass collection centers:

Table – 3.8

Packages Group – Existing Biomass Collection Centers

Center Name	Year Established	Land Ownership Status	Storage Area (acres)	Distance from BSPM-Kasur (Km)	Distance from PKG - Lahore (Km)	Storage Capacity (tons)	Number of Balers	Baling Capacity (tons)	Wheat Straw Purchased in 2008 (tons)	Wheat Straw Purchased in 2009 (tons)	Wheat Straw Purchased in 2010 (tons)
PAKPATTAN	1988	Own	21.5	140	180	20,000	4	8,000	13,364	6,881	11,900
DEPALPUR	1992	Own	13.25	105	145	6,200	0	0	6,112	808	3,910
HUJRA SHAH	1986	Own	10	80	120	14,000	2	4,000	12,143	10,068	11,043
MANDI FAIZABAD	1993	Own	8.25	120	65	2,000	0	0	3,614	2,219	4,782
JARANWAL	2005	Lease	25	175	120	9,000	0	0	8,666	9,052	8,079
TANDLIANWALA	2007	Lease	12.25	225	170	14,000	2	4000	9,288	8,899	10,878
JHANG	1998	Lease	10	320	265	12,000	3	6,000	9,536	8,826	10,429
SHORKOT	2008	Lease	0	370	315	0	0	0	2,579	Centre closed	Centre closed
PACKAGES PLANT LAHORE	1966	Own	7	40	0	7,000	0	0	21,340	22,111	12,225
PAPER MILL KASUR	2006	Own	4	0	40	4,000	0	0	5,125	1,818	4,594
									91,767	70,627	77,840

Proposed new collecting and already existring centers, which will be required to meet the future biomass demand, are shown in Tables 3.9 and 3.10.

Table – 3.9

Proposed new Primary & Already Existing Biomass Collection Centers within 200 km radius of BSPPL

Collecting Center	Status	Distance from the mill
Faizabad	Existing	120 km
Jaranwala	Existing	175 km
Hujra Shah Muqeem	Existing	80 km
Depalpur	Existing	105 km
Kamoke	Proposed	120 km
Khanqah Dogran	Proposed	146km
Khudian Khas	Proposed	36 km

[Source: COWI A/S Study]

Table – 3.10
Secondary Biomass Collection Centers within 300km radius of BSPPL

Collecting Center	Status	Distance from the mill
Pakpattan	Existing	140 km
Tandlianwala	Existing	225 km
Jhang	Existing	320 km
Wazirabad	Proposed	105 km
Rasulnagar	Proposed	187 km
Sargodha	Proposed	258 km
Chiniot	Proposed	211 km
Thatta Muhammad Shah	Proposed	266 km
Chichawatni	Proposed	197 km

[Source: COWI A/S Study]

This incoming wheat straw is baled on site and then transported to BSPPL o Packages Limited, Lahore. The transportation of the wheat straw to the mills i also subcontracted out. Typically 40 feet flatbeds are utilized to deliver the straw to BSPPL or Lahore sites. Average loading on the flatbed is close to 40 tonnes.

Packages is planning to expand and open up new collection centers based on the same successful approach as operations of the existing wheat straw collection centers. As per existing operations the baling and transportation components could be subcontracted to minimize infrastructure expenditure or any other economical and convenient approach to be worked out after adoption of feasibility study. It is pertinent to note that whatever the approach is followed the environment related facts will remain the same which are duly addressed in the later sections of this report.

Collection centers will be used to collect the biomass available as close to BSPPL as possible to mitigate transportation costs. Figure-3.7, shows potential collections centers about 30 km apart to capture required quantities of biomass. A major consideration is for the collection center to be close to a highway. Assumptions were made on biomass availability in top five districts of each crop and then collection centers in each district are proposed. Figure-3.7 shows the location of

BSPPL, major transportation routes, and potential locations of the biomass collection centers.

3.8 ASH HANDLING

Biomass Boiler will generate the following three (3) types of ashes:

- Bottom ash
- Boiler ash
- Filter ash

The bottom ash from the grate is collected in a wet scraper. It serves the purpose of putting out possible glowing particles in the ash, air sealing between the boiler and the surrounding and serve as basis for transport of ashes. The wet scraper is a water filled scraper, and a certain water level will be maintained. Water for the scraper will be primarily blow down water from the boiler, which is cooled and condensed.

Boiler ashes, which are ashes collected from the bottom of the 2nd/3rd pass and possible additional passes, are collected in hoppers at the bottom of the boiler. Rotary locks in the system ensure gas tightness between the boiler and the surroundings. Boiler ashes are mixed with the bottom ashes in the wet scraper, as they will constitute rather coarse material. From the wet scraper the mixture of bottom ashes and boiler ashes are conveyed to an ash bunker or container from where further transport is arranged.

Bottom ash and Boiler Ash will be used to manufacture refractory and the left over will be sent to cement factories.

The filter/fly ash will be used as fertilizer becase it conatins P&K and as such it will partly cut upon the use of synthetic P&K fertilizer.

According to some studies carried out in India, "Fly ash holds a potential to improve the physical health of the soil. It can serve as a soil modifier and also enhance the water retaining capacity and fertility of the soil. It improves the plants water and nutrient uptake; helps in development of roots and soil binding, stores carbohydrates and oils for use when needed, protects the soil from soil borne diseases and detoxifies contaminated soil".

Use of Fly ash in agriculture can increase the yield of cereals, oil seeds, pulses, cotton and sugarcane by 10-15%, vegetables by about 20-25% and root vegetables by 30-40%. Waste lands, degraded lands, saline alkaline soils, eroded soils etc., can be successfully reclaimed by fly ash."

Some of the other uses include use of fly ash in mine filling, construction of roads/ flyover embankments, hydraulic structures, raising of dykes, manufacture of several building components like bricks, blocks, tiles and use in agriculture.

It is also used as a pozollanic substitute for cement in Roller Compacted Concrete dams-an innovative dam technology developed as a result of efforts to design more economical concrete dams that could be constructed rapidly with designed performance. Fly ash in R.C.C. is used not only for saving cement cost but also for enhancing strength and durability.

Fly ash can also be used in Portland cement concrete to enhance the performance of the concrete.

Utilizing fly ash in roads saves top soil, avoids creation of low lying areas, does not deprive the nation of the productivity of top soil and reduces the demand of land for fly ash disposal.

The use of fly ash in the Nizamuddin bridge road embankment at Delhi, India for about 2 Kms. and a height of 8 meters in a flood zone has demonstrated the use of

fly-ash in adverse conditions. This has not only saved the top soil and used fly ash which was otherwise a waste but also saved Rs. 1.4 crores in a total project of Rs. 10 crores.

Fly ash-Lime-Gypsum bricks are manufactured using the properties of the mixture as an 'Hydraulic Cement' meaning thereby that it sets and hardens in the presence of moisture and on the lines of Portland cement, gets stronger with age but unlike clay bricks does not need sintering.

Cellular light weight concrete blocks are used as a substitute to bricks and conventional concrete blocks. This is a foaming agent based technology from Germany using Fly-ash (to the extent of1/3rd to 1/4th of the total materials constitution), sand, water and foam manufactured from biodegradable foaming agents.

Fly ash based polymer products are also being used as wood substitutes. They have been developed by using fly ash as the matrix and jute cloth as the reinforcement.

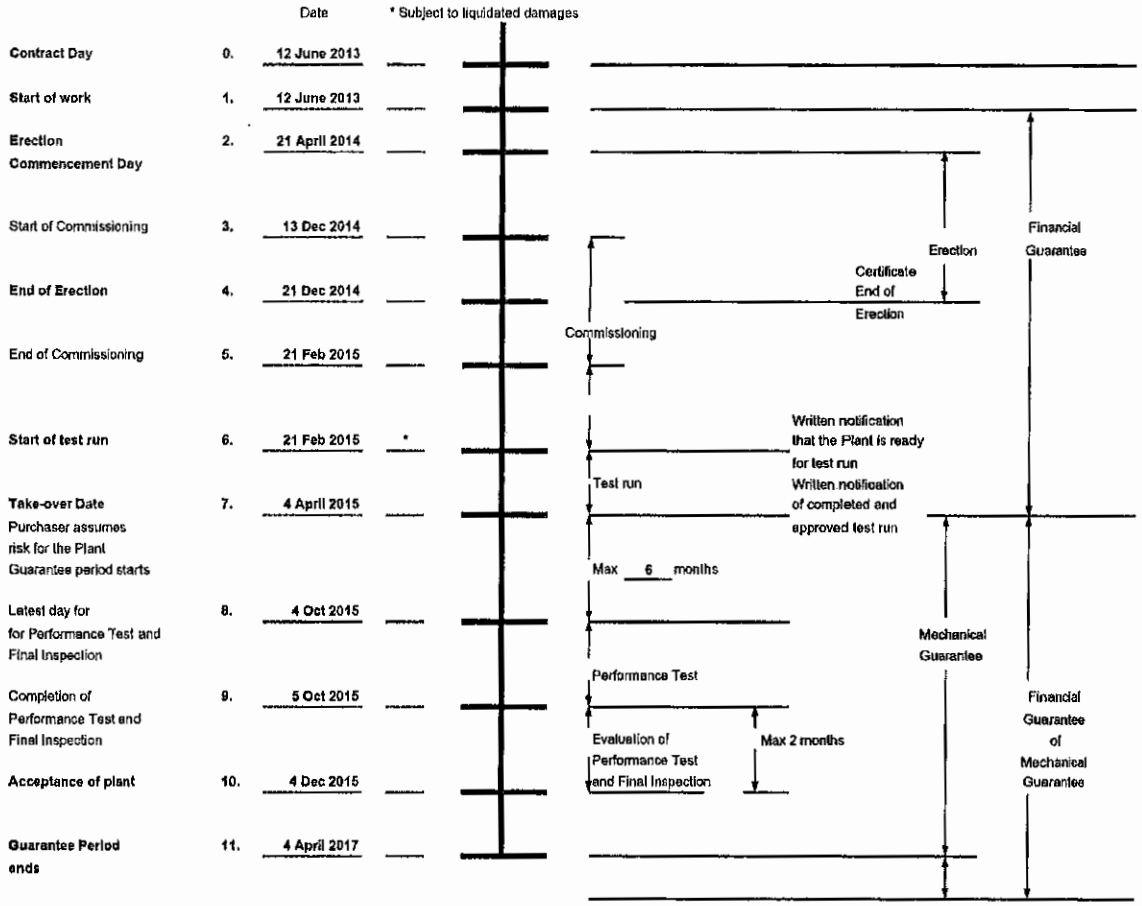
The Government of India has withdrawn a 8% **excise duty** imposed earlier on fly ash products. Now no excise duty is levied on manufacture of goods in which a minimum of 25% w/w fly ash is used.

3.9 PROJECT IMPLEMENTATION SCHEDULE

Tentive Project implementation schedule is presented below:

Table – 3.10

Contract designation. Equipment and erection



3.10 POTENTIAL CDM CREDITS

- **The Current Situation**

With the current commitment period of the Kyoto Protocol drawing to a close in 2012, future demand for carbon emission reductions is expected to be driven by the outcome of agreements, and from emerging national and regional climate policies. The required commitments of Annex 1 countries (industrialized and countries in transition which have ratified the Kyoto Protocol) beyond 2012 are currently unclear and therefore the future market for Certified Emission Reductions (CERs).

Participants of the World Bank's present set of Carbon Funds are primarily interested in buying CERs from projects that will generate sizeable CERs before the end of 2012.

With the regulatory period of the Kyoto Protocol ending in 2012, and discussions between the Parties to the UNFCCC on a long-term framework for the post-2012 period not concluded, there is a period of uncertainty regarding the future international climate regime. The challenge along with the lack of regulatory framework has created a limited demand for post–2012 carbon assets.

As a response to these challenges, the new proposed Carbon Partnership Facility is designed to develop emission reductions and support their purchase over long periods after 2012. "Learning by doing" approaches will be an essential aspect of the "Carbon Partnership Facility" as it moves from individual projects to programmatic approaches, including methodologies needed for such approaches.

Because this project will not be formally registered before 2013 (at the earliest), preliminary discussions with staff from the World Bank Carbon Finance Unit indicates that the project cannot rely on the European CER market, in particular in the case of Pakistan which is considered a Low Income Country, rather than an

LDC. This will limit the market for CERs to perhaps the Japanese market. Unfortunately, this uncertainty will persist for the next couple of years. However, as the proposed Carbon Partnership Facility is implemented, there should be opportunities to enter the CERs marketplace.

- **The Kyoto Protocol**

Basically the Kyoto Protocol is an agreement under which industrialized countries agree to reduce their collective greenhouse gas (GHG) emissions by 5.2% below 1990 levels for the period from January 2008 until 2012. Countries have been divided into two general categories: Annex I countries which are developed countries who have accepted GHG obligations and Non-Annex I countries which are developing counties who have no GHG obligations. Pakistan falls into this latter category.

The Kyoto Protocol includes three "flexible mechanisms" which are intended to lower the overall costs of achieving emission targets. The flexible mechanisms enable Annex I countries to meet emission targets by taking credit for carbon reductions in other countries. The three flexible mechanisms are:

i- ET (Emissions Trading),
ii- JI (joint Implementation) and
iii- CDM (Clean Development Mechanism).

Emissions Trading: Each Annex I country is given a certain number of AAUs (Assigned Amount Units), which represent the total amount of GHG that the country is allowed to emit in the first commitment period (2008-2012). The AAUs are tradable units that represent 1 tCO_2e (ton of CO_2 equivalent). Countries can trade AAUs to help meet emissions targets. Alternatively an individual firm can purchase AAUs to meet its own emissions targets.

Clean Development Mechanism: The CDM allows industrialized countries to meet their domestic emissions targets by purchasing GHG reduction credits from *non-industrialized* countries as an alternative to achieving 100% of the required emissions reductions within its own borders. Since non-industrialized countries have no emissions reduction targets, they have nothing to lose by allowing another country to take credit for emissions reductions. In order to take credit for the reduction, the project developer must demonstrate that the total emissions have been reduced below the business as usual scenario.

Joint Implementation: Joint Implementation (JI) allows industrial countries to meet their domestic emission reduction targets by purchasing GHG credits from other *industrialized* countries as an alternative to achieving 100% of the required emission reductions within their own borders. Most JI projects are expected to take place in countries with economies in transition in Eastern Europe and the former Soviet Union for example, where the cost of reducing emissions is considerably lower. JI projects are much less common than CDM projects. This is especially the case for Pakistan.

- **CDM Overview**

There are many steps to taking a CDM project from an idea to eventually generating cash. Hereunder, are outlined different types of CDM projects, the project cycle, and the methods for calculating emissions reduction, and the various ways the CERs can be monetized?

Biomass Boiler Project can fall into one of several types of projects.

Types of CDM Projects:

There are seven types of CDM projects:

1. Energy Efficiency -Increase energy efficiency of buildings or commercial/industrial facilities.

2. Switch to less carbon intensive fuels

3. Methane Recovery - Recover methane from animal waste, coal mines, landfills, wastewater sludge, or other sources

4. Industrial Process Change - Change an industrial process resulting in reduced GHG emissions

5. Cogeneration - Make use of waste heat from electric generation

6. Transport - Improve fuel efficiency, Switch to less carbon intensive transport mode, and Reduce frequency of transport

7. Agricultural - Any agricultural change that results in the reduction of GHG emissions

8. Land Use - A forestation or reforestation

- **The Project Development Cycle**

The CDM development cycle consists of the following steps.

1. Project Identification:

To qualify as a CDM project, the project must establish "additionality". Additionality refers to the incremental improvement over the business as usual scenario. Any project that would have been developed without the CDM process would not be considered additional. So the art in CDM projects is to fully justify this position.

2. Project Idea Note:

The developer can submit a project idea note (PIN) to potential carbon credit buyers to gauge the level of interest in the project. The PIN typically includes information on project size anticipated GHG reductions, suggested CER price, financing structure, other economic effects, etc.

3. Stakeholder Participation and Validation:

Local stakeholders are invited to comment on the Project Design Document (PDD) over a 30 day period. The PDD gives a description of the project and outlines the methods for measuring and calculating emission reductions. A report is created to show how relevant concerns were addressed.

4. Host County Approval:

Host countries are given a great deal of leeway in choosing to accept or reject CDM projects. This approval is required.

5. Validation by Designated Operational Entity (DOE):

In the validation process, the DOE confirms that all the information and assumptions in the PDD are reasonable. DOEs are domestic or international entities that have been accredited by the CDM Executive Board. Typically the project developer is responsible for contracting with and paying the DOE. Validation does not guarantee the issuance of credits.

6. Registration:

Registration of the project with the CDM Executive Board is the act of final acceptance of the project.

7. Implementation and Monitoring:

Once the project is implemented, the project developer needs to monitor the project performance and submit monitoring results to the DOE for verification and certification. The monitoring results are used to determine the number of credits granted. Monitoring must be in accordance with validated monitoring plans.

8. Verification, Certification, and Issuance:

Verification is the periodic review and ex-post determination of GHG reductions. To avoid a conflict of interest, the DOE contracted for verification will generally be different from the DOE contracted for validation.

Certification is the written assurance by a DOE that the project has achieved a given reduction in GHG emissions. The DOE is liable for eventual mistakes, misrepresentations, and fraud. Certification is effectively a form of liability transfer. After certification, the CDM registry administrator will issue CERs by forwarding them to the appropriate accounts.

- **Current Configuration of BSPPL**

  Specification of current equipments is as follows:

Equipment	**High pressure boiler**
Manufacturer	Descon Engineering Pvt. Ltd. Pakistan
Type	Water tube
Steam production	200 tph
Steam parameters	T=525degC, P=95bar
Fuel	Natural gas (main) or HFO
Current status	Main supplier of steam to the turbine / generator
Post-project role	Additional supplier of steam to the turbine / generator

Equipment	**Steam turbine and generator**
Manufacturer	Siemens Czech Republic
Type	Condensing Extraction Type
Generating capacity	41MW
Generating voltage	11kV
Current status	Supplier of electricity and heat to the paper machines.
Post-project role	Supplier of electricity and heat to the paper machines.

Equipment	Low pressure boiler
Manufacturer	Descon Engineering Pvt. Ltd. Pakistan
Type	Water tube
Steam production	65tph
Steam parametera	T=198degC, P=13bar
Fuel	Natural gas (main) or HFO
Current status	Backup supplier of heat to the paper machines.
Post-project role	Backup supplier of heat to the paper machines.

Quantity of fuel used historically is as follows.

Gas (Hm^3)	2008	2009	2010	2011
41MW SPP	582	356,022	409,319	155,703
65 tph Boiler	267,998	183,462	101,054	48,568

HFO(Tonne)	2008	2009	2010	2011
41 MW SPP	0	0	1699	8,559
65 tph Boiler	0	683	6880	3,741

Quantity of electricity generated and imported historically is as follows:

Unit: MWh	2008	2009	2010	2011 till Aug
Generated	29,363	80,426	65,356	30,684
Imported	56,555	46,949	65,596	52,469

长青集团 CHANT GROUP **Yishui Chant Waste-To-Energy Co. Limited**

February,05,2015

To Whom It May Concern

This is to certify that **Mr. Arif Hussain** an employee of OMS Private Limited, Pakistan has successfully attended the training session from January 26, 2015 to February 05, 2015 held at **30MW Power Plant owned by Yishui Chant Waste to Energy Co. Ltd. Yishui, Shandong China.**

Power Plant consists of Water Cooled Vibrating Grate Boiler 130T/H manufactured by Jinan Boiler Group Co. Ltd and 30MW Turbine manufactured by Changjiang Motor Co. Ltd.

Charles Zhou

Facilitator/Trainer

长青集团 CHANT GROUP **Yishui Chant Waste-To-Energy Co. Limited**

February,05,2015

To Whom It May Concern

This is to certify that **Mr. Muhammad Tahir** an employee of OMS Private Limited, Pakistan has successfully attended the training session from January 26, 2015 to February 05, 2015 held at **30MW Power Plant owned by Yishui Chant Waste to Energy Co. Ltd. Yishui, Shandong China.**

Power Plant consists of Water Cooled Vibrating Grate Boiler 130T/H manufactured by Jinan Boiler Group Co. Ltd and 30MW Turbine manufactured by Changjiang Motor Co. Ltd.

周东印方

Charles Zhou
Facilitator/Trainer

长青集团 CHANT GROUP

Yishui Chant Waste-To-Energy Co. Limited

February,05,2015

To Whom It May Concern

This is to certify that Mr. Khalid Rasool an employee of OMS Private Limited, Pakistan has successfully attended the training session from January 26, 2015 to February 05, 2015 held at 30MW Power Plant owned by Yishui Chant Waste to Energy Co. Ltd, Yishui, Shandong China.

Power Plant consists of Water Cooled, Vibrating Grate Boiler 130T/H manufactured by Jinan Boiler Group Co. Ltd and 30MW Turbine manufactured by Changjiang Motor Co. Ltd.

方周印赤

Charles Zhou

Facilitator/Trainer

长城集团 CHINT GROUP Yishui Chint Waste To Energy Co., [illegible]

[illegible]

To Whom It May Concern

This is to certify that Mr. Noor Fareed an employee of [illegible] Pakistan has successfully attended the training session from [illegible] February 05, 2015 held at 30MW Power Plant owned by [illegible] Waste to Energy Co. Ltd. Yishui, Shandong, China. [illegible] Power Plant consists of Water [illegible] manufactured by [illegible] Boiler Group Co. Ltd. and [illegible] by Changjiang Motor Co. Ltd.

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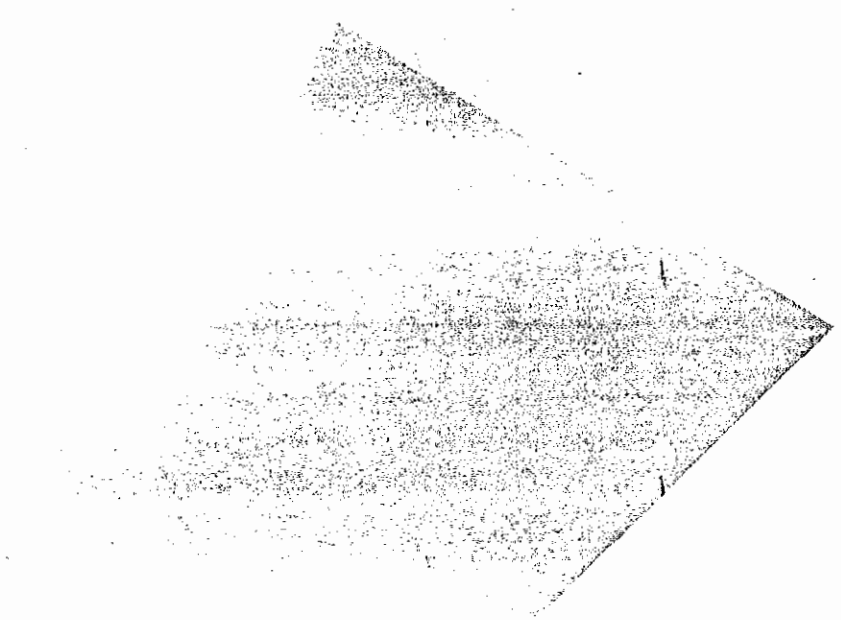
ANNEXURE N (ii) - TRAINING MANUAL

APRIL 2015
BULLEH SHAH PACKAGING

BIOMASS POWER PLANT

OPERATION TRAINING HANDBOOK



COWI

COWI

ADDRESS COWI A/S
Parallelvej 2
2800 Kongens Lyngby
Denmark

TEL +45 56 40 00 00
FAX +45 56 40 99 99
www cowi.com

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CONTENTS

1 Training handbook Introduction

The intension of this training handbook is to give the reader an overall introduction to the BSPL new biomass boiler plant and hence to bring general understanding to the reader.

It is of the most importance to stress that this handbook is NOT an operation and maintenance manual. ALL operation and maintenance instruction must be found in the operation manual delivered by RUNH Power or their sub suppliers.

The content are as follows:

In chapter 2 the general key figures/design data of the plant are highlighted and the limitations of the boiler are explained.

Chapter 3 explains the philosophy of the fuel reception and fuel yard logistic and highlights some important safety issues that has been identified.

Chapter 4 systematically describes the main components of the fuel transport and storage systems.

Chapter 5 describes the combustion system of the boiler starting with the inlet of the fuel and combustion air and ending at the flue gas outlet at the chimney and at the ash/slag outlet.

Chapter 6 finally describes water and steam system.

It is recommended to have a set of P&I diagrams available when reading this handbook.

2 General

2.1 New Biomass Power Plant

The new biomass power plant constitutes of a fuel reception, handling, shredding and conveying/transport feeding system able to handle different types of biomass fuels, both in baled form as well as in loose (bulk) form.

The biomass fuels are combusted in a biomass boiler, which produces steam to the existing turbine/generator system. The combustion take place on a vibrating grate, designed for the fuel.

The steam is diverted to the existing turbine/generator system and the operation of the Plant are integrated with the steam pipes and the operation of the existing boiler.

The feedwater is taken from the existing feedwater/deaerator tank and steam for feedwater preheating is taken from existing bleeds from the turbine.

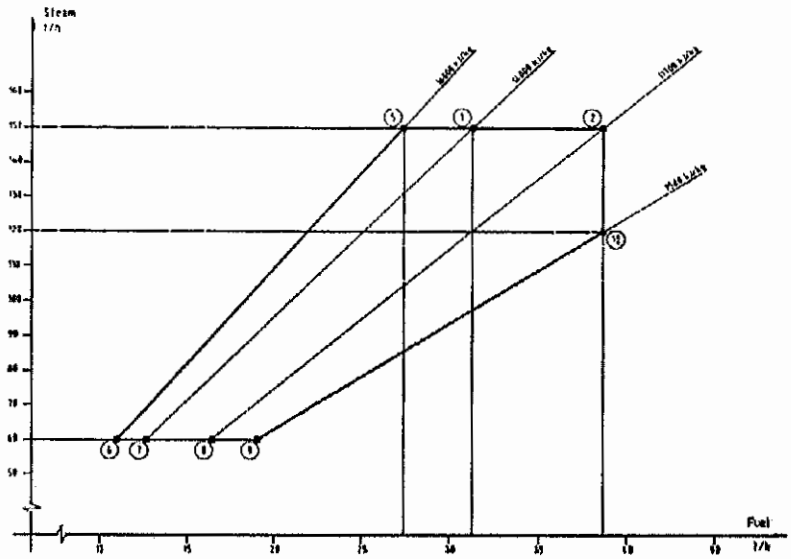
The slag and ash from the boiler are led to a slag bunker.

The flue gas is cleaned in a bag house filter system, and the ashes are collected in an ash silo. An induced draft fan is keeping sub-pressure in the boiler and before emitting the flue gases via the stack, an automated emission measuring system shall measure and control the emissions.

Dual fuel burners are installed as backup fuel for the biomass enabling the boiler to operate on either heavy fuel oil or natural gas.

2.1.1 Plant Operation

The Plant will operate automatically and continuously at MCR (Maximum Continuous Rating), but is able to operate the plant continuously in all load points within the boundaries of the Capacity Diagram.



The numbers in the capacity diagram refers to the numbering in the key figures diagram as described in the following chapter.

The capacity diagram describes the boundaries of the operation of the boiler which is based on the calorific value of the fuel that are represented as the 4 sloped lines in the diagram. The diagram numbering refers to the operation data of the boiler as shown in the next chapter.

The 4 different calorific values are represented as the 4 sloped lines in the diagram:

- Loadcase/loadpoint 9 and 10 (LP9 and LP10): 9500 kJ/kg
- Loadcase/loadpoint 2 and 8 (LP2 and LP8): 11700 kJ/kg
- Loadcase/loadpoint 1 and 7 (LP1 and LP7): 14000 kJ/kg
- Loadcase/loadpoint 5 and 6 (LP1 and LP10): 16000 kJ/kg

If the calorific value of the fuel is 14000 kJ/kg the capacity diagram describes that:

- Point 1 describes that the maximum output of the boiler is 150 t/hr and that the fuel/biomass flow will be 31,27 t/hr
- Point 7 describes that the minimum output of the boiler is 60 t/hr and that the fuel/biomass flow will be 12,8 t/hr

If the calorific value of the fuel is 11700 kJ/kg the capacity diagram describes:

- Point 2 describes that the maximum output of the boiler is 150 t/hr and that the fuel/biomass flow will be 37,61 t/hr

- Point 8 describes that the minimum output of the boiler is 60 t/hr and that the fuel/biomass flow will be 15,37 t/hr

and the same for the rest of the load points....

Reasons for the limitations of the boiler are many, below are examples of typical limitations:

- If the calorific value of the fuel is low, as in point 10 (9500 kJ/kg), typically if the biomass is wet, the size of the grate limits the amount of fuel that can be combusted. If too much fuel are forced through the combustion chamber/grate it will not be fully combusted when it reaches the end of the grate and unburned biomass will drop down in the wet ash chain conveyer together with the boiler ash. In point 10 this maximum biomass amount is 37,61 t/hr and this amount of fuel will then generate a steam flow at 120 t/hr.

- If the calorific value of the fuel is low, as in point 9 (9500 kJ/kg), typically if the biomass is wet, the requirement for a steam temperature at 525°C require a minimum of heat input and flue gas flow. If the heat input gets too low, the steam temperature will drop below the 525°C. The minimum limit for this is a fuel flow at 18,98t/hr that will generate a steam flow at 60 t/hr.

2.2 Operational Data

The following table is a part of the key figure table 0520611 that shows the design values for the eight different load cases.

		LP 1	LP 2	LP 5	LP 6	LP 7	LP 8	LP 9	LP 10
Loadcases		Case 1	Case 2 / Design	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8
Load	%	100,0	100,0	100,0	40,0	40,0	40,0	40,0	85,6
Lower Heating value	MJ/kg	13,70	15,70	14,00	16,00	11,09	13,70	9,50	[illegible]
Thermal fuel input	MW	171,1	172,2	171,8	49,7	49,9	47,6	50,1	99,1
Fuel and ash									
Fuel flow	t/h	11,27	27,61	27,32	11,19	12,96	15,17	19,95	37,62
Ash	% w/w	7,61	9,35	10,35	13,11	10,68	9,35	5,81	5,13
Humidity	% w/w	11,0	25,00	17,40	12,80	13,00	25,50	37,50	37,50
Combustibles (Constructed Supplied)		Constructed	Constructed	Constructed	Constructed	Constructed	Constructed	Constructed	Constructed
C	% w/w	37,84	32,64	42,16	42,18	37,84	37,62	28,16	34,16
H	% w/w	4,79	4,13	4,13	4,83	4,29	4,13	3,49	3,49
O	% w/w	31,47	27,99	28,73	28,75	32,47	27,99	23,91	23,91
N	% w/w	0,38	0,31	0,53	0,56	0,38	0,31	0,38	0,38
S	% w/w	0,10	0,09	0,21	0,28	0,10	0,09	0,06	0,06
Cl	% w/w	0,11	0,70	0,61	0,67	0,03	0,70	0,67	0,67
Nominal grate ash flow	kg/s	0,52	0,96	0,78	0,32	0,18	0,38	0,31	0,61
Nominal grate siftings	kg/s	3,09	0,10	0,08	0,08	0,04	0,04	0,05	0,10
Nominal fly ash - radiation part	kg/s	0,04	0,06	0,04	0,02	0,02	0,02	0,02	0,04
Nominal fly ash - convection part	kg/s	0,09	0,10	0,09	0,04	0,04	0,04	0,09	0,09
Combustion air									
Air reference temperature	°C	25	25	25	25	25	25	25	25
Air ambient temperature	°C	25	35	25	25	25	15	15	25
Air relative humidity at ambient temperature	%	65	65	65	65	35	55	55	65
Density combustion air	kg/Nm³	1,28	1,28	1,28	1,28	1,28	1,21	1,28	1,28
Total excess air after Volumix		1,249	1,256	1,340	1,482	1,486	1,434	1,319	1,271
Primary air excess air		0,5	0,5	0,5	0,6	0,6	0,6	0,5	0,5
Combustion air flow total	Nm³/h	140424	146963	140082	68476	68307	68503	60887	127766
Primary air	%	40,2	39,9	39,8	40,8	39,9	38,8	40,3	40,3
Temperature	°C	230,0	230,0	235,0	115,0	217,0	223,0	225,0	243,0
Flow	Nm³/h	56461	58566	55479	27364	27279	27270	24930	51112
Secondary air (To air nozzles)	%	59,8	60,1	60,1	60,0	60,5	61,2	59,7	51,6
Temperature	°C	142,6	139,3	140,8	155,7	155,7	155,7	155,7	142,8
Flow	Nm³/h	83963	88314	74620	41111	41027	41224	40017	76470
Boiler main figures									
Boiler Feedwater flow	kg/s	41,64	41,60	41,67	16,66	16,67	16,67	15,67	33,51
Temperature	°C	180	180	180	180	180	180	180	180
Enthalpy	kJ/kg	768,6	768,6	768,8	768,9	768,6	768,6	768,4	768,8
Pressure at delivery - indication	BarA	116,5	116,3	116,7	116,7	116,3	116,7	116,4	116,7
Expected boiler output without safety (excl steam to APH)	kg/s	41,680	41,600	41,670	16,660	16,670	16,670	20,070	33,510
Expected boiler output without safety (excl steam to APH)	t/h	150,0	150,0	150,0	60,0	60,0	60,0	80,0	120,0
Pressure at Super Heater outlet	BarA	98,5	98,0	98,2	98,0	99,0	98,0	98,0	98,0
Temperature at Super Heater outlet	°C	530,0	530,0	530,0	530,0	530,0	530,0	530,0	530,0
Enthalpy at Super Heater outlet	kJ/kg	3454	3454	3454	3454	3454	3454	3454	3454
Pressure at Turbine inlet	BarA	95	95	93	95	95	95	95	95
Temperature at Turbine inlet	°C	525	525	525	525	525	525	525	525
Enthalpy at Turbine inlet	kJ/kg	3445	3445	3445	3445	3445	3445	3445	3445
Flue gas main figures									
Fluegas exit boiler flow	Nm³/h	161745	175056	157460	75507	76846	79977	82144	150111
Temperature	°C	140	140	140	140	140	140	140	140
O_2 Wet	% vol. wet	3,570	3,500	4,500	6,000	5,999	5,299	3,999	3,405
O_2 Dry	% vol. dry	4,3	4,3	4,1	6,8	6,8	6,0	5,3	4,5
H_2O	% vol. wet	15,3	18,3	13,4	12,1	13,6	16,6	21,5	21,8
CO_2	% vol. wet	13,1	11,0	11,6	11,8	11,5	11,7	12,4	12,4
N_2	% vol. wet	64,8	64,1	78,2	69,4	68,4	65,7	62,0	61,8

The key figures must be used as reference values during the daily operation of the biomass boiler in order to ensure proper operation of the boiler plant. The full table is a part of the documentation from B&W Vølund and can be found in the Boiler O&M manual.

3 Fuel Yard

The new BSPL boiler requires 250.000-300,000 tonnes of biomass residues yearly, which will be collected at a number of collection centres in the province of Punjab. The biomass will arrive to the mill by trucks and trailers.

More than 11,000 trucks and trailers loaded with biomass fuel will arrive to the mill yearly. The logistics at the mill gate and unloading area are designed in order to handle the traffic load of trucks, trailers, telescopic forklift trucks and front loaders.

The biomass boiler will be able to operate on a variety of different biomass residues. The three primary biomass residues for the boiler are corn stovers, cotton stalks and wheat straw.

3.1 Safety issues during transportation, unloading and fuel handling

Personal safety at the mill is the main concern for the BSPL organisation.

Traffic and unloading could be the most dangerous part of the mill and the large quantities of biomass transported and handled at the mill premises will require the drivers as well as the staff to maintain a high level of attention at all times.

Safety is not a matter of optimal logistics design alone, as a high level of awareness from drivers and staff at the mill is essential to ensure safety. The staff must behave according to high safety standards and instruct the persons at the premises to behave according to the safety requirements.

The photos below show examples of dangerous situations, which are associated with potential risks of injures to the persons involved.

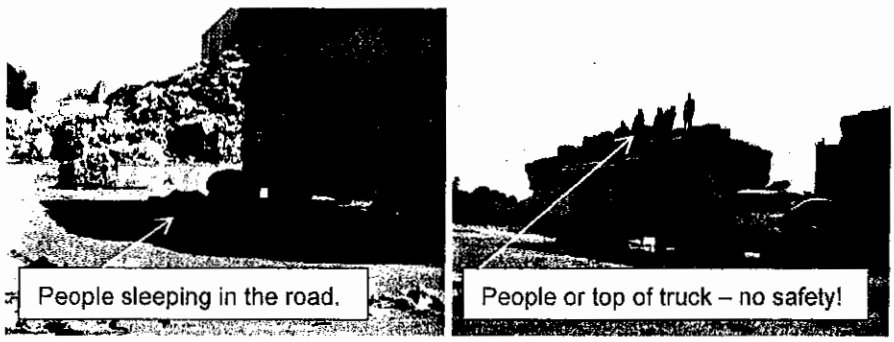


Figure 1: Photo (right side) shows people sleeping on the driving area, photo (left side) shows persons working on top of truck without any safety precautions against falling

3.1.1 Manually unloading

Manual unloading of biomass is the currently used practise in the fuel yard, but it should be avoided in future in order to reduce the risk of accidents and injuries.

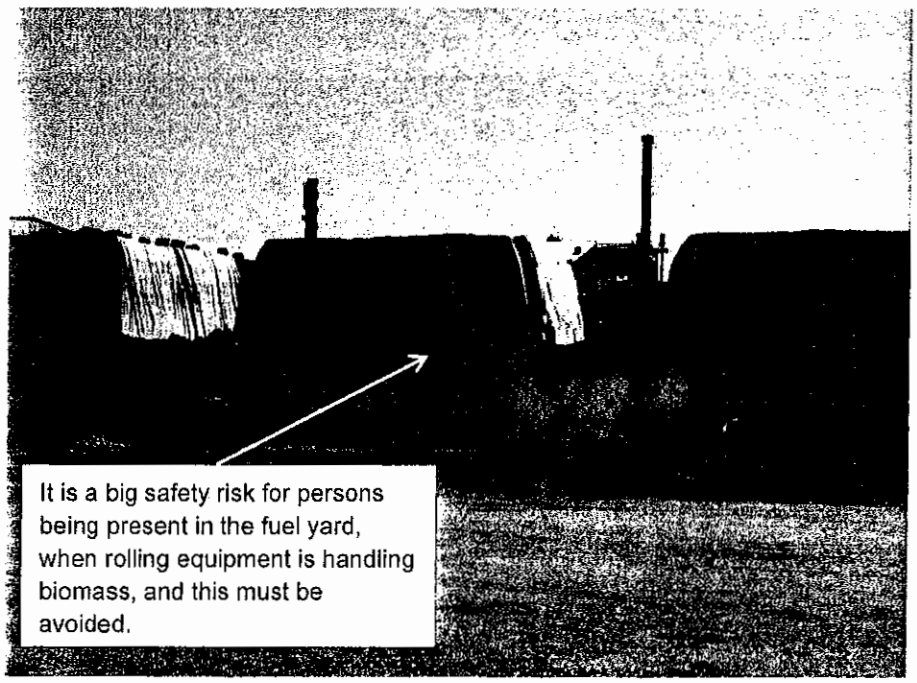


Figure 2: Hazardous working conditions in the fuel yard

3.1.2 HSE considerations

HSE (Health, Safety and Environment) considerations and personal safety always comes first like:

- Safety equipment for the operators working at the fuel yard e.g. correct protection clothing and personal safety equipment. Such as respirator protective mask, antistatic safety shoes, helmet, visibility vest in fluorescent colours for good visibility
- Walking and working in the fuel yard should be forbidden in order to prevent accidents when trucks and other rolling equipment are driving and unloading trucks and trailers and loading fuel into the hoppers
- Organizing the traffic pattern (one direction traffic routing for trucks) and good visible road signs in order to reduce the risk of accidents and traffic jam
- Precautions in order to reduce the risk of fire when operating with motorized rolling equipment in the fuel yard
- No walking on top of biomass trucks and trailers

3.2 Gate area layout

The layout of the gate area is shown below.

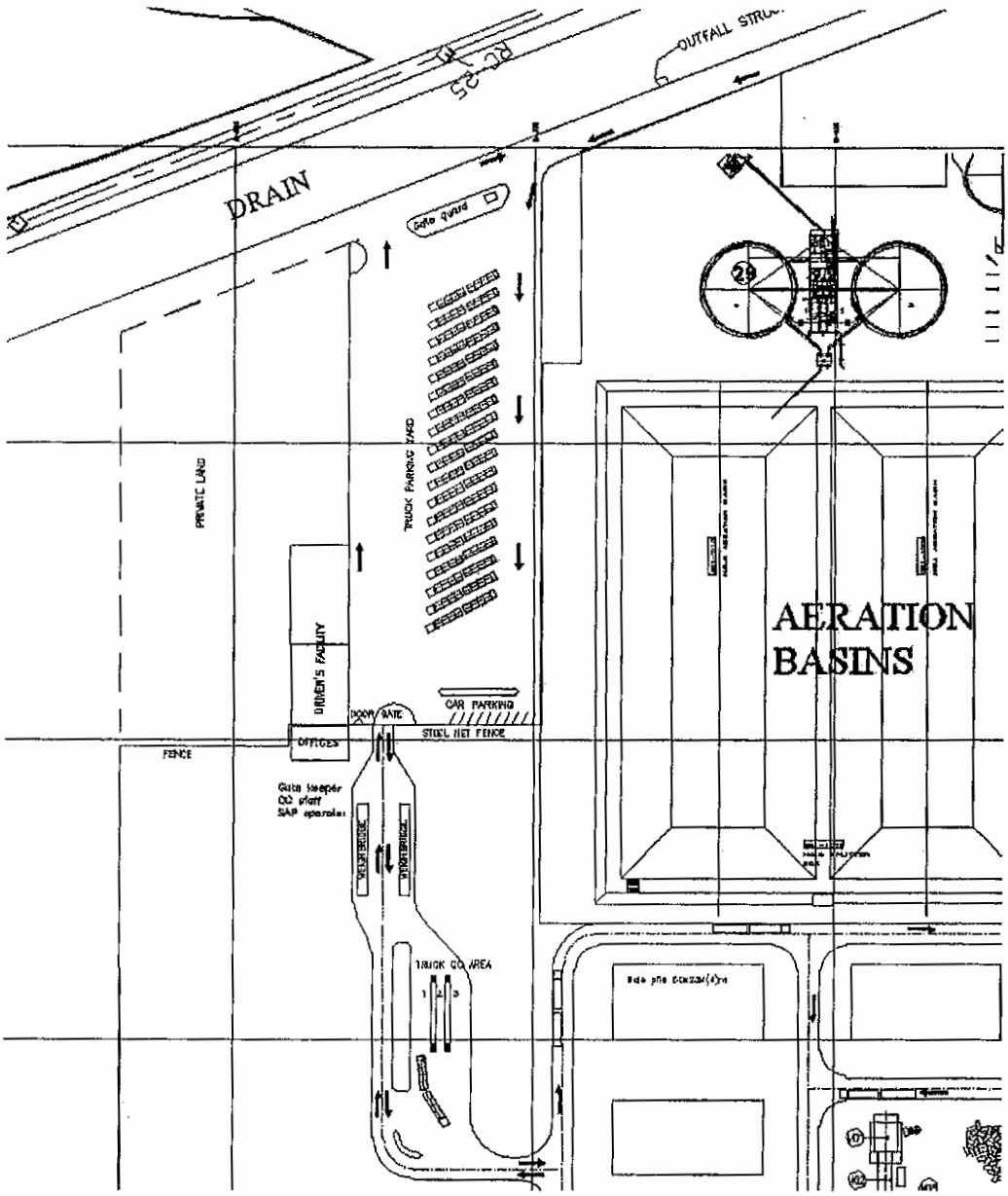


Figure 3: Gate area layout

3.2.1 Truck weighbridge

After the truck is granted access to the site and is driven through the gate the truck must drive to the weighbridge in order to record the weight of the truck and the truck must again be weighed on its way out of the mill after having unloaded the biomass fuel.

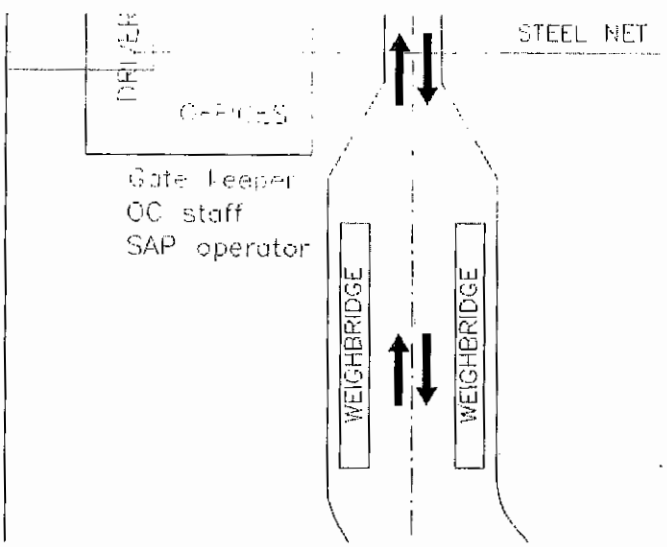


Figure 4: Weighbridges at the gate area

3.2.2 Sampling station for quality control and humidity measurement

Sampling and quality control of the biomass will be performed manually on the vehicles arriving with biomass fuel to the mill.

The sampling station design shown below with three lanes separated by two elevated platforms.

The quality control operators will perform the sampling/humidity measurements manually. Handheld measurement instruments will be used and data recorded.

Figure 5: Manually humidity measurement

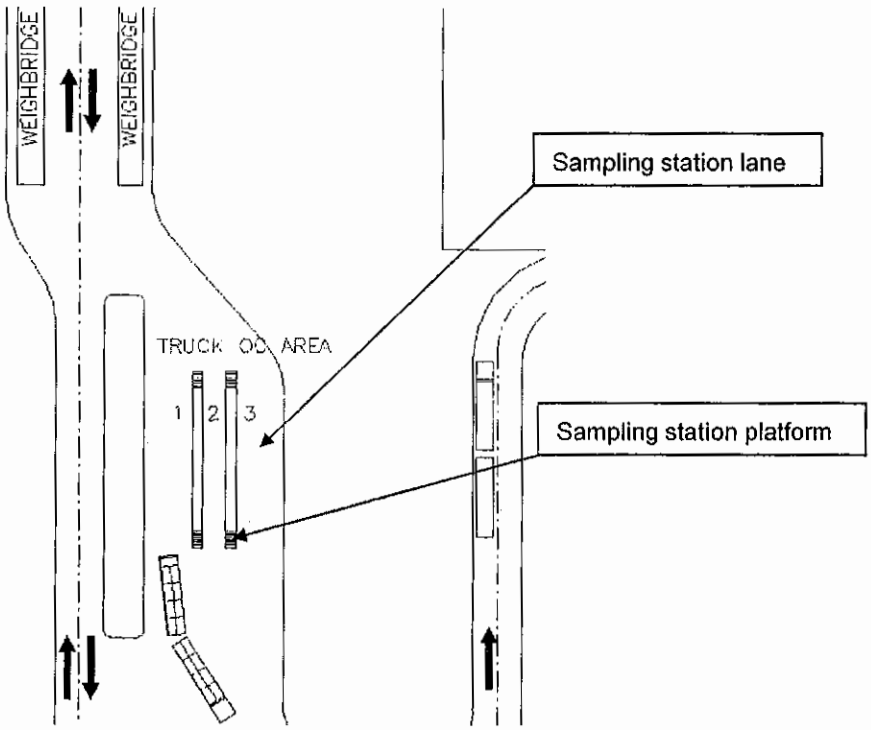


Figure 6: Sampling station with three lanes separated by two elevated platforms

From the sampling station the trucks drive to instructed area for unloading the biomass fuel.

3.2.3 Fuel yard biomass storage

The storage capacity of the fuel yard is approx. 10,000 tonnes equals the approx. 11 days of full boiler operation.

The figure below shows the approx. storage capacity of the fuel yard based on the shown location of respectively baled and loose biomass of wheat straw.

The fuel yard storage capacity for wheat straw is smaller compared to other biomass residues with higher density and therefore the actual storage capacity (weight) is expected to be higher.

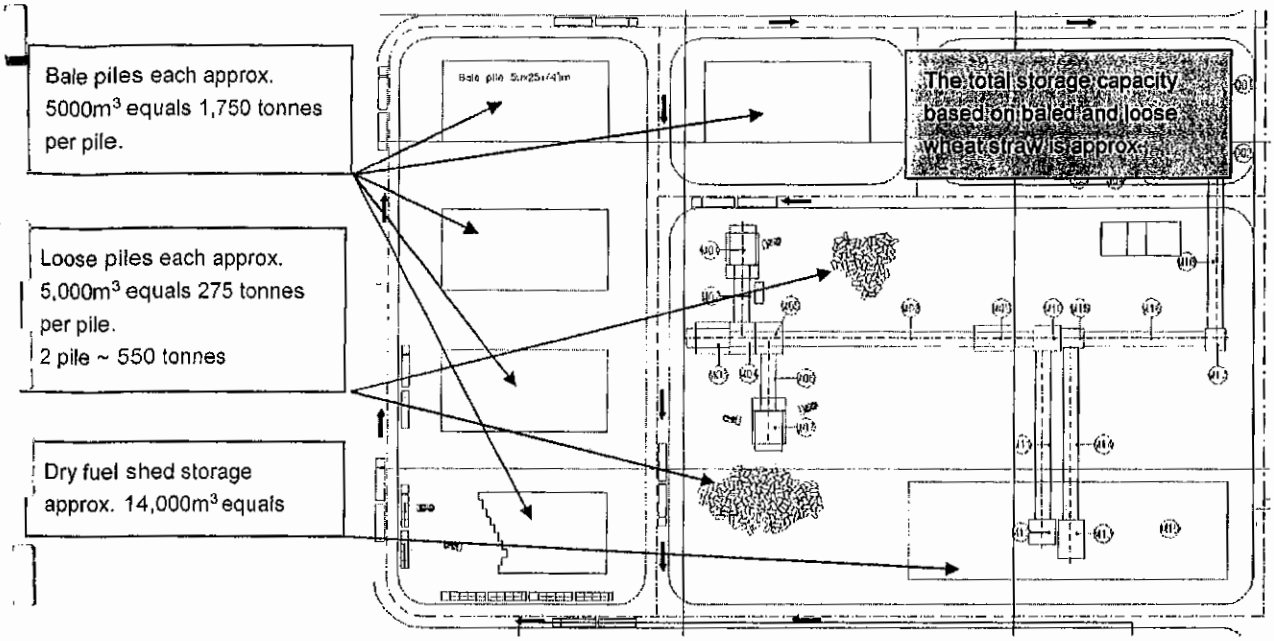


Figure 7: Approx. storage capacity of fuel yard based on the shown location of respectively baled and loose and based on wheat straw biomass (baled density = 350 kg/m³ and loose density= 55 kg/m³).

4 Fuel yard handling system

The fuel handling system is a general description for the reception hoppers, shredders, conveyor system, transition stations, dry fuel storage shed, crab cranes and the fuel silos located in front of the boiler.

This section describes the fuel handling system main components and their function. Operation and maintenance instructions are described in the O&M manual section 2.14 to section 2.21.

4.1 Fuel yard layout and logistics

The fuel system consist of the following main components:

- Two (2) shredder with power stations
- Three (3) feeding hoppers stations for already shredded loose material equipped with dosing screws
- Eight (8) belt conveyors
- Three (3) transfer stations
- One (1) Dry fuel shed
- Two (2) grab cranes

The overall location of the main components of the fuel yard and on the DCS display are shown below.

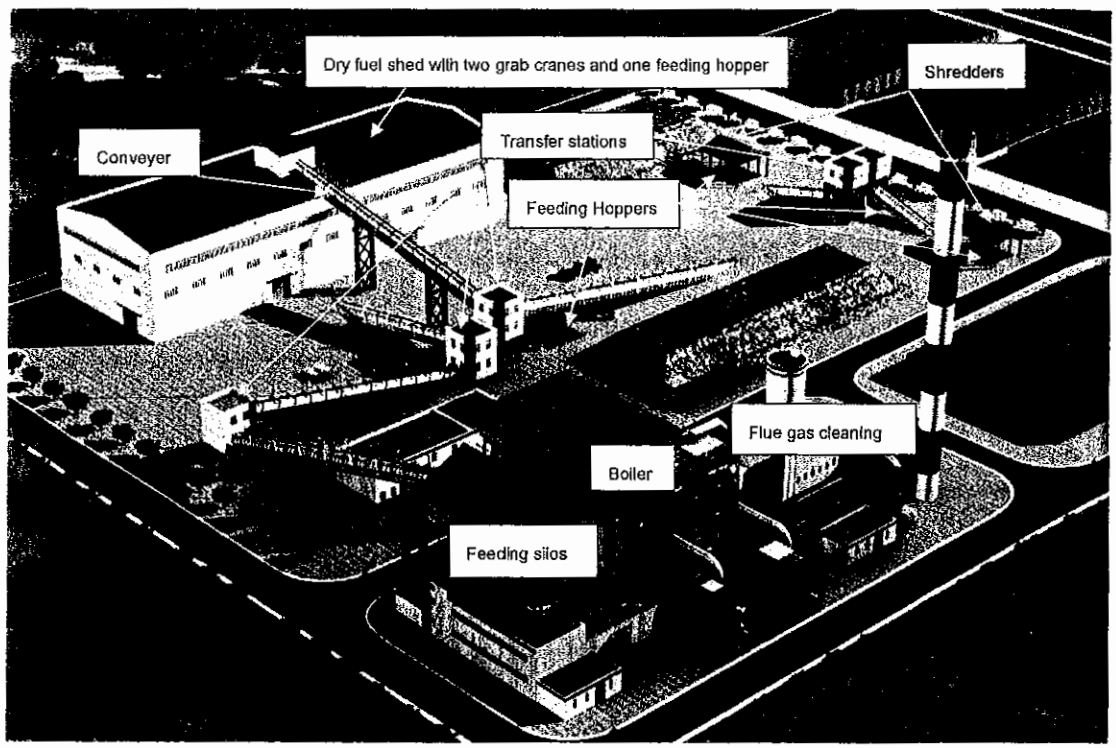


Figure 8: BSPL biomass power plant 3D model

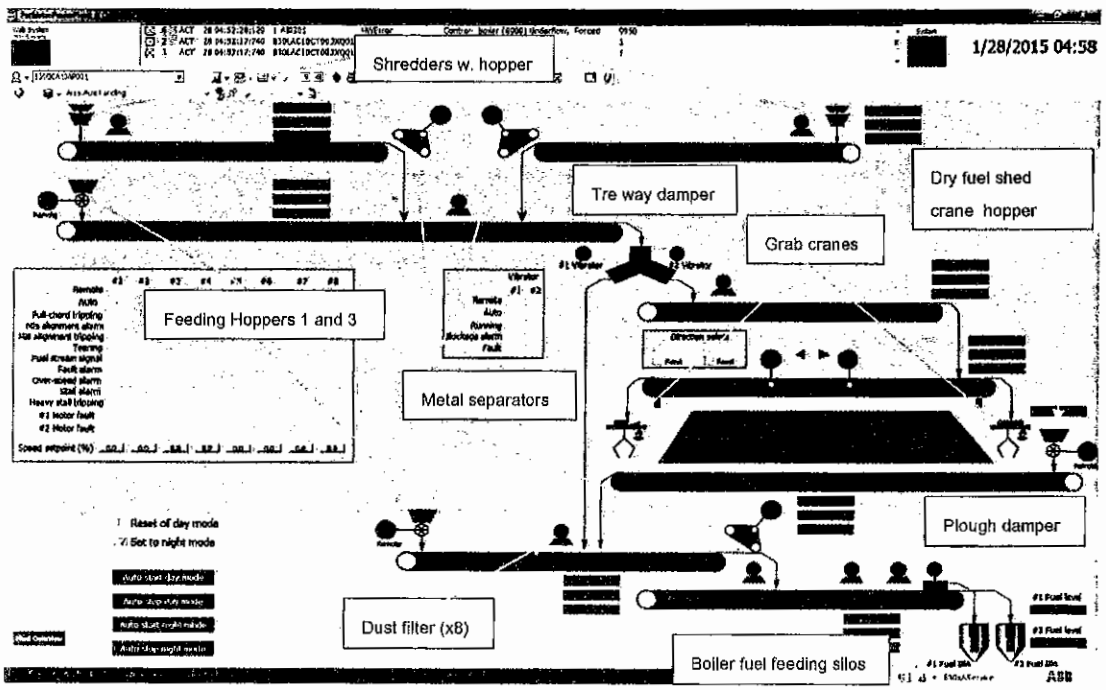


Figure 9: Fuel handling main DCS display w. name references

4.2 The biomass fuel logistics in the fuel yard

The biomass fuel arrives to the power plant, either in bales or as loose material on trucks and trailers. All biomass fuel is unloaded from the trucks and trailers by telescopic forklift trucks or front loaders and stored in piles on the fuel yard.

Operation during daytime

The fuel from the piles is loaded into the shredder hoppers by the telescopic forklift trucks or front loaders. The conveyor system transport the shredded fuel to the boiler and/or to the dry fuel shed. The fuel handling system automatically direct the fuel flow to the dry fuel shed when the boiler fuel feeding silos are full.

Operation during night

There are no activities on the fuel yard during night and therefore all biomass fuel needed for the boiler operation must come from fuel stored in the dry fuel shed. The two fully automatic grab cranes in the dry fuel shed load the conveyor system for the boiler. Operators are only required for monitoring of the system.

4.3 Feeding hopper stations and shredders

Feeding hoppers and shredders location at fuel handling system

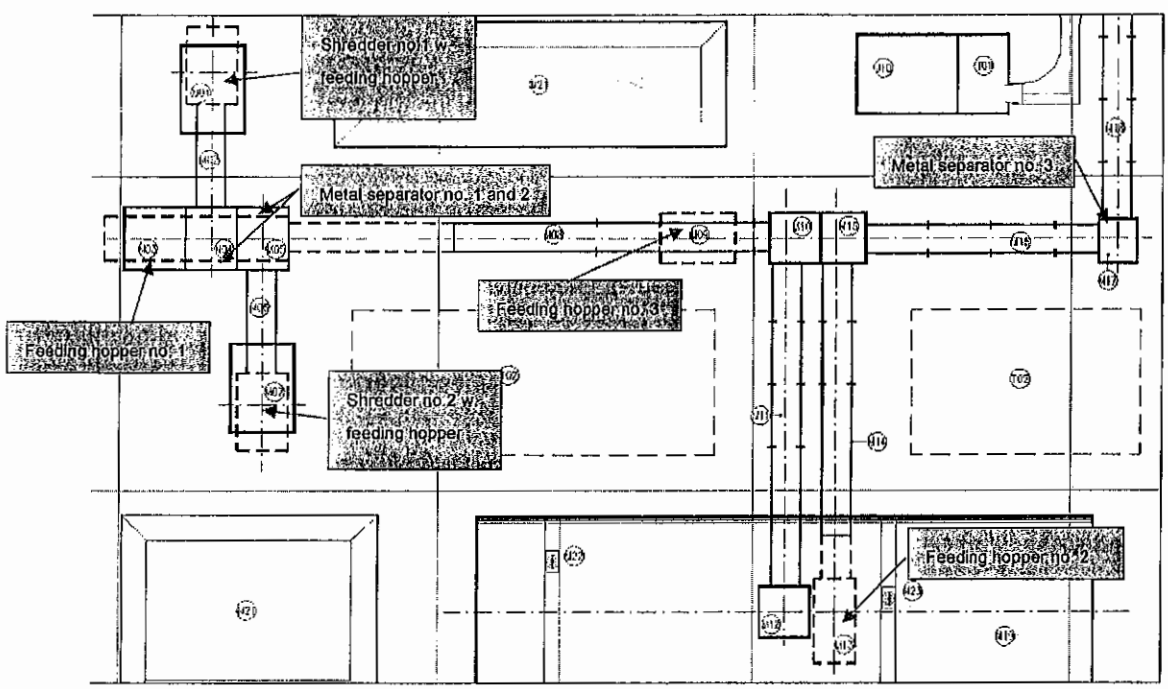


Figure 10: Hopper and shredder location at fuel handling system (plane view drawing)

4.3.1 Feeding hopper no. 1, 2 and 3

Feeding hopper no. 3, 4 and 5 are equipped with dosing screws for dosing loose and already shredded material onto the conveyors.

Hopper no. 1 and 3 are located in the fuel yard and can be loaded by front loaders or telescopic forklift trucks, while, hopper no. 2 is located inside the dry fuel shed and is used by the two fuel crab cranes to feed the conveyor system to the boiler.

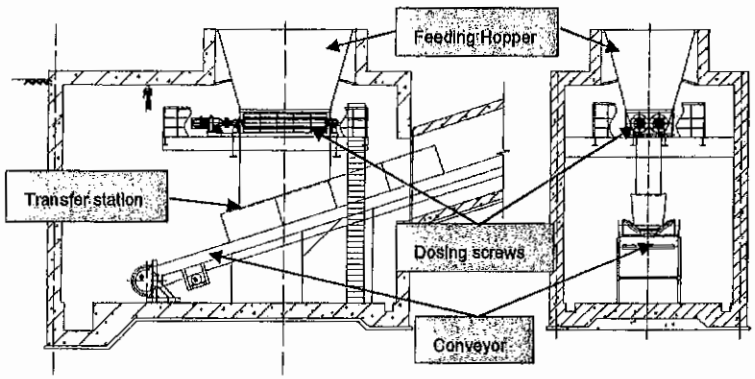


Figure 11: Hopper no. 3 in its underground pit with conveyor.

4.3.2 Hopper dosing screws for shredded biomass fuel

Each of the three hoppers no.1, 2 and 3 for shredded loose material are equipped with two screws that are rotating. The dosing (flow of fuel) from the hopper to the below conveyor is controlled by the speed of the screws.

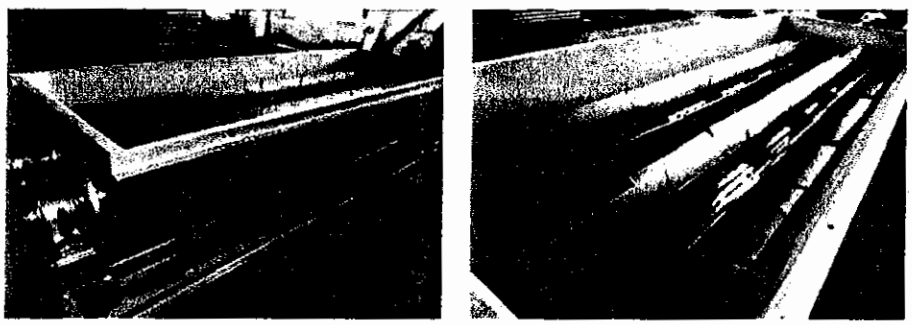


Figure 12: Hopper dosing screws

4.4 Transfer stations

When biomass transfer from one conveyor to the next or from a hopper to the conveyor, transfer stations are used similar to the one shown on the below photo (left). The function of the transfer station is to guide the fuel and limit the spill and dust. The transfer stations are equipped with exhaust system that suck the air from the inside of the transfer station into a filter unit and hereby reduce the dust from spreading to the environment. The dust collected in the filters is led from the bottom of the filter and back to the biomass fuel on the conveyor. The dust filter unit is show below (right).

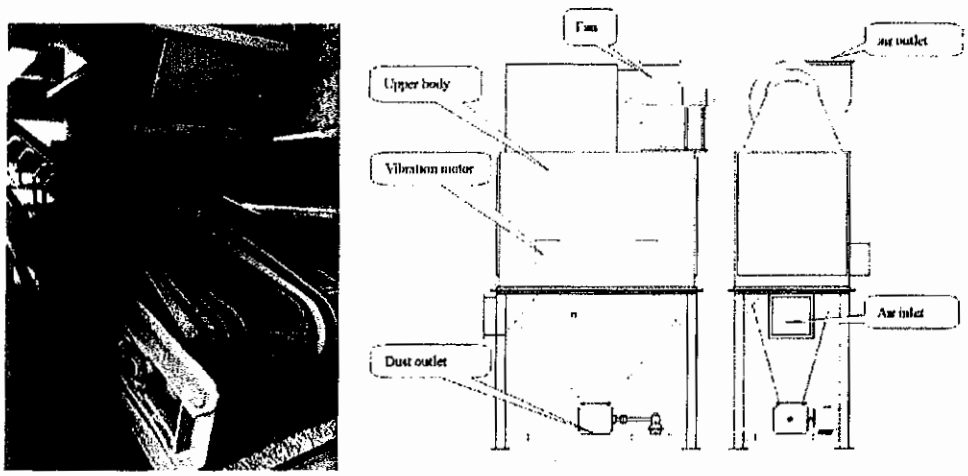


Figure 13: Transfer station (left, source Dunlop manual) Filter unit (right)

4.5 Shredders (KKS no. B30EBC10 and B30EBC20)

The Metso M&J 6000 shredders is one of the world largest shredders with a processing capacity of approx. 30 tonnes per hour. The biomass fuel is fed into the hopper above the shredder and the shredder's rotating shafts with its twelve (12) knives on each shaft will shred the biomass and let it through the knife table and onto the conveyor below. Each shredder is powered by a so-called power pack. Each power pack is equipped with two 250kW electrical motors directly connected and driving two hydraulic pumps. Energy is transferred from the power pack to the shafts by hydraulic hoses and transferred into shaft rotation by two hydraulic motor units one on each shaft.

Safety issues

It should not be necessary to point out how dangerous these machines can be, if not handled correctly and it is mandatory that the operators carefully read and strictly follows all instructions described in the operation and maintenance manual from the shredder supplier.

The figure below show the Metso shredder and the two knife shafts positioned on the knife table. When the shafts rotates, the knives will cut the material between the knives and the knife table. The shafts can rotate in both directions and change direction when needed (e.g., if the torque gets too high and trip the rotation torque sensor the shaft rotation direction will automatically change).

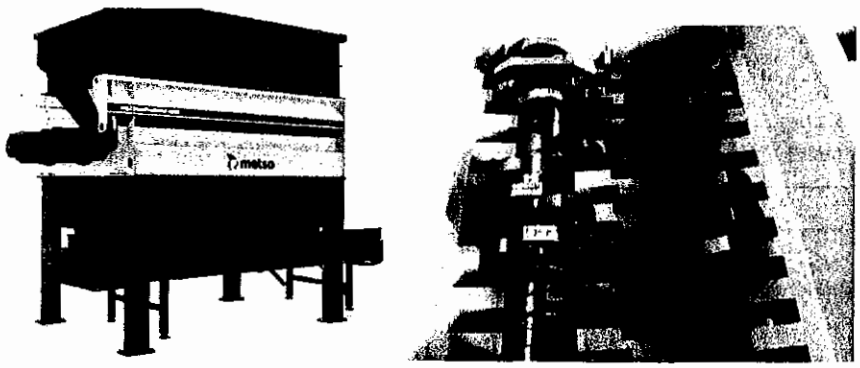


Figure 14: Metso shredder and a look down the open knife table (left)

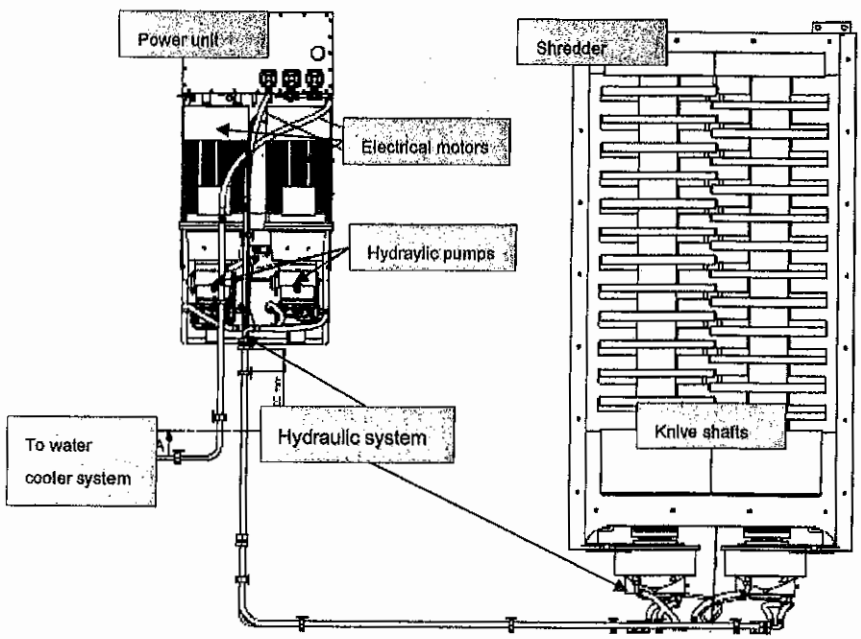


Figure 15: Shredder and power pack unit system

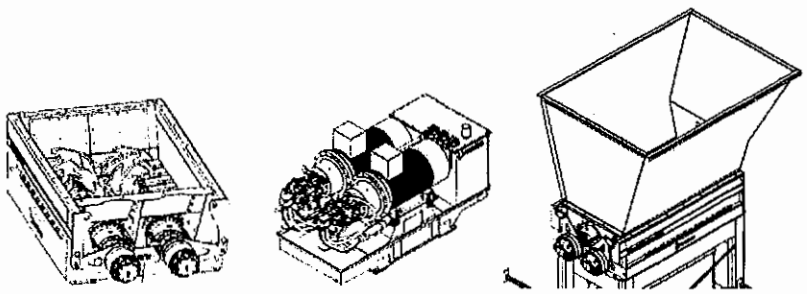


Figure 16: Shredder knife table (left), power pack unit (middle) and the shredder hopper (right)

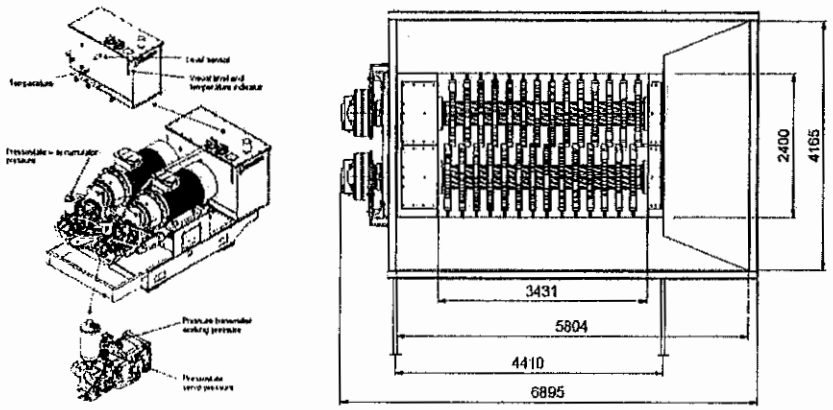


Figure 17: Power unit components and shredder with the biomass hopper (top view)

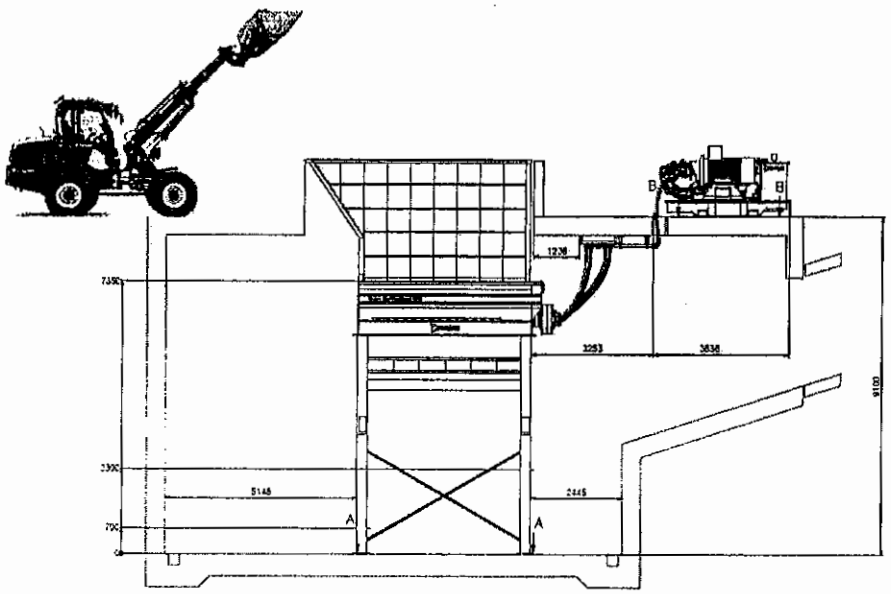


Figure 18: The shredder in the pit and with the power unit located on the ground level and connected with hydraulic hoses.

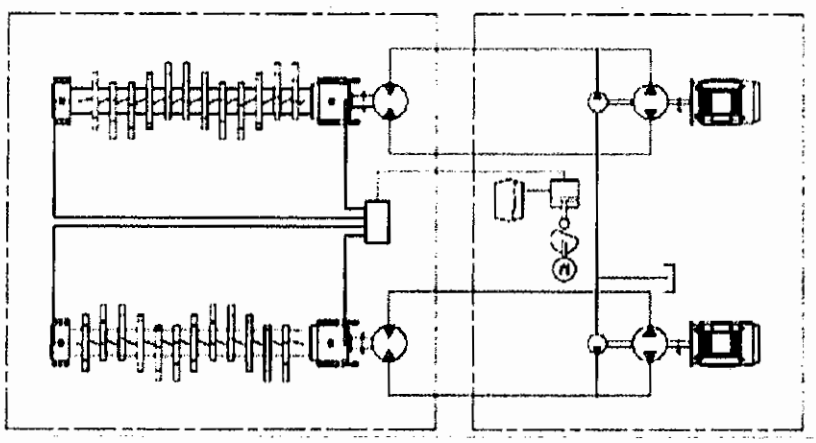


Figure 19: Principle hydraulic diagram

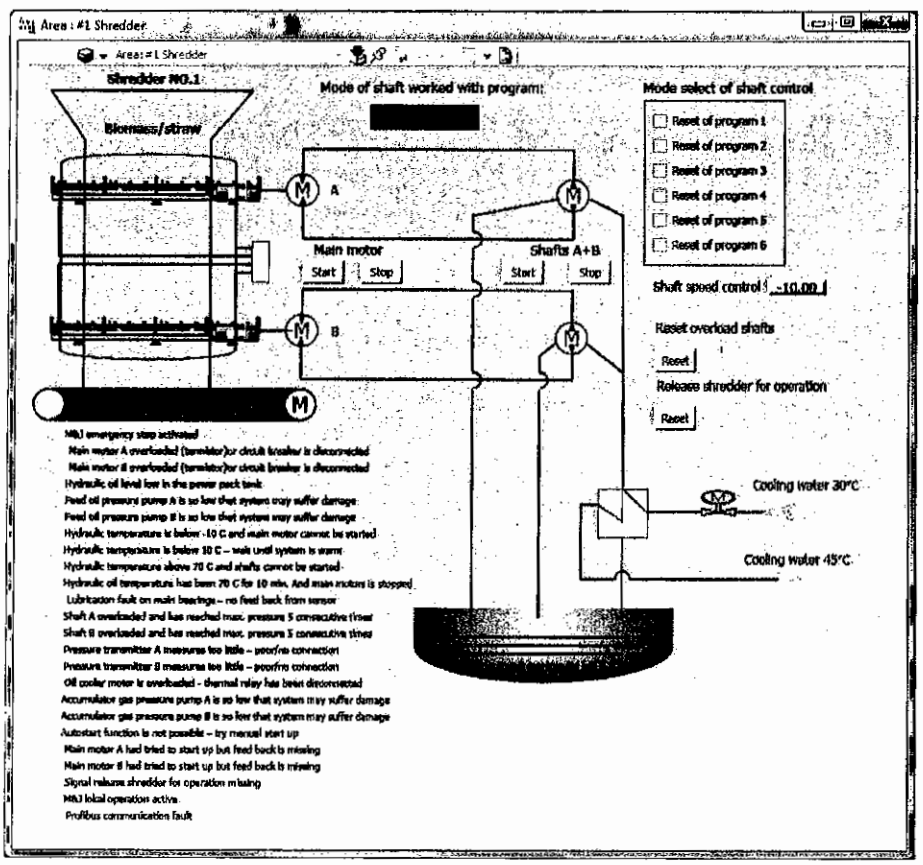


Figure 20: DCS display for one of the two shredders with the status indications and alarms displayed on the right side of the display. These status indications and alarms will only be shown (be visual) when active.

4.6 Belt conveyers

The biomass conveyors used for biomass fuel handling are all trough belt type.

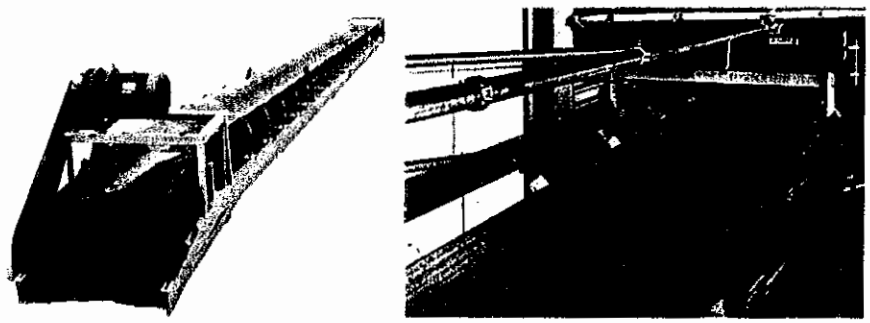


Figure 21: Standard troughed belt conveyers (source Google)

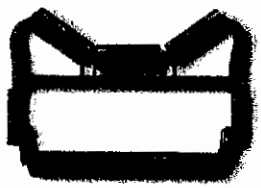


Figure 22: Troughed conveying idler frame with straight return support idler below.

Troughed conveying is referring to the belt V-shape of the conveyer belt and is generally used for fuel and loose materials in order to ensure that the material stay safely on the conveyor belt.

The conveyors are designed with idlers in Y-shape and straight support idlers underneath in order to support the belt returning. The idlers are wear parts and it is important to replace warn idlers when detected.

4.6.1 Conveyor covers

Conveyors belts will over ground and outside be equipped with covers in order to reduce dust and loose biomass to be spread by the wind. The covers shall be easily removable and all conveyors equipped with firefighting nozzles as shown on photo below.

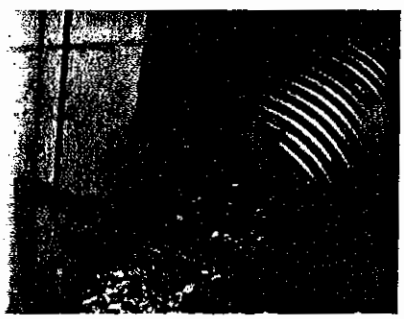


Figure 23: All conveyors are equipped with firefighting nozzles as shown on photo.

4.6.2 Belt conveyer principles

The below figure shows a principle of the belt configuration on the conveyer:

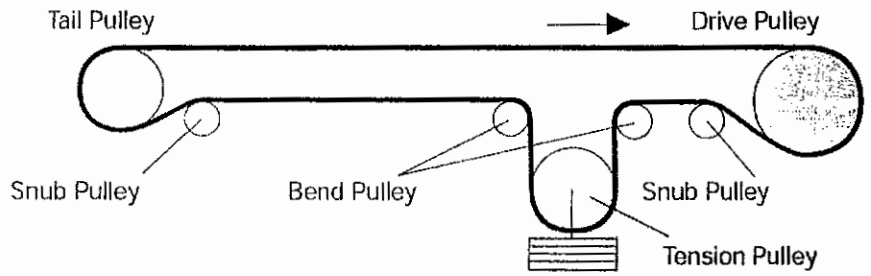


Figure 24: Principle of belt conveyer

The drive pulley must always pull the conveyor (never push) and therefore it must always be located in the fuel outlet end of the conveyor.

The belt tension is maintained by the hanging weight on the tension pulley.

4.6.3 Conveyor components and instruments

The below figure shows a principle drawing of a belt conveyer with components.

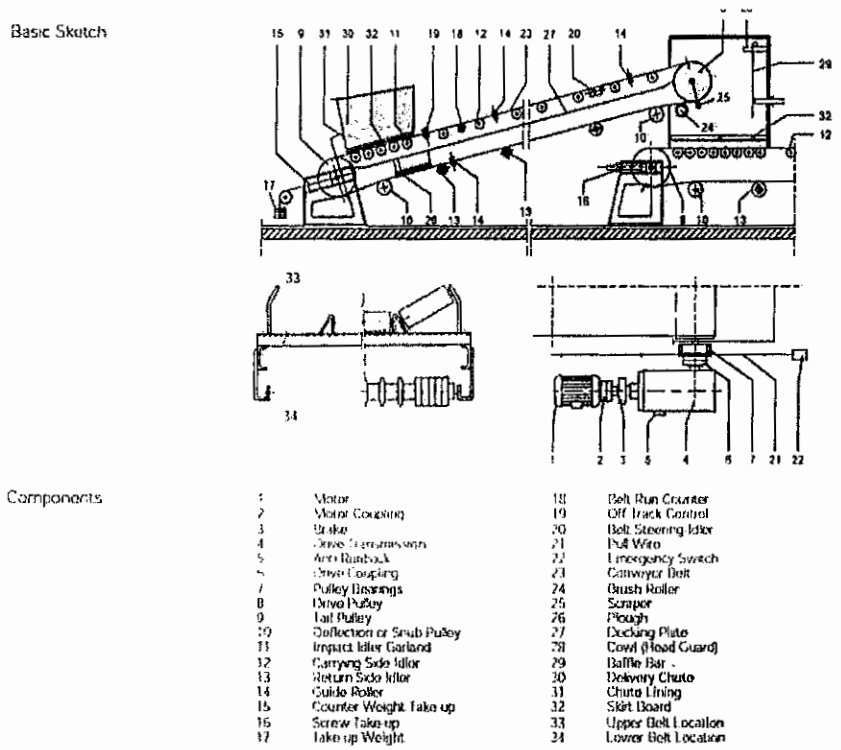
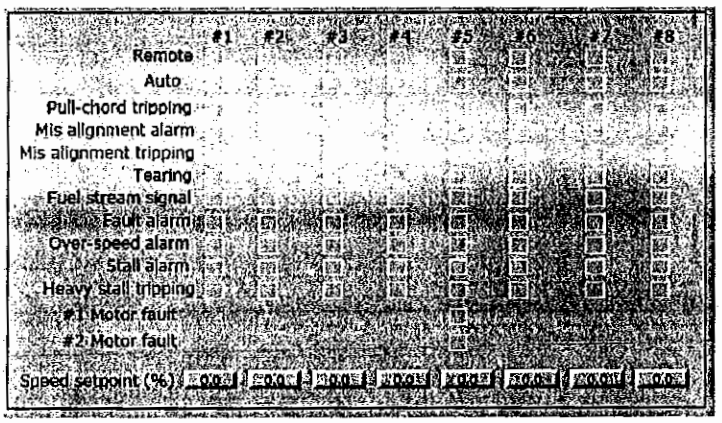


Figure 25: Principle drawing of a belt conveyer with components

4.6.4 Conveyor instruments

The conveyors are equipped with instruments to ensure safe operation. The instruments with related alarms are shown on the alarm display on the conveyor system DCS screen as shown below.



The following alarms are displayed on the DCS screen when a component fails, an instrument give alarm or an emergency alarm switch has been activated.

- Pull core tripping
- Misalignment alarm
- Misalignment alarm tripping
- Tearing
- Full stream signal
- Fault alarm
- Over speed alarms
- Stall alarms
- Heavy stall tripping
- Motor fault

The purpose of the above alarms are to either warn the operator and initiate inspection of the equipment or tripping alarms that cut the power to the equipment in order to prevent accidents and/or damage to equipment.

One of the very important alarms is the "Pull core tripping" alarm that indicates that the pull core situated on both sides of the conveyers has been pulled and this alarm should immediately and automatically shut off the conveyer.

For more detailed information on the conveyor instruments and components, please refer to the conveyor operation and maintenance manuals.

4.7 Conveyor belt diversion plough

The Conveyor belt diversion plough (KKS no. B30EBA90AF001) is located at the outlet of conveyor no. 8 on top of the boiler fuel feeding silos and the function is to control the flow of biomass fuel to the two silos and this way equal the filling level of both silos. The diversion plough is driven by an actuator that can either be engaged or not engaged (work on/off), meaning that either silo no. 1 or no. 2 is receiving work on/off and will either fill silo no. one or no. two.

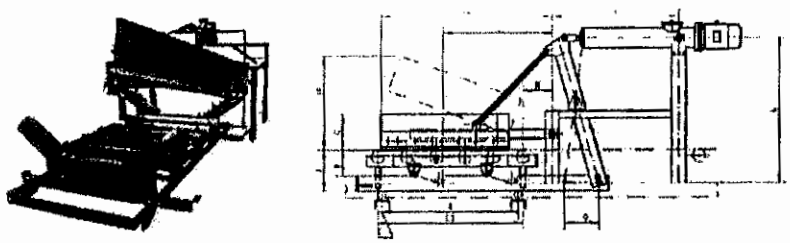


Figure 26: Conveyor belt diversion plough (KKS no. B30EBA90AF001)

4.8 Magnet metal separator

The conveyor system is equipped with three metal separators (KKS no.B30EAC10AW001, B30EAC20AW001, B30EAC30AW001). The purpose of the metal separators is to separate the shredded bale steel wire and other magnetic steels in the biomass fuel. Two metal separators are positioned at the end of the conveyor after shredder no. 1 and 2. The third metal separator is positioned at the transfer station at the end of conveyor no. 7.

The figure below shows the function of the metal separator at the end of a belt conveyer, where the magnet pull out the steel from the biomass and the separator belt pulls the metal from the magnet and drop it into the metal container.

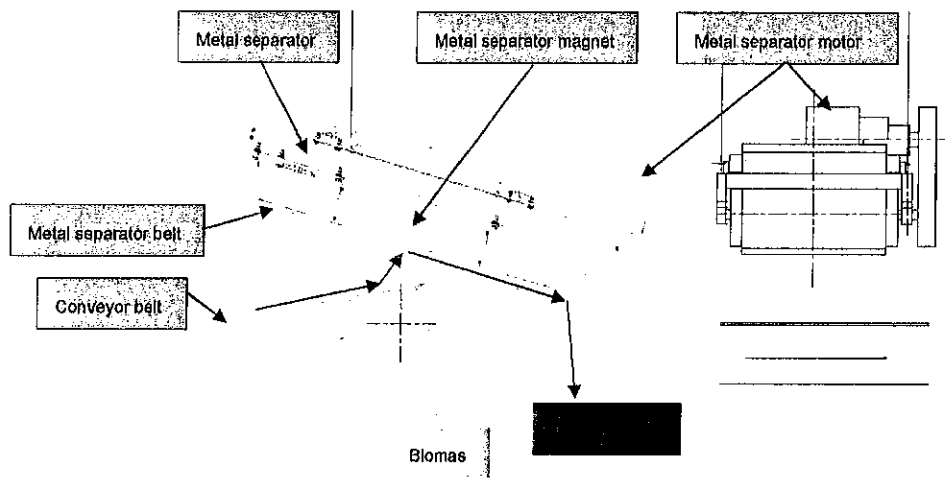
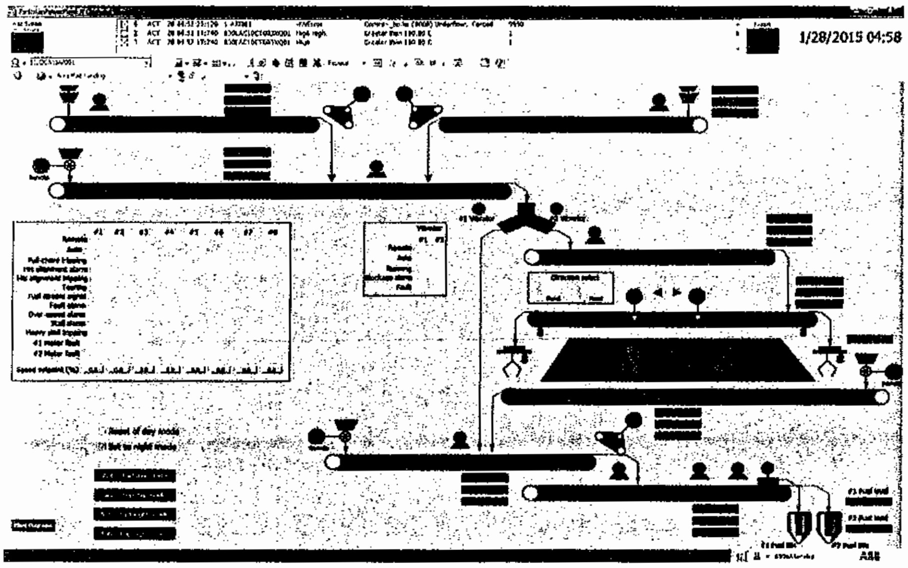


Figure 27: Magnetic metal separator

4.9 Fuel handling main DCS display



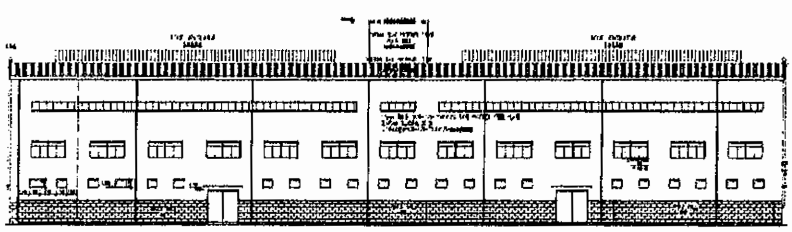
4.10 Dry fuel shed

Dry fuel shed is a light storage building for storage of biomass fuel.

The dimensions of the dry fuel shed storage space is Length x Width x Height = 97.5 meter x 28.5 meter x 12.7meter.

Storage volume capacity of the dry fuel shed is approx. 40,000m^3

The dry fuel shed is divided (in half) into two storage areas for biomass fuel. One area for each crane and a common hopper with dosing screws for the shredded biomass fuel that is located in the middle and used by both cranes to feed the conveyor hopper that feeds the biomass boiler.



4.11 Grab cranes in dry fuel shed

The dry fuel shed is equipped with two overhead grab cranes, each covering half of the storage area. The crane grabs are used for positioning and levelling the stored biomass in the dry fuel shed and for feeding the hopper.

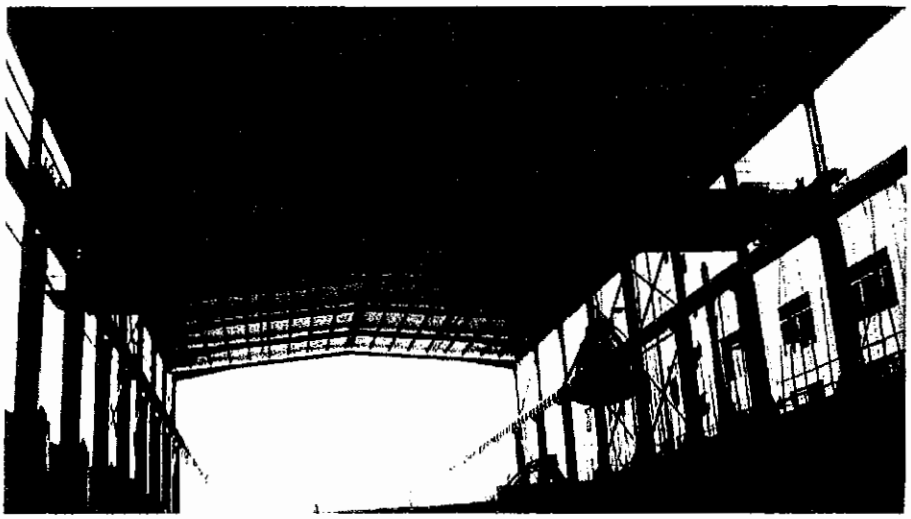


Figure 28: Overhead grab crane with the operator cabin (left) under the crane traverse beam.

4.11.1 Grab crane different operation modes

Automatic operation mode

The grab cranes can operate in automatic mode with no interference from the operators. In this mode, the operation of the crane is based on laser level scanner system that read the level of the biomass pile and enable the crane to grab the biomass and feed the hopper. This laser level scanner runs along the full length of the biomass storage area and the data from the scanner is loaded into the crane control system. The crane system is interfaced with the boiler system and when the boiler call for more fuel the crane starts from its parked position and begins to feed the hopper.

Semi-automatic operation mode

The crane can be operated semi-automatically from the operator's touch panel display. Several different functions and programs can be activated by a touch of a finger from the touch panel display.

Manual control operation mode

In manual mode, the crane can be operated from the crane operator cabin under the crane. This gives full control over the crane but require skilled operators.

Wireless remote control

From the handhold wireless control panel the crane can be operate manually up to a distance of 100 meter from the crane.

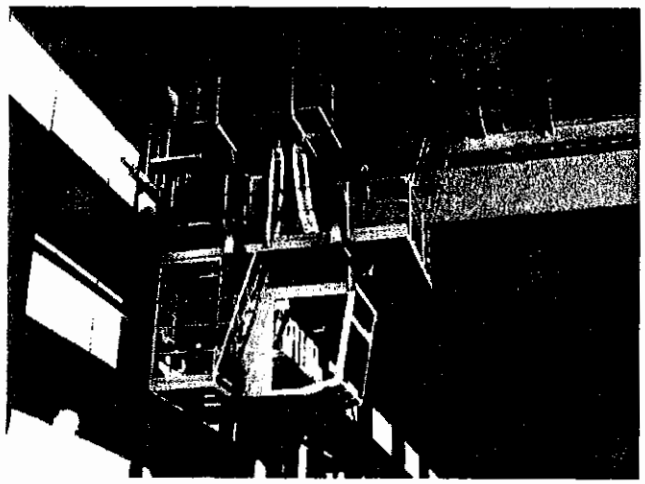


Figure 29: Operator cabin for manual operation of grab crane

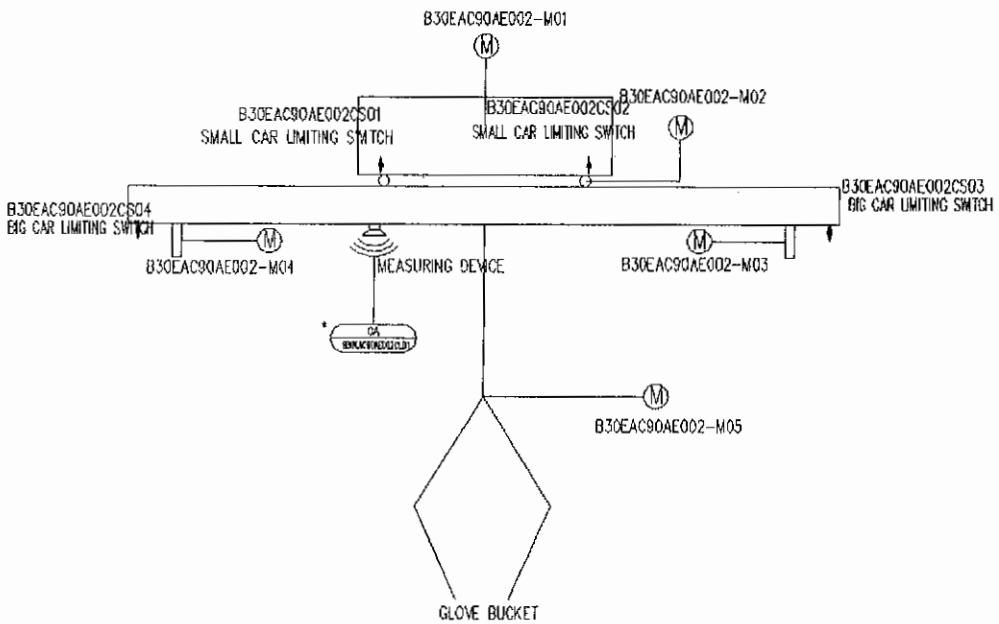


Figure 30: Principle diagram of one of the two cranes.

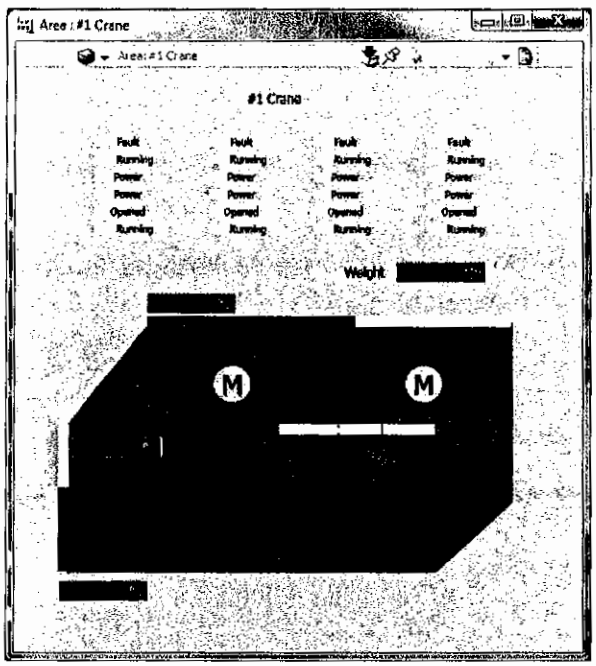


Figure 31: Grab crane DCS display.

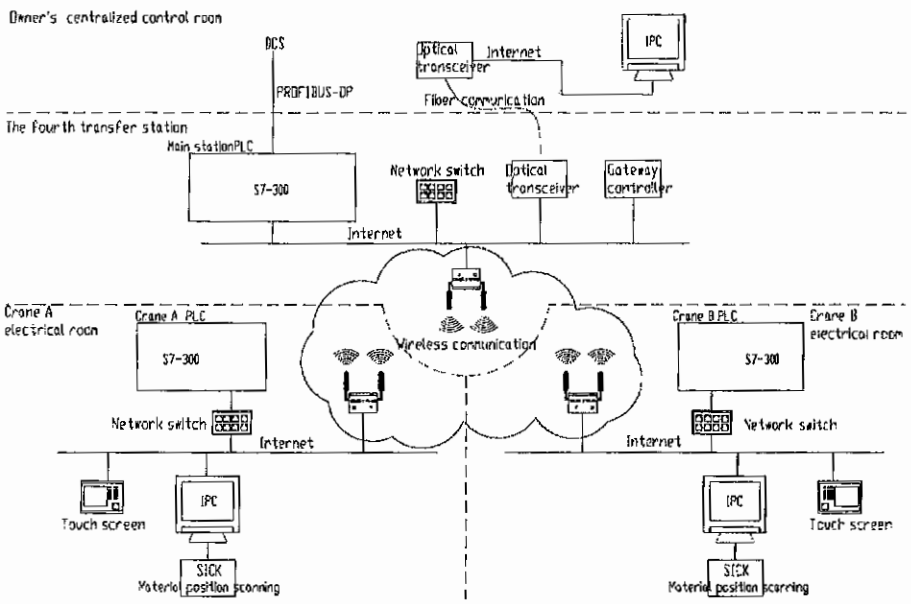


Figure 32: The principles of the grab crane control and data communication system.

5 Combustion system

This chapter describes the path of the biomass through the boiler, starting with the two fuel silos and ending at the outlet of the ash products and outlet of the flue gas at the chimney. The following describes the function of the main components, partial systems and auxiliary systems based on an operation point of view. For a more detailed and technical description, please refer to the subsequent instructions for operation and the sections describing the documentation of partial systems.

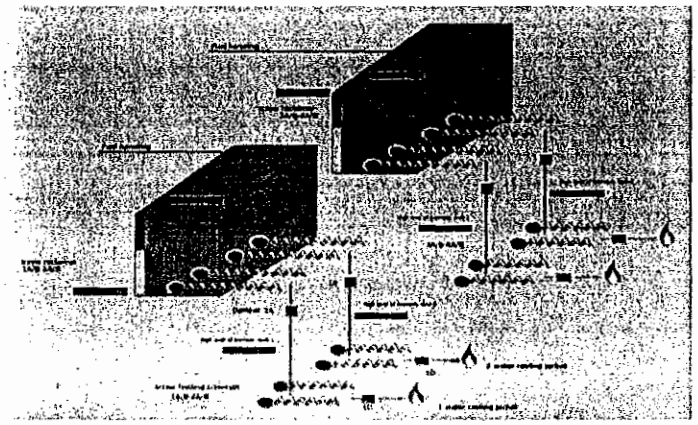
5.1 Fuel feeding system

Operation and maintenance instructions for this system is described in the O&M manual section 2.22.

The fuel feeding system mainly consist of the following equipment:

- Two fuel silos/bins
- 8 screw reclaimers in the bottom of the fuel silos
- 8 fire dampers to prevent back fire to the fuel silos
- 4 biomass stoker to feed biomass into the combustion chamber

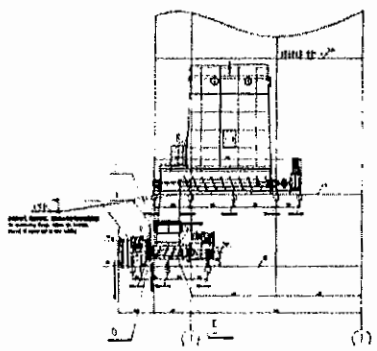
The equipment are presented on the DCS the following way:

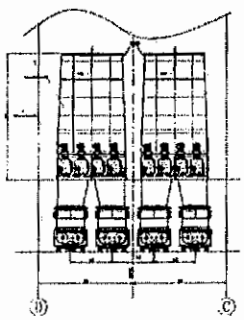


5.1.1 Fuel feeding silos

To ensure stabile biomass supply to the boiler, two fuel feeding silos are installed each with a capacity of 100 m³ which equals approximately 20 minutes operation.

The Conveyor belt diversion plough (KKS no. B30EBA90AF001) is filling the silos from a top opening whenever the level in each is getting low.





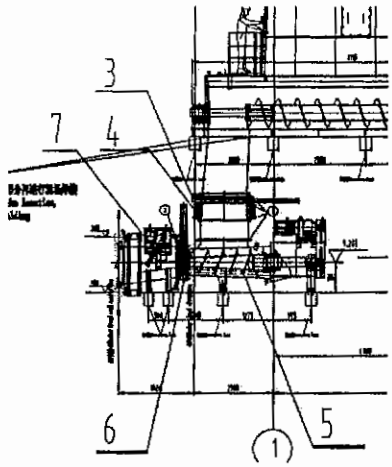
Each silo isemptied from the bottom by four screw conveyors that are feeding biomass to the four feeding stokers. During normal operation and with the systems in automatic mode, the screw conveyers are governed by the boiler load control. I.e. the screw speed automatically increases or decreases depending on the steam output of the boiler.

Each silo are equipped with a level detector to control the level of biomass i.e. controlling the filling.

Each silo are equipped with a temperature transmitter for detection of fire. If the temperature gets high the biomass feeding is immediately stopped and fire water is injected via fire water nozzles installed inside the silos.

5.1.2 Feeding stoker system

The fuel is delivered to the combustion grate by means of four feeding stoker systems.



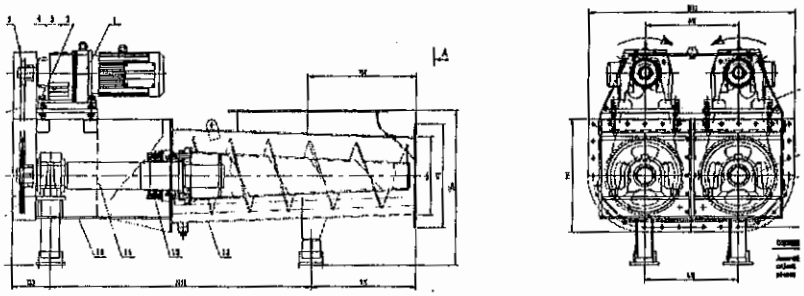
Each of the four stoker systems mainly consists of; fire damper 1 (pos. 3), stoker screws (pos. 5), fire damper 2 (pos. 6), dynamic restriction (pos. 7), water cooled casing, temperature transmitters for fire detection.

5.1.3 Fire damper 1

Position 3 on the above sketch shows the pneumatic controlled fire damper 1. If the temperature transmitter detects high temperature this damper immediately will close and prevent fire to spread to the fuel silos.

5.1.4 Feeding stoker

Each of the four feeding stokers are consisting of a double screw conveyer as shown below.



Each screw is connected to an electrical motor by a belt drive. The two motors on the each stoker unit should run at the same speed.

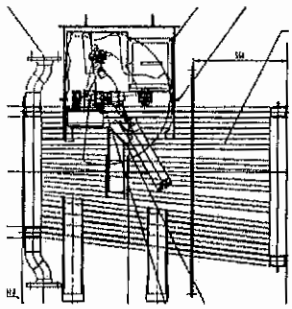
The four feeding stoker electrical motors (8 in total) are frequency controlled and normally run at matching speeds in order to ensure a uniform spread of fuel across the grate. During normal operation and with the systems in automatic mode, the stoker speed is governed by the boiler load control. I.e. the screw speed automatically increases or decreases depending on the steam output of the boiler.

5.1.5 Fire damper 2

Position 6 on the above sketch shows the pneumatic controlled fire damper 2. If the temperature transmitter detects high temperature this damper immediately will close and prevent fire to spread to the fuel silos. This fire damper is water cooled in order to be protected against the high temperature in the combustion chamber.

5.1.6 Water cooled stoker ducts

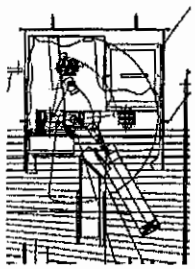
To protect the stoker system against the high temperature inside the combustion chamber the stoker casing is designed with water cooling. The cooling water is supplied from the central cooling water system and should be kept below 70°C. The cooling water system is designed in a way that the water cooled stoker ducts are ensured water even if the electrical power fails.



If the water supply to these ducts fails the plant must be stopped immediately.

5.1.7 Dynamic restriction

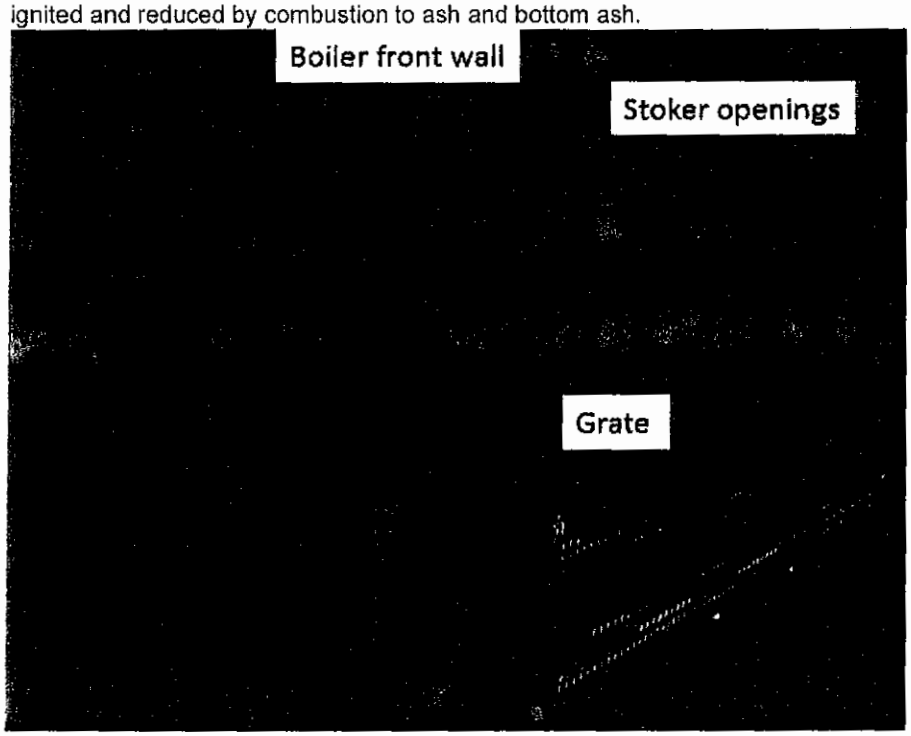
Each of the stoker ducts are equipped dynamic restrictions ensuring that the biomass are compressed in the duct and hence avoiding air to pass through to the combustion chamber which would create back fire in the biomass ducting system.



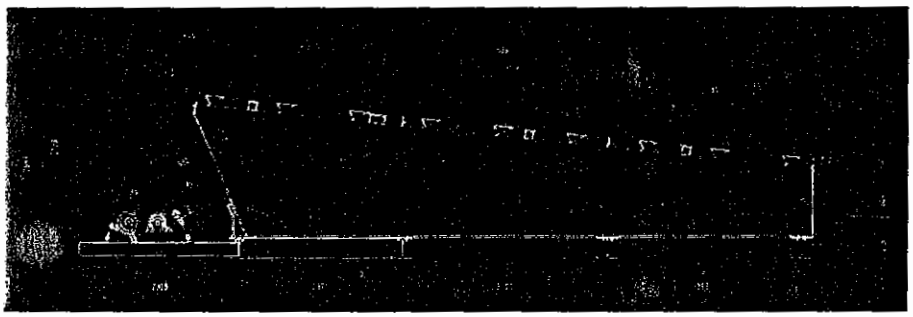
5.2 Vibrating combustion grate

Operation and maintenance instructions for this system is described in the O&M manual section 2.1.

The primary purpose of the vibrating grates is to carry the fuel through the furnace. The electrically operated vibrators for the operation of the vibrating grates transmit vibrations to the grate at a frequency that causes fuel and ash to slide down the grate panel.
The biomass enter from the 4 stoker openings and drops down on the grate.
First, the biomass is carried through the drying zone. Subsequently, the biomass is ignited and reduced by combustion to ash and bottom ash.



During normal combustion and with the systems in automatic mode, the grate speed is governed by the boiler load control.
The combustion grate is divided into sections to allow the primary air to be distributed in zones. This makes it possible to control the combustion on the grate.

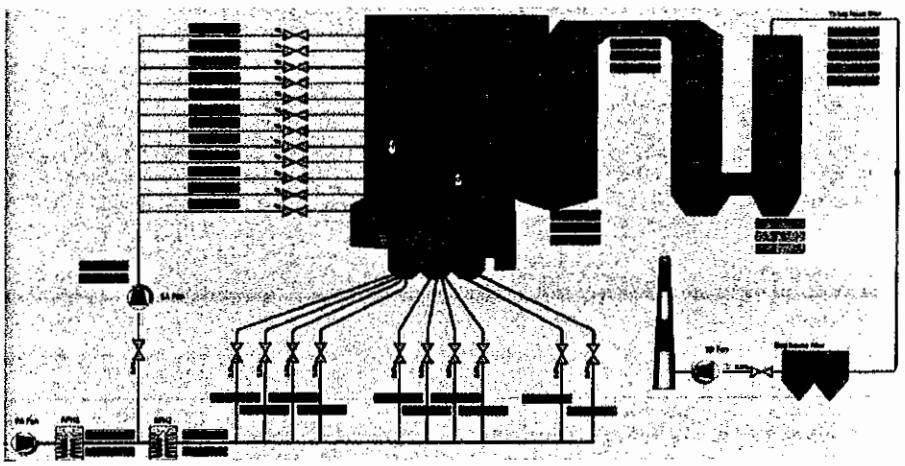


5.3 Combustion air and flue gas

Operation and maintenance instructions for this system is described in the O&M manual section 2.1.

Combustion air is air which is supplied to the furnace, partly as primary air under the combustion grates, and partly as secondary air through nozzles into the furnace and into the post-combustion zone in the boiler first pass.
The frequency-controlled combustion air fan supplies combustion air to both the primary air and the secondary air system and to the dual fuel burners.
A dedicated frequency-controlled secondary air fan connected to the combustion air system supplies secondary air to the secondary air system with higher delivery pressure.

The combustion air is preheated in a combustion air preheater, APH1. The media applied to the air preheater is preheated feed water after the high pressure preheaters. The combustion air temperature is not controlled.



5.4 Primary air system

The system consists of a frequency-controlled primary air fan (combustion air fan) which is running continuously in normal operation, a duct system, flow- and pressure measurements and control dampers. The pressure is controlled by the speed of the primary air fan (combustion air fan) and the flow is regulated by control dampers.

The primary air is further preheated in a second air preheater, APH2. The primary air is led to the furnace through ten sections, 4 sections to the first zone of the 4 vibrating grates (1 grate per lane), 4 sections to the second zone, and the third zone comprising of 2 sections. The primary air flow to each section is measured by

differential pressure flow meters and controlled by means of a control damper. This means that the air flow can be controlled by means of the control dampers and distributed between the sections at suitable ratios.

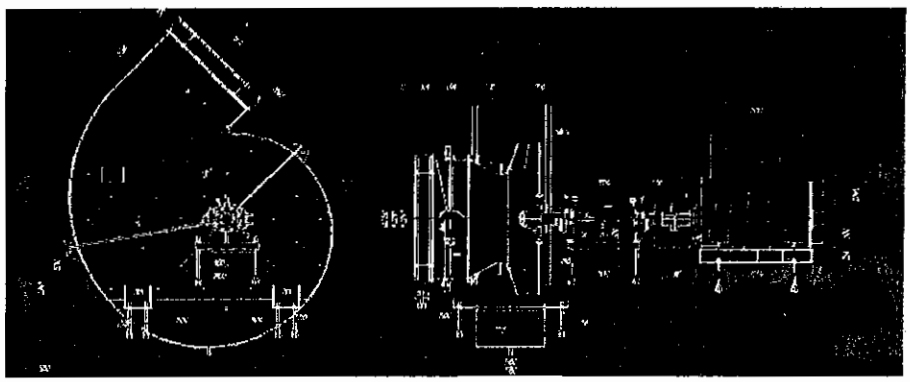
The primary air flows are distributed and controlled in such a way that the air flow profiles correspond to the desired position of the combustion zones. The main steam flow control works by influencing the primary air flows.

The primary air is blown into the hoppers under the combustion grates and is thereby forced up through the grates, further up through the fuel layer, and then participates in the combustion process.

5.4.1 Primary air fan

Operation and maintenance instructions for this fan is described in the O&M manual section 2.5.

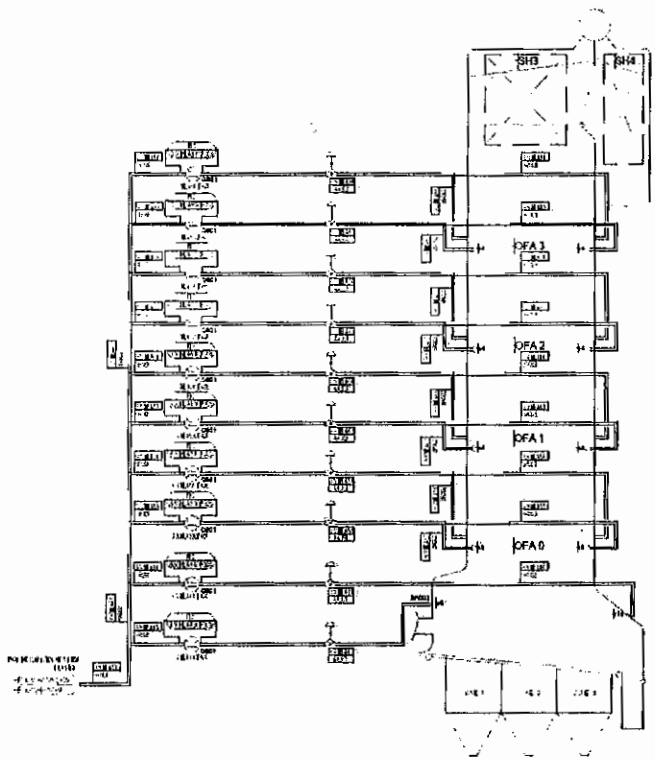
The primary air fan is a centrifugal fan driven by a frequency controlled electrical motor. The shaft bearings are equipped with temperature transmitters and vibration transmitters in order to be able to follow the fan operation in the control system.



5.5 Secondary air

Operation and maintenance instructions for this system is described in the O&M manual section 2.1.

The secondary air system consists of a frequency-controlled secondary air fan which is running continuously in normal operation, a duct system, flow- and pressure measurements and control dampers.



The purpose of the secondary air fan is partly to supply air to the system and partly to keep a constant air pressure in the duct system before the various control dampers.

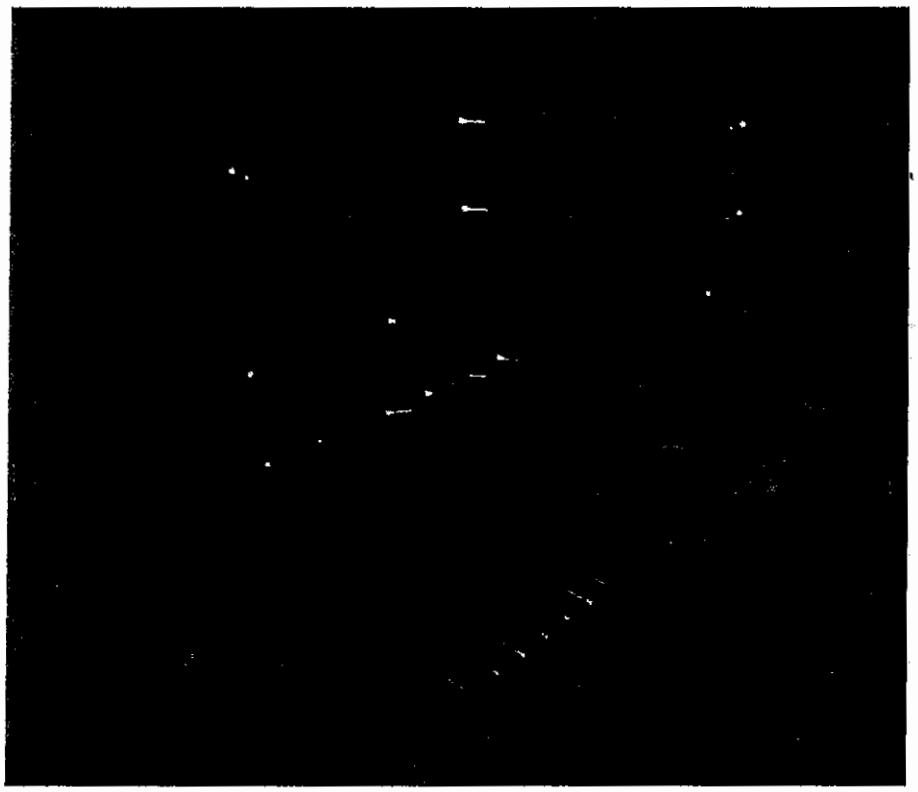
The duct system leads the air to the control dampers. The system is provided with flow measurements for the individual rows of nozzles. This means that the air flow can be controlled by means of the control dampers.

The secondary air system provides an excess of combustion air in the secondary combustion zone in order to ensure that the flue gasses are well burnt out. Furthermore, the injection of secondary air at high velocity creates turbulence in the flue gas, which ensures good mixing of the air and flue gas.

The frequency controlled secondary air fan supplies the secondary air to the secondary air system. Secondary air is injected into the furnace through a number of nozzles in 6 zones in the furnace and boiler. The injection zones are:

1. Furnace ceiling front (Front) nearest the feeding system (6 nozzles)
2. Furnace ceiling back (Back) (16 nozzles)
3. Over fire air 0 (OFA0) at the entrance to the boiler first pass (2x8 nozzles)
4. Over fire air 1 (OFA1) at the entrance to the boiler first pass (2x4 nozzles)
5. Over fire air 2 (OFA2) at the entrance to the boiler first pass (2x4 nozzles)
6. Over fire air 3 (OFA3) at the entrance to the boiler first pass (2x4 nozzles)

The secondary air flows to each of the six zones are measured by means of a differential pressure measurements and are controlled by means of a control damper.

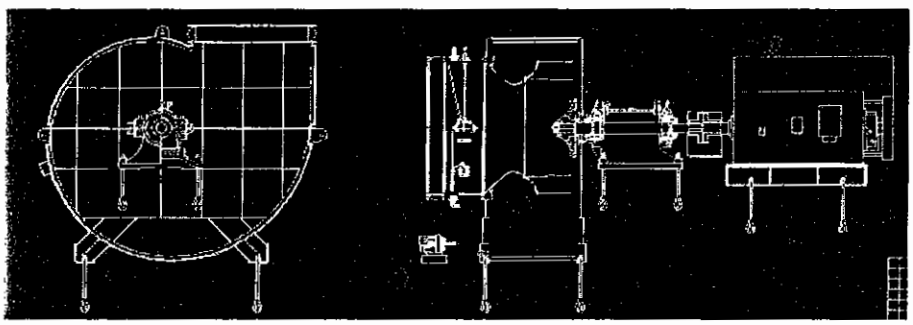


3D model of secondary air ducting

5.5.1 Secondary air fan

Operation and maintenance instructions for this fan is described in the O&M manual section 2.5.

The secondary air fan is a centrifugal fan driven by a frequency controlled electrical motor. The shaft bearings are equipped with temperature transmitters and vibration transmitters in order to be able to follow the fan operation in the control system.



5.6 Flue gas

Flue gases are released during the combustion of fuel in the furnace.

The flue gas is led through the first, second and third passes in the boiler. These are the radiation part and the convection parts where the energy is released, partly to the steam in the superheaters and partly to the feed water in the economisers.

From the convection part the flue gas is led through a duct system to the bag house filter and the ID fan. A number of measurements are installed in order to control and monitor the flue gas condition.

5.7 Bag House filter

Operation and maintenance instructions for this system is described in the O&M manual section 2.11.

The boiler is equipped with a bag house/fabric filter from Zhejiang Feida Environmental Science & Technology Co., Ltd. with a central inlet plenum placed between the 8 compartments. The cleaned gas exits the filter through the outlet duct located on the opposite side of the inlet duct. The filter is fitted with at by-pass.

The design is characterised by:

- Heavy industrial design for reliability and durability
- Maintenance from the clean side
- Powerful cleaning system for on-line cleaning

The bag house filter has the following design data:

Design data	Units	Design
Flue gas temperature	°C	140
Efficiency of dust collector	%	> 99.25
Dust content in outlet flue gas	Mg/Nm3	< 30

Table 1 – Design data for the fabric filter

5.7.1 Pre-coating

Before the bag house filter is used for the first time, the filter bags shall be coated with either calcium hydrate or fly ash. In addition, pre-coating of filter bags shall be performed when new filter bags have been inserted in the filter.

Inlet plenum and distribution to compartments

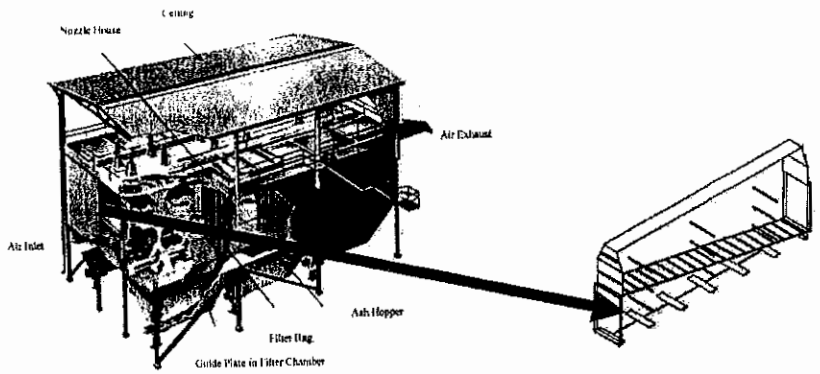


Figure 33 – Inlet and outlet plenum of filter

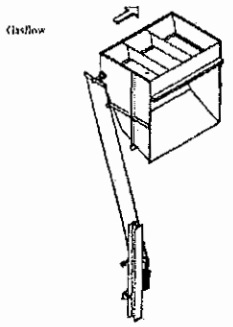


Figure 34 – Inlet to a compartments

The inlet plenum, located in the centre of the filter, distributes the flue gas to the individual compartments. There are eight compartments in the filter. For every two compartment there is one hopper. At the entrance of each compartment inlet damper(s) and gas distribution plates are located and integrated with the hopper distributing the flue gas before it enters the filter bag nests.

This gas distribution arrangement offers the following advantages, which allow a higher air-to-cloth ratio (0.88 m/min) and longer bag life than conventional filters with entry in the hopper:

› Low velocity in filter prevents gas velocity induced bag movement

- Low gas velocity in plenum also allows heavy dust particles to separate from the gas stream and fall directly into the hopper
- Gas flow in hopper is minimal preventing dust re-entrainment

5.7.2 Support structure

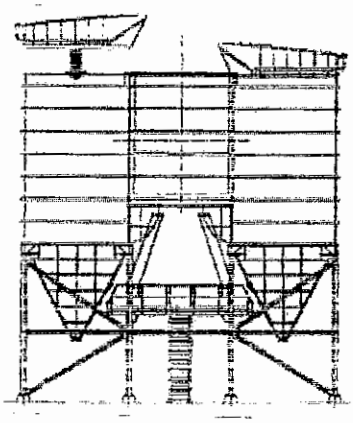


Figure 35 – Principle drawing of support structure for the filter

The support structure is designed to absorb thermal expansions.

5.7.3 Casing

The casing is designed for under pressure operation, and the casing is adequately stiffened to avoid fatigue failures through the life of the unit. The unit is designed with efficient insulation, and the casing is reinforced to accommodate outside stiffening. Access to the clean gas side is through the inspection covers on top of the filter roof.

The filter is insulated and the outside of the insulation is covered with cladding.

5.7.4 Hoppers

The dust hoppers are divided into two parts, an upper hopper and a lower hopper. The incline of the hopper plate is more than 65°, and the hopper is designed to ensure that the ash will not build up inside the filter, but falls down into the ash discharge system.

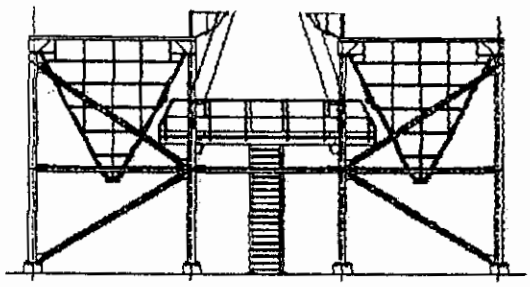


Figure 36 – Lower hoppers

The hopper is equipped with heating elements preventing the acid from the flue gas to condensate on the hopper plates. The hoppers are designed to contain the ash of eight hours of 100 % boiler load, making it possible to perform minor repair jobs on the ash discharge system without stopping the plant.

5.7.5 Mode of filtration

Filtration is from the outside to the inside of the bag, consequently depositing dust on the outside of the bags. The clean gas on the inside of the bags will flow to an outlet plenum and from there onwards into the exhaust gas duct.

The bags are arranged in nests and are supported by the cell plate and kept cylindrical by means of the bag cage.

Figure 37 – Principle of filter bag, where dust is filtrated on the outside of the bag

5.7.6 Bag and cage design

The support cage is of a rigid design in order to provide adequate support for the filter bag at all times.

To prevent bag collapse during filtration, each bag is provided with a two-piece internal bag cage. The bag cage is made of mild steel wires and it fits neatly inside the bag and is supported off the tube sheet in a manner which allows the bag cage and bag to hang perpendicular from the tube sheet. The cage is designed for easy, tool-free removal.

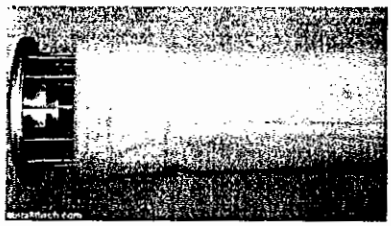


Figure 38 – Principle picture of cage and bag

The support wires are designed to minimize bag creasing during bag cleaning and to facilitate easy bag/cage separation.

› The cage has a length of 8,065 mm and a diameter of 130 mm.

› There are 1,544 bags in the filter

› The total area of the filter bags is 5,459 m²

› The bag material is PPS

5.7.7 Bag cleaning method

The filter bags are cleaned by means of a compressed air pulse injected vertically down inside the bag and in the opposite direction to the normal filtering gas flow. Compressed air is used to create the pulse, and each filter cell is provided with header tanks with solenoid valves and distribution pipes.

Pulsing normally occurs at call from the differential pressure switch via the fabric filter control unit.

The distribution pipes are connected to nozzle pipes, each row of bags having one distribution pipe.

The bag cleaning control system is of the type S7-300, which is a Siemens design. The main feature of the system is the use of medium compressed air pressure in the tank, a low power consumption and a very high cleaning effect. All this is achieved with a very simple tank, valve and nozzle pipe arrangement.

For cleaning of the bags, the filter remains online during the cleaning cycle.

The pulse valves are integrated with the pressure tank.

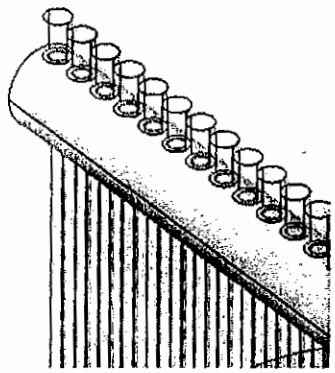


Figure 39 – Tank and pipe system for air

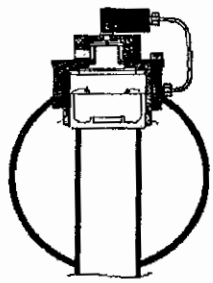


Figure 40 – Pulse valve closed

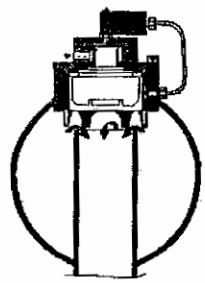


Figure 41 – Pulse valve open

The filter pulsing system includes a pulse valve integrated into the manifold for maximum efficiency. The use of a lower pressure also reduces the risk of condensation with moist gases. The membrane and pilot valve ensure reliability of performance.

The pulse distribution pipes are designed for even distribution of cleaning power to each bag. A rigid support system guarantees the correct position of the pipe on reassembly.

5.7.8 Clean gas outlet

The cleaned gas exits the compartment through the outlet dampers.

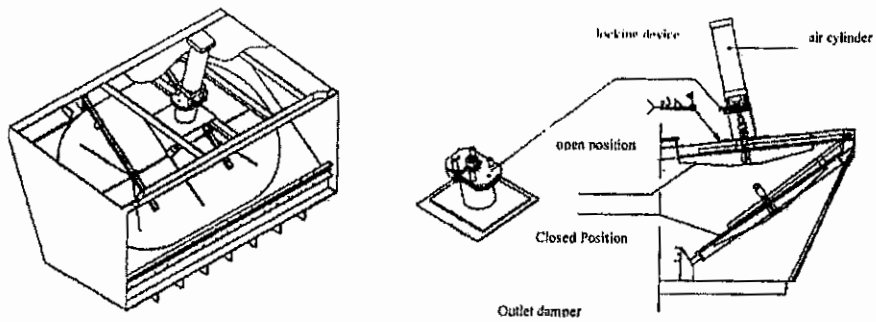


Figure 42 – Principle drawings of the design of the outled dampers

5.7.9 Access

Access to bottom hoppers and roof level is from stairs, platforms and galleries as shown on the project layout drawing.

5.7.10 The fabric filter cleaning control

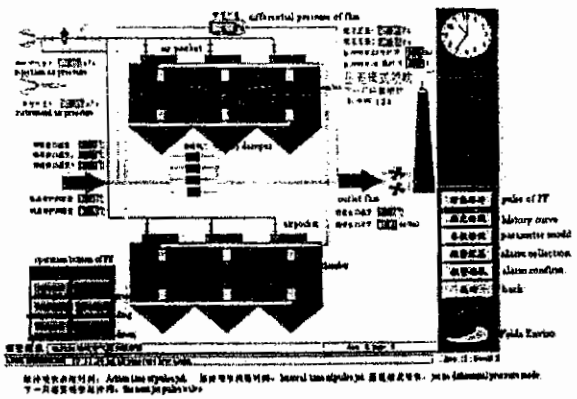


Figure 43 – Typical monitoring picture of normal operation

The Siemens *S7-300* mini PLC system is used to control the cleaning of the fabric filters.

The Software built into the Fabric Filter Control can be summarized as follows:

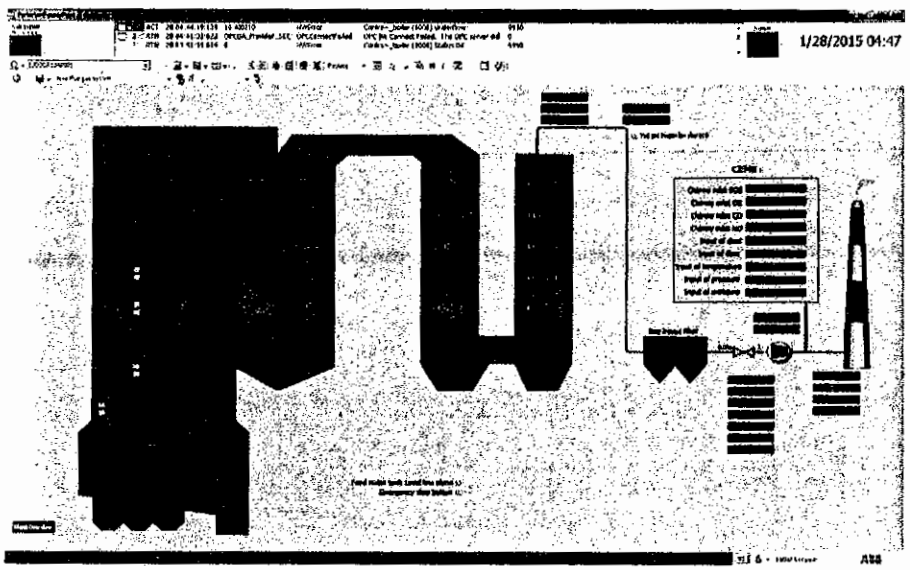
- Pressure-drop cleaning
- Time-cycle based cleaning
- Load-based cleaning (dust layer thickness)
- Manual cleaning
- Communication with DCM.

5.8 Continue Emission Measuring System

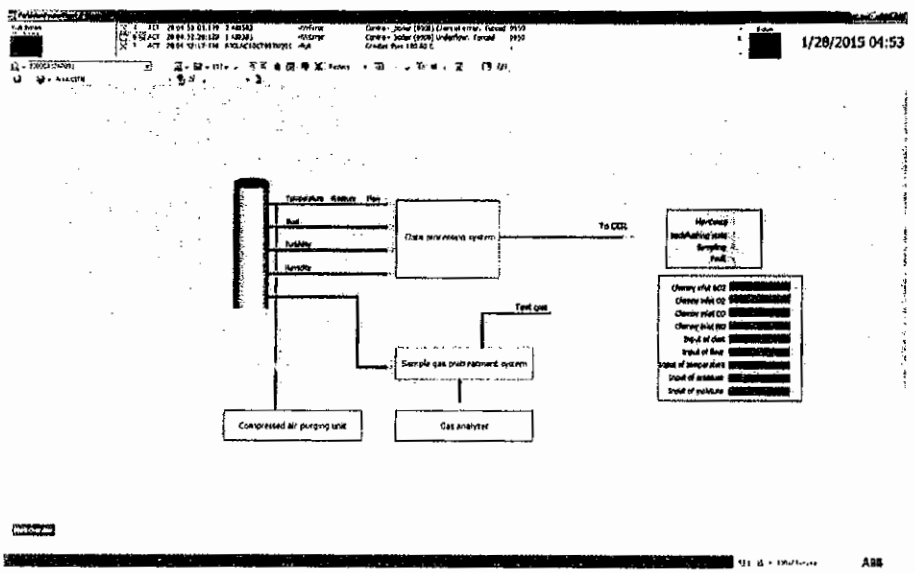
Operation and maintenance instructions for this system is described in the O&M manual section 2.12.

A CEMS system is installed in the stack to monitor the emission values to ensure that the emissions are below the emission limit values (ELV) specified by the authorities.

The CEMS system consists of several analysers/systems for emission monitoring. The parameters that are analysed in the CEMS system is both pollutants (CO, NOX, SO_2 and dust/particle matter) and additional parameters (flue gas temperature, pressure and H_2O) to calculate the emission values to reference conditions (dry gas at 1 atm., 273 °K and 6 vol.% O_2). Furthermore the flue gas flow is measured to be able to monitor the total emission in kg for each pollutant.



Process overview including flue gas emissions, DCS



CEM equipment principal drawing, DCS

5.8.1 Pollutants end emission limit values (ELV)

The following ELV's are specified by the authorities:

Pollutant	Emission limit	Unit	Condition/measurement
NOx	< 510	mg/Nm3	Dry gas, 6% O_2 content
Particle matter (dust)	< 30	mg/Nm3	Dry gas, 6% O_2 content
SO_2	< 900	mg/Nm^3	Dry gas, 6% O_2 content

Table - Emission limit values (ELV)

Emissions of NOx and SO_2 causes formation of acid rain when these pollutants reacts with water molecules in the atmosphere. Furthermore, these pollutants has significant impact upon human health.

Particle matter (dust) emissions causes health risk and influences the visibility in the surroundings.

NOx, SO_2 and particle emissions are measured for environmental protection.

CO is analysed in the CEMS system as well. This is not because of legislation requirements, but because the CO emission is a parameter for combustion quality, why it is an important parameter for surveillance of the combustion process.

The additional parameters O_2, H_2O (moisture), flue gas temperature and pressure are measured for conversion of the real-time analysed raw values to reference condition dry gas at 1 atm., 273 °K and 6 vol.% O_2. The reason for this conversion to reference conditions is for being able hold up against the emissions to the ELV's.

5.8.2 Quality assurance of emission measurement

It is of great importance that the complete CEMS is a part of the regularly, preventative maintenance programme at the plant. This is important to ensure a high-quality measurement of the pollutants to fulfil the requirements from the authorities.

The supplier of the CEMS system is obliged to deliver manuals for safety, operation and maintenance of the equipment. Additionally it is strongly recommended that the supplier carry out a training programme for the operation personnel (engineers) that are involved in the routine maintenance of the CEMS equipment.

5.8.3 CEMS installation

The CEMS installation is at a vertical flue gas duct. The flanges for the different analysers/systems are mounted respectively around the duct and in two levels to ensure that the measurements does not give negative impact to one another.

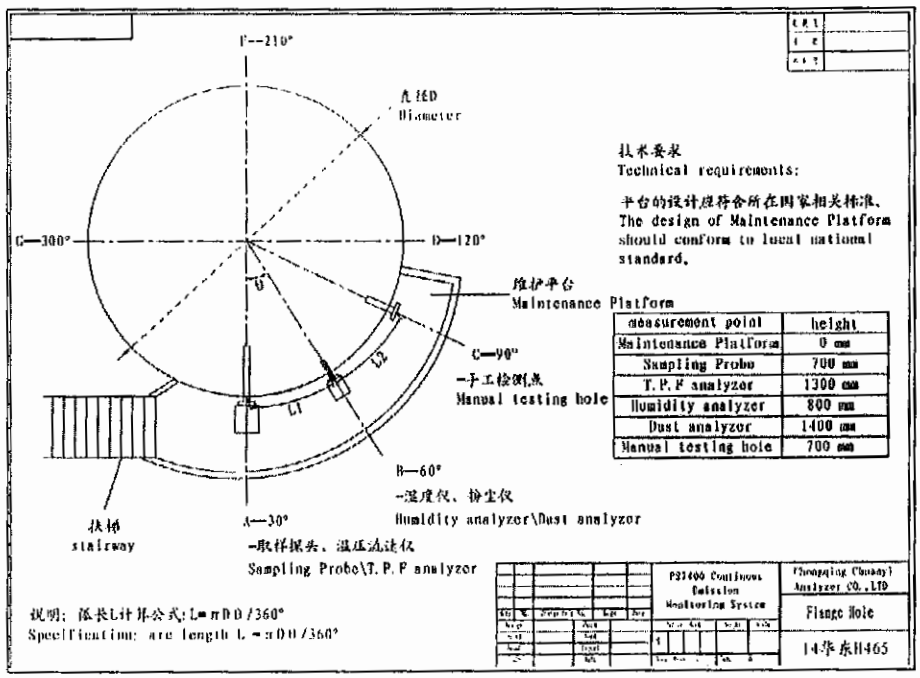


Figure - Flange installation for CEMS equipment, top view

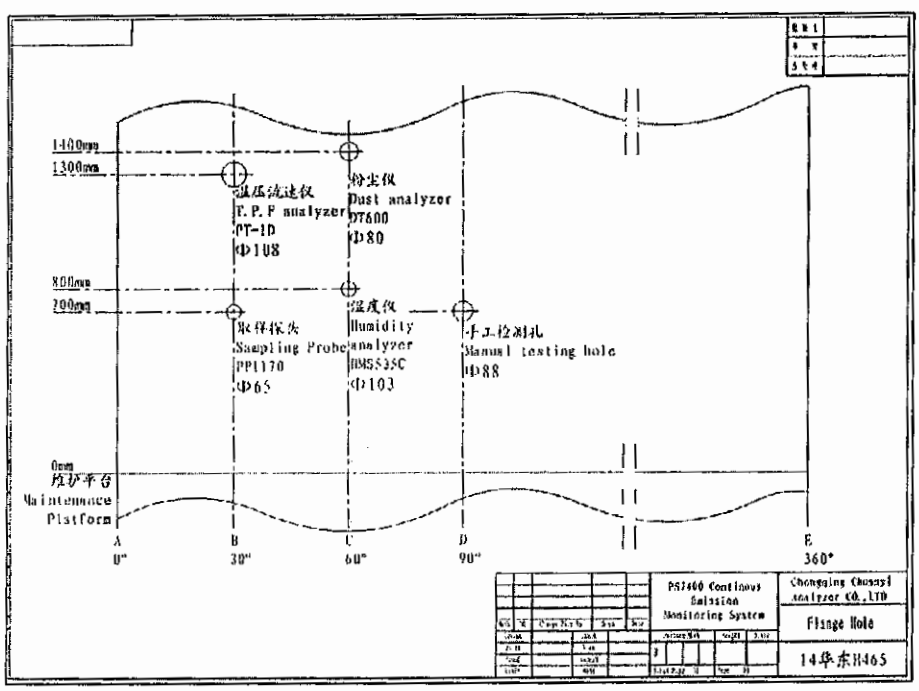


Figure - Flange installation for CEMS equipment, side view

5.8.4 CEMS for NO_X, SO_2, CO and O_2

The layout of the equipment is based on extractive analysis. A sample of the gas is being drawn out from the process by a sample pump placed in the gas analysis cabinet. A heated sample probe with filter is mounted on the flue gas duct to ensure a prober gas sampling and removal of dust particles from the gas. From the heated sample probe to the gas analysis cabinet the flue gas is transported in a heated sample line.

In the gas analysis cabinet the flue gas is lead through a gas preconditioning part (cooler and filter with humidity sensor) in order to remove all dust, dry the gas and remove any contaminating component from the gas. The gas is then delivered to the analytical part of the system with a fixed reference of dew point, flow, pressure and temperature in order to establish correct analytical correlation with any data taken at any other time.

Before the flue gas enters the analyser itself it is sent through a NO_2-NO converter, where the NO_2 in the flue gas is converted to NO by use of a catalyst. In the analyser, the content of NO (NO_X), SO_2, CO and O_2 is measured. The NO, SO_2 and CO content is measured in mg/m³. The O_2 content is measured in vol. %.

Since the flue gas is cooled in the preconditioning part, the water is removed and the result in mg/m³ or vol. % is at the condition dry gas, 273 °K and 1 atm.

The gas analyser for NO, SO_2 and CO need to be calibrated with certified calibration gasses in regular intervals. Calibration and regular preventative maintenance is to be done by the operation personnel or engineers at the plant. Instructions for calibration and maintenance are described in the operation manual of the PS7400 CEMS system.

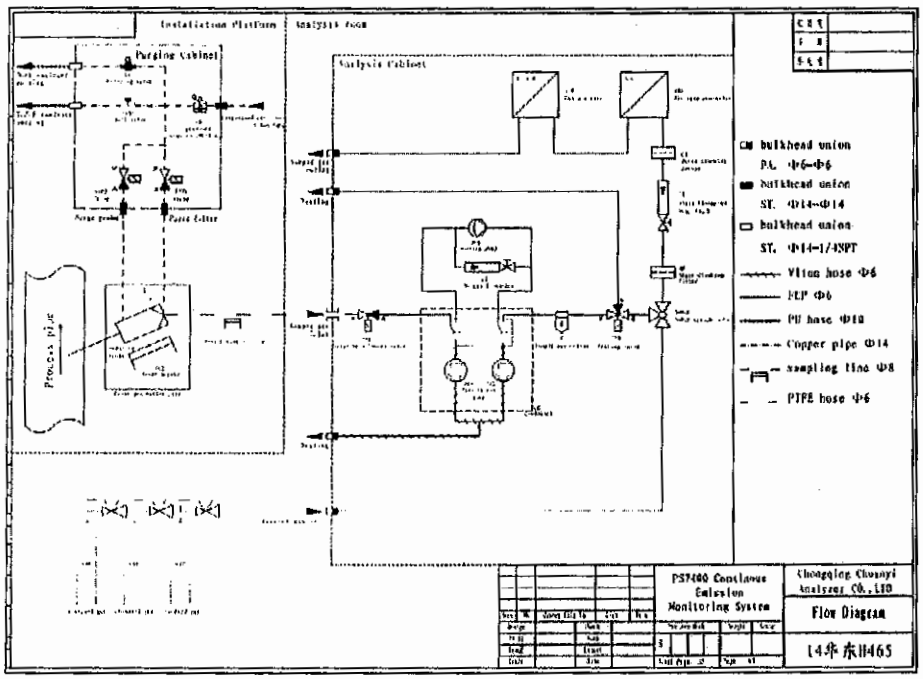


Figure - Flow diagram of PS7400 CEMS system

Measuring principles[1]

The analysis of NO, SO_2 and CO is done with infrared light measuring principle.

Many gasses absorb infrared light extremely well, which makes the use of infrared light (IR) very useful for the analysis of many gasses such as NO, SO_2 and CO. The measurement is made by a gas flow which is led through a cuvette where the IR light source and an optical filter has been placed by one end of the cuvette and a detector has been placed by the other end. The IR light source sends out a scattered IR light and the wave length of the light that is sent through the gas in the cuvette is determined by an optical filter that has been placed between the light source and the cuvette. Different kinds of wave lengths from IR light are used for analysis of different gasses. The absorption of the light that is send into the cuvette is an expression of the concentration of the gas to be analysed. The amount of light passing through the gas is measured by the detector at the other end of the cuvette.

[1] Information source for description and principle drawings on measuring principles is the Danish supplier of CEMS equipment FLSmidth Airloq A/S (www.flsairloq.com)

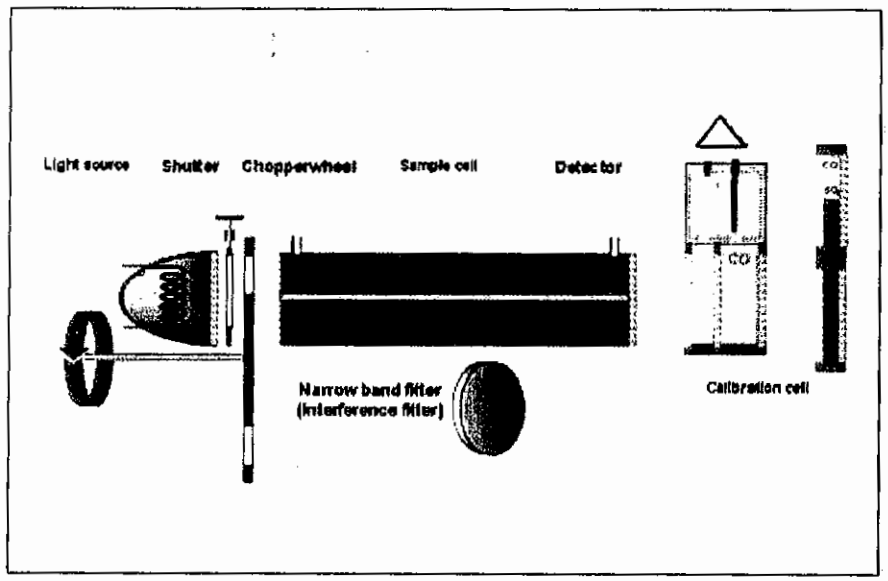


Figure - Infrared measuring principle

The analysis of O_2 is done with electrochemical measuring principle.

The electrochemical measuring principle is often used for measurement of O_2 in extractive gas analysis systems. The measurement is made by letting for instance O_2 pass through a gas selective membrane, which only allows for the gas to be measured to pass through. The O_2-molecules diffuse into an electrolyte solution and are converted to H_2O. This reaction is provoked by a gold cathode in the electrolyte. By the anode, which is made of lead, lead oxide is produced by means of the electrons that are released when O_2 reacts and is converted to H_2O. The migration of electrons between the anode and the cathode represents the amount of O_2 converted to H_2O, and it is thus an indicator of the O_2-concentration in the process.

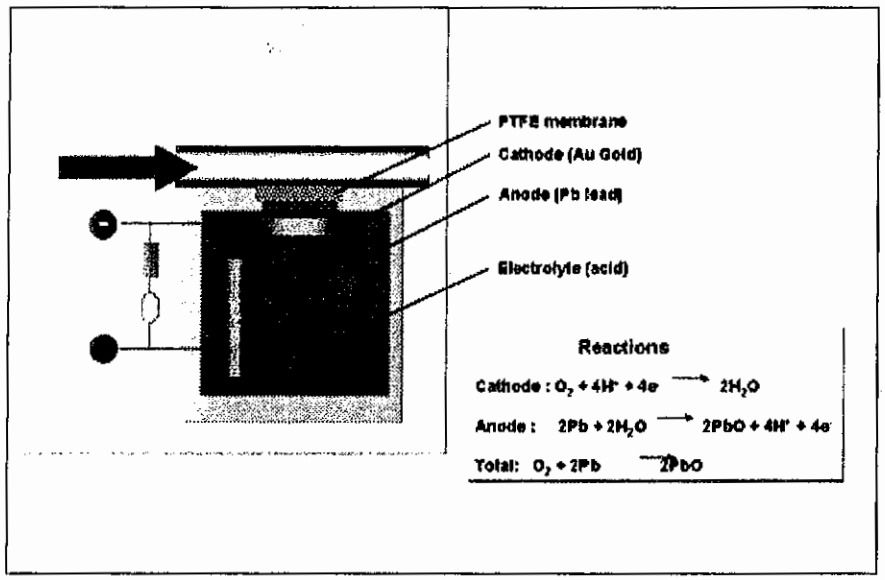


Figure 44 - Electrochemical measuring principle

5.8.5 CEMS for particles (dust)

The contractor/RUNH has not yet provided data or specification for the dust monitor. This chapter will be completed when the data are available.

Measuring principle

5.8.6 CEMS for H_2O (moisture)

The contractor/RUNH has not yet provided data or specification for the dust monitor. This chapter will be completed when the data are available.

Measuring principle

5.8.7 CEMS for flue gas flow

The contractor/RUNH has not yet provided data or specification for the dust monitor. This chapter will be completed when the data are available.

Measuring principle

5.8.8 CEMS for flue gas temperature and pressure

Flue gas temperature and pressure are measured to be able to convert the measuring values for the pollutants and flue gas flow to reference conditions.

These measurements are done by means of a temperature transmitter and a pressure transmitter. Regularly maintenance and control of the transmitter's

functionality and accuracy is recommended to be integrated in the maintenance programme at the plant.

5.8.9 Data acquisition and environmental reporting

Data from the CEMS equipment are sent to a data acquisition and environmental reporting system. For the pollutants and additional parameters the measuring data are transferred as 4-20 mA analogue signals. Status signals (digital signals) for alarms, maintenance e.g. are transferred as well. Specification of the signals from the CEMS equipment are found in the project information for the PS7400 CEMS system from the supplier.

In the data acquisition and reporting system the raw values from the CEMS equipment are converted to reference conditions (dry gas at 273 °K, 1 atm. and 6 vol. % O_2). The emission values at reference condition are used for calculation of average values at hourly and daily basis. The average values are compared with the ELV's to define whether the ELV's are exceeded or not.

Environmental reports are saved as log files or printed on daily and monthly basis. Environmental reports are sent to the authorities acc. to the requirements in the environmental permit for the plant.

5.9 Boiler Ash

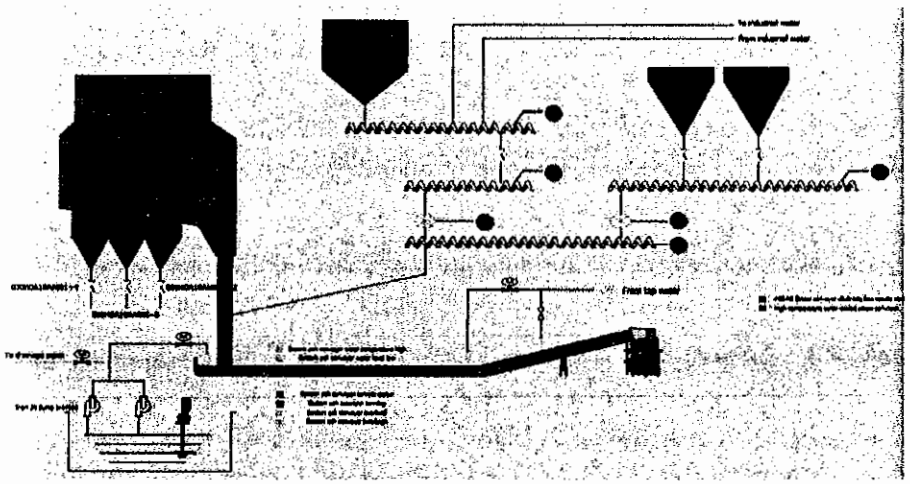
Operation and maintenance instructions for this system is described in the O&M manual section 2.10.

Not all of the biomass are burning in the combustion chamber. Different biomass contains different amounts of ash that cannot burn and steel wires from the straw bales together with sand and stones that are mixed into the biomass all ends up in the combustion chamber. The heavy parts stays on the grate and ends up in the bottom ash conveyer while light particles goes together with the flue gas and ends up either as boiler ash or as the fly ash separated in the bag house filter.

The ash content in different biomass fuels varies a lot depending both on the type of biomass and on the location where it has been growing. A typical ash content on wheat straw are 5-10% while rice straw has as ash content up to 20%.

A typical biomass flow into the boiler is 30 ton/hr hence could give an ash flow out of the combustion at 3 ton/hr.

The following screen dump from the DCS shows the boiler ash outlet system.

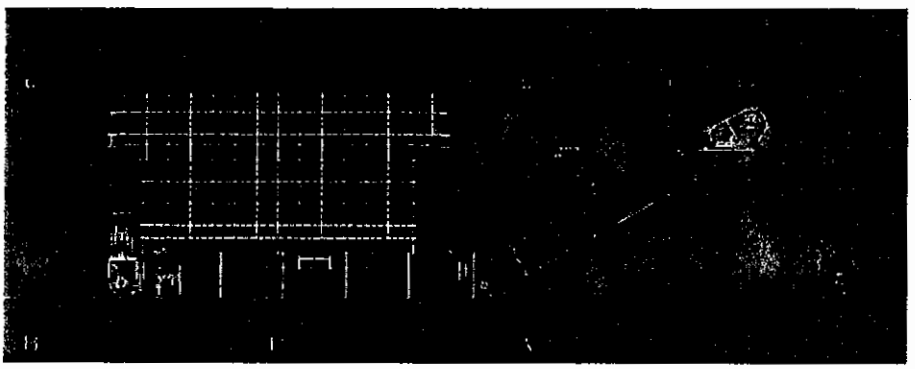


5.9.1 Bottom Ash Handling

Operation and maintenance instructions for this system is described in the O&M manual section 2.12.2.

The heavy parts of the ash (bottom ash) coming from the combustion grate drops down to a wet ash chain conveyer. The water in the conveyer are cooling down the ash and at the same time the water are creating an airlock avoiding air to enter the combustion chamber.

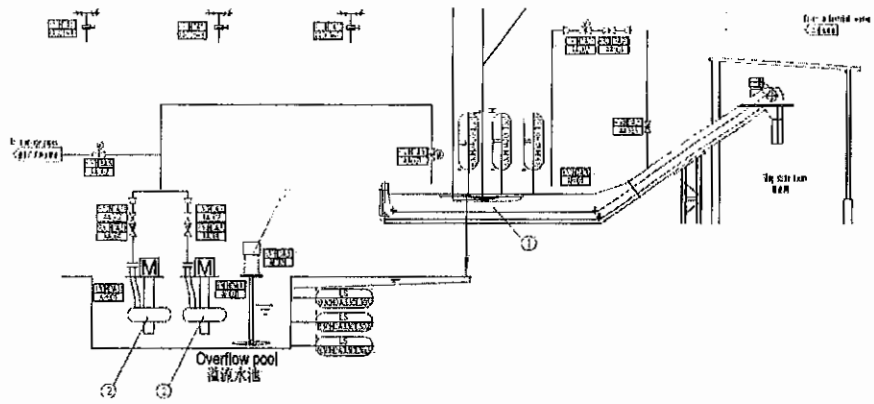
The bottom ash is transported and dumped to an open ash container that needs be removed/changed on a regular basis.



The chain conveyer is driven by a frequency controlled gear motor that are running at a constant speed.

The water temperature in the chain conveyer is measured by a temperature transmitter and are kept below 60°C. The temperature is kept down by adjusting the amount water led to the chain conveyer. If the temperature gets too high the amount of water are increased.

The water level in the wet ash conveyer is maintained and controlled by a level switch. If the water level gets low the control system will open the valve B30HDA20AA002 and more water will be added.



Overflow from the chain conveyer are led to an overflow pool/pit from where the water can be recycled to the chain conveyer or emptied to the drain system.

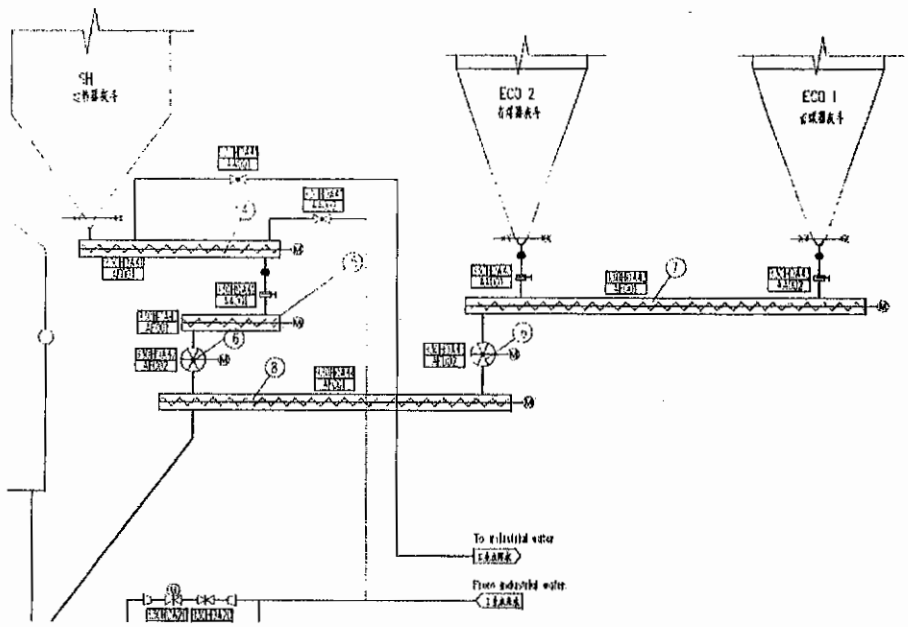
An agitator in the overflow pool/pit ensures that there will be no ash sedimentation.

5.9.2 Boiler ash

In the bottom of the 2nd and 3rd pass of the boiler and in the bottom of the two economizers ash outlets are installed. When the flue gas flow are changing direction from downward to upward the ash particles are separated and falls down into the hoppers.

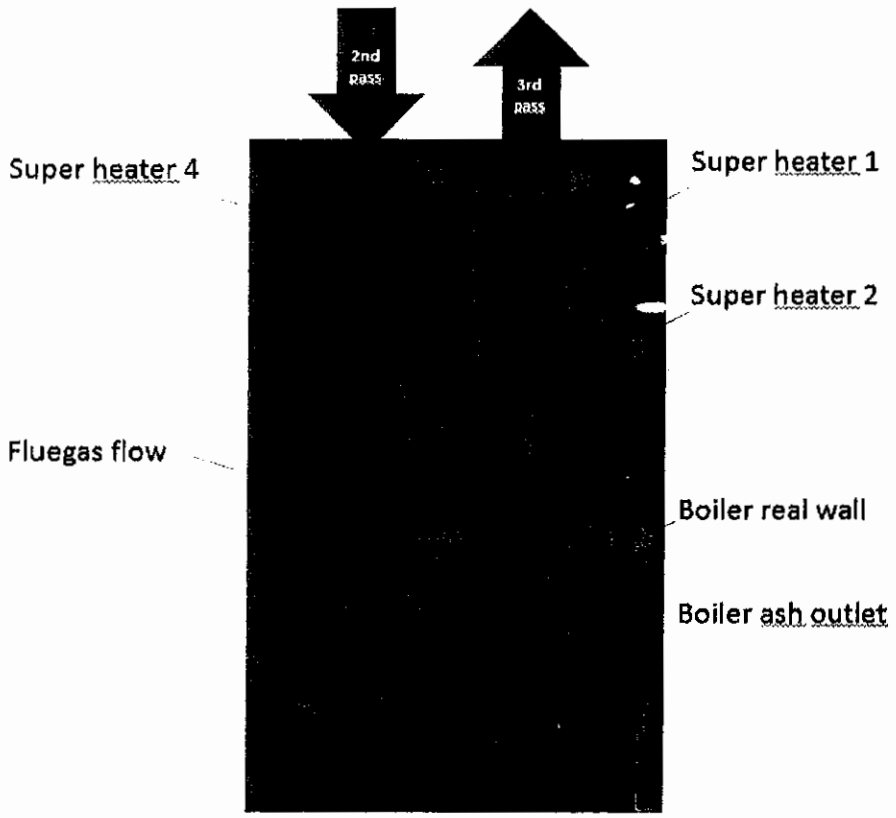
This ash transport system consist of the following equipment:

- Water cooled screw conveyer below 2nd/3rd boiler pass
- 3 screw conveyers
- 2 rotary air locks



5.9.3 Water cooled screw conveyer

The ash outlet below the 2nd and 3rd pass of the boiler are approximately 400mm x 10 meter. The below picture shows the 3D model of the boiler without the right boiler wall. In the bottom the ash outlet can be seen.



Because of the big opening the screw conveyer is exposed to the heat inside the boiler and hence water cooling is required for protection of the conveyer.

If the cooling water fails the plant must be shut down.

5.10 Fly Ash transport and storage.

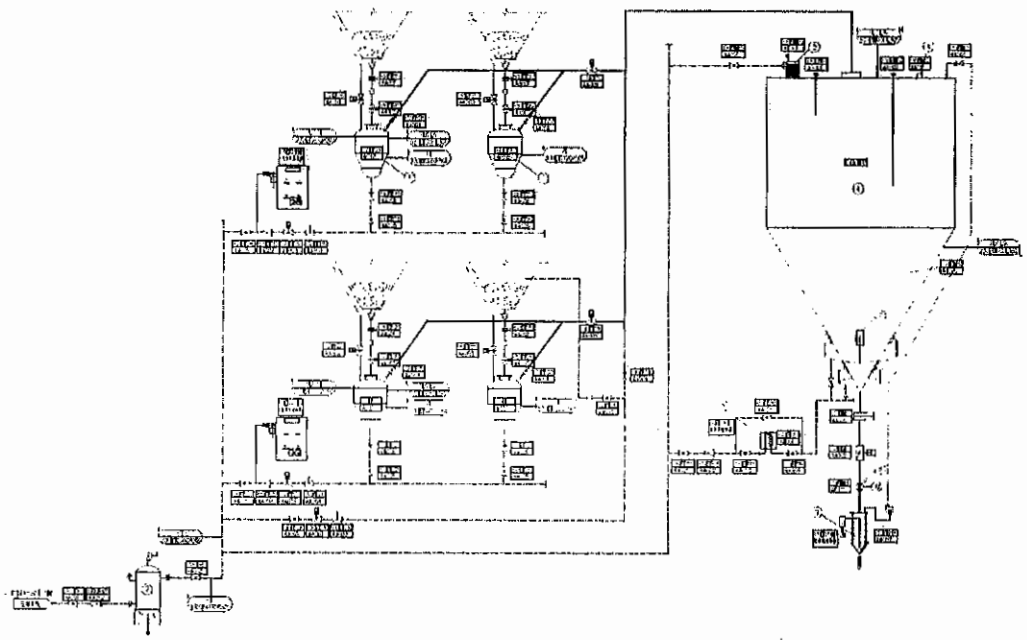
Operation and maintenance instructions for this system is described in the O&M manual section 2.12.1.

The ash removed from the flue gas in the bag house filter is called fly ash. A pneumatic transport system is transporting the fly ash from the 4 hoppers below the bag house filter to a storage silo. The air used for the pneumatic transport is coming from the existing compressed air system installed at the paper mill.

The main parts of the system are:

- Compressed air tank
- Dosing/fluidizing tanks
- Fly ash silo
- Silo truck loader

- Silo fluidizing system
- Instrumentation
- valves and dampers
- Piping for the pneumatic transport

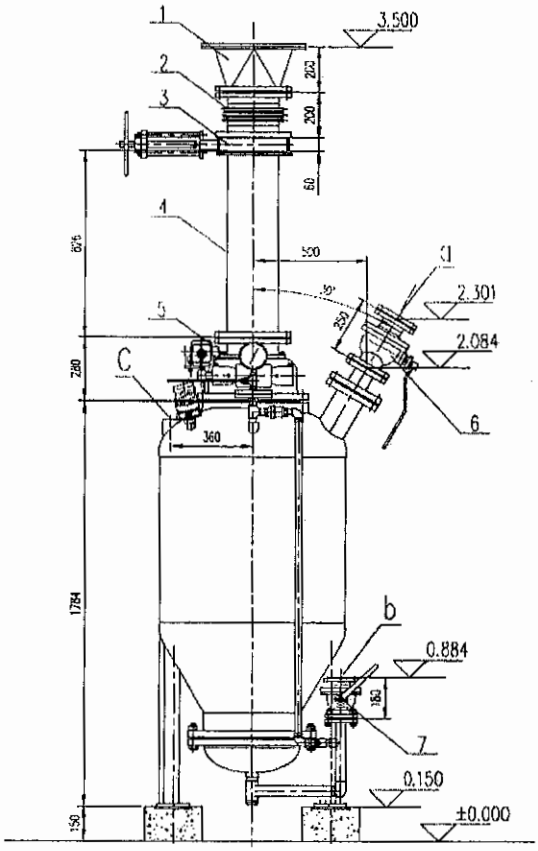


5.10.1 Compressed air tank

In order to ensure stabile compressed air supply to the pneumatic transport system and to avoid too big variation in the pressure of the compressed air system a buffer tank is installed.

5.10.2 Dosing/fluidizing tanks

4 dosing/fluidizing tanks are installed below the hoppers of the bag house filter. The tanks are shown on the below drawing. The fly ash is dropping through the cone (position 1) and the damper (position 3) and down into the tank. When the tanks are emptied compressed air is led into the bottom of the tank through nozzle "b" and the fluidized fly ash and is emptied through nozzle "a".

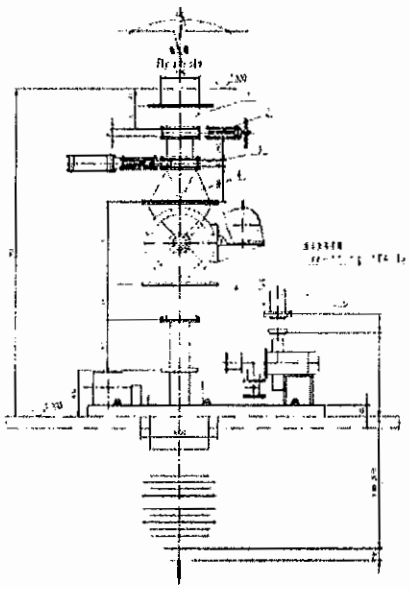


5.10.3 Fly ash silo

The pneumatic transport system delivers the fly ash to the top of the fly ash silo. The silo can be emptied from the bottom into a truck or container. The silo is equipped with a small bag filter at the top to avoid dust emission from the vent pipe of the silo. To avoid blockage when the silo is emptied warm air is injected in the bottom cone of the silo. The air is fluidizing the fly ash and hence avoiding bridge building of the ash.

5.10.4 Truck loader

At the bottom outlet of the silo a truck loader is installed. The fly ash flow out of the silo is automatically controlled by the star feeder.

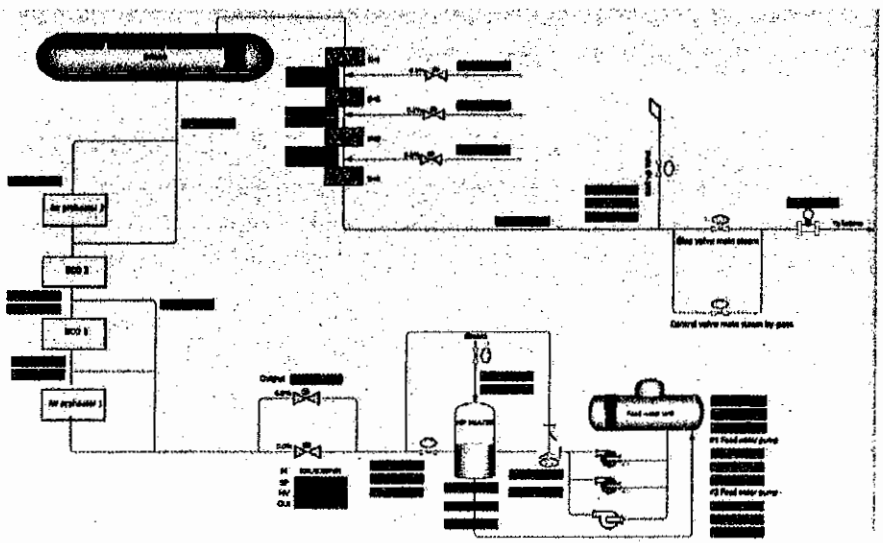


6 Steam and water cycle

Operation and maintenance instructions for this system is described in the O&M manual section 2.1.

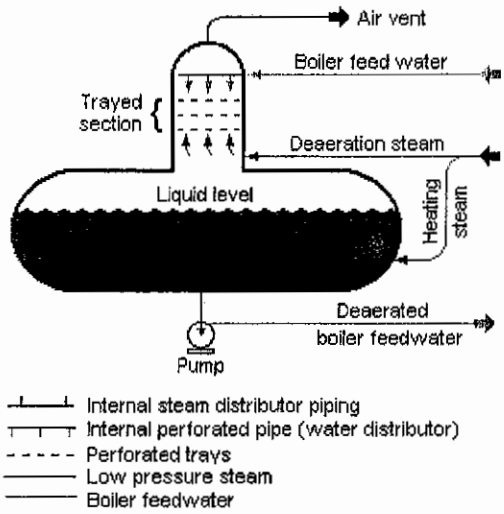
This chapter describes the steam and water cycle starting at the outlet of the feed water tank/dearator and ending at the inlet of the steam turbine.

The purpose of the water/steam cycle is to transport energy. In brief, this is the process that transports the energy from the place of combustion to the consumer in this case the steam turbine.



6.1 Deaerator/feed water tank

The purpose of the deaerator/feed water tank is to ensure deaeration of the feed water and to ensure a feed water buffer in the system. Dearation means to remove oxygen and CO_2 from the feed water as oxygen is harmful to the boiler.
The deaeration is achieved by heating and pressurising the feed water in the tank and blow the gasses into the atmosphere through an opening in the top of the tank. Typically the feed water is heated to 130° C at the saturation pressure (2,7 bar).



The feed water tank is connected directly to the feed water pump inlet at the bottom.

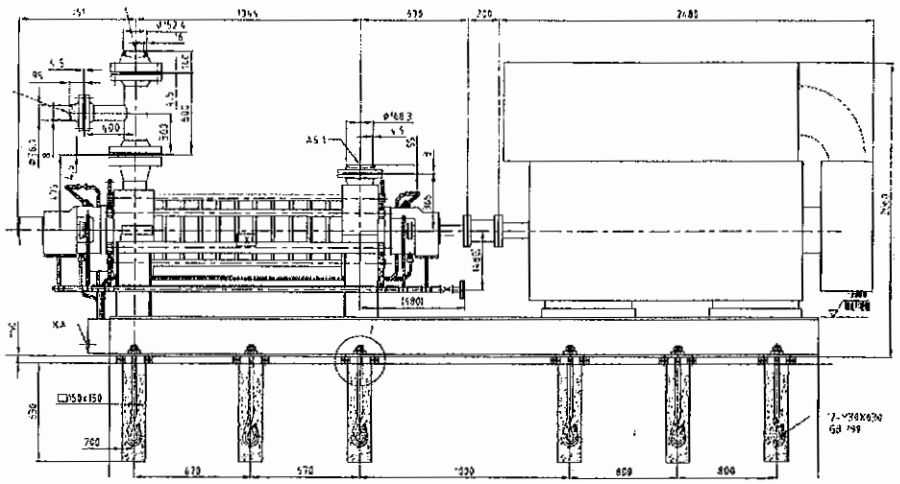
6.2 Feed water pumps

Operation and maintenance instructions for this system is described in the O&M manual section 2.7.

The feed water pumps supply the boiler with feed water by increasing the feed water pressure and by pumping the water from the feed water tank through the economiser to the boiler drum. Further the feed water pumps also supply water to the spray water injections between the super heaters to control the steam temperature.

The pumps are driven by a frequency controlled electrical motor and are controlled by the pressure before the feed water control valve at a constant value.

To protect the pump a minimum flow through the pump is always required. A special 3-way valve is installed at the outlet of the pumps ensuring the sufficient flow that are led back to the feed water tank.



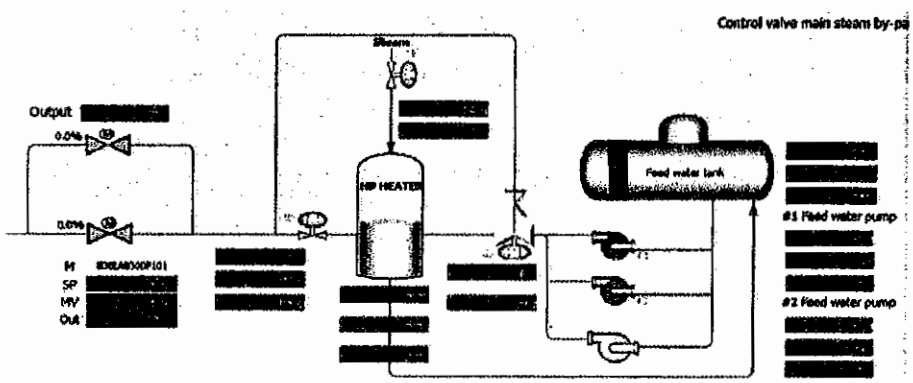
The feed water pump bearings are equipped with temperature and vibration transmitters in order to monitor the operation in the control system.

6.3 Feed water High pressure preheater

Operation and maintenance instructions for this system is described in the O&M manual section 2.9.

To increase the thermal efficiency of the plant the feed water is preheated in the High pressure feed water preheater by low pressure steam from the turbine. The feed water temperature is increased from 130°C to 180°C while the steam from the turbine is condensed and led to the feed water tank.

The heater is a vertically installed shell and tube heat exchanger, where the feed water is passing through the tube side of the heat exchanger and the steam is condensed on shell side and led out through the bottom.



The condensate level in the feed water heater is measured by level transmitters and the condensate level is controlled by a level control valve that is installed at the condensate outlet.

6.4 Feed water control valve

The purpose of the feed water control valve is to control the feed water flow into the boiler and thereby maintain the level in the boiler drum and hence ensuring water in the boiler.

6.5 Economiser

Operation and maintenance instructions for this system is described in the O&M manual section 2.1.

The purpose of the economizer is to improve the economy of the plant by transferring some of the energy in the hot flue gas to the feed water, which runs inside the economizer.

The economizer is composed of membrane serpentine tubes and is divided into two groups, which both are divided into another four coolers. They are connected in tandem to achieve ideal temperature for the flue gas.

The feed water running inside the tubes is in counter-current with the flue gas.

6.6 Boiler drum

Operation and maintenance instructions for this system is described in the O&M manual section 2.1.
The boiler drum is placed at the top of the boiler and its primary purpose is to separate the generated steam from the boiler water and to ensure a high steam quality. The boiler drum is a cylinder-shaped reservoir with a diameter of 1,600 mm and a length of 14,800 mm. It works as a separator, and separates the generated steam from the boiler water.

Furthermore, the drum is used to ensure that the right amount of water is led to the boiler by means of maintaining a constant boiler drum level.

The boiler drum is connected directly to the boiler downcomers and evaporators and forms an important part of the boiler circulation.
Picture and drawing to be added

6.7 Boiler/evaporator

Operation and maintenance instructions for this system is described in the O&M manual section 2.1.
From the boiler drum the water is led on the outside of the boiler down through the downcomers to the boiler bottom headers.

From the bottom headers the water is distributed to the heat exposed surfaces of the boiler, also called the evaporators or boiler walls.

The vibrating grate, which is also a part of the heat exposed part of the boiler, is fed with water directly from the boiler drum.

In the evaporators the energy from the combustion is induced, causing part of the boiler water to evaporate.

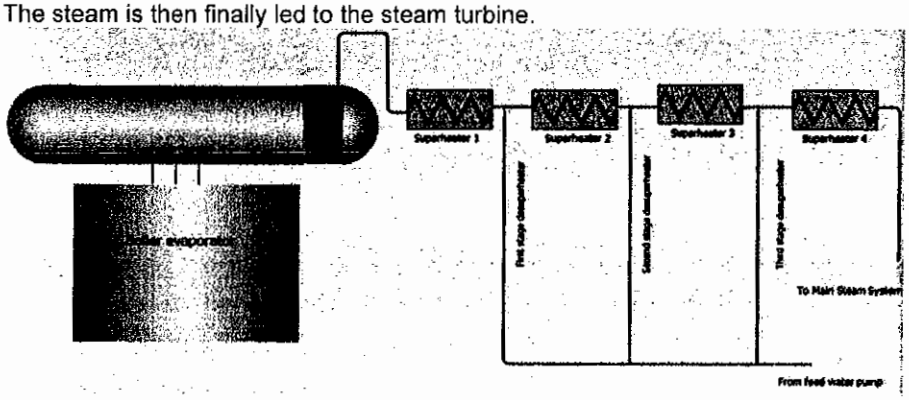
The mixture of water and steam rises up through the evaporators to the boiler drum, where the generated steam is separated from the boiler water.

6.8 Superheaters

Operation and maintenance instructions for this system is described in the O&M manual section 2.1.

From the boiler drum the steam is led to the superheaters, which are placed in the boiler convection part.

In the superheaters the energy from the flue gas is transferred to the steam, which causes superheating of the steam.
Water injection valves LAE41AA301 and LAE42AA301 are installed after the superheaters, enabling the control system to maintain correct steam temperature before superheater 4.
The steam is then finally led to the steam turbine.



6.9 Vibrating grate

Operation and maintenance instructions for this system is described in the O&M manual section 2.1.

The fuel enters the combustion chamber in front of the furnace into the vibrating grate. The vibrating grate is made of vibrating structures to carry the fuel through the furnace. It is divided into sections to allow air to be distributed in the lower zone to control the combustion.

6.10 Oil gas burners

Operation and maintenance instructions for this system is described in the O&M manual section 2.3.

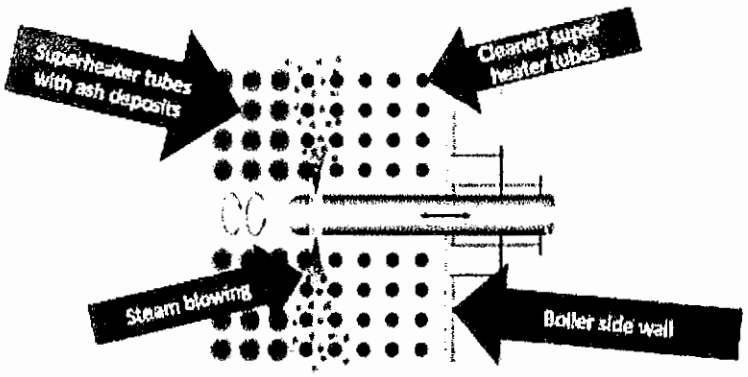
The boiler is equipped with two dual fuel burners at the entrance of the furnace. The fuel applied for the burners are heavy fuel oil and natural gas. The burners are intended in case of shortfalls in biomass supply.

6.11 Steam sootblowers

Operation and maintenance instructions for this system is described in the O&M manual section 2.2.

During normal operation soot and ash are building up a layer on the boiler heating surface. This layer acts as an unwanted heat insulator that reduces the efficiency of the boiler and can, if no actions are taken, block the flue gas flow through the boiler. In order to remove this layer a soot blower system is installed.

Ash layer on boiler tubes before and after cleaning.

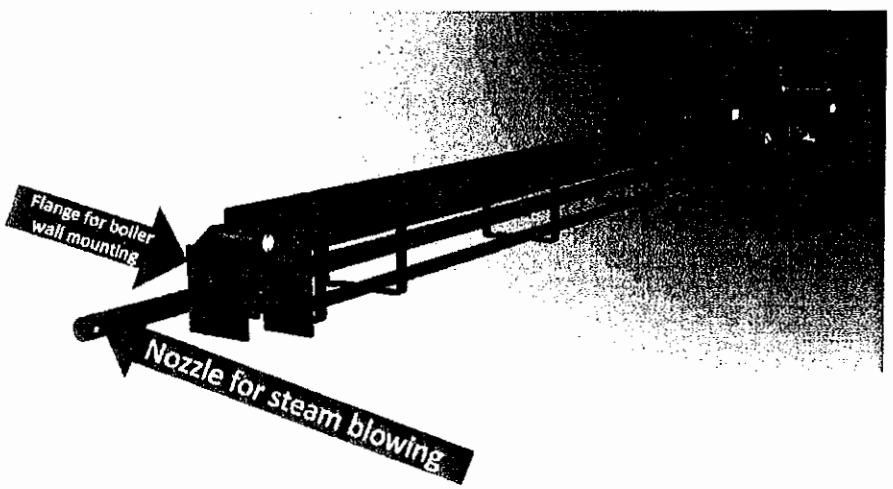


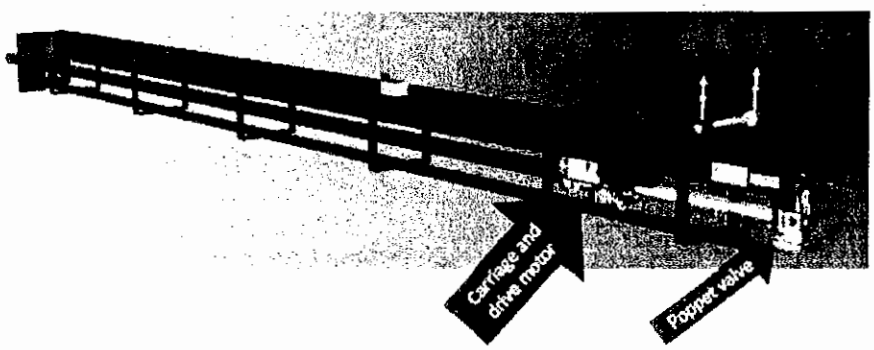
The soot and ash are removed by slightly superheated steam that are blown against the soot/ash layer on boiler tube surface. The ash fall down into the hoppers and are removed together with the boiler ash.

6.11.1 Superheater 1 and 2 sootblowers

Because of the high flue gas temperature before and after the superheater 1 and 2 the soot blowers for the super heaters are retractable. In order not to be damaged the lance of these sootblowers are removed from the flue gas flow when they are not in operation. During operation of the sootblowers steam will cool down the lances and protect it against the high temperature of the flue gas.

On the below picture the principle of a retractable sootblower are shown.





Retractable soot blower of super heater 1 and 2.

6.11.2 sootblower operation

When a sootblowing cycle begins the sootblower is in the retracted position, i.e. the lance nozzle are outside the flue gas flow.

A sequence is as follows:

1 Superheated steam is led to the inlet of the poppet valve

2 The electrical motor starts and moves the carriage and the lance into the boiler. The lance rotates around its axis while it is moving.

3 When the lance enters into the boiler and shortly after it has start moving, the poppet valve automatically opens for the steam supply and the steam flows through the lance and through the nozzles at the end of the lance and creates a steam jet. Because of the rotation of the lance the steam jet inside the boiler creates a helix and the steam removes the ash deposits on the boiler tubes.

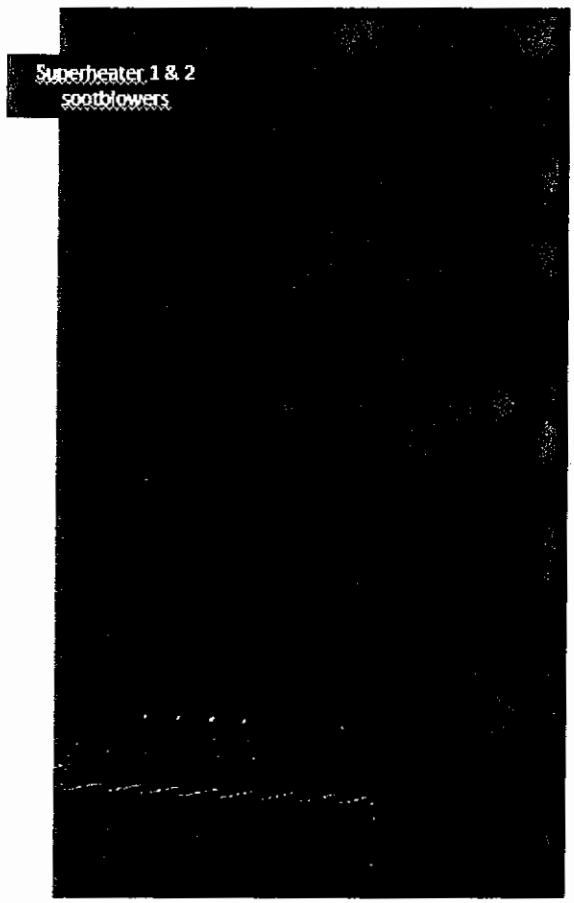
4 When the lance are fully inside the boiler the rotation of the drive motor is changed and the carriage retracts the sootblower lance from the boiler.

5 When the lance are removed from the flue gas flow the poppet valve shut off the steam supply.

The steam supply must never be stopped while a sootblower is in operation as the steam is ensuring cooling of the lance while it is in contact with the warm flue gas. If the steam supply is failing the soot blowers must be retracted immediately.

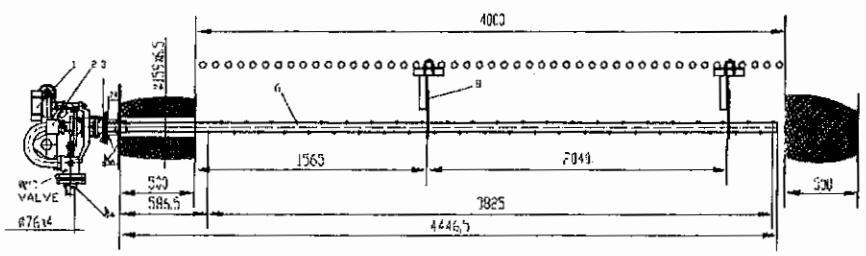
6.11.3 Location of superheater sootblowers

The below 3D model of the boiler shows the opening between the superheaters where the sootblowers are installed. Because of the relatively high width of the boiler (approx. 10m) soot blowers are installed on both sides of the boiler covering approximately 5m each. This gives in total 8 retractable sootblowers.



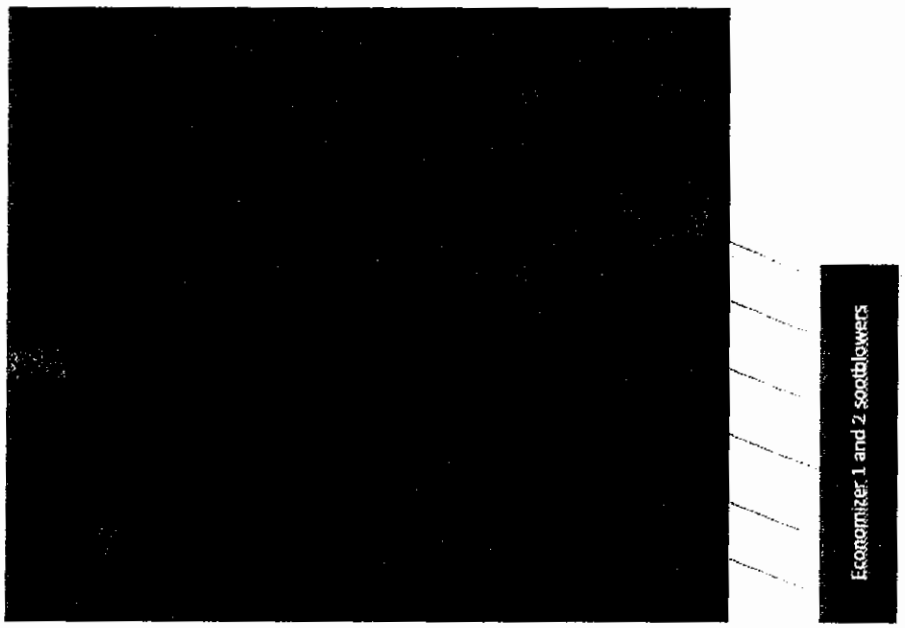
6.11.4 Economizer 1 and 2 sootblowers

In front of each of the economizer sections two rotating sootblowers are installed. The sootblower lances are equipped with steam nozzles for each 50-70mm and when rotating steam jets from each nozzle are cleaning the economizer tubes. The sootblower lances are permanently installed inside the flue gas flow.



6.11.5 Location of economizer sootblowers

The below 3D model of the boiler shows the location of the economizer sootblowers. Before each economizer section two sootblowers are installed. This gives in total 20 sootblowers.



6.11.6 Sootblower steam supply

The steam for the sootblowing is supplied from the main steam line from the new biomass boiler. The steam data must be around 14-15 bar(a) and 200-220°C i.e. slightly superheated to avoid water droplet in the steam that would damage the boiler tubes and cause boiler leaks.

6.12 Blow Down and Drain

Operation and maintenance instructions for this system is described in the O&M manual section 2.9.

6.13 Cooling Water

Operation and maintenance instructions for this system is described in the O&M manual section 2.8.

6.14 Chemical dosing and water-steam chemistry

This chapter contains general recommendations regarding the chemical dosing and water/steam chemistry on a typical steam boiler.

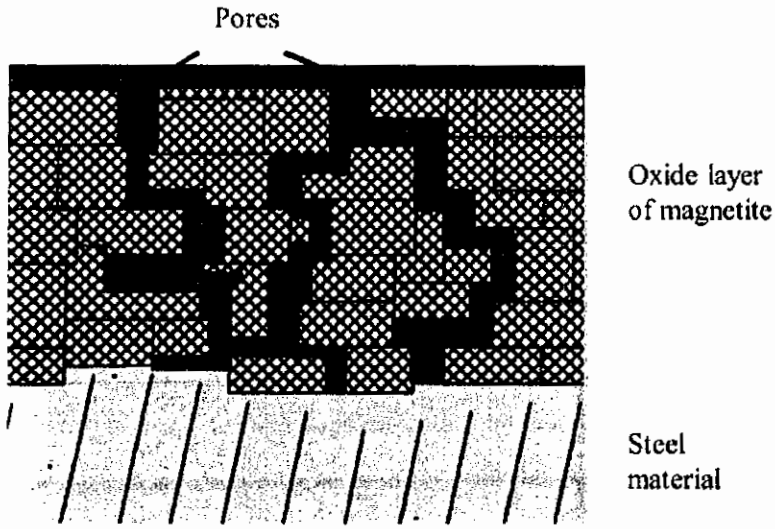
Operation and maintenance instructions for this system is described in the O&M manual section 2.1 and section 2.23.

6.14.1 Purpose of chemical dosing and surveillance of water purity

Steel materials are not stable under the conditions that rules in the water-steam system of a boiler. If ordinary water was applied in the boiler without further action, corrosion would run wild, soon the boiler tubes would start to leak, and valves and nozzles would be filled with corrosion products and become unable to function. The main tools to avoid this and maintain good stability and integrity of the boiler components are:

- Applying only make-up water of good quality, i.e. essentially pure without contents of dissolved solids (salts) or other contaminants,
- Controlling the chemical environment by feed water and boiler water conditioning, i.e. addition of the right chemicals in proper concentrations.

With high purity water in feed water and boiler systems and a suitable pH from the conditioning chemicals, a protecting layer of magnetite, Fe_3O_4 - an iron oxide, forms and covers the steel surfaces as shown on the figure below. The crystals of magnetite build a relatively tight layer on top of the basic steel material, but do not seal it completely. Pores of micrometer size remain and allows the passage of water and solutes (or steam) to the steel surface. Thus, the reactions between water and the steel material continue, although much slower than in the initial stage when the boiler is first commissioned. If salts are present in the water, the chemical processes change character, and corrosion accelerates and attacks the material much more locally. This means that the corrosion changes from a surface corrosion that forms the protecting layer to e.g. pitting that digs deep in the material and may continue all the way through and thus create a leak. These considerations show the importance of maintaining the proper water chemistry – otherwise, the boiler will operate with frequent damages that force shutdown and repair and increase maintenance costs.



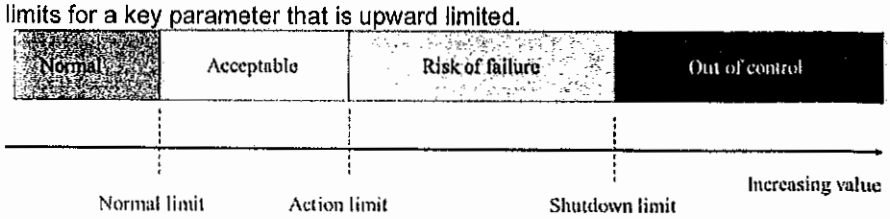
Schematic picture of a protecting layer of iron oxide on top of a steel surface.

Adding ammonia and hydrazine to the feed water controls the chemical environment of feed water, steam and condensate and defines the pH and the oxygen content near the steel surfaces. pH and oxygen content are the two most important parameters controlling the continuous formation of magnetite and thus the maintenance of the protective layer on the steel surfaces. Ammonia is primarily responsible for the pH control of the feed water but does not give sufficiently robust control of pH in the boiler water. Ammonia is very volatile; in the drum, where boiling water and saturated steam equilibrate, most of the ammonia leaves with the steam, and only 10-20 % remains in the boiler water. This lowers the pH and makes it easier for acid contaminants, which concentrate in the boiler water, to bring the conditions in the evaporator out of order and into the corrosive regime. Adding tri-sodium-phosphate to the boiler water eliminates this risk, increases the pH to a favorable value, and brings about a robustness towards acidic contaminants.

High purity is achieved by applying make-up water of high quality, i.e. always within the specifications, and by monitoring signs of contamination. Acidic conductivity, i.e. conductivity measured after a sample cation filter, is the on-line measure of the purity of water and steam. The cation filter removes the conditioning agents, i.e. ammonia and hydrazine, and thereby their contribution to conductivity. Additionally, the cation filter converts contaminants like chloride and sulfate from the salt form to the corresponding acids, which means that the conductivity is enhanced by a factor of roughly 3.5. Removing the background conductivity from the conditioning agents and enhancing the signals from the contaminants give a sensitive measure of contaminant levels. However, if acidic conductivity is increased, only chemical analysis of grab samples may disclose which contaminants are responsible – this does the conductivity not tell. Whenever a contamination occurs, the operators must take the proper actions to find and eliminate the source and to remedy the negative effects on the boiler.

Action levels keep focus on the most important operational parameters, called **key parameters**, and on maintaining the proper conditions in the water-steam system. The action levels divide the ranges of the key parameters in regimes according to

the risk of failure. The following figure shows the regimes and the corresponding limits for a key parameter that is upward limited.



Operational regimes according to risk of failure and the associated limits.

The relevant limits are:

- **Normal limit** – this distinguishes between optimal operation and an acceptable regime where the risk of failure is only slightly increased.
- **Action limit** – above the action limit, the risk of failure is increased, and operation here over longer periods is not recommended. The operating personnel must initiate actions to find the causes of the disturbance and to remedy the situation as soon as possible.
- **Shutdown limit** – in this regime the chemistry is out of control, and there is a high risk of immediate failure of main components of the system. Unless immediate actions can bring the situation under control, the boiler should be stopped to avoid serious failure.

Key parameters may be both downward and upward limited. In this case, the normal regime is bounded in both directions of action and shutdown limits. Key parameters are monitored on-line so that the values are available in real time.

The other chemical parameters – the so-called diagnostic parameters – are also important, but they have no direct influence on the operation of the boiler, i.e. no shutdown limit is defined for those.

The following table gives an overview of the chemical parameters and the relevance of them.

Overview table of chemistry parameters

Parameter	Symbol	Unit	Description
Specific conductivity	SC	µS/cm	Indirect measure of phosphate in boiler water. Increases in boiler water, if salt contamination occurs. It is a key parameter in boiler water.
Acid conductivity	AC	µS/cm	Measure of the purity of feed water, steam and condensate. AC is a key parameter in feed water and steam.
pH-value	pH	-	Measure of the strength of acids (pH < 7) and bases (pH > 7) in water. To maintain a proper oxide film on steel surfaces, pH must be maintained at basic values, i.e. pH > 9. pH <7 is detrimental to the protective layer and must be avoided. pH is a key parameter in feed water and boiler water.

Parameter	Symbol	Unit	Description
Dissolved oxygen	DO	µg/kg	Oxygen is an oxidant that reacts readily with steel and magnetite. To maintain a proper protecting film of magnetite the oxygen level should be kept at the low µg/kg-level. It is a key parameter in feed water and steam
Ammonia	NH_3	mg/kg	Ammonia is the conditioning agent of feed water that is responsible for the correct pH in feed water, steam and condensate. It is dosed to the feed water to obtain pH 9.4.
Hydrazine	N_2H_4	mg/kg	Hydrazine is an oxygen scavenger that reduces oxygen in condensate and feed water and keeps the level in the low µg/kg-range.
Phosphate	Na_3PO_4	mg/kg	Phosphate is the conditioning agent of boiler water that is responsible for correct pH in boiler water. It is dosed to the boiler water to obtain a pH above 9.
Sodium	Na	µg/kg	Sodium is added together with phosphate to boiler water. Minute fractions may be carried with the saturated steam into the superheaters. Here, it deposits and may harm the materials by stress corrosion later.
Iron	Fe	µg/kg	Total iron is a measure of the corrosion products formed in condensate, feed water, and boiler water. It is measured on a regular basis to check that the conditioning is working properly.
Silica	SiO_2	µg/kg	Silica is a contaminant that concentrate in the boiler water but also goes with the steam to some degree. From the steam, it deposits on the turbine and may give operational problems later on.

6.14.2 Sampling system and monitored parameters

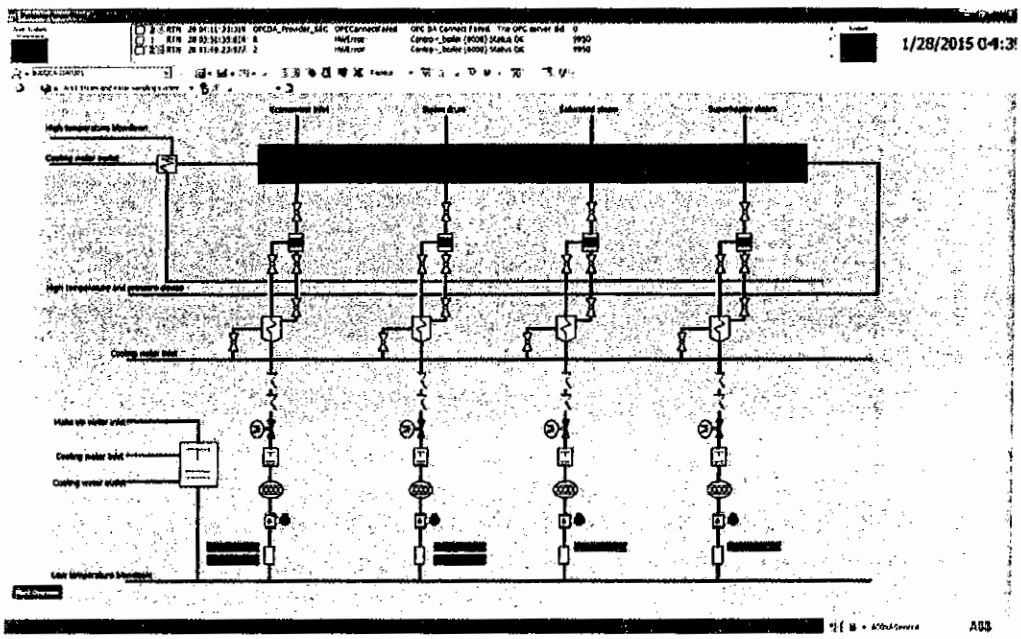
The following table shows the sampling points and the parameters measured on-line.

Table of sampling points and on-line parameters

Parameter	Measured	Eco Inlet	Drum	Sat. steam	Sup. steam
SC	On-line		X		
AC	On-line	X		X	X

pH	On-line	X	X		
DO	On-line	X			
NH_3, N_2H_4, Na_3PO_4, Na, Fe, SiO_2	Manually on grab samples	NH_3, N_2H_4, Fe	PO_4, Fe	Na	SiO_2, Fe

All sampling points are connected to the sampling rack where the key parameters are measured on-line and manual samples are taken. The below figure shows the sampling rack and the measurements as they are displayed in the DCS. The manual sample lines are omitted from the figure.

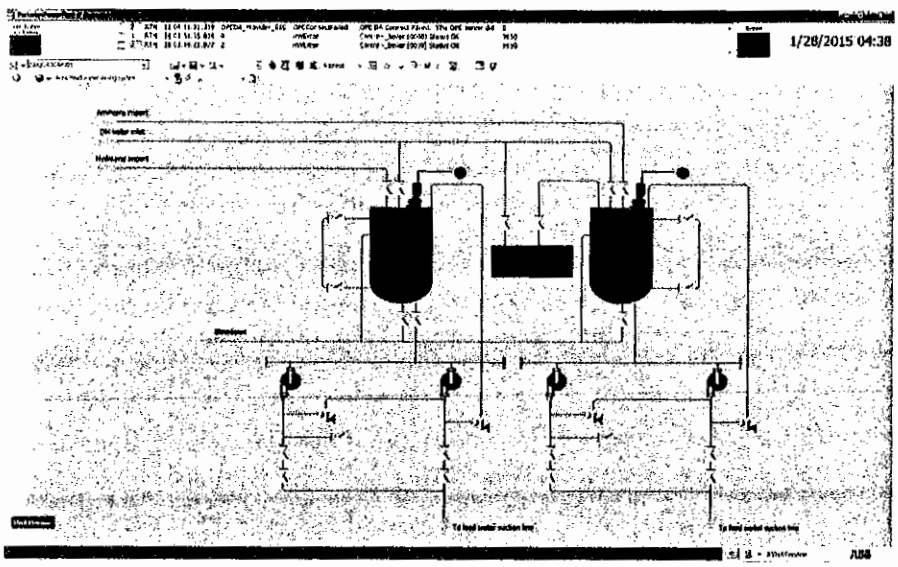


Sampling rack and on-line measurements. ***Note, the figure is in error and must be updated for the final version.***

The regulating valves displayed in the figure are used to adjust the flow to the on-line monitors to a suitable rate, typically 0.25-1 L/min. The manual sampling lines are normally closed when not in use. Ahead of sampling they must be opened fully for 10 min to flush deposited iron oxides thoroughly out, then the flow is adjusted to about 1 L/min. The sample is taken after further 15 min to allow the conditions of the sampling line to stabilize.

6.14.3 Conditioning of feed water and boiler water

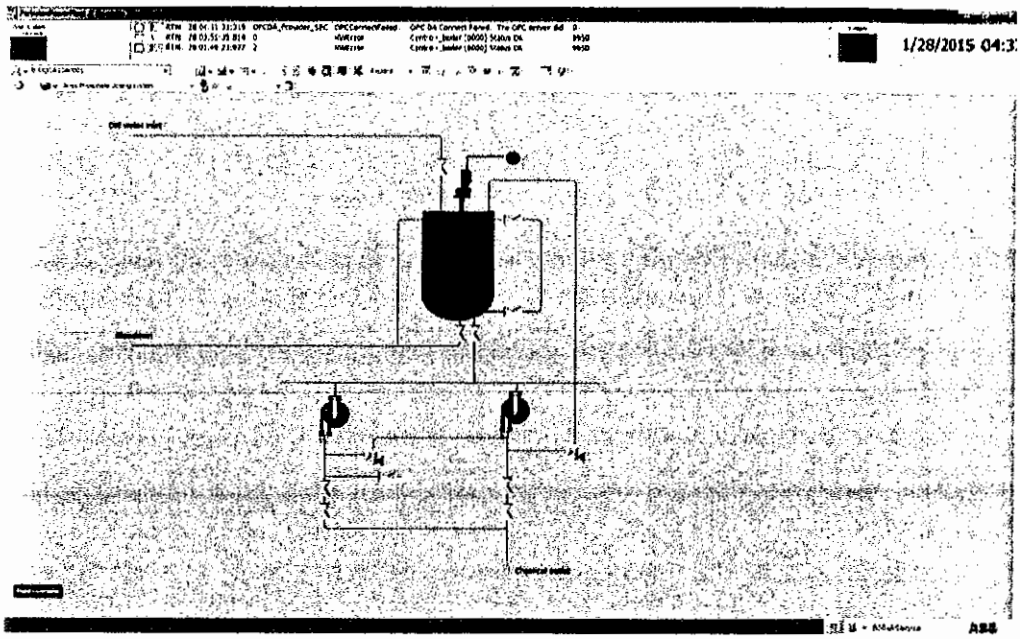
Conditioning of feed water is performed by dosing ammonia and hydrazine after the feed water tank. Both chemicals are dosed from storage tanks with diluted chemicals as shown in the below figure.



Storage tanks and dosing pumps for ammonia and hydrazine

Concentrated solutions of the two chemicals may be pumped into the storage tanks and diluted on site by addition of demineralized water (DM water). The diluted solutions are dosed to the feed water according to the make-up water added and the loss from evacuation in the condenser and in the deaerator. This may be done by running the dosing pumps parallel with the make-up water pump. Besides this, a manual dosing is available. Ideally, the operator should initiate the dosing action manually, whenever needed, and the DCS should turn it off automatically after a certain dosing time. This avoids incidents of overdosing, because something else is happening and the operator forgets to stop the dosing.

Conditioning of the boiler water is done by dosing tri-sodium-phosphate to a downcomer or the drum. Note, that only the content of the phosphate ion is specified and measured. The stock solution is made up in a storage tank as shown in the below figure. Here, the basic chemical is added as a powder and diluted with DM water. The diluted solution is dosed by means of the two dosing pumps shown in the figure. Again, the operator should initiate the dosing manually, and the DCS should stop it automatically after a certain dosing time. Dosing is initiated whenever pH drops below the lower limit of the normal range. This typically happens after a blowdown of the boiler. The need for blowdown is indicated whenever the conductivity or the content of silica in the boiler water increase above the upper limit of the normal range.



Storage tank and dosing pump for tri-sodium-phosphate.

Below table shows the normal ranges of the conditioning chemicals that the operating personnel should observe.

Normal ranges for dosing chemicals (key parameters: yellow background)

Parameter	Sample	Unit	N-lower	N-upper
pH	Feed water	-	9.3	9.5
SC	Feed water	µS/cm	5.4	8.7
NH_3	Feed water	mg/kg	0.7	1.5
DO	Feed water	mg/kg		0.010
N_2H_4	Feed water	mg/kg	0.01	0.05
pH	Boiler water	-	9.1	9.5
SC	Boiler water	µS/cm		8
PO_4	Boiler water	mg/kg	2	3

Specific conductivity in feed water should be measured on-site at the sample rack by means of a portable conductivity meter, ammonia and hydrazine are analysed on grab samples. Phosphate in boiler water is analysed likewise on grab samples. The lab analyses should be conducted with regular intervals.

6.14.4 Purity of water and steam

The purity of water and steam are supervised by means of acidic conductivity on-line and a range of laboratory analyses as shown in below table.

Normal ranges for purity indicators (key parameters: yellow background)

Parameter	Sample	Unit	N-lower	N-upper
AC	Feed water	µS/cm		0.2
Na	Feed water	µS/cm		0.002
Fe	Feed water	mg/kg		0.020
SiO_2	Feed water	mg/kg		0.020
Fe	Boiler water	mg/kg		0.100
SiO_2	Boiler water	mg/kg		1.0
AC	Sat. steam	µS/cm		0.2
Na	Sat. steam	µS/cm		0.002
AC	Sup. steam	µS/cm		0.2
Fe	Sup. steam	mg/kg		0.010
SiO_2	Sup. steam	mg/kg		0.020

The measurement of acidic conductivity is performed on-line; the remaining parameters are measured on grab samples. This should be done regularly to keep track of the chemical conditions of the water-steam cycle.

6.14.5 Guiding values for monitored and analysed parameters

The two following tables summarise the action levels for the parameters that specify conditioning and purity. For clarity all on-line measurements are shown in the first and all laboratory analyses in the second

Action levels for on-line parameters (key parameters: yellow background)

Parameter	Unit	Shutdown	Action	Normal	Normal	Action	Shutdown
Feed water							
AC	µS/cm				0.2	ND	ND
pH	-	ND	ND	9.3	9.5	ND	ND
DO	mg/kg				0.010	ND	
Boiler water							
SC	µS/cm				8	ND	
pH	-	ND	ND	9.1	9.5	ND	ND
Sat. steam							
AC	µS/cm				0.2	ND	ND
Sup. steam							
AC	µS/cm				0.2	ND	ND

ND: Not defined yet.

Action levels for laboratory parameters

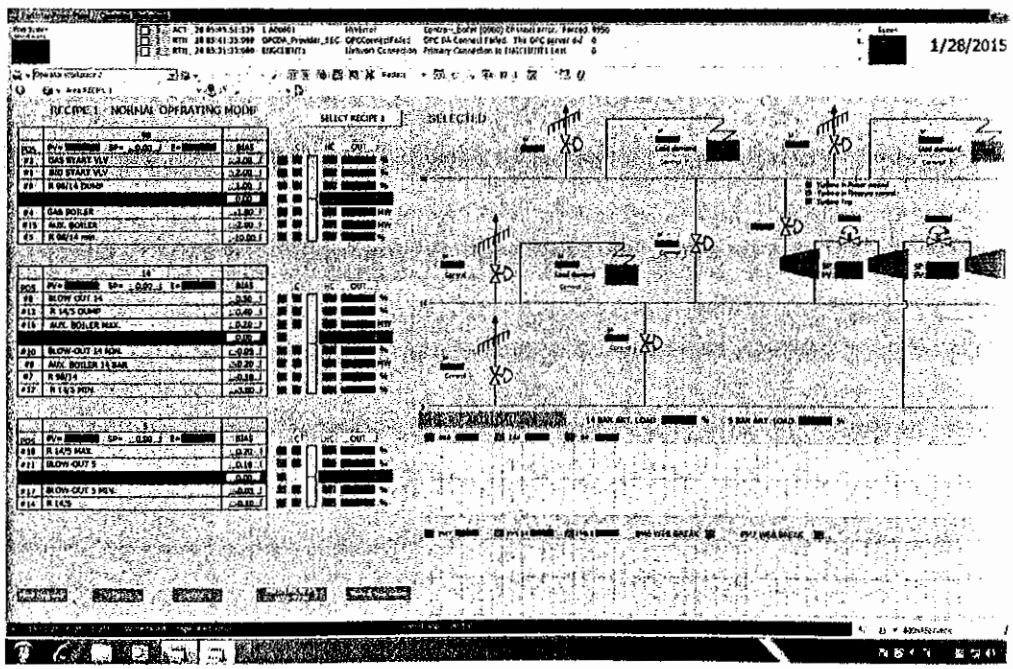
Parameter	Unit	Shutdown	Action	Normal	Normal	Action	Shutdown
Feed water							
SC	µS/cm		ND	5.4	8.7	ND	
NH_3	mg/kg		ND	0.7	1.5	ND	
N_2H_4	mg/kg		ND	0.01	0.05	ND	
Na	mg/kg				0.002	ND	
Fe	mg/kg				0.020	ND	
SiO_2	mg/kg				0.020	ND	
Boiler water							
PO_4	mg/kg		ND	2	3	ND	
Fe	mg/kg				0,100	ND	
SiO_2	mg/kg				1.0	ND	
Sat. steam							
Na	mg/kg				0.002	ND	
Sup. steam							
Fe	mg/kg				0.010	ND	
SiO_2	mg/kg				0.020	ND	

ND: Not defined yet.

With these two tables at hand, the chemical conditions of the water-steam cycle are easily overviewed and checked.

6.15 Steam-net System

Recipe 1 operating display:



The following features can be found on the display. In left, there are three fields for displaying all the 98, 14 and 5 bar pressure header controllers in order of activation. In right top corner there is a display for the overview of the whole steam-net, and in right bottom corner there are the three header pressure signal trend curves, and three PM flow signal trend curves indicating the status of the biggest disturbance sources.

The green lines in the middle of each pressure net field represent the main controller of the pressure level. On the left are the position numbers of the controllers, further to the right the controller description, controller Bias values, controller status lights (active/inactive), controller modes A/M, auto-hand station modes A/M and hand station outputs.

On the upper part there are three values: the first on the left shows the actual pressure in the corresponding header, the second in the middle is the pressure setpoint for the header and the third on the right is the calculated difference between the two previous values. Abbreviations used here are:

PV = measured value of process variable

SP = setpoint

E = error (control difference)

For each pressure level there is also a red pressure deviation column, which indicates the error (control difference) in corresponding header.

Function

When the system is in balance, the red pressure deviation column is actually a thin red line at the same level as the controller in green field. In that case the deviation is zero, which means that the header pressure is at the setpoint. The controller in the green field always must have a zero Bias-value, which means that this controller is always trying to maintain the pressure in the header at the given setpoint value. All other controllers upwards have ascending Bias-values, and the ones under the green line have descending Bias-values.

Should a pressure rise take place in the steam header, the red column would grow upwards and show the operator the magnitude of the pressure measurement difference from the given setpoint value. As the pressure rises and the pressure difference rises above the first supporting controller's Bias-value, the status light of the controller changes from grey to green when the controller becomes active. (Note! The status light is lit only if the controller can have an effect on the valve position. A scenario is possible, where a controller would want to control a valve, but a different controller is currently in charge instead. The status light of the controller in charge indicates which of the controllers is actually controlling the valve.)

For example, should the pressure difference rise at 98 bar(g) header above the Bias-value of controller #3 of Gas boiler start valve, it would mean that all the

controllers between that and the green line would try to take part in the control simultaneously, which is displayed by the status lights. This means further that the maximum control capacity is always tried to use in order to keep the header pressure as stable as possible.

When the pressure then starts to drop, the status light of the controller on top (#3) will turn off first. The others (#1 and #6) will follow until the pressure is back in balance. Then the controller in the green line (#2) remains and takes care of the control. The same happens if the pressure drops in the net, except that the pressure column grows downwards and the controllers below the green line are then activated in the correct order.

Operation

The recipe selection is executed from the recipe displays. In case operator wants to select a different recipe, the recipe display of the desired recipe must be opened, and the recipe must be selected from the "Select Recipe X" pushbutton. In case operator has a recipe display open, but this recipe is not selected, the "Select Recipe X" pushbutton will blink red. Once operator selects the recipe, the blinking stops and the text "Selected" appears next to the recipe selection pushbutton. Operatos should always keep the selected recipe display open in one of the operating screens.

The setpoints (SP) for the 98, 14 and 5 bar headers are given from the recipe display by clicking the SP-values from the operating display. The individual controller setpoints are calculated by adding the main SP value and the individual Bias-value, and the result will then be the setpoint of a controller. Please note that the Bias-value may be positive or negative.

The Bias-values for the controllers can be given by clicking the Bias-values from the operating display. The operator can change the Bias-values from the controller display if needed. This is the case, if for example, a process unit is taken out of use and the remaining controllers Bias-values should be moved closer to the zero, or if operator wants to disable one of the controllers, and therefore would need to give a very large positive (or negative, depending on whether the controller is above or below the green line) Bias-value in order to make sure the controller will never become active.

It should be noted that the Bias-values are adjusted during the start-up and tuning phase, and these Bias-values will then be set as the "Default Bias-values". The Default Bias-values remain in the system memory, and can be changed only by authorized persons. The Bias-values of each controller in the recipe can always be reset back to default values from the "Default Bias values" display.

Operators may select the valve control modes from Auto to Manual. The modes can be changed by clicking the mode from the pressure net fields (below the "HC" indicator) or by clicking the mode from the steam-net overview display.

When mode is in Auto, the steam-net control concept will control the valve, and when the mode is in Manual, operator will be in control of the valve. It should be

noted, that in case even one of the valves is on Manual mode, the steam-net control concept will not function optimally. It is therefore recommended to keep all the valves in Auto mode during normal operation, and only operate the valves on Manual in case there is something wrong, e.g. a valve must be shut down for maintenance.

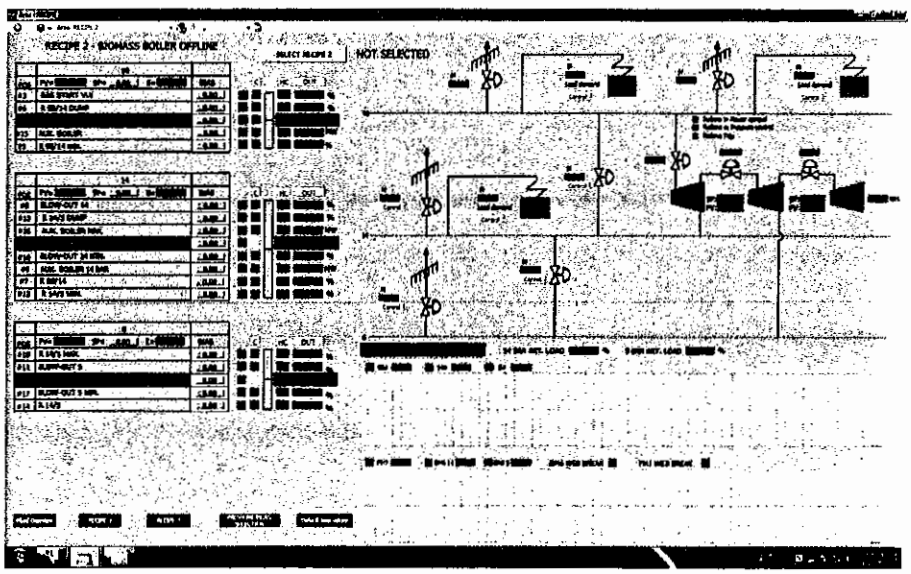
The steam-net overview display shows the simplified flow diagram of the steam-net. The outputs of the hand stations, i.e. the valve openings, are displayed next to each valve, as well as the modes (Auto/Manual).

By clicking the "Control"-button of the valve, the hand station faceplate is opened. It shows the tracking between all the controllers connected to the particular valve. The selection of winning controller may also be observed here.

By clicking the light blue "ART LOAD" pushbutton below the steam-net overview display, the artificial load operating screen will be opened. The artificial load operation will be executed from this display.

By clicking the "Pressure Meas. Selection", the header pressure selection display will be opened. The pressure measurement logic and pressure measurement selection can be executed from this display.

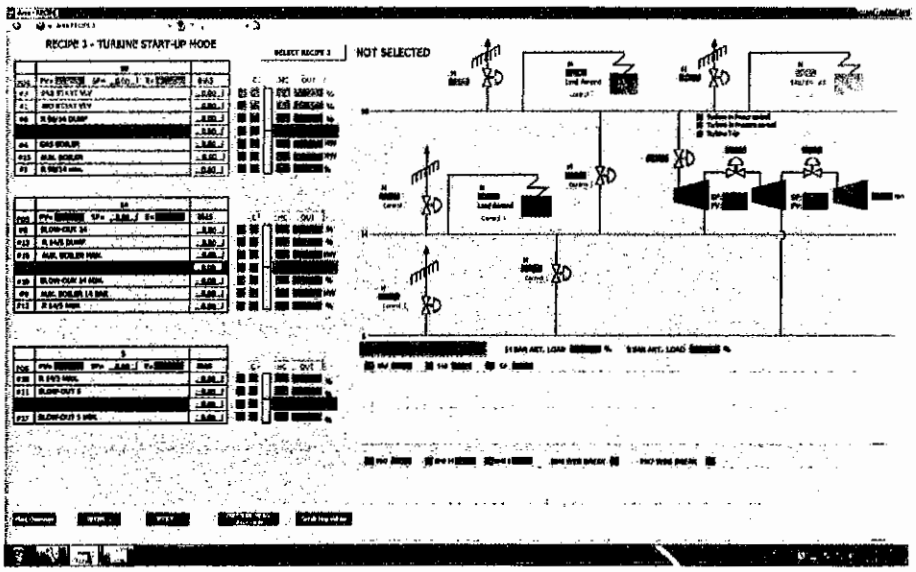
Recipe 2 operating display:



This recipe is to be selected when the biomass boiler is off-line. Operator must then open this recipe display, and push the "SELECT RECIPE 2" pushbutton. Once recipe 2 is selected, the red "NOT SELECTED" text will change to green "SELECTED", and the recipe name will change green.

Once the biomass boiler is started up and ready for pressure control, operator must go to recipe 1 display, and select the recipe 1.

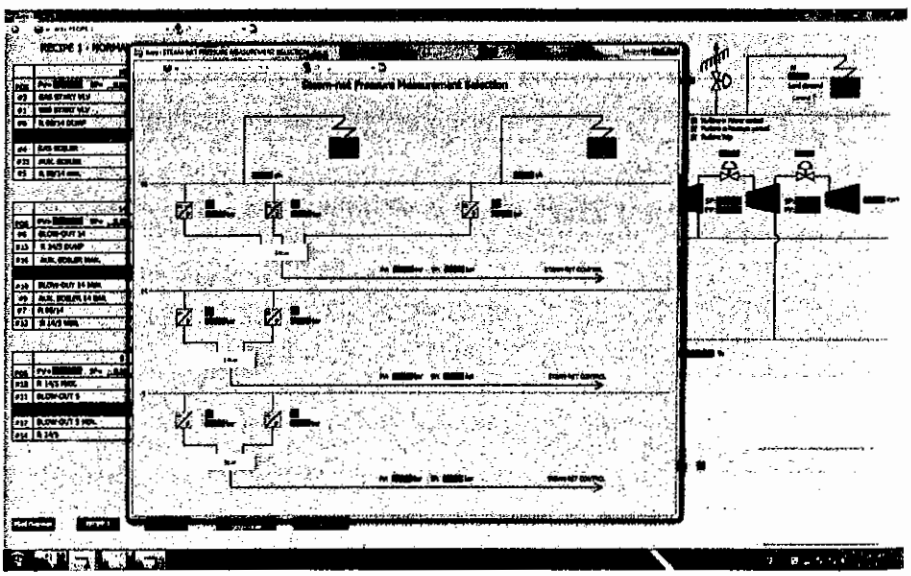
Recipe 3 operating display:



This recipe is to be selected when the turbine is being started or if the power plant is operated without turbine (with connection to power grid). Operator must then open this recipe display, and push the "SELECT RECIPE 3" pushbutton. Once recipe 3 is selected, the red "NOT SELECTED" text will change to green "SELECTED", and the recipe name will change green.

Once the turbine is started up and it is on island control, operator must go to recipe 1 display, and select the recipe 1.

Pressure measurement selection display:

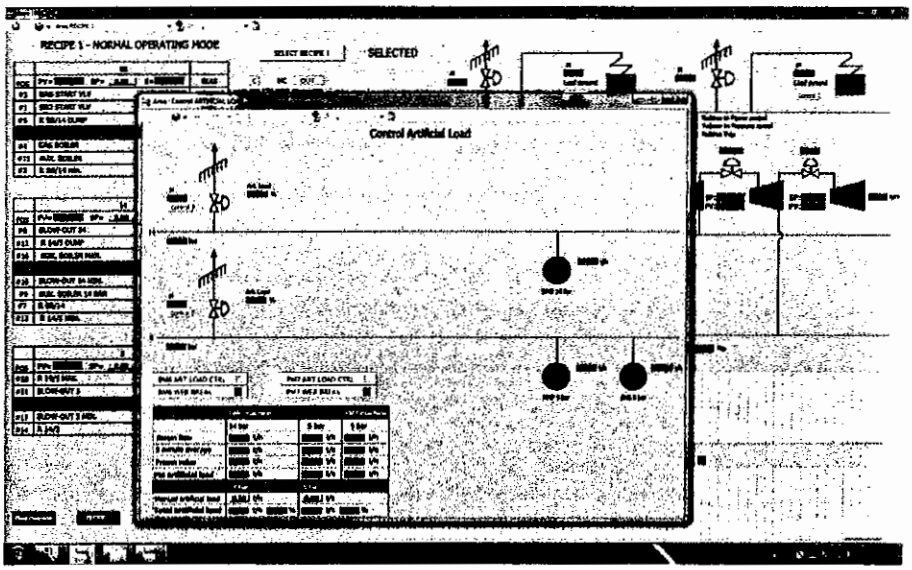


This display can be opened from any of the recipe displays from the pushbutton "PRESSURE MEAS. SELECTION".

From this display, the operator can choose which pressure measurement is used for each pressure levels by clicking the white pushbutton with the pressure level name.

In case one of the pressure measurement signals is giving a faulty measurement, operator is not able to select that measurement for pressure control. In case the selected pressure measurement goes bad, there is an automated logic which will automatically switch to use the back-up measurement.

Artificial load display:



This display can be opened from any of the recipe displays from the pushbutton "ART. LOAD".

From this display, the operator may switch on the artificial load logic, which opens the vent valves from 14 and 5 bar in case paper machine has a web break. The artificial load logic calculates the amount of which the paper machine steam flow decreases during a web break situation, and then opens the vent valves automatically to release similar amount of steam to the atmosphere. This way the boiler load is not decreased, and once paper machine re-starts, the steam can be lead back to the paper machine by closing the vent valves: the artificial load logic will do this automatically.

Operator may individually switch on or off paper machines BM6 and PM7 from the artificial load logic. In case a paper machine goes off-line for a long period of time e.g. during maintenance, it is recommended to switch the paper machine off from the artificial load logic.

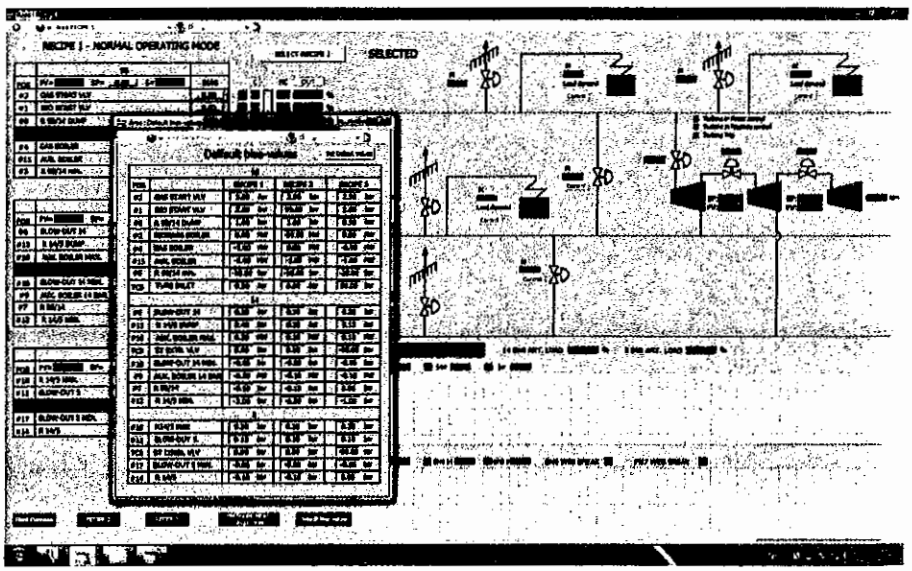
Operator can observe the paper machine steam flows, and how they change during a web break. The deviation between the steam flow before the web break, and the actual flow during the break, will give the amount of steam flow needed to

be vented out. The vent valves will be opened to a certain position based on this steam flow value and the vent valve characteristic curve.

Operators also have possibility to give manual artificial load value for both of the vent valves. The "PM artificial load" and "Manual artificial load" will be summed up, and used as the "Total artificial load". The "Manual artificial load" may also be a negative value, should an operator want to decrease the amount of "Total artificial load".

Please note that even when the artificial load is giving a valve opening for the vent valves, the vent valve pressure controllers are always able to open the vent valve more, in case the header pressure picks up, or close the vent valves, in case the header pressure falls. Therefore it is recommended that operators use the "Manual artificial load" value if they want to give a signal for the vent valve to open up. If the valve is opened manually, the pressure controllers will not be able to open or close the vent valve if the header pressure starts to deviate too much from the header pressure setpoint.

Default bias-values display:

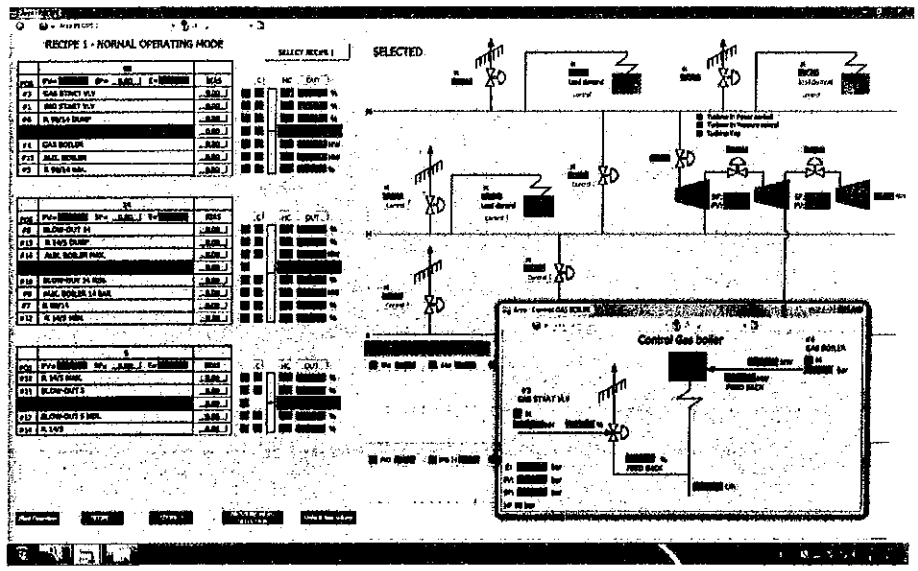


This display can be opened from any of the recipe displays from the pushbutton "Default bias-values".

From this display, operator can observe the default bias values of all controllers, for all the recipes. If operator manually changes the bias values, and he wants to change the values back but does not remember what the bias value was, operator may switch all the bias value back to default values from the "Set Default Values" push-button.

The default bias values will be set and tuned during the implementation of the steam-net control concept.

The gas boiler control display:

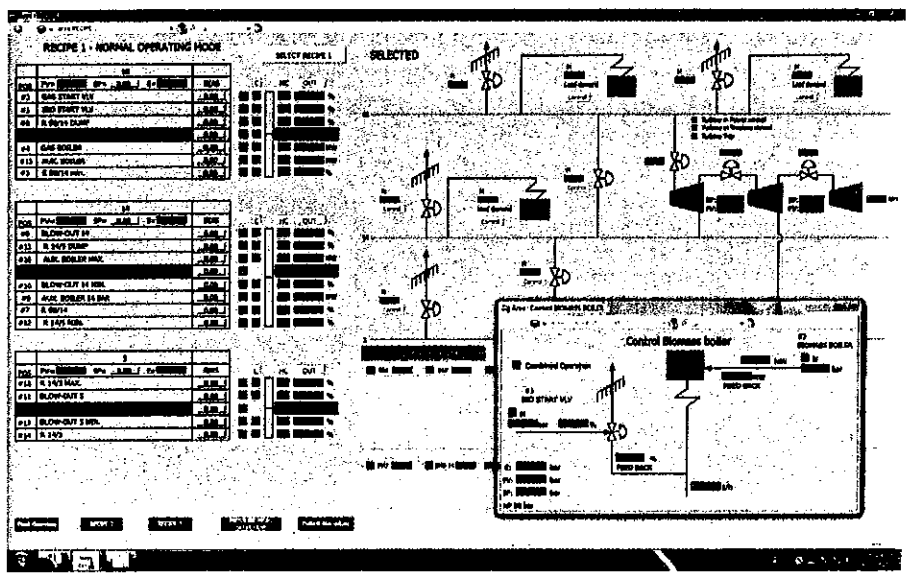


This pop-up is opened from the "Control" pushbutton, located in the steam-net overview display, near the Gas boiler.

From this display, operator may observe the load demand value sent for the gas boiler load control, and the feedback value which is given from the boiler control system.

Operator may also observe the gas boiler start-valve opening signal sent from the steam-net controls, and the feedback signal from the boiler control system. The start-valve may be opened by both the steam-net controller, as well as the gas boilers own start valve controller.

The biomass boiler control display:

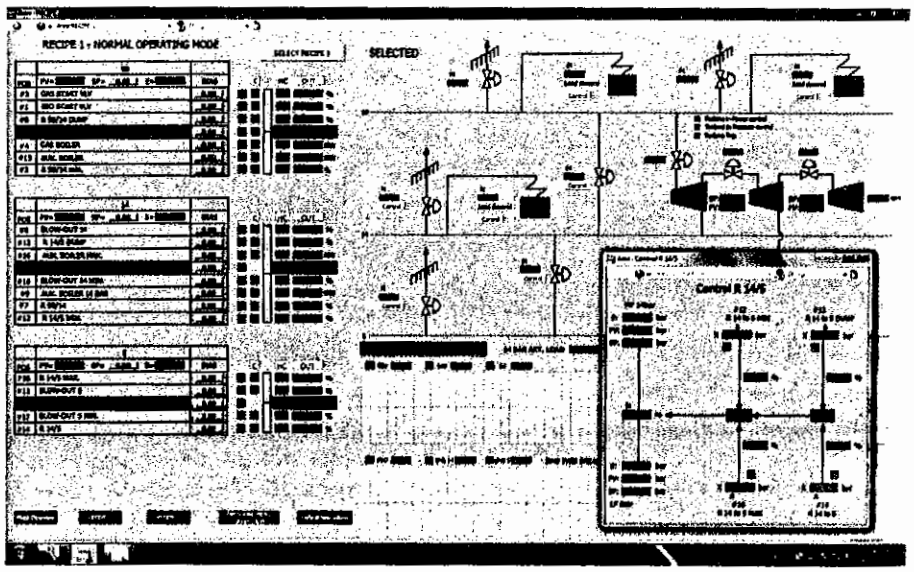


This pop-up is opened from the "Control" pushbutton, located in the steam-net overview display, near the Biomass boiler.

From this display, operator may observe the load demand value sent for the biomass boiler load control, and the feedback value which is given from the boiler control system.

Operator may also observe the biomass boiler start-valve opening signal sent from the steam-net controls, and the feedback signal from the boiler control system. The start-valve may be opened by both the steam-net controller, as well as the biomass boilers own start valve controller, when the "Combined Operation" signal is on. When the boiler is started up, and the boiler shut-off valve is closed, the "Combined Operation" is not possible: then only the start valve controller from the boiler control system is able to operate the vent valve.

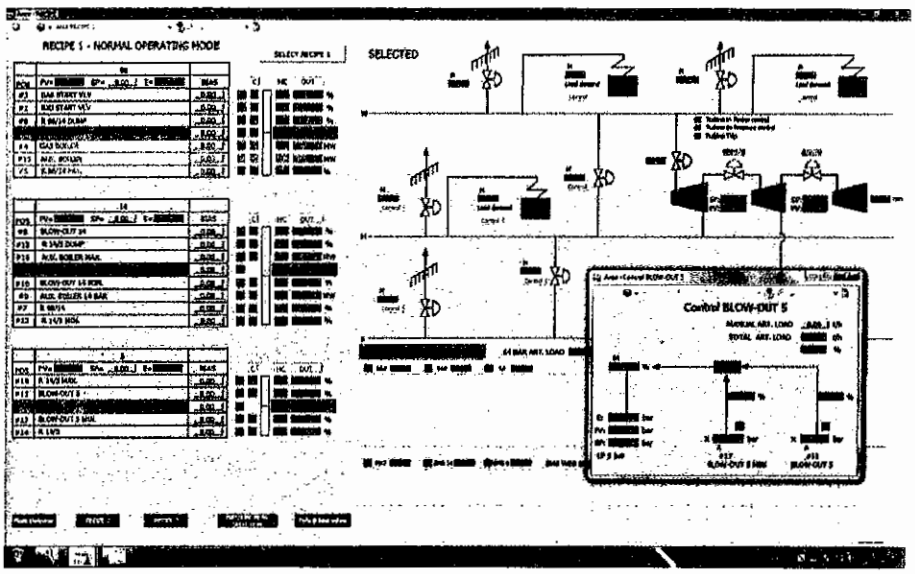
The reducing station control displays:



These pop-ups are opened from the "Control" pushbuttons, located in the steam-net overview display, near the reducing stations R98/14 and R14/5 (example screen display is from the R14/5).

From these displays, operators may observe the reducing station controller behaviours in more detail. All the pressure controllers that have a possibility to affect to the reducing station steam valve opening are visualized in the display. Each controller outputs and how they are selected in the maximum and minimum selectors are visualized as well.

The vent valve control displays:



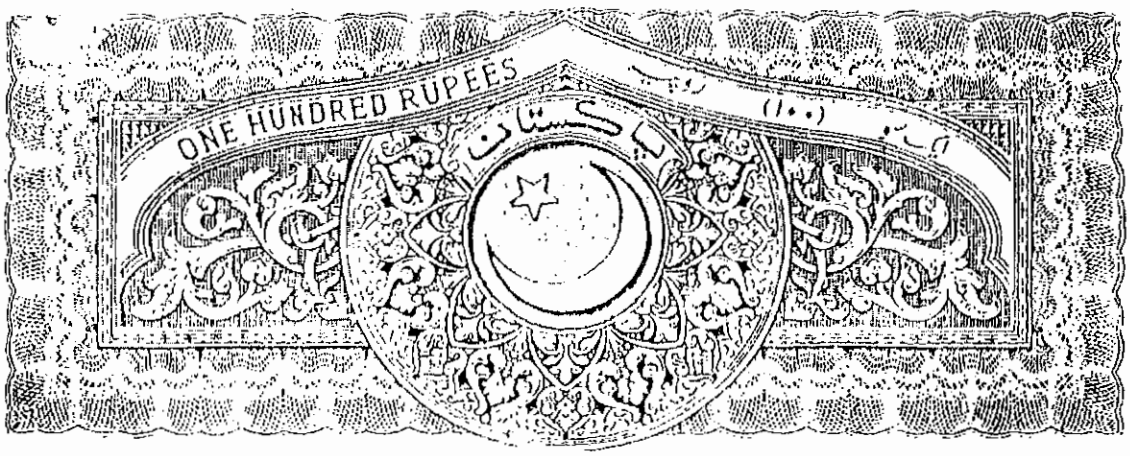
These pop-ups are opened from the "Control" pushbuttons, located in the steam-net overview display, near the 14 bar and 5 bar blow-out valves. (example screen display is from the 5 bar blow-out).

From these displays, operators may observe the blow-out controller behaviours in more detail. Both of the pressure controllers that have a possibility to affect to the reducing station steam valve opening are visualized in the display. The controller outputs and how they are selected in the minimum selector is visualized as well. Also the artificial load values related to each blow-out valves are visualized in the pop-up display, and operators may also give the manual artificial load value from these displays.

ANNEXURE O – AGREEMENT WITH SNGPL

MR. AMJAD ALI (OMS)
POWER PLANT

PAKISTAN 100 RS



Sui Northern Gas Pipelines Limited

CONTRACT FOR THE SUPPLY OF GAS FOR INDUSTRIAL USE & CO-GENERATION

BY THIS CONTRACT, made between SUI NORTHERN GAS PIPELINES LIMITED (hereinafter referred to as the "Company"), and **PACKAGES LIMITED** having the status of Limited Company (hereinafter called the "**Consumer**"), the Consumer agrees to purchase from the Company and the Company agrees to supply to the Consumer **Twenty (20) MMCFD** of natural Gas on **Nine (9) months** (March to November) and **"As and when available"** basis at **PACKAGES LIMITED, CHAH ROAD, SINGHWALA, KOT RADHA KISHAN ROAD, DISTRICT KASUR** for Industrial usage & Co-generation from the 1st day of June 2007 upon the terms and conditions set forth hereinafter and upon the statutory terms and conditions (if any) for the time being in force at the current tariff for the time being in force both for the Gas consumed and for hire of the meter particulars whereof as at the date hereof are set out below:-

TERMS AND CONDITIONS

1. DEPOSIT

1.1 Immediately upon the execution of this agreement by the Consumer, the Consumer shall pay to the Company a sum of Rs. **308.240 Millions** in Cash equivalent to two (2) months estimated Gas consumption or furnish a Bank Guarantee of **Rs. 462.359 Millions** issued by any scheduled Bank in Pakistan, in accordance with the enclosed proforma, equivalent to three (3) months estimated Gas consumption as security deposit for the performance of its obligation.

1.2 If subsequent to the execution of this agreement by the Consumer and the Company:-

(a) the Consumer shall desire installation of additional burner equipment entailing increase in consumption of Gas by the Consumer or the usual consumption of Gas by the Consumer shall be otherwise increased,

(b) or the price of Gas or rent for the meter shall be increased in

(c) or any new tax or charge shall be levied on Gas by any Government or local or other authority or any such tax or charge already levied on Gas shall be increased,

Then in addition to the sum mentioned in sub-clause 1.1 above, the Company shall have the right to demand from the Consumer and the Consumer shall pay

the Company such amount in Cash or furnish a Bank Guarantee in lieu of this amount from any scheduled Bank in Pakistan, in accordance with the enclosed proforma, on account of additional deposits as the Company may deem necessary or expedient. Provided the total amount required to be deposited under sub-clause 1.1 and 1.2 of this clause shall not exceed the amount which, according to the estimate that the Company may from time to time make, the Consumer may have to pay to the Company under this agreement on account of probable consumption of Gas in three months together with taxes and charges payable thereon and three months rent for the meter.

1.3 The security deposit if in cash is a security to be retained by the Company for the duration of this Contract and the Company may at its option use the security deposit for the purposes of the Company from time to time. The Company shall be entitled to set off from the amount of security deposit any amounts due from the Consumer to the Company on any account whatever. No connection for Gas being supplied hereunder will be activated or maintained in the absence of the Consumer paying the appropriate prevailing security deposit to the Company or furnishing an appropriate bank guarantee for such amount as contemplated by this Clause 1.

2. PRICE

2.1 Subject to the provisions hereinafter made, the Consumer shall pay to the Company price for the Gas supplied to the Consumer and the minimum charges as notified by the Competent Authority from time to time under the Oil & Gas Regulatory Authority Ordinance, 2002 as modified, amended or altered in future or any substitution thereof. The minimum charges shall be payable by the Consumer to the Company from the date of installation of Gas meter irrespective of the quantity of Gas used by the Consumer

Date of Meter Installation_____

3. TAKE OR PAY

3.1 From the commencement of the gas operations date and during the term of this Contract, the Consumer shall take a minimum specified quantity of Gas per Month i.e equal to 50% of the gas delivery for each contract month (the "Take or Pay Quantity"), on 9 months basis (March to November), failing which the Consumer shall in any event pay for the specified quantity of gas not taken by it for any reason whatsoever.

3.2 The delivery of gas during any month can be partially reduced or totally prevented for the reason that operation of the delivery of specified quantity of gas at the delivery point has been interrupted or curtailed during a particular period by virtue of clause 17, 18 & 19 of this contract, experienced by Company for which Company shall not be liable to pay any compensation. However, the gas delivery, if not taken by the Consumer, on account of maintenance or for any other reason

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whatsoever, it is incumbent upon the Consumer to pay for such quantity of gas, the delivery of which may not be taken.

4. METER RENT

4.1 The Consumer shall also pay to the Company rent of the meter at the rate of Rs. 1600.00 per month, or as fixed by the Company from time to time, from the date on which the meter is fixed upto the date when the same shall be removed by the Company at the written request of the Consumer provided if the quantity of Gas consumption necessitated replacement of meter by a meter of different size, the Consumer shall pay rent of the new meter at the rate prescribed by the Company for such meter.

5. OTHER CHARGES

5.1 In addition to the price of Gas and meter rent, the Consumer shall also pay to the Company all taxes or charges levied on Gas by any Government or Local or other authority or any increase in the rate or charges of Gas by the Producers/Purifiers of Gas.

5.2 The Consumer shall be entitled to service of houseline /appliances etc., upon payment of the service charge prevailing from time to time.

6. MEASUREMENTS

6.1 The unit of volumetric measurement shall be one cubic foot of Gas at absolute pressure of 14.65 pounds per square inch and temperature of 60 degree Fahrenheit (or their equivalent in measure) without adjustment for water vapour content and required correction factors such as pressure, flowing temperature, specific gravity, deviations from Boyle's Law, expansion and Reynold's number shall be applied. The value of atmospheric pressure for calculating the pressure factor shall be 14.65 pounds per square inch and the value of acceleration due to gravity shall be 32.17 feet per second per second. The Gas delivered hereunder shall be measured in accordance with methods in use in the industry generally and recommended by the Gas Measurement Committee of the Natural Gas Department of the American Gas Association, applied in a practical manner.

6.2 The unit of measurement for the purpose of billing shall be MMBTU (Million British Thermal Units of heat) converted from volumetric recordings / registrations using standard conversion factors as per standard practices.

7. QUALITY AND PRESSURE SPECIFICATIONS

7.1 The Gas supplied under this Contract shall be predominantly methane with a gross heating value in the range of 880-950 BTU (British Thermal Unit) per

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standard cubic foot. However, during Annual Turn Around period of various Gas fields this heating value may change during that period.

7.2 The pressure of Gas to be supplied will be 35 psig (Pound per Square Inch Gauge)

8. GAS METER AND OTHER COMPANY'S PROPERTY

8.1 All pipes and fittings from the Gas Main to the property line will be provided by the Company and shall remain Company's property. All pipes and fittings on and within the property line will be provided by and at the expense of the Consumer, the Company not being responsible for leakage of Gas from, nor repairs to such pipes or fittings. The main cock service regulator and inlet pipe of meter and the meter then rented from the Company will be fixed and kept in repair by the Company free of charge. The Consumer shall be responsible for the safety of the meter as well as the service regulator, valves and the inlet pipe of the meter from theft, loss, damage, etc., during the existence of this Contract and since these are fitted for the purpose of ensuring continued Gas supply to the Consumer at their premises, they shall in case of any such eventuality, be responsible for payment of the price of such meter, regulator, relief valves, pipe etc., if replacements are required.

8.2 Company's meter, the registering index of the meter, pressure regulator(s), pressure recording gauge and meter by-pass valves shall be sealed by the Company's authorised representative(s) using Company's authorised seal in presence of the Consumer or their authorised representative. The Consumer will then be responsible to ensure that the Company's meter including recording equipment for pressure and temperature recording, regulators, relief valve, etc. is not tampered with and if any such tampering is found, it shall be at the sole liability of the Consumer. The Company's authorised representative shall check the meter in the presence of the Consumer's representative both of whom shall simultaneously sign the register maintained by the Company's representative in this respect, in token of inspection of the meter, its condition and the index number.

9. HOUSELINE INSTALLATION

9.1 All pipes and fittings on and within the property boundary wall and upto the Consumer Meter Station (CMS) shall be termed as "House Line". It shall be responsibility of the Consumer to ensure installation of "House Line", using materials and fittings in accordance with plan, technical specifications provided and approved by the Company.

9.2. The "House Line" mentioned as in 9.1 above shall be tested by the Company's representative to ensure its conformity to the technical specifications and design and is free from leaks. In case, it is observed that same is found to be deviating

from the above, all defects pointed out by the Company shall be rectified at the Consumer's cost to the fullest satisfaction of the Company.

10. METER INSTALLATION

10.1 The Gas meter shall be affixed by the Company at the property of the Consumer at the suggestion of the Consumer and if at any time the property boundary where the Gas meter is affixed turns out to be of some one other than the Consumer or if there is any objection to the affixing of the Gas meter by the owner of the property, the Company shall be at liberty to remove the Gas meter without notice to the Consumer and to disconnect the Gas supply till such time that alternate place is provided by the Consumer for affixing the Gas meter, which shall be entirely at the expense of the Consumer.

10.2 The Company shall retain the title and ownership of all regulators, meters, pipes, valves, devices and other appurtenances placed by it upon the said premises and may remove or replace the same at any time before or after the termination of the Contract.

11. FURTHER CONNECTIONS/ALTERATIONS

11.1 The Company shall have the right to provide further connections to other parties or premises from the outlet of the regulator installed for the purpose of supplying Gas to the above mentioned premises of the Consumer but the cost of any alteration in or addition to the pipes and fittings incidental thereto shall not be borne by the Consumer.

11.2 Alteration in or additions to Gas installations will be made only by the Company, but the Company, may in exceptional cases exercise its discretion to permit the Consumer to undertake alterations in or additions to the Gas installations. Such permission must be obtained in writing from the Company in advance.

12. METER INSPECTION

12.1 No meter is to be connected to or disconnected from the Company's pipe except by the authorised workmen of the Company. The meters are inspected periodically. The Company's authorised representative(s) shall have free access at all reasonable times to inspect, adjust or replace the meters or other fittings or appurtenances without let or hindrance.

13. METER REGISTER

13.1 The register of the meter maintained by the Company shall be prima facie evidence of the quantity of Gas consumed, but should the accuracy of the meter be officially tested and be found to register erroneously, the meter shall, if the

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period of inaccuracy is not known or ascertainable, be deemed to have registered erroneously to the degree so found for the last half of the period since the date of the previous meter test, provided that the period of adjustment shall not exceed 15 days. This clause shall not be applicable in case where the Consumer is found by the Company to have been responsible directly or indirectly in tampering with the Gas meter in any way whatsoever. In case the meter shall, for any cause whatsoever, cease or omit to register regularly the quantity of Gas used, the Consumer shall pay to the Company for the Gas supplied to them during the period the meter shall so remain out of order on the basis of average monthly consumption of Gas by the Consumer during the two months immediately preceding or following the months in which the meter so remained out of order, whichever is more

14. BILLING

14.1. The accounts will be furnished periodically. This period may be one month to three months depending on the current policy of the Company in this respect. Any change in this policy will be at the sole discretion of the Company but the Consumer will be duly notified at least 15 days in advance. The bills pertaining to Gas consumption based on the above accounts are payable on demand irrespective of any deposit in hand. The accounts /bills are to be paid at the Company's office or at authorised bank within 15 days of the date of issue shown on the bills. In default thereof interest at the rate of 1.5% per month for 1st year (18% per year) and thereafter 2% per month (24% per year) on the outstanding amount of the Gas bills without compounding shall be payable in addition to the bill amount, subject to change from time to time with the approval of OGRA. After the bills/accounts have been furnished and paid, if the Company at any time discovers any errors; omissions or discrepancy in any such accounts/bills due to any reason whatsoever, the Company shall be entitled to bring such discrepancy to the notice of the Consumer and furnish correct accounts/bills which the Consumer undertakes to pay within 15 days of the date of issue shown on the bills.

14.2 If the Consumer finds any mistake in the bills, it must be brought to the notice of the Company immediately upon receipt. Once payment in respect of a bill, which had been corrected on the complaint of the Consumer, has been made by the Consumer, it shall be considered that the bill is correct in every respect and thereafter no further complaints in this respect shall be entertained by the Company. Furthermore, any mistakes in the bills or incorrect billing shall not entitle the Consumer to withhold payment of the bills, in time. Provided however, if the Company finds any mistake in the bill sent to the Consumer, then irrespective of the fact whether payment has been made or not, the Company shall upon having discovered the mistake at any time, be entitled to send a correct bill and the Consumer shall be liable to pay the same

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15. PAYMENT

15.1 The responsibility for making payment for the Gas consumed is that of the Consumer. If a bill is not received by the 10th of each month the Consumer shall communicate with the Company in order to ascertain their liability for payment and if the Consumer fails to pay the bills within 15 days of the date of the bill or if the Consumer has not received the bill and fail to ascertain their liability and to make payment of the amount so due by the 15th day of each month, the Company shall be entitled to terminate this Contract and to disconnect the supply of Gas and to remove its Gas meter and other equipment without any notice. All bills sent by the Company at the address given in the Contract in the ordinary post or delivered by hand at the said address shall be considered sufficient delivery of the bills to the Consumer by the Company intimating the Consumer's liability to payment for Gas consumed.

15.2. Payment should be made either by cash or local bank draft /cheque in favour of Sui Northern Gas Pipelines Limited at the office/banks mentioned on the bill. Payment by cheque or bank draft shall not be considered payment unless this is realized. Failure of the cheque or bank draft to be realized within 3 days from the date of deposit in the bank for clearing by the Company shall make the supply of Gas liable to disconnection and this Contract liable to termination by the Company.

15.3 Payments must be made on or before the date failing which the supply of Gas is liable to be terminated without notice at the risk of the Consumer. Notwithstanding such disconnection/ termination of Gas supply, the Consumer shall pay to the Company the full amount of Gas bill up to and including the date of disconnection together with the interest accrued thereon as stipulated in clause 14.1.

15.4. The Consumer confirms and understands that in the premises required to be supplied with Gas connection, no such connection was previously disconnected, on account of non-payment of Gas bills/charges etc. In case, it is found otherwise the Consumer hereby undertakes to clear/pay such dues/charges on demand as if such amount is due from and payable by the Consumer.

16. UNAUTHORISED CONNECTION

16.1 The Consumer agrees not to allow, make or maintain any connection with the Gas pipes installed at the premises of any person or corporation during the existence of the Contract without the written consent of the Company.

17. INTERRUPTION IN SUPPLIES

17.1. The Company shall have the right to close or interrupt Gas supply to the Consumer's premises for short periods for carrying out necessary extension/repair and/or alteration, work in the Company's pipeline, equipment and devices.

For PACKAGES LIMITED

18. COMPANY'S RIGHT TO REDUCE/INTERRUPT/SUSPEND SUPPLIES

18.1. As the production of Gas from Wells, Purification Plants and conveyance of it over long distances are subject to accidents, interruptions and failures and the lines to breaking, freezing and closing which cannot be foreseen or prevented by any reasonable care or expenditure and the supply of Gas and transportation facilities therefore are limited, the Company does not by this contract undertake to furnish to the Consumer a full and uninterrupted supply of Gas but only to furnish such supply and for such length of time as it reasonably can; and it is expressly agreed by the Consumer that the Company shall not be liable for any loss, damage, or injury that may result either directly or indirectly due to interruption in the supply of Gas, or in the discontinuance thereof from any cause whatsoever. The Company shall in its sole judgment have the right to reduce or interrupt or completely suspend Gas supply due to any other aforesaid reasons to the Consumer and shall be the sole judge with, regard to such conditions.

19. CURTAILMENT OF SUPPLIES

19.1 The Company shall have the right to curtail deliveries of Gas to the Consumer contracting to purchase in excess of 1,000,000 cu ft. per month or its equivalent in metric measure whenever and to the extent necessary in its sole judgment for the protection of service to its other consumers it may require. The Company shall be the sole judge with regard to such conditions and curtailment of deliveries.

20. INDEMNIFICATION

20.1 The Consumer knowing the inflammable character of Gas shall take all precautions in its use and maintain Gas installations on its premises and shall be solely responsible for any loss, damage, injury or accident resulting, directly or indirectly and for any reason whatsoever, from Gas or Gas installations. The Company shall not be liable to the Consumer or to any person for any loss, damage or injury resulting from the use of Gas thereon, all risks in the said use being assumed by the Consumer. The Consumer shall indemnify the Company against all demands and claims for any such loss, damage, injury or accident.

21. SIGNING OF CONTRACT

21.1 This contract shall not be binding nor in force until approved and signed by an authorised officer of the Company and no promises or agreements or representation of any agent or employee made in soliciting the same or otherwise, shall be recognised or made good by the Company or shall form part of the Contract unless incorporated herein.

For PACKAGES LIMITED

22. CONTRACT CANCELLATION

22.1 This Contract shall be subject to cancellation by the Company at any time for any of the following causes.

(a) Neglect or default of the Consumer to pay within 15 days of the date of issue of the bill by the Company for any month's supply of Gas. (Tendering of cheques and bank drafts shall not be considered payment unless realized).

(b) Any action by the Municipal Authorities, Improvement Trusts, Local Bodies or any Government, or any legal proceedings against the Company by any party (including the Consumer) interfering with Company's right to supply Gas and collect payment for the same under the terms of this Contract.

(c) Any action by the Consumer to secure through the meter Gas for other purposes and/or other premises than that contracted for herein.

(d) Any action by the Consumer tending to secure more Gas than the meter registers or to secure said Gas through said meter at a higher pressure than that at which the regulators are set by the Company, or any interference with the meters or regulators tending to prevent the same from properly operating and registering correctly.

(e) Any alteration, addition or extension to the existing Gas installation carried out by the Consumer without obtaining prior approval of the Company in writing.

(f) The violation and default by the Consumer of any of the terms and conditions of the Contract.

And it is understood and agreed that in case the premises of the Consumer supplied hereunder, or the personal property thereon, shall be levied upon under execution, or in case of bankruptcy or any of insolvency on the part of Consumer, the Contract at the option of the Company shall be liable to be terminated and the Company shall have the right to remove any or all of its property from the premises of the Consumer. If the Contract shall be cancelled or terminated for any cause, all claims for Gas previously supplied shall become forthwith due and payable without notice from the Company and the Consumer covenants and agrees to pay the same on demand

22.2 This Contract shall stand cancelled if the premises and/or the purpose for which the Gas is supplied under this Contract have been transferred or assigned in favour of any other person, body, corporate or firm with effect from the date of such transfer or assignment and the Company shall have the right to discontinue supply and to remove any or all of its property from the premises unless a fresh Contract is signed by the new owner/occupier of the premises or property in question

For PACKAGES LIMITED

23. METER TAMPERING

23.1 If the Consumer has been found to have been responsible in any way in tampering with Gas Meter in order to secure more supply to him than is recorded on the meter and other installation or to obtain Gas at a higher pressure than maintained by the Company the Consumer shall be liable to pay to the Company Gas charges commensurate with the Consumer's production and consumption charges in respect of Gas consumed but not recorded by the meter and the entire amount so due from the Consumer shall be payable on demand within 15 days from the date of issuance of the demand notice by the Company.

24. RECONNECTION

24.1 If supply of Gas to the Consumer is disconnected for any reason whatsoever, it shall be reconnected only after the Consumer has paid the usual reconnection charges of the Company and has cleared all arrears. Restoration of Gas supply shall in any case be subject to the availability of meter and/or other necessary equipment.

25. CONTRACT TERMINATION

25.1 Either of the parties hereto may, at their absolute will, terminate this Contract by one month's notice of their intention to do so to be given in writing to the other party and this Contract shall remain in force as specified in 27.1. In the case of termination of this Contract under this clause, no party shall be entitled to any damages or compensation for any loss or injury, arising from such termination of this Contract.

25.2 In the case of termination of the contract for any cause whatsoever, all claims for Gas supplied and for services rendered by the Company upto the date of disconnection of Gas supply shall become forthwith due and payable without notice from the Company and the Consumer shall pay the same on demand.

26. RESOLUTION OF DISPUTES

26.1 In the event of any difference or disputes arising out of or in connection with the Contract between the Company and the Consumer which cannot be amicably resolved shall be referred to Oil & Gas Regulatory Authority (the Authority) as contemplated under Clause 6 (2) (k) of OGRA Ordinance.

On receipt of such a reference from either of the parties, the Authority shall proceed to serve a notice to both the parties for their appearance before the Authority at such time, date and place as may be specified by the Authority in this regard. After hearing the parties to the disputes, the Authority shall give its finding which shall be binding on the parties to the dispute.

For PACKAGES LIMITED

27. TERM OF CONTRACT

27.1 This Contract shall take effect on the date hereof and, unless terminated earlier in accordance with the terms hereof, shall continue for a period of five (05) Contract years or for such longer period as may be agreed between the Parties (the "Term"), except the obligation of the Consumer to provide Security Deposit, which shall expire two months after the Term of this Contract. Notwithstanding the foregoing, it is agreed between the Parties that the terms and conditions of this Contract shall be mutually renegotiated and agreed after the expiry of first four (04) Contract years, failing which the terms and conditions contained herein shall continue for the remaining One (01) Contract years. For the said purpose the Parties shall start discussions six (06) months prior to the expiry of the fourth (04th) Contract year. After the expiry of the Term, the Contract may be renewed for successive periods of three (03) Contract years each subject to mutual agreement of the Parties.

28. ENTIRE AGREEMENT

28.1 This Contract constitutes the entire agreement between the parties hereto with respect to the subject matter hereof and there are no understandings, representations or warranties of any except as expressly set forth herein.

For and On behalf of
Packages Limited

Witnesses:

1. _____
Name: Khurram Raza
N.I.C. No.: 35201-5415315-1
Address: C/o Packages Limited

2. _____
Name: M. Awais Jawaid
N.I.C. No.: 35202-9975314-5
Address: c/o Packages Limited

Date: 29/5/2007

For and On behalf of
Sui Northern Gas Pipelines Limited

Witnesses:

1. _____
Name: Ishtiaq A Qureshi
Designation: GM-I (Comm'l & Bulk Sales)
Address: SNGPL, 21-Kashmir Road, Lahore.

2. _____
Name: Rehan Nazeer
Designation: Chief Sales Officer
Address: SNGPL, 21-Kashmir Road, Lahore

Date: 01/06/2007

For PACKAGES LIMITED

Address for submission of Gas bills PACKAGES LIMITED
SHAHRAH-E-ROOMI, P.O ALLER SADHU.
LAHORE

Telephone: Office: 5811541-46

Residence: _____

LANDLORD'S PERMISSION TO INSTALL GAS SUPPLY

I/We (Name in full SYED HYDER ALI) being the landlord of the above-named consumer in respect of the above mentioned premises neither have nor shall have any objection whatsoever to any Gas piping, fittings, appliances or accessories being, from time to time, fixed in or removed for the said premises by the above named Company nor shall I/We have any objection to further connections being provided by the said Company to other premises or person(s) from the outlet of the regulator installed for the purpose of supplying Gas to the said premises. I/We undertake to inform the Company in time in case the tenant vacates the said premises.

Witness _____

Date 24/5/2007.

Signature Syed Hyder Ali

Address C/o Packages Limited

Telephone 5811541

PAKISTAN

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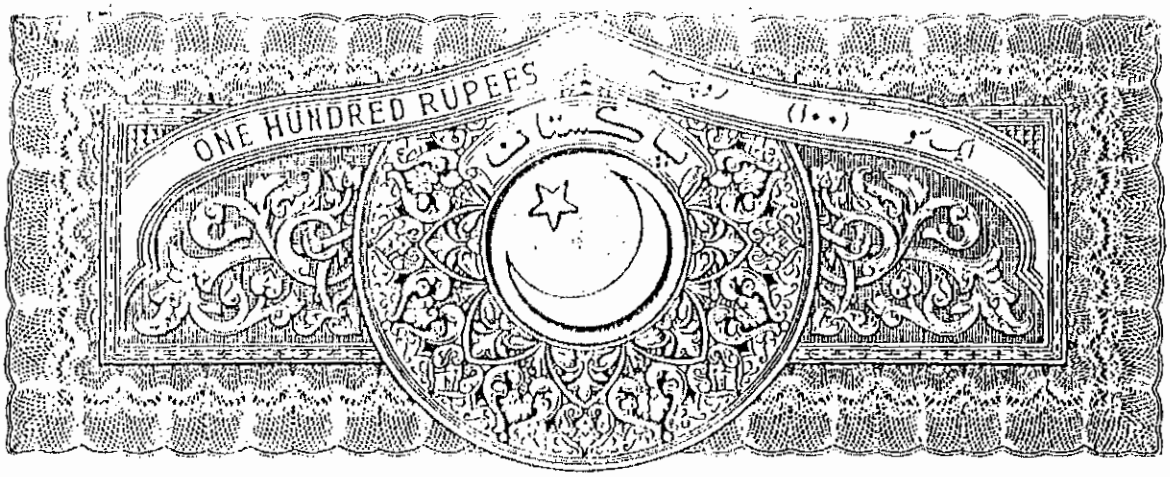

SUPPLEMENTAL AGREEMENT

THIS SUPPLEMENTAL AGREEMENT is made to the Contract for the Supply of Gas for Industrial Use & Co-generation between **M/s Sui Northern Gas Pipelines Ltd.** a company incorporated under the company act and having its registered office at 21 Kashmir Road, Lahore, hereinafter referred to as the Company of the one part.

AND

M/s Packages Limited, Chah Road, Singhwala, Kot Radha Kishan Road, District Kasur, hereinafter referred to as the Consumer of the other part.

WHEREAS the parties have entered into Gas Purchase Contract of 20 MMCFD dated 01.06.07 and whereas in supplement thereinto the parties have agreed to add the following terms and conditions to the said Contract for Industrial use.

NOW THEREFORE THE AGREEMENT WITNESSETH AS FOLLOWS:-

1 It is condition precedent to the providing of Gas connection by the Company to the Consumer that the Consumer shall be given Gas on "As and When Available Basis" during period 1st March to 30th November of each year only if available. The availability of Gas during this period shall be determined solely by the Company, entirely at its discretion, keeping in view its commitment to the other consumers, priority or other preference criteria determined for this purpose by the Company. The Consumer

FOR PACKAGES LIMITED

Mujeeb Perdesi

Khalid Yaqub

undertakes to provide guarantee to the satisfaction of the Company that it shall have and make arrangement for alternate fuel. It is further agreed between the parties that the Gas connection to the Consumer shall be disconnected as and when required in order to meet the Company's priority to provide gas to other consumers of higher priority in line with the Natural Gas Allocation and Management Policy, 2005, and for such extended period as may be considered necessary by the Company, during which period the Consumer shall utilize alternate fuel at its own cost. It is further agreed, that the expenditure with regard to disconnection and reconnection as stated above or on such other occasion when the supply is disconnected or reconnected, shall be borne by the Consumer.

2. Both the parties agree that the provision of this "Supplemental Agreement" shall be in addition to the terms and conditions provided in the "CONTRACT FOR THE SUPPLY OF GAS FOR INDUSTRIAL USE & CO-GENERATION" and its provisions will stand amended modified, and changed to the extent specified in this "Supplemental Agreement".

IN WITNESS WHEREOF the parties have set their respective hands to this Agreement on the 12th day of June 2007 at the place and date mentioned therein above.

FOR PACKAGES LIMITED

Mujeeb Rashid
Director & General Manager

Khalid Yacob
Director & Finance Manager

For and On behalf of
Packages Limited

Witnesses:

1. _____
Name: Khurram Raja
N.I.C. No. 35201-5915815-1
Address: c/o Packages Limited

2. _____
Name: M. Awais Jawaid
N.I.C. No. 35202-8975364-5
Address: c/o Packages Limited

Date June 06, 2007

For and On behalf of
Sui Northern Gas Pipeline Limited

Witnesses:

1. _____
Name Saadat Ali Khan
Designation Chief Sales Officer
N.I.C. No.
Address: SNGPL, 21-Kashmir Road
Lahore

2. _____
Name Rehan Nawaz
Designation Chief Sales Officer
N.I.C. No.
Address: SNGPL, 21-Kashmir Road
Lahore

Date June 12, 2007