



TOGETHER
for a sustainable future

OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.



TOGETHER
for a sustainable future

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as “developed”, “industrialized” and “developing” are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

21998

FINAL REPORT

PHASE II

**PREBASIC ENGINEERING CONCEPT FOR
RETROFITTING THE EXISTING MILL**

ON

JUTE PULPING

FOR

UNIDO, VIENNA

BY

IVA

SYNOPSIS

Introduction:

The United Nation Development Programme (UNDP) in response to a request from the Ministry of Textiles, Government of India has approved the project DG/IND/92/316

- JUTE FOR INTERNATIONAL QUALITY SPECIALITY PULP -

as a part of the National Jute Programme. The implementing Agency is the Ministry of Textiles through the Central Pulp and Paper Institute (CPPRI), Saharanpur, in collaboration with the ITC Ltd. - Tribeni Tissue Division /TTD), Calcutta.

UNIDO as cooperating Agency for the project engaged IMPCO-VOEST-ALPINE Pulping Technologies GmbH (IVA), Linz, Austria, as contractor, to provide services and perform the work for Phase II as described in the terms of reference for the subcontract envisaged by the project.

Prebasic engineering concept for retrofitting the existing mill

Scope of Work

- ◆ To carry out a detailed mill study and mill inventory in cooperation with mill personnel.
- ◆ To prepare a pre-basic engineering study to retrofitting the mill including the following chapters:
 - Preliminary process design including: process descriptions, material balance, process flow diagrams.
 - Preliminary plant design including: mill lay out, mechanical design criteria, instrument design criteria, project time schedule, list of potential suppliers; equipment list (imported and locally manufactured) plant lay out.
 - Investment cost estimation
 - Basic figures for calculation of operating cost.

The services and work of IVA was carried out under the contract No. 94/028, Project DG/IND/92/316 in collaboration with CPPRI and ITC Ltd.

Objective of the Project:

The objective of the project is

1. to produce jute pulp of international standard which can be used as long fibre speciality pulp such as pulp produced from hemp, flax etc.

This includes to use an environmental friendly bleaching sequence and adding screening and cleaning equipment to remove impurities like bark, dirt, plastics, etc.

2. Increase the capacity of the plant by using the 8 existing digester

Based on laboratory test and mill trials it was decided

- adding new cleaning equipment
- adding oxygen delignification and
- selecting a TCF bleaching sequence A-EOP-P

Whereby modifications in digesting, screening and washing will be done in one stage (Stage 1).

After commissioning the next stage (Stage 2) - changing the bleaching sequence - will be done.

As the space available is very limited, it has been decided to use the existing fibre line building, subsequently it will be necessary to break parts of the building and to remove existing equipment.

As shown in detail in item 8 the production cost per ton of BDMT of bleached pulp depends heavily from price of purchased jute. For this reason two different cases are shown.

Case A: For a jute price of Ind. Rs. 14.000,-- the operating cost will be 36.594,-- Ind. Rs.

Case B: For a jute price of Ind. Rs. 7.000,-- the operating cost will be 23.216,-- Ind. Rs.

As shown in detail in item 9 the overall investment cost for the retrofitting phase will be

176,5 Million Indian Rs.

TABLE OF CONTENT

1. INTRODUCTION	6
2. OBJECTIVE OF THE PROJECT	7
3. EXISTING PROCESS	9
4. RETROFITTING CONCEPT.....	13
General.....	13
4.1 Capacity	13
4.2 Process	13
4.2.1 Digesting.....	13
4.2.2 Washing, Screening and Cleaning.....	14
4.2.3 Oxygen Delignification and Bleaching	14
4.3 Location.....	14
4.3.1 Blowtank and Heat Recovery	14
4.3.2 Washing, Screening and Cleaning.....	15
4.3.3 Oxygen Delignification and Bleaching.....	15
4.4 Implementation	15
5. DESCRIPTION OF RETROFITTING CONCEPT	18
5.1 Process Design and Description.....	18
5.1.1 Digesting.....	18
5.1.2 Washing, Screening & Cleaning.....	20
5.1.3 Oxygen Delignification & Bleaching.....	22
5.2 Material Balance	27
5.3 Process Flow Diagrams.....	28
6. PLANT DESIGN	29
6.1 Mill and Plant Layout	29
6.2 Mechanical Design Criteria	30
6.3 Piping Design Criteria	31
6.4 Electrical Design Criteria	32
6.4.1 General.....	32
6.4.2 Equipment Specification.....	34
6.5 Instrumentation and Control Design Criteria	41
6.5.1. General.....	41
6.5.2. Field Instruments.....	41
6.5.3. Installation	44
6.5.4. Distributed Control System (DCS).....	44

7.0 PROJECT EXECUTION.....48

- 7.1 Time Schedule..... 48
- 7.2 List of Potential Suppliers 48
- 7.3 Equipment List..... 48

8. BASIC FIGURES FOR CALCULATION OF OPERATING COST 49

9. INVESTMENT COST ESTIMATION.....50

10. ANNEX52

- 10.1 Description Oxygen Generation Plant.....53
- 10.2 Chemical Recovery System.....57
- 10.3 Cost Information Received from Tribeni..... 72

1. INTRODUCTION

The United Nation Development Programme (UNDP) in response to a request from the Ministry of Textiles, Government of India has approved the project DG/IND/92/316

- JUTE FOR INTERNATIONAL QUALITY SPECIALITY PULP -

as a part of the National Jute Programme. The implementing Agency is the Ministry of Textiles through the Central Pulp and Paper Institute (CPPRI), Saharanpur, in collaboration with the ITC Ltd. - Tribeni Tissue Division /TTD), Calcutta.

UNIDO as cooperating Agency for the project engaged IMPCO-VOEST-ALPINE Pulping Technologies GmbH (IVA), Linz, Austria, as contractor, to provide services and perform the work for Phase II as described in the terms of reference for the subcontract envisaged by the project

Prebasic engineering concept for retrofitting the existing mill.

Scope of Work

- ◆ To carry out a detailed mill study and mill inventory in cooperation with mill personnel.
- ◆ To prepare a pre-basic engineering study to retrofitting the mill including the following chapters:
 - Preliminary process design including: process descriptions, material balance, process flow diagrams.
 - Preliminary plant design including: mill lay out, mechanical design criteria, instrument design criteria, project time schedule, list of potential suppliers; equipment list (imported and locally manufactured) plant lay out.
 - Investment cost estimation
 - Basic figures for calculation of operating cost.

The services and work of IVA was carried out under the contract No. 94/028, Project DWG./IND.92/316 in collaboration with CPPRI and ITC Ltd.

2. OBJECTIVE OF THE PROJECT

The objective of the project is to produce jute pulp of international standard which can be used as long fibre speciality pulp such as pulp produced from hemp, flax etc. In addition TRIBENI will increase its pulping capacity from 14.000TPA to 24.000 TPA by using further 90.000 bales of jute.

The following problems are being encountered in increasing the content of jute pulp in various grades of paper and extending its use to more varieties of speciality papers.

- ◆ Removal of internal and external contraries like bark, dirt, plastics, rubber pieces and other trash material from the pulp produced out of jute during the manufacturing process.
- ◆ Low brightness of bleached pulp if high physical properties of pulp are required, partly due to morphological characteristics of the material and partly due to entrapped dirt.
- ◆ Stiffness of fibre due to pulping process and fibre characteristics. The fibre needs to be softened.

Table A summarizes the target bleached pulp quality which should be achieved. Based on the problems mentioned extensive cooking and bleaching laboratory and mill trials has been undertaken, which are summarized in the Final Report Phase 1.

Based on these tests the TCF - sequence O - A - EOP - P has been selected by ITC. Table B summarizes the physical properties which has been achieved in the tests. As it can be seen the brightness level for O-A-EOP-P is lower than the originally desired, however due to the coming new environmental regulation within the next years the market should pay a premium price for these TCF quality.

TABLE A: General Targets for Bleached Pulp Quality

Bleaching sequence	1 Existing (actual cond.) (actual cond.)		2 Desired (intermediate) Intermediate		3 Desired (Final) Final
	CEH	CEpH	CEH	CEpH	
Viscosity cP	15-25	15-25	15-25	15-25	15-25
Brightness % Elrepho	73-77	77-79	78-80	82-84	88+
Dirt count mm ² /m ²	250	250	10	10	5
Breaking length (30°SR) m*	8.200	8.200	9.000	9.000	9.000+
Fibre length mm	1.56	1.56	1.60	1.60	1.60+
Coarseness mg/100 m	11.4	11.4	10.5	10.5	10.5
Fibre strength Index Nm/g	114	114	120+	120+	130+
Slenderness factor 100 x WAFL/coarseness	13.7	13.7	16+	16+	17+
Kappa no. after cooking	15	15	13 ± 2	13 ± 2	13 ± 2

* Based on Valley beating equipment, bone dry

During the execution of the project Phase 1 it has been decided to modify the brightness and the breaking length to the ISO standard. The new values are:

Brightness % Elrepho: 88+

Brightness % ISO (relative): 88+

Brightness % ISO (absolute): 86+

Breaking length (30° SR) m: 6.700+ (based on PFI/Rapid Koethen analysis air dry)

TABLE B: New Bleaching Sequence: O-A-EOP-P

Bleaching sequence	Reached	Target
Viscosity ml/g	650 - 850	600 - 800
Brightness % ISO absolute	81 - 83	82 - 83
Brightness % ISO relative	83 - 85	84 - 85
Breaking length (50°SR) km	6,8 - 6,9	6,7
Coarseness mg	0,11 - 0,12	0,105
Slenderness factor 100 x WAFL/coarseness	12 - 15	16,0

Remark: In spite of the final brightness being lower (82 - 84 % Elrepho) than the target (88 % Elrepho) the sequence O - A - EOP - P was selected as a better option of TCF regarding fibre strength. This is an anticipation that future market would demand for environmental friendly TCF pulp.

3. EXISTING PROCESS

TRIBENI Tissues is making pulp in the conventional kraft pulping process. The details of pulping conditions is given in the Table I. After the jute fibre is cooked in the rotary digester, the pulp is dumped to a pit where a part of the black liquor is drained off. This unwashed pulp is conveyed to breaker washer either by belt conveyor or by bucket conveyor. Fibre separation and washing take place in the breaker washer. The semi-washed pulp is then washed further in drum washer/brown stock washers. Washed pulp goes for bleaching.

The details of black liquor analysis is given in the Table II. There is no chemical recovery at present. TRIBENI Tissues is in search for a suitable recovery system.

The unbleached pulp is bleached either by CEH or CEpH sequence. The details of bleaching conditions are listed in Table III. The pulp is cooked to a Kappa Number of 15 - 16 and bleached to a brightness of 74 - 76 % Elrepho with CEH sequence at a viscosity of 16 to 18 cps. With CEpH sequence the pulp brightness was 77 - 78 % Elrepho at a viscosity of 22 - 25 cps in open chest.

Subsequent to December 1996 with the use of better jute (TD 5 - Top) and conducting Ep-stage in the tower at higher consistency (within 10 %) and at a higher temperature (60 °C) the pulp brightness could be increased to 79 - 80 % Elrepho.

In addition a proximate analysis of the used jute bast fibre is shown in Table IV.

TABLE I: (EXISTING) COOKING PARAMETER

Equipment

Type/Number	-	Spherical rotary/8
Material of Construction	-	M.S.
Diameter	m	4.3
Volume	m ³	40
Heating	-	Bare steam

Cooking charge**Earlier Condition****Actual Condition
from Nov. 96**

Fibre (Jute Cuttings)	tonnes	6.5 to 7.2	6.5 to 7.2
NaOH (as such)	%	12.5	11.75
(as Na ₂ O)	%	9.7	9.1
Na ₂ S (as such)	%	2.0	2.0
(as Na ₂ O)	%	1.6	1.6
Effective alkali (as Na ₂ O)	%	10.5	9.9
Sulphidity (as Na ₂ O)	%	14.1	15.0
Material: Liquor (start)	ratio	1 : 2	1 : 2

Cooking condition

Steam pressure	psi	50	56
Time	hr		
- to 20 psi (air blow)		0.75	0.79
- to 50 psi (air blow)		1.25	1.25 (to 56 psi)
- at 50 psi		9.00	9.50 (at 56 psi)
Total cycle time	hr	19 - 20	19 - 20
Steam	t.p.t.p.	2.5	2.5

Unbleached Jute Pulp

Kappa No.	-	13 to 15	12 to 14
Viscosity	cp	60 to 80	60 to 80
Ash	%	2.0 to 2.5	2.0 to 2.5

* Changes in cooking chemicals addition were due to changing to a better quality jute (TD5 Top), that means bark content is reduced from 10 % to within 1 %).

TABLE II: RAW BLACK LIQUOR ANALYSIS

Based on the following analysis, received from ITC Tribeni on December 16, 1996, IVA give recommendations for a suitable chemical recovery system as described in the Annex 10 of this report.

	% w/w	Black Liquor	First Wash
pH	-	11,7	11,3
Total Solids	% w/w	16,0	12,8
- do -	% w/w	17,2	13,5
Suspended Solids	% w/w	0,007	0,012
Active Alkali, Na ₂ O	gpl	3,3	2,6
Total Alkali, Na ₂ O	gpl	35,6	32,5
Inorganics as NaOH	% w/w	30,1	34,2
Organics	% w/w	69,9	65,8
Silica	% w/w	0,55	0,91
Inerts	% w/w	Nil	Nil
Chlorides	% w/w	Nil	Nil
Sulphur	% w/w	1,30	1,70
Carbon	% w/w	39,6	37,9
Hydrogen	% w/w	4,0	4,3
Nitrogen	% w/w	2,2	1,8
Oxygen (by difference)	% w/w	36,4	35,0
Calorific value	cals/gm	3507	3420

Viscosity Results

Viscosity in CPS at various Temperature

Solid % w/w	Black Liquor Sample		First Wash	
	at 60 °C	at 90 °C	at 60 °C	at 90 °C
Original	Too low	Too low	Too low	Too low
45	21,3	8,5	8,0	6,5
60	436	50	126	46

TABLE III: EXISTING BLEACHING CONDITIONS

Sequence	Consistency %	pH	Av. Cl ₂ %	NaOH %	Other chemicals. %	Time hr	Temp. °C
C (open chest)	4.0 - 5.0	4.0	2.4	-	-	0.50	room
C (retention vessel)*	3.5	4.0	2.5-3.0	-	-	0.50	room
E	4.0	11.0	-	1.5	-	0.75	room
EP	4.0	11.0	-	1.5	0.5 (H ₂ O ₂)	1.50	38-40
EP(after Dec. 96)	10	11.0	-	1.5	0.5 (H ₂ O ₂)	1.5	60
H	4.0	9.0	2.0-3.0	-	0.1 (Sulfamic acid)	1.50	room

* Retention vessel in regular operation since December 1996

Total time - cycle: 10 - 11 hours/ batch

Bleached Jute Pulp

Bleaching Sequence		C-E-H	C-EP-H
Brightness	% Elrepho	75.0 (73.0 - 76.0)	77.0 (76.5 - 78.5)**
Viscosity	cp	25 (20 - 27)	24 (20 - 27)
Dirt	mm ² /m ²	200 - 250	200 - 250
Dirt ***	mm ² /m ²	100 - 150***	100 - 150***

** After December 1996 79 - 80 % Elrepho

*** Dirt content reduced due to better raw material (TD5 Top)

TABLE IV: PROXIMATE ANALYSIS OF JUTE BAST FIBRE

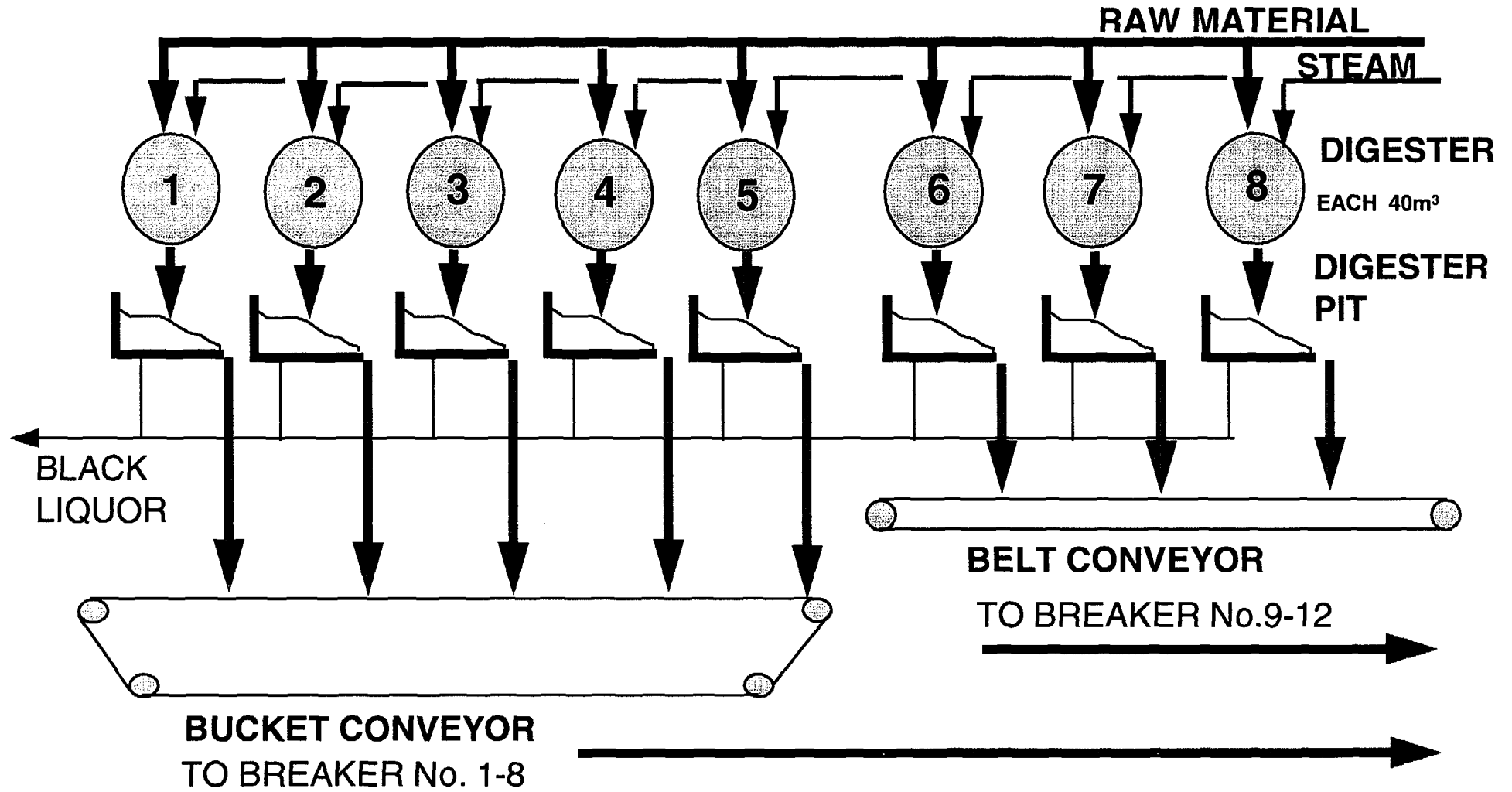
Se.No.	Property	Unit	Bast Fibre			Bast Fibre (B'Desh)
			Lower	Top	Whole	Whole
1.	Moisture	(%)	7,7	6,8	9,1	10,7
2.	Ash	(%)	1,7	0,6	0,3	1,6
3.	Water Sol	(%)	0,5	0,5	0,6	0,4
4.	Alkali Sol	(%)	15,5	10,7	14,5	15,6
5.	Lignin	(%)	13,8	-	11,8	19,3
6.	Holocellulose	(%)	88,0	90,2	90,0	

Data received from CPPRI

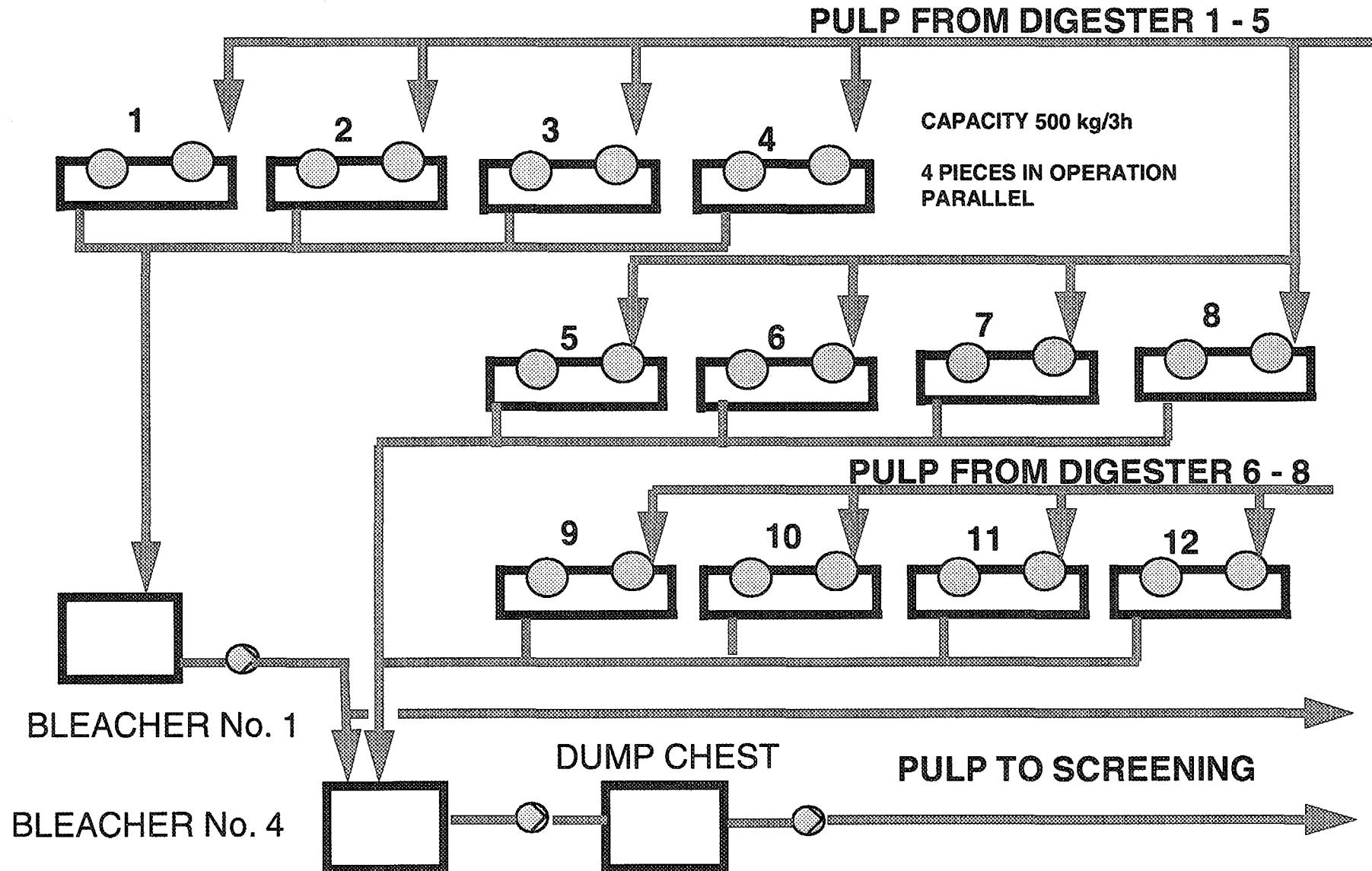
Enclosure: Existing System Simplified flow diagram (11 sheets)

TRIBENI EXISTING SYSTEM

DIGESTING FLOW DIAGRAM

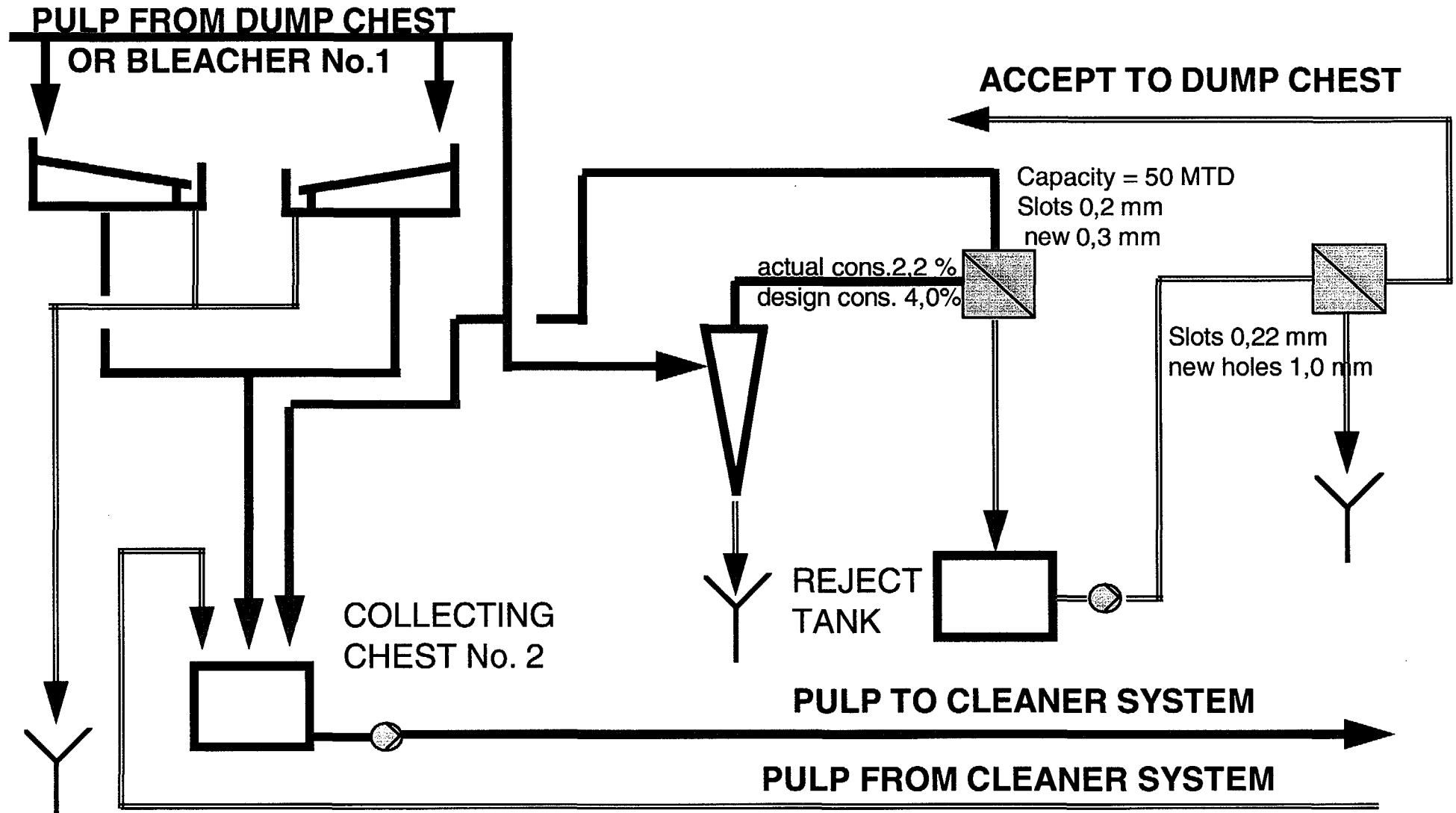


TRIBENI EXISTING SYSTEM BREAKERS FLOW DIAGRAM

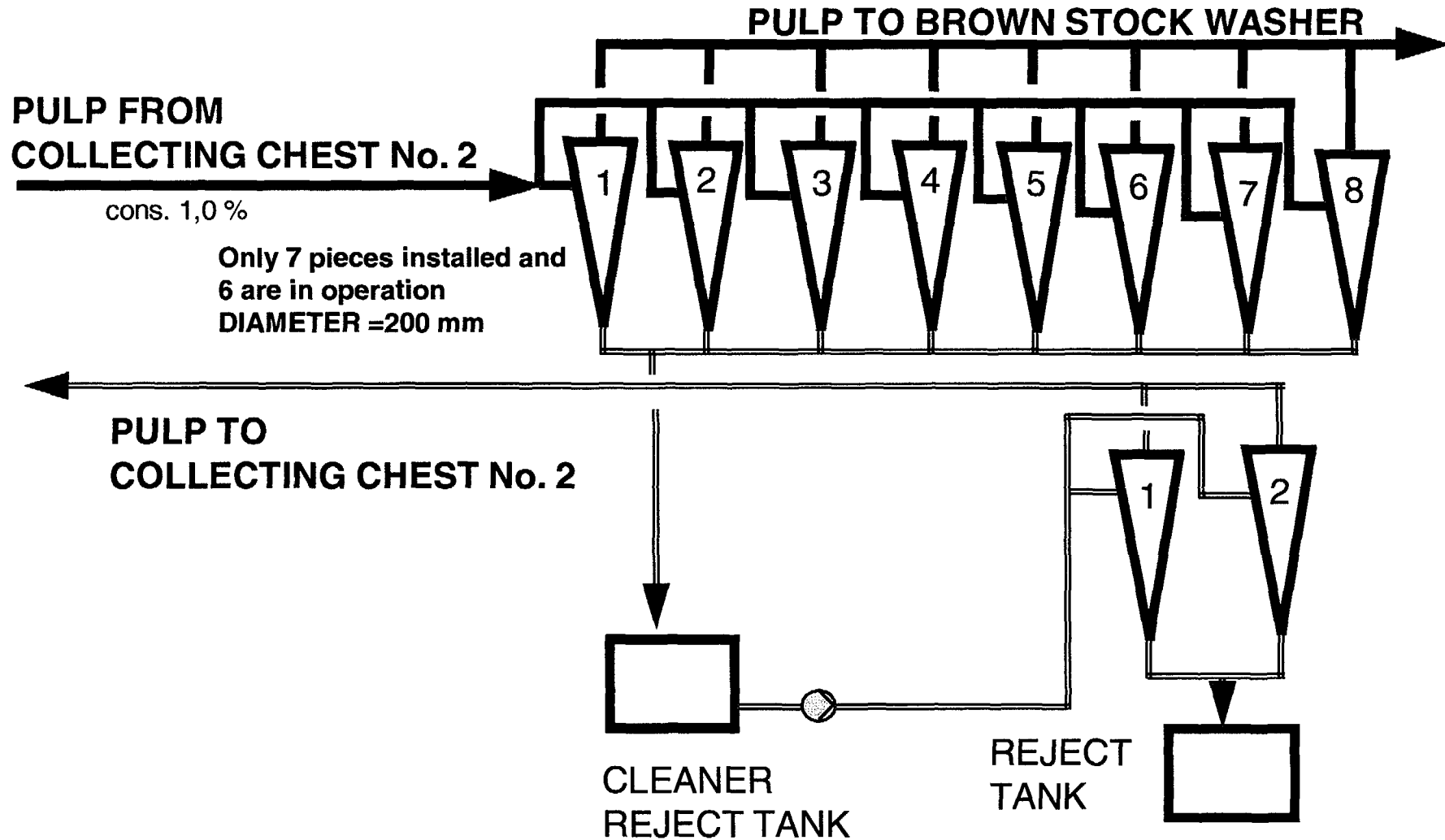


TRIBENI EXISTING SYSTEM

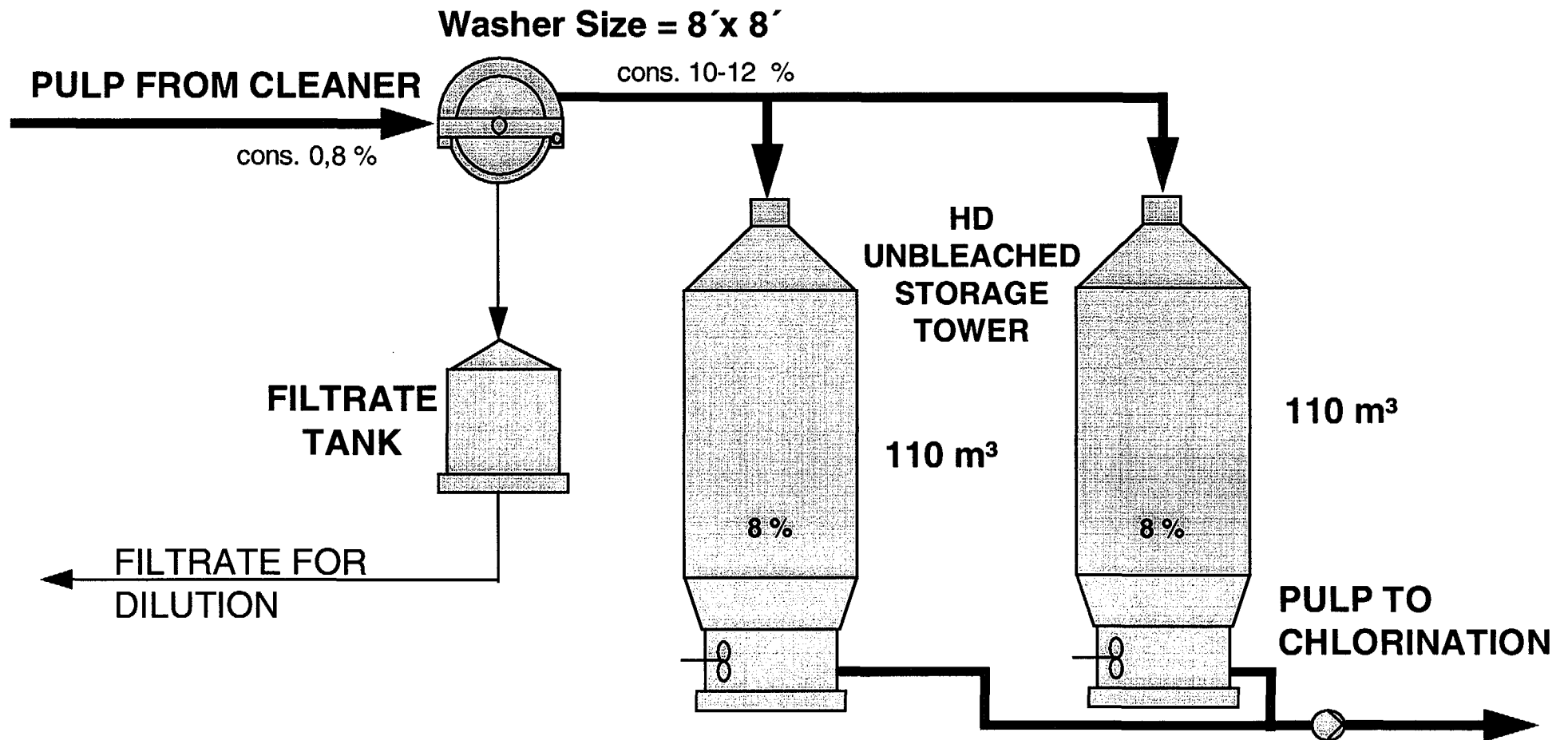
BROWN STOCK SCREENING



TRIBENI EXISTING SYSTEM CLEANER INSTALLATION

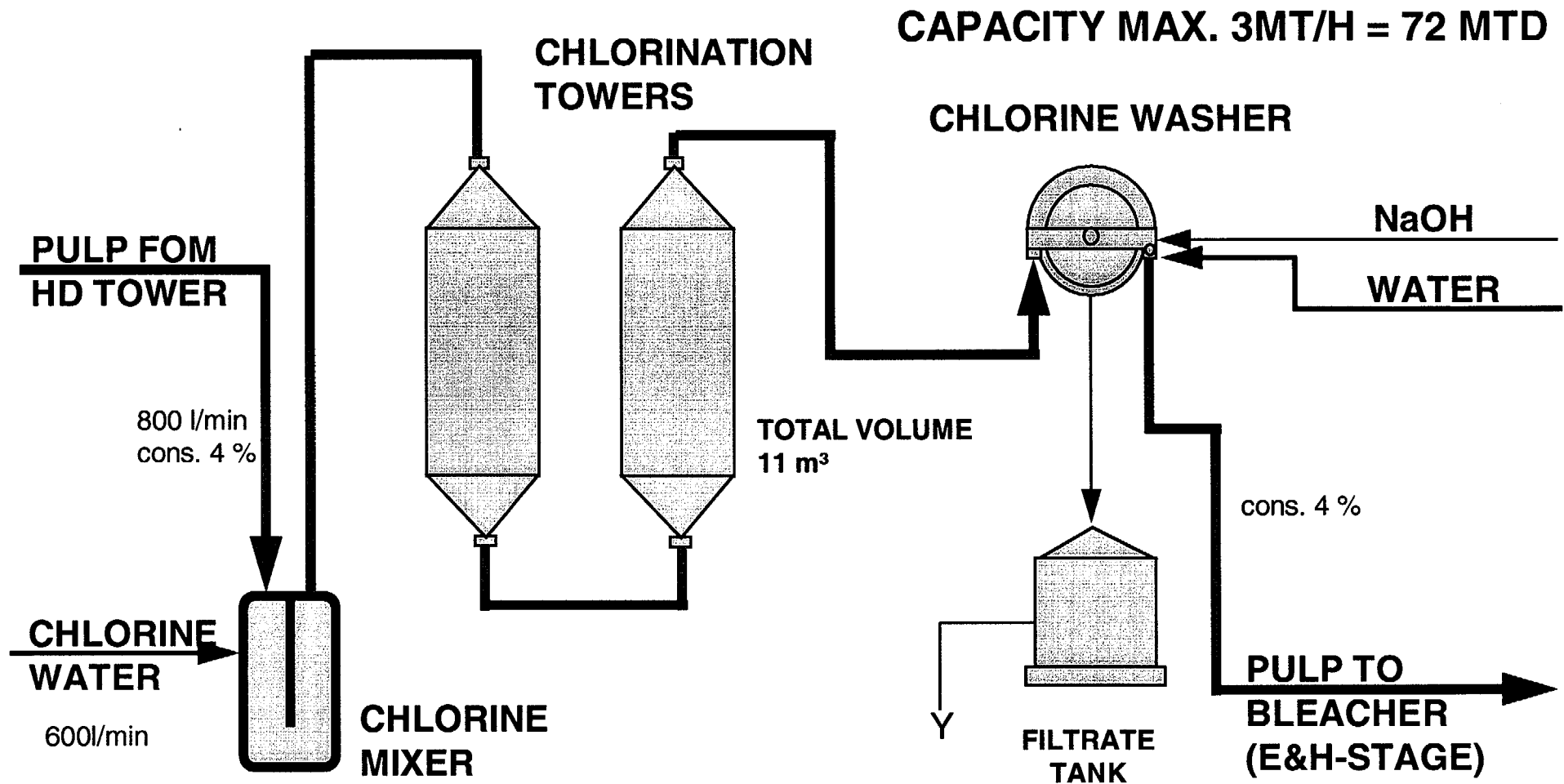


TRIBENI EXISTING SYSTEM BROWNSTOCK WASHER AND HD STORAGE



TRIBENI EXISTING SYSTEM

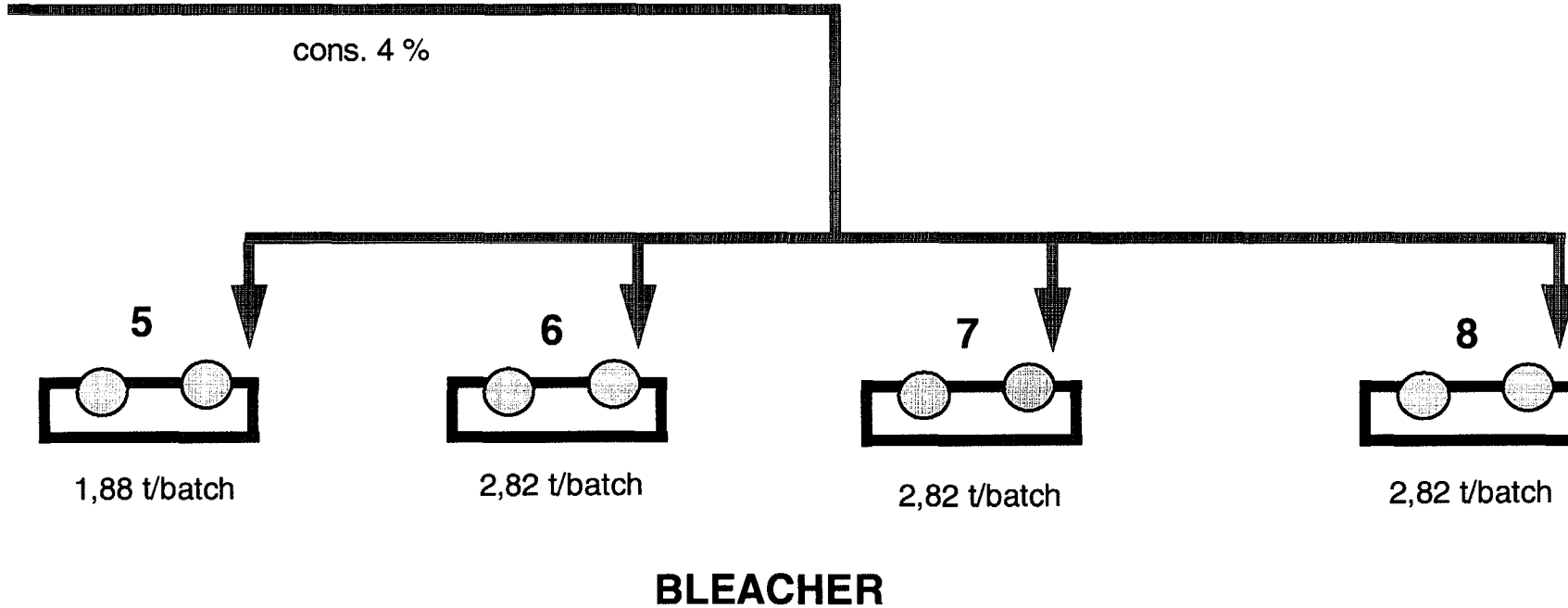
BLEACH PLANT C - STAGE , LINE 1



TRIBENI EXISTING SYSTEM

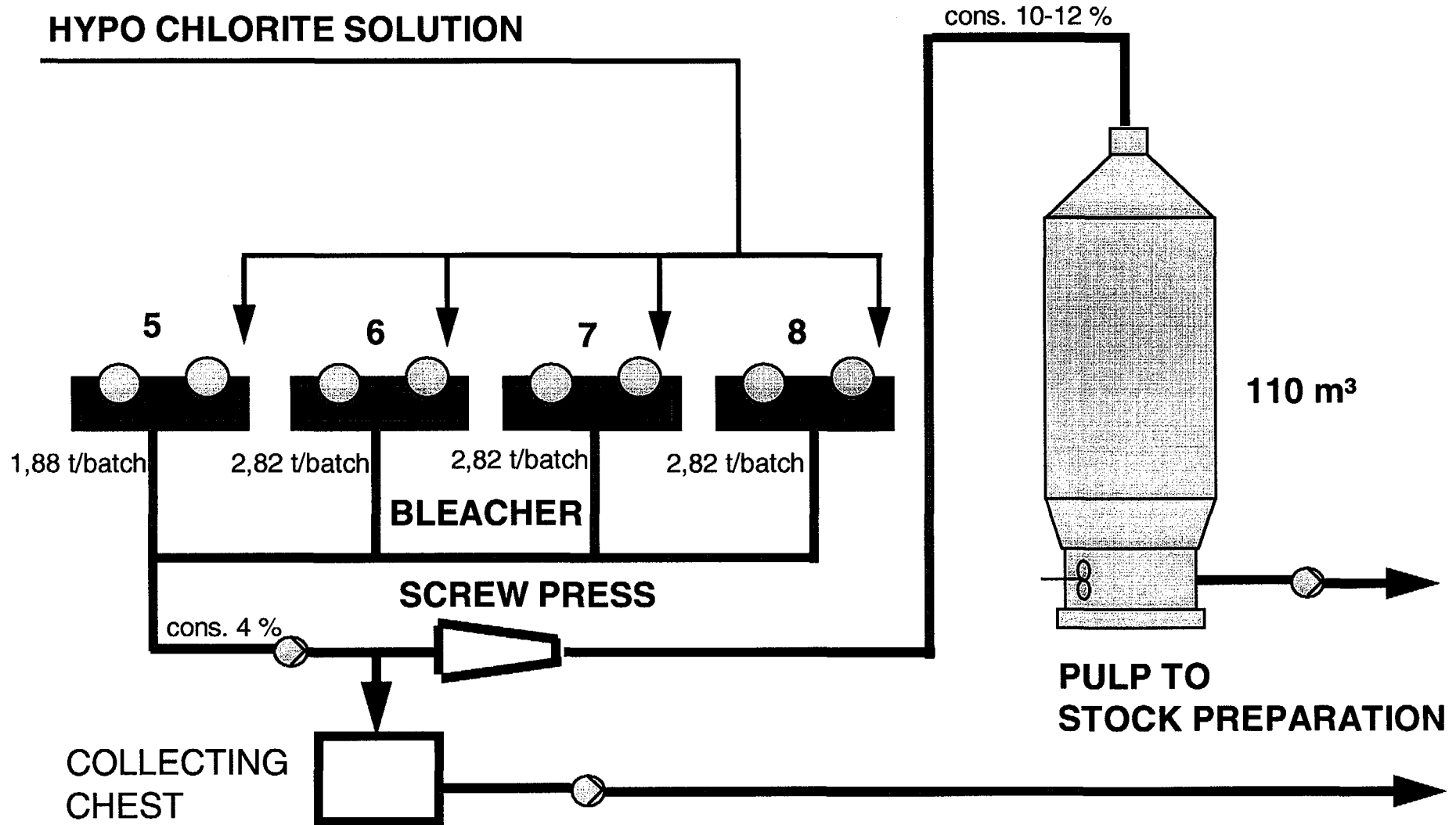
BLEACH PLANT E - STAGE , LINE 1

PULP FROM CHLORINE WASHER



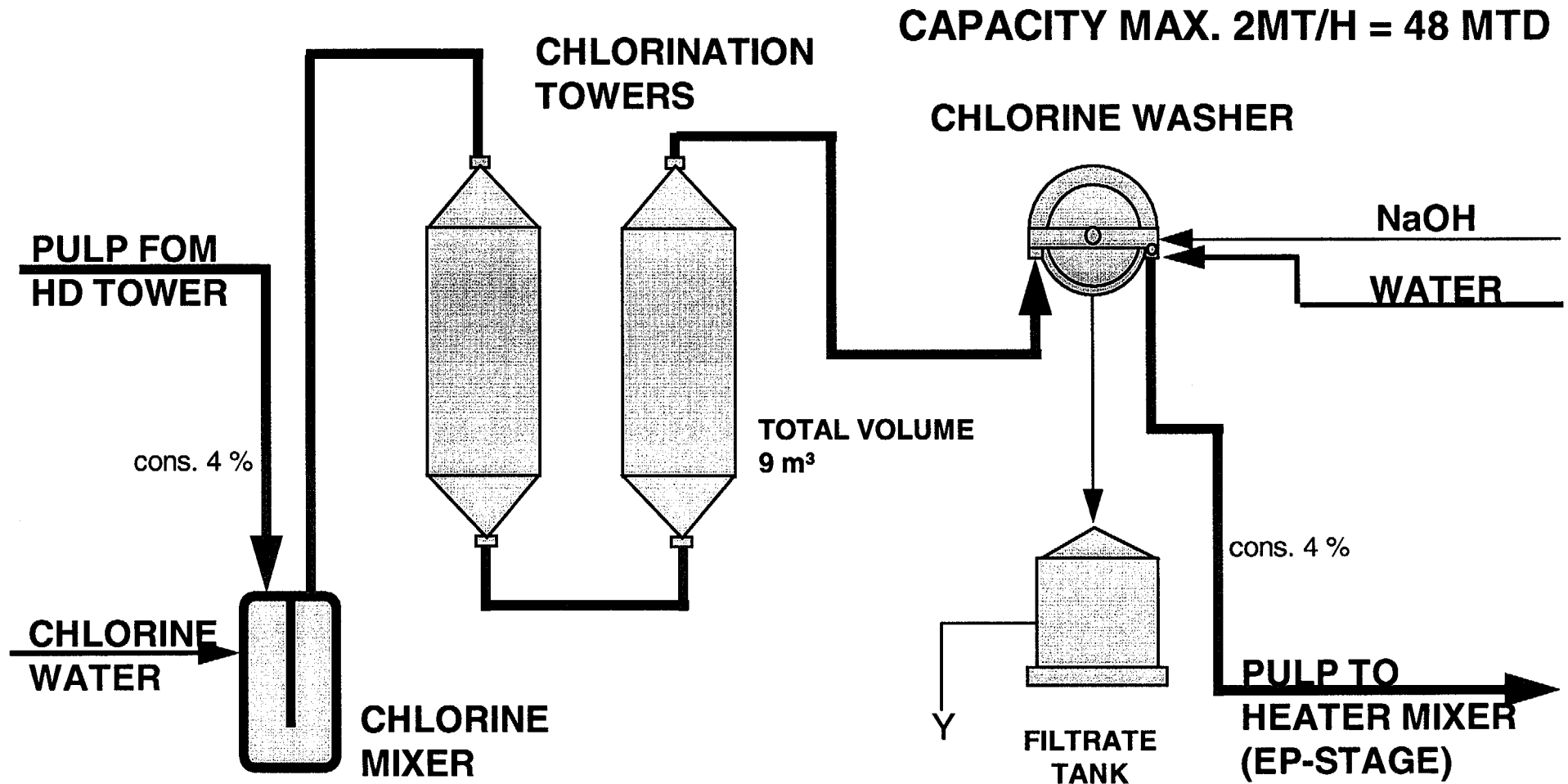
TRIBENI EXISTING SYSTEM

BLEACH PLANT H - STAGE, LINE 1



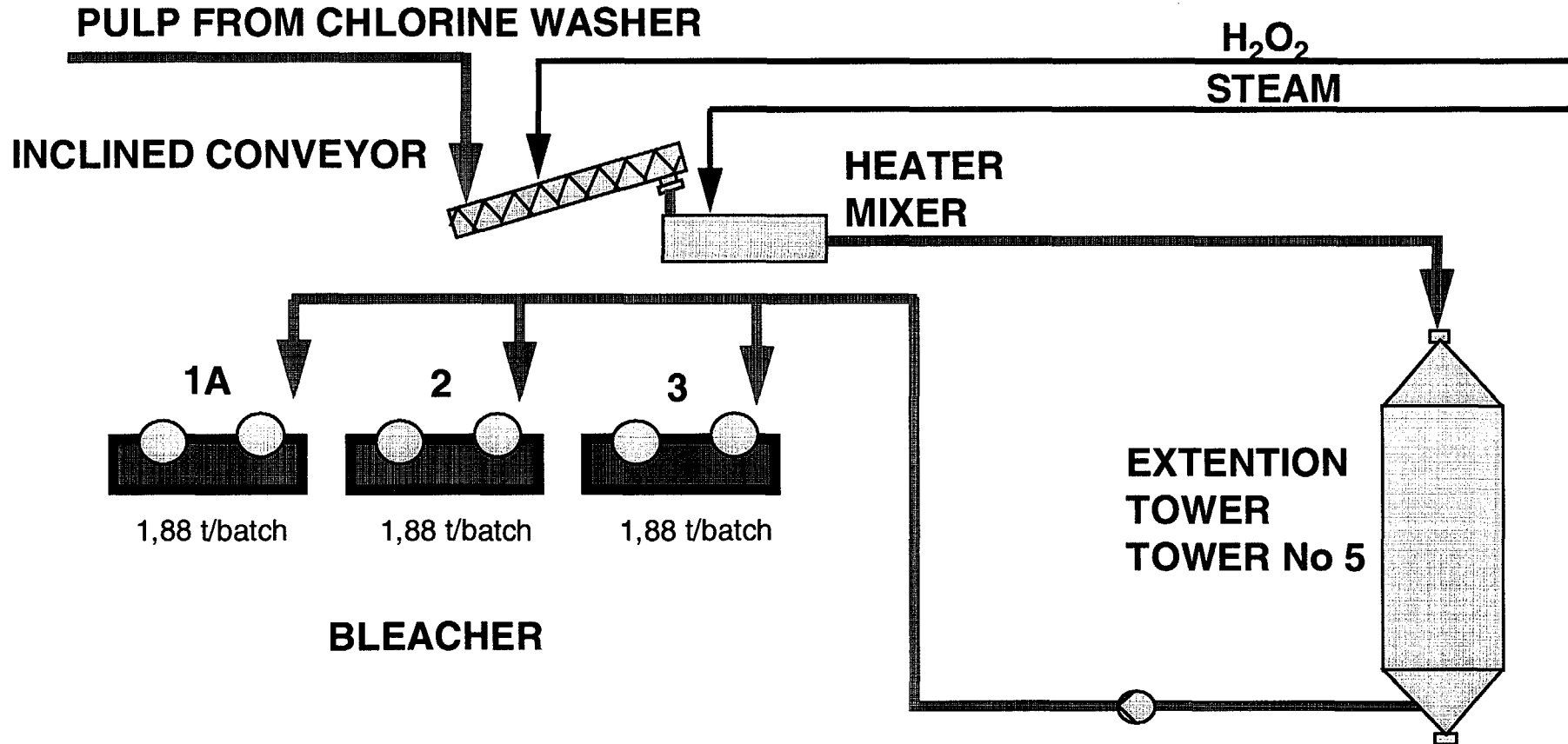
TRIBENI EXISTING SYSTEM

BLEACH PLANT C - STAGE , LINE 2



TRIBENI EXISTING SYSTEM

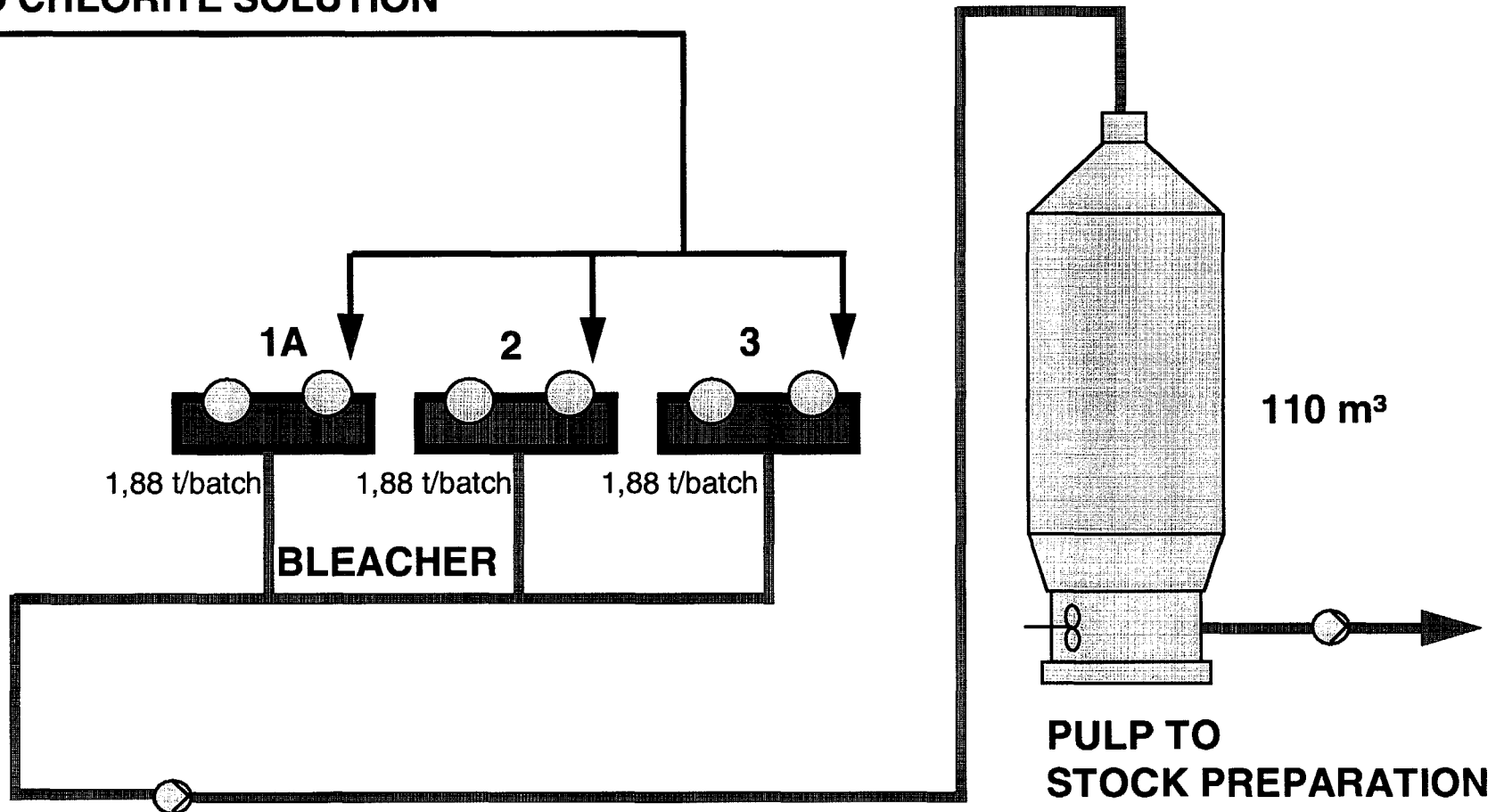
BLEACH PLANT Ep - STAGE , LINE 2



TRIBENI EXISTING SYSTEM

BLEACH PLANT H - STAGE , LINE 2

HYPO CHLORITE SOLUTION



4. RETROFITTING CONCEPT

General

To increase the capacity to 24 - 25.000 tpy (assuming 350 working days) and to obtain an international acceptable jute pulp quality following modifications based on laboratory and mill tests should be implemented.

For better utilization of the mill during executing the retrofitting it has been decided to divide the retrofitting into two stages:

Stage 1 A: Implementation of new cooking process and changing to the blow system.

Stage 1 B: Implementation of new washing, screening and cleaning

Stage 2: Implementation of new oxygen delignification and bleaching

4.1 Capacity

Based on the available 8 spherical digesters each having 40 m³ volume the new capacity for unbleached pulp will be

75 ADMTD (= 67,5 BDMTD)

For the final bleached pulp the capacity will be

70 ADMTD (= 63 BDMTD)

4.2 Process

4.2.1 Digesting

Cooking process should be changed to Kraft-AQ process.

In addition with

- ◆ Changing the digester lid to a quick opening device
- ◆ Installation of a blow system instead of dumping the pulp into the pits

- ◆ Using medium pressure steam and therefore increasing temperature the cooking cycle time can be reduced to 600 min (including spare time).

4.2.2 Washing, Screening and Cleaning

To reduce the bark content and dirt count as well as to remove as much sand as possible a 3-stage screening combined with a 3-stage cleaning in the accept line and an additional cleaning system in the reject line are foreseen.

4.2.3 Oxygen Delignification and Bleaching

To be prepared for the future the new bleaching sequence will be O-A-EOP-P with a brightness level of 82 - 84 %.

4.3 Location

For selecting the location for the new process equipment it has been considered that the existing operation should not be disturbed as far as possible.

There were the possibilities to install the equipment:

1. In the area of the overhead tank
2. In the area of the carpentry shop
3. In the area of the existing building

Finally after evaluating the various options and their impact on overall cost and existing operation it was decided by ITC to go for option 3.

4.3.1 Blowtank and Heat Recovery

For the new blowtank and heat recovery system the area of breaker 5 and 6 are foreseen. The necessary breaking of equipment and building will be done.

4.3.2 Washing, Screening and Cleaning

For installing this system the area of bleachers 6, 7, 8 and Cl₂-Towers will be foreseen. The necessary breaking of the equipment and building will be done.

After installation and comissioning of this part breaker area 9 - 12 is available for the bleaching.

4.3.3 Oxygen Delignification and Bleaching

Will be located in the area of breakers 9 - 12.

The necessary breaking of equipment and building will be done.

4.4 Implementation

As mentioned before the implementation should be done not to disturb the production as far as possible. For this reason the retrofitting has to be divided into two stages:

Stage 1 A: Digester house modifications

Implementation	Effect on production area
Implementation of Kraft-AQ process and increasing steam pressure and temperature	No interruption of production
New blowtank and heat recovery system	Breaking of breaker 5 and 6
Digester 5,6,7,8 connected to new blowtank	Digester 1,2,3,4, still in operation with breakers 1 - 4 and 7,8. Achievable capacity 28,8 t/d

Stage 1 B: Installation of new screening, cleaning and washing

Implementation	Effect on production area
Breaking building in area bleacher 6 - 8	During this period all available bleachers 1A,1,2,3,4 and 5 having a capacity of 2t/10 h or 2t/12 h (if peroxide is not used) shall be used
Civil works and installation of equipment for screening, cleaning and washing	No effect
Digesters 1,2,3,4 connected to new blow tank	No effect

For proper operation of the system after finalising this stage, pulp from the MC pump will be pumped to HD storage towers 4 and 5 each with a volume 110 m³, that means a storage capacity of approx. 17 t pulp at a consistency of 8 % will be available.

As informed by ITC for storage a maximum of 8 % consistency is allowed for proper operation of the chlorination stage.

For further storage after the bleachers HD Tower number 6 (110 m³) and all three collecting chests (each with 75 m³) will have a storage capacity at 4 % consistency of approx. 13 t pulp. This gives enough room for operational fluctuations.

It shall be noted that due to the small capacity of the existing bleachers the maximum capacity of the mill will be 28,8 t/d. Therefore to reach the desired final capacity 70 ADMT/Day the new bleaching Stage 2 should be implemented as soon as possible.

Stage 2: Installation of the new oxygen delignification and bleaching

Implementation	Effect on production area
Breaking building in area breaker 9 - 12	During this period all available bleachers 1A,1,2,3,4 and 5 are still in operation
Civil works and installation of equipment for oxygen delignification and bleaching	No effect on operation.

5. DESCRIPTION OF RETROFITTING CONCEPT

5.1 Process Design and Description

5.1.1 Digesting

5.1.1.1 Process Description/Technical Data

The jute cutting is fed manually into the spherical digesters. Cooking is done by using the Kraft-AQ-process. After closing the lid cooking liquor is added according to the weight of the jute.

Cooking is done with following cycle:

Jute filling	60 min
Lid tightening	15 min
Chemical charging	60 min
Rotation	30 min
Preheating	90 min
Digesting at temperature	180 min
Connecting blow line	15 min
Blowing	15 min
Lid opening	15 min
Net time	480 min
Spare time	120 min
Total cooking cycle	600 min

After digestion the blow line is connected to the digester and then the pulp is blown out into the top dome of the blow tank. The blowtank has a capacity of 120 m³, that means enough storing time for two digester blows. In the bottom zone the pulp will be mixed and diluted and pumped to the washing section.

For heat recovery there is a two stage condensing / heating system installed. Vapors from blow tank are condensed in a direct condenser with circulated condensate. The condensate heats fresh water in the indirect heat exchanger to approx. 70°C and cools the circulated condensate to 70°C. Contaminated excess water from the condensate tank is led to the effluent treatment plant or to the cooking chemical preparation.

Technical Data:

Pulp production	BDMTD	67,5
Cooking temperature	°C	160 - 165
Digester yield	%	62
Digesting process:		Kraft - AQ
A.A. charge per BDMT jute	% as Na ₂ O	12 - 14
Cooking liquor conc. as Na ₂ O	g/l A.A.	365
Sulphidity	%	20 max.
Antraquinone	% on BD Jute	0,05
Liquor ratio in digester (excl. steam)	t/t	3.5
MP steam pressure (in line)	bar (g)	12
MP steam temperature	°C	200

5.1.1.2 Modifications at Mill

Existing Digesters

Lid: Due to the long closing and opening time for the lid, which has to be bolted with the digester, a new type with quick opening mechanism shall be foreseen.

Blowing:

In the existing installation after cooking the pulp is discharged into a pit and subsequently put manually onto conveyors. By means of two different conveying systems the pulp finally is transported to the breakers. To reduce this discharging time and also to open the pulp fibres a blowing system consisting of new outlet design blow valves, blow lines and a blow tank shall be foreseen.

The outlet flange and blow valve size are 6" (150 mm). The blow pipe size should have a diameter of 8" (200 mm).

Cooking Liquor charging:

To reduce charging time the existing pump should be replaced by a bigger one.

For the suggested modification on the spherical digester see mechanical standard section drawing No. ITC.ZF13.M01/ZAM-2001 E.

5.1.2 Washing, Screening & Cleaning**5.1.2.1 Process Description/Technical Data**

The purpose of the brown stock washing is to wash out the pulp from the used cooking chemicals and dissolved organic material at minimal water consumption. The black liquor from the first filter is collected and pumped to the chemical recovery system.

The brown stock is pumped from the blow tank via a sand separating cyclones through a single washing line, where displacement washing takes place in a counter current flow system comprising of three vacuum washers. The third washer is installed after the screening system and operate as thickener / washer.

Each washer has its own filtrate tank, enabling the filtrate from each washing stage to be kept segregated for individual reuse. The first tank is fitted with a foam breaker.

Filtrate from the first washer is injected, into the blow tank for dilution and at the stock entry to the washing line. Excess liquor is filtered by a black liquor filter before flowing to the recovery plant. Fibres removed by this filter are returned to the 1st stage washer inlet. The filtrate from the second and third washers is, in each case, used as the washing medium for the proceeding stage and for dilution in the intermediate repulpers. In the third stage washing filtrate from O₂-delignification and / or hot water are used.

Screening and Cleaning Plant

The purpose of the screening and cleaning is to remove undigested fibrous material, shives and foreign materials, and other impurities, especially bark. The pre-washed pulp, collected in the brown stock HD-tower, is diluted, mixed and pumped to the primary centrifugal screen. Screening by size will take place in the two-stage screening. Accepted pulp is fed to a stock chest, diluted and pumped to a three stage centricleaner unit in which classification is not made by size but by weight which means that mainly heavy particles like sand, knots, etc. are sorted out.

Accept from first centricleaner stage is brought to the third washer where it will be washed and thickened to approx. 12 % consistency. The third washer consists of 2 vacuum filters one as prethickener and the other one as washer. From there the stock is transferred to the oxygen delignification system.

Rejects from the first pressure screen are screened once more in the secondary stage. Accepts from the secondary screen are brought back to the inlet of primary screen, the rejects will be pumped through a sand separating unit to a vibrating screen. Rejects from the vibrating screen will be discharged and accepted fibre will flow back to the secondary screen.

The reason for installing the sand separating unit is to reduce the sand content in the recirculated fibers to avoid accumulation of fine sand in the system.

The filtrate of the third brown stock washer is pumped and used in the second brown stock washer as wash water.

The third washer uses filtrate from the O₂-delignification or alternatively hot water.

Technical Data:

Screening and cleaning losses	%, max.	2.0
Consistency after thickener (third brown stock washer)	%	12
Dilution factor	t/t	3.0

5.1.2.1 Modifications at Mill

The new screening, and cleaning and the third washer/thickener will be located in the area bleachers 6, 7, 8 and Cl₂-Towers. The necessary breaking of the equipment and building will be done. The existing chlorine washer will be used as first washer. For connecting the first washer with the second existing washer the existing chlorine washer needs to be lifted by approx. 1 m. Connection between both filters will be done by a pipe with inline pump. (A typical pump for this purpose is shown in Article 6.2.) Using this pump eliminates the use of an intermediate chest before pumping to the next washer.

For the existing HD towers two will be further used as storage towers between second washer and screening. The advantage of this arrangement is to use the existing filters without to much modifications and/or relocations and to have some storage area in case there is an upset in the screening room. Therefore it is not necessary to shut down the digester area.

The third HD towers should be used as black liquor filtrate tank for the first washer. As the place in this area is very limited another filtrate can not be accomodated.

5.1.3 Oxygen Delignification & Bleaching

5.1.3.1 Process Description/Technical Data

The technical concept of oxygen delignification and post oxygen washing is made in order to combine the advantage of oxygen delignification with the effect of counter-current washing.

Advantages of proposed system are as follows:

- ◆ Selective delignification to lower Kappa number
- ◆ Elimination of chlorinated organic compounds formed in bleach plant
- ◆ Utilization of the heat value of dissolved organic solids from the oxygen stage with simultaneous recovery of inorganic chemicals used in oxygen bleaching
- ◆ Reduction of the effluent load

Screened pulp from the third brown stock washer, drops into the stand pipe of the MC-pump and is pumped via oxygen mixer to the bottom of the oxygen reactor. Low pressure steam is uniformly distributed in the stand pipe to reach nearly the reaction temperature at approx. 85 °C.

In the pipe line between the MC pump and oxygen mixer the pulp is heated to 95°C with medium pressure steam and mixed with caustic soda and oxygen gas in the oxygen mixer.

In the oxygen reactor, having 10 - 12 % inlet consistency, 60 min. retention time and 4 bar (g) of discharge pressure, the pulp is performed to delignification with oxygen.

The pulp is blown from the oxygen reactor to a blow tank, diluted and fed to the first post oxygen wash filter. As wash water filtrate from the second post oxygen wash filter is used. Pulp from the first wash filter is diluted, mixed and transferred to the second wash filter by an intermediate repulper.

The washed and dewatered pulp from the second post oxygen wash filter drops, after adding of H₂SO₄ to the repulper, directly into the A-tower of the bleaching plant.

Design Criteria

Consistency

The pulp fiber matrix formed in a consistency range of 11 - 14 % has been found to be optimal for retaining gas bubbles and maintaining plug flow. At consistencies below 10 %, channelling may occur in the reactor. Above 14 %, fluidization of the pulp slurry becomes difficult, resulting in a loss of high shear mixing efficiency. Therefore, equipment capable of handling these consistencies, such as BELOIT's HI™-Shear Mixer, is critical in this application.

Oxygen Mixing

Good mixing occurs when the chemical is efficiently distributed throughout the pulp fiber matrix and gas bubbles are sheared to the smallest possible diameter. This enhances diffusion by providing the largest surface area between the reactants. This requires that the oxygen bubbles formed during high shear mixing be small enough to provide the maximum surface area available. The amount of oxygen addition also plays an important role since coalescing of the gas bubbles commences when oxygen occupies more than 30 % of the total volume. This reduces the gas contact surface area and increases the risk of channelling.

Reactor Design

The primary criteria for the reactor design is to provide effective pressure control at the mixer while minimizing the risk of channelling. To minimize reactor channelling and assure plug flow, the height to diameter ratio, or aspect ratio is kept within strict guidelines. In addition, a transition cone is provided at the reactor bottom eliminating the requirement of a mechanical bottom distributor.

Bleaching Plant

The bleaching plant is designed for a three stage sequence: A - EOP - P

Washed and dewatered pulp from second oxygen washer drops directly into the A-tower. H₂SO₄ will be added at the repulper of the second washer.

The A-tower is designed as an down flow tower. At the bottom of the tower the pulp is mixed, diluted and pumped to the A-washer.

After washing and dewatering NaOH, DTPA, MgSO₄ are added in the repulper. After the repulper the pulp drops into a steam mixer to obtain the required temperature for the EOP-stage. After the steam mixer the pulp drops into the stand pipe of the MC-pump where O₂ and is added. H₂O₂ is added in the Peroxide mixer located after the MC-pump.

Via the MC-pump the pulp is transferred to a pressurized EOP-pretube. The pressure in the pre-tube is maintained by a pressure control valve, which acts as a blow valve to the down flow EOP-tower.

In the bottom of the EOP-tower pulp is diluted, mixed and pumped to the EOP-washer. After washing and thickening MgSO₄, DTPA and NaOH are added.

Before entering the down flow P-tower H₂O₂ is added in a mixer.

In the bottom of the P-tower pulp is diluted, mixed and pumped to the P-washer. After washing and thickening SO₂-water is added.

In the repulper dilution water is added and the pulp drops into a stock chest. From there the pulp is pumped to the three existing HD-towers ahead of the paper machine. Above of the three existing HD Towers the existing LAMORT Press (which is now installed at line No. 1 washing area can be installed. This press increases the consistency to approx. 8 % and therefore the storage capacity ahead of the paper machine can be increased.

Technical Data

Ingoing Kappa	approx.	14
Kappa number to Bleach Plant	approx.	8
Bleaching losses total	%	6.0
Final brightness of bleached pulp	% ISO	82 - 84
Estimated COD-Load to effluent	kg/BDMT	20

Process Data		O	A	EOP	P
NaOH	kg / BDMT	15		15	7,5
Oxygen	kg / BDMT	18		5	
SO ₂	kg / BDMT				0-3 *
H ₂ SO ₄	kg / BDMT		10		
H ₂ O ₂	kg / BDMT			30	10
DTPA	kg / BDMT			2	2
MgSO ₄	kg / BDMT			2	2
Retention time	minutes	60	30	15 + 150	180
Temperature	°C	95	70	85	90
Consistency	%	10	10	10	10

* For acidification of pulp - depending on paper machine requirements

5.1.3.2 Modifications at Mill

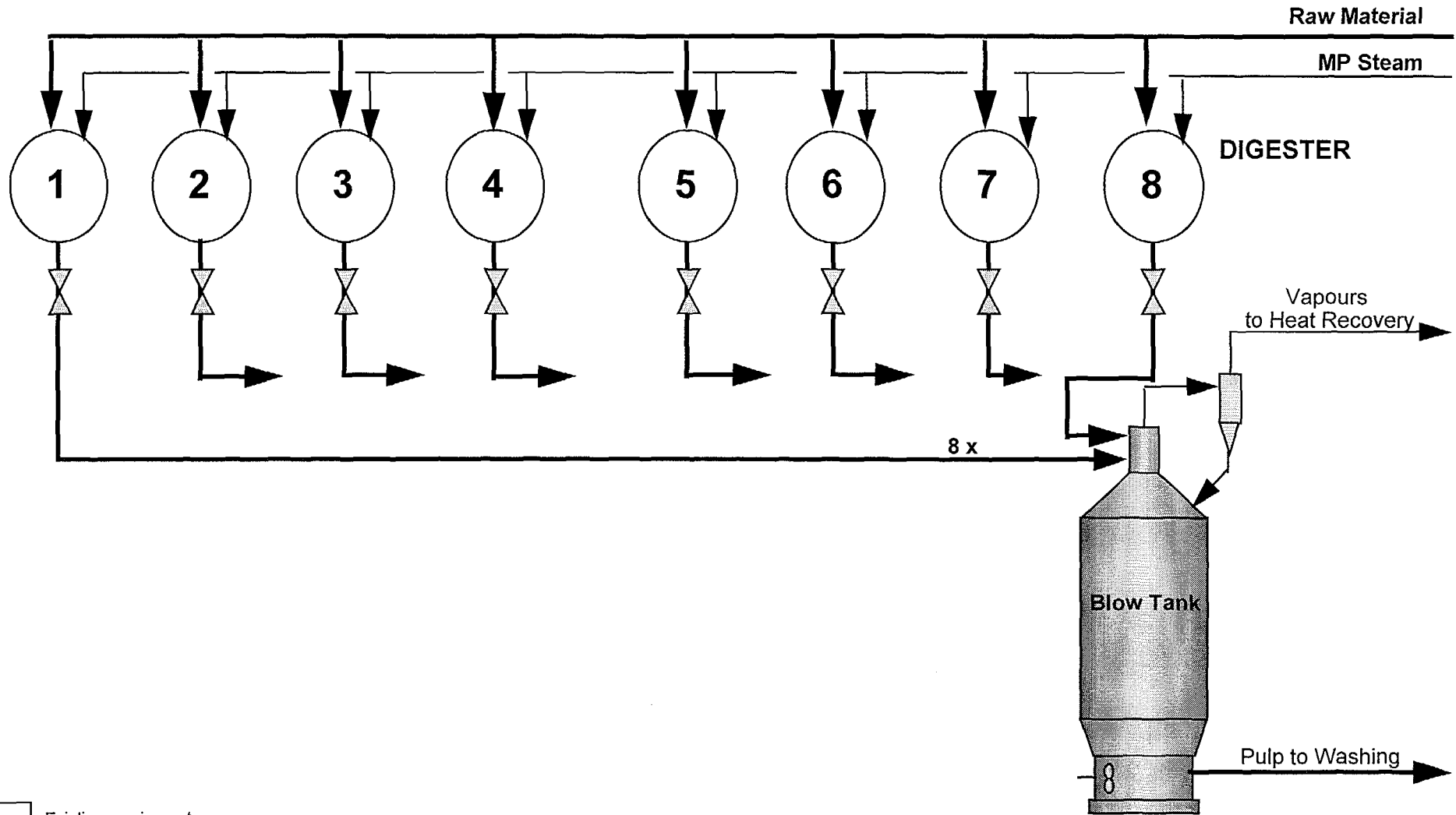
The existing building in the area of Breakers 9 - 12 will be made available. It will be necessary to break the existing building and the equipment. After breaking the existing building a complete new building has to be made.

Enclosure

Simplified flow diagrams (Retrofitting) - 7 sheets

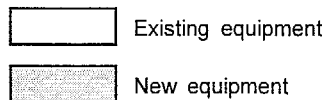
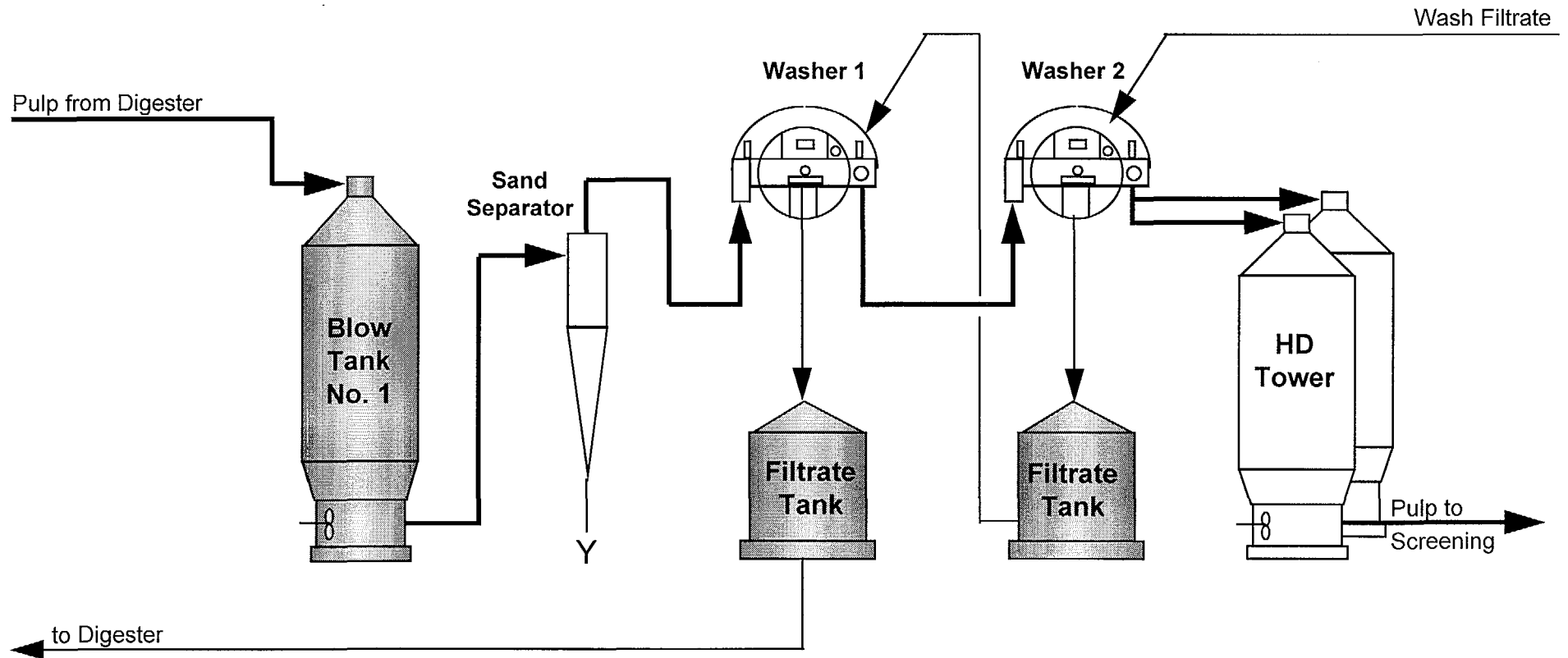
TRIBENI - RETROFITTING CONCEPT

DIGESTING FLOW DIAGRAM



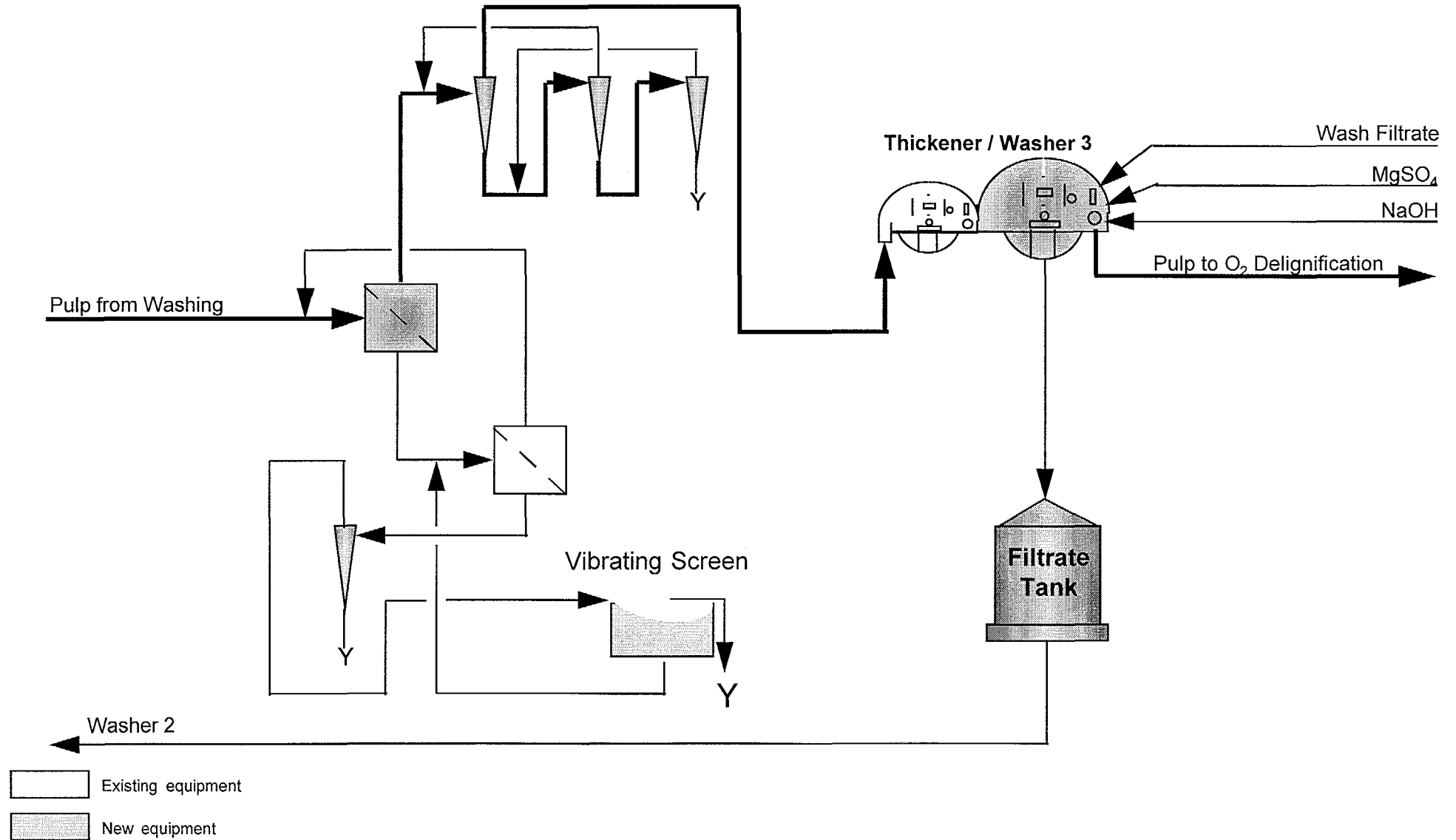
- Existing equipment
- New equipment

TRIBENI - RETROFITTING CONCEPT WASHING PLANT



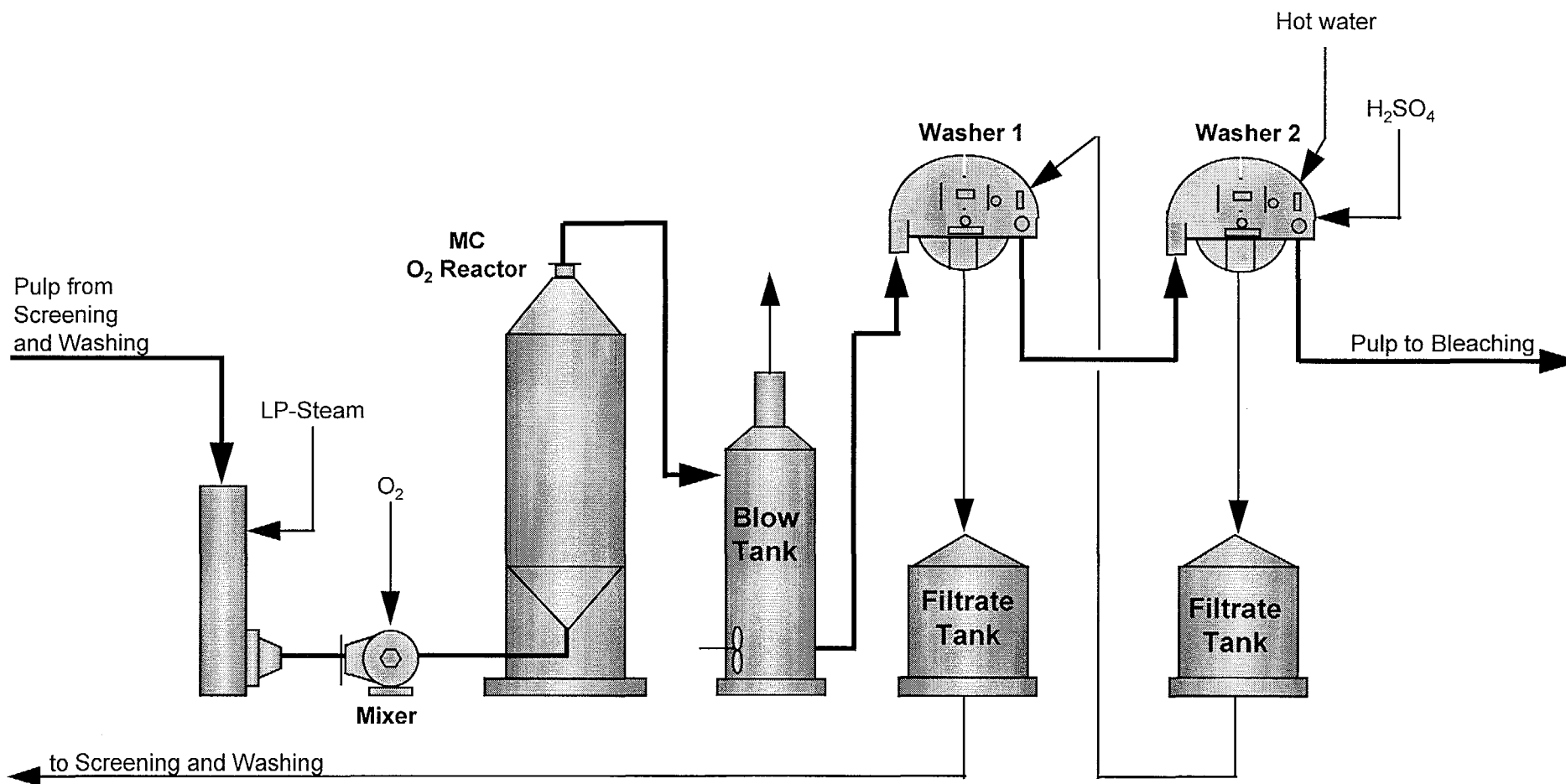
TRIBENI - RETROFITTING CONCEPT

SCREENING AND WASHING



TRIBENI - RETROFITTING CONCEPT

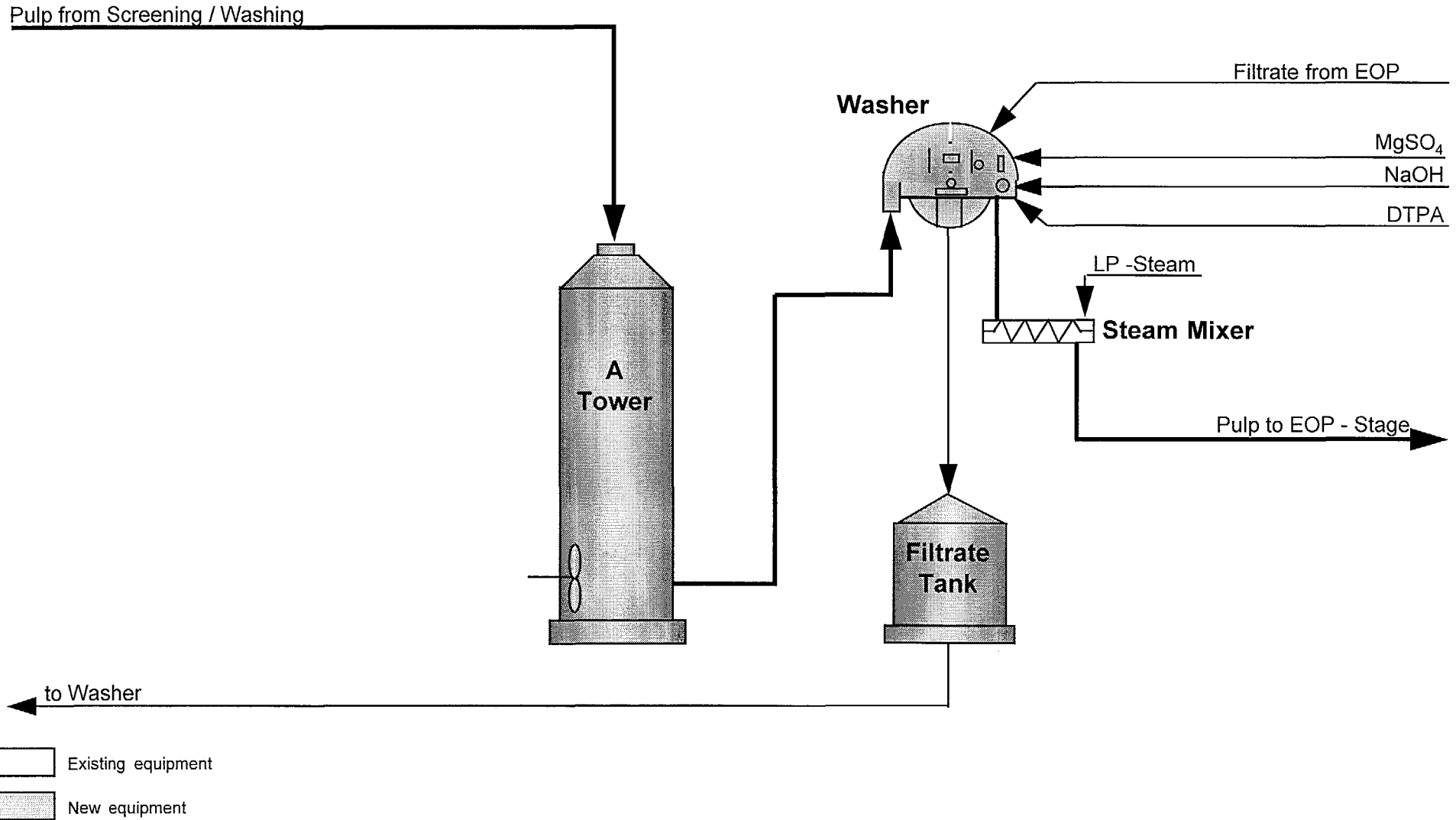
MC - OXYGEN DELIGNIFICATION



- Existing equipment
- New equipment

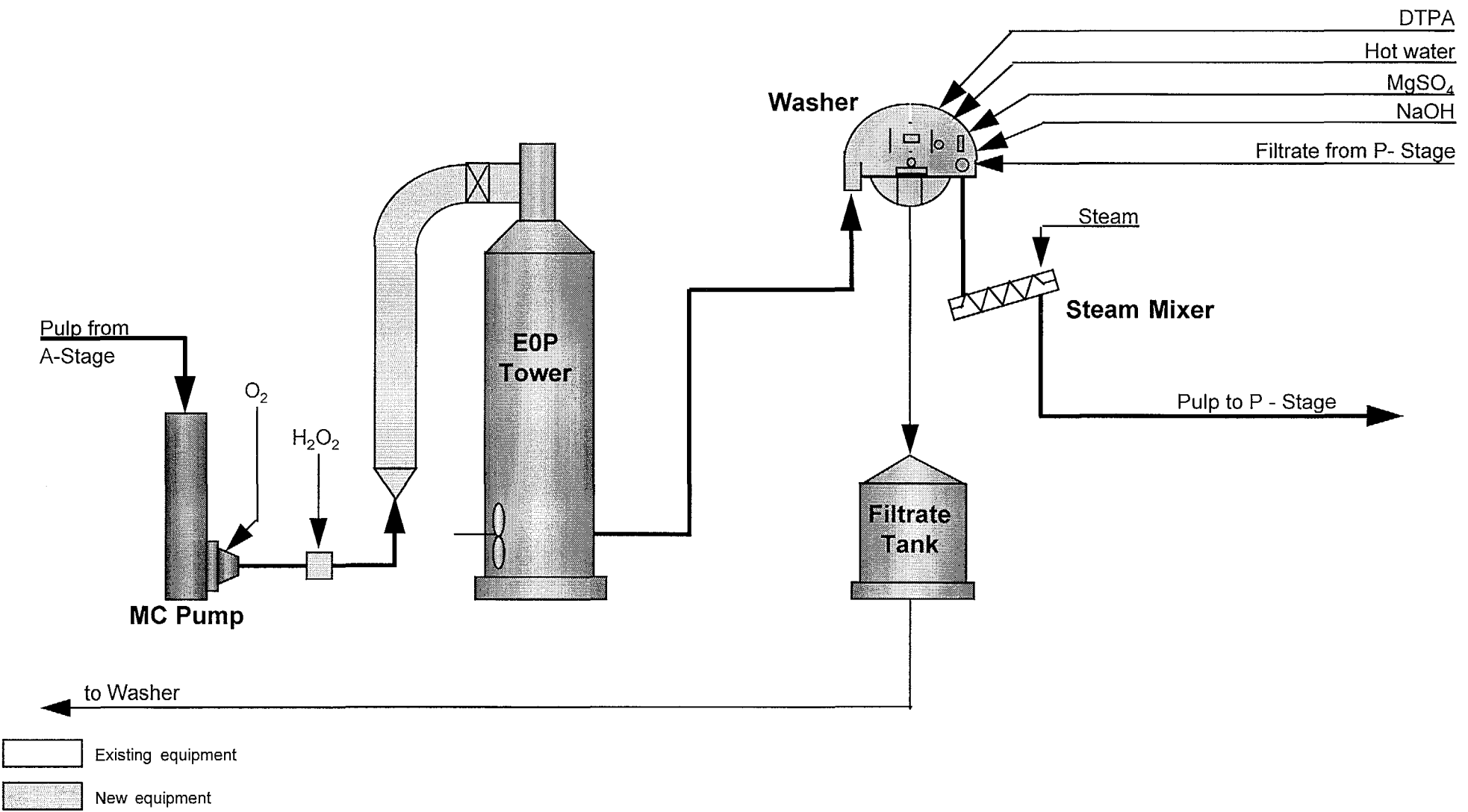
TRIBENI - RETROFITTING CONCEPT

BLEACH PLANT - A - STAGE



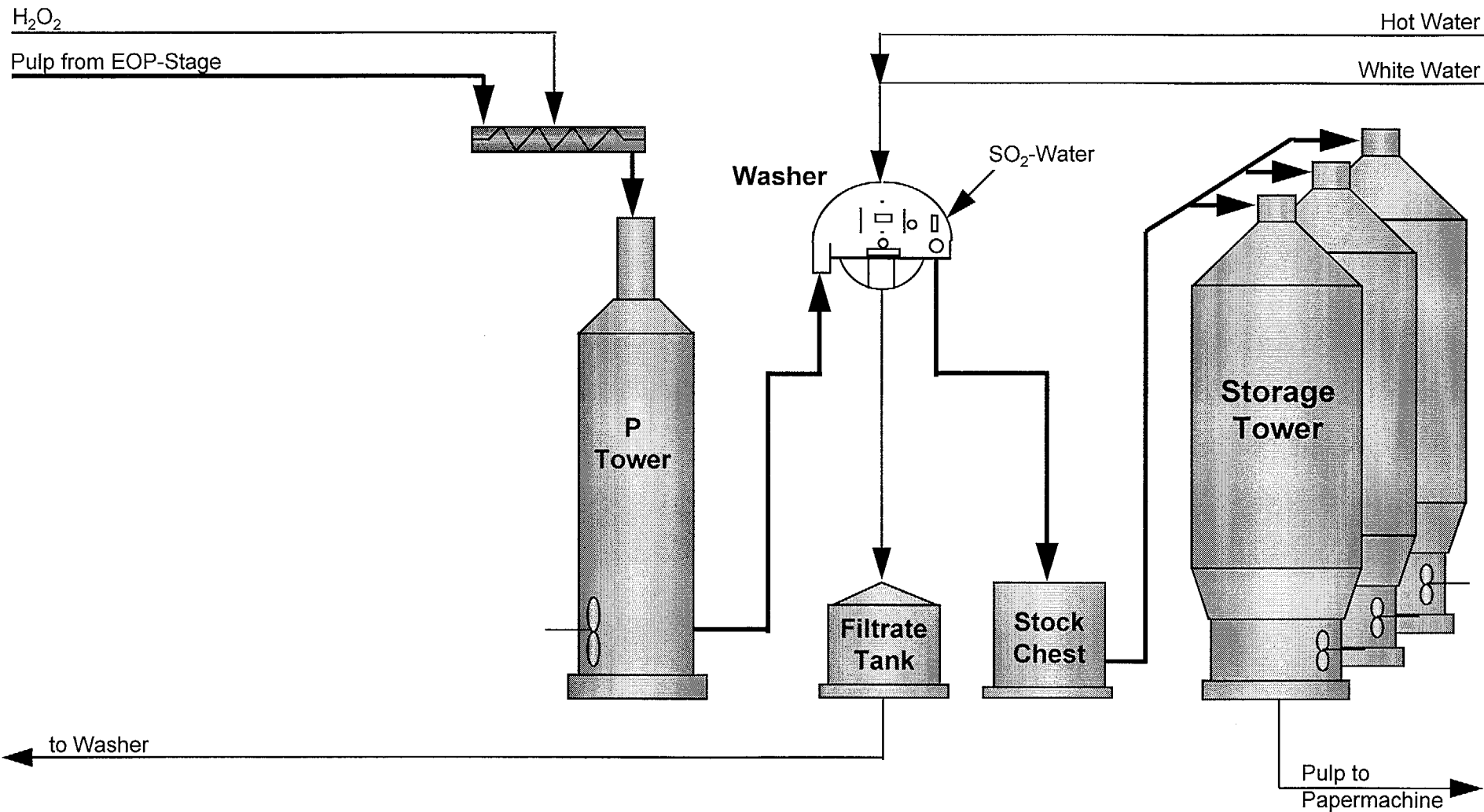
TRIBENI - RETROFITTING CONCEPT

BLEACH PLANT - EOP - STAGE



TRIBENI - RETROFITTING CONCEPT

BLEACH PLANT - P - STAGE



- Existing equipment
- New equipment

5.2 Material Balance

Attachment:

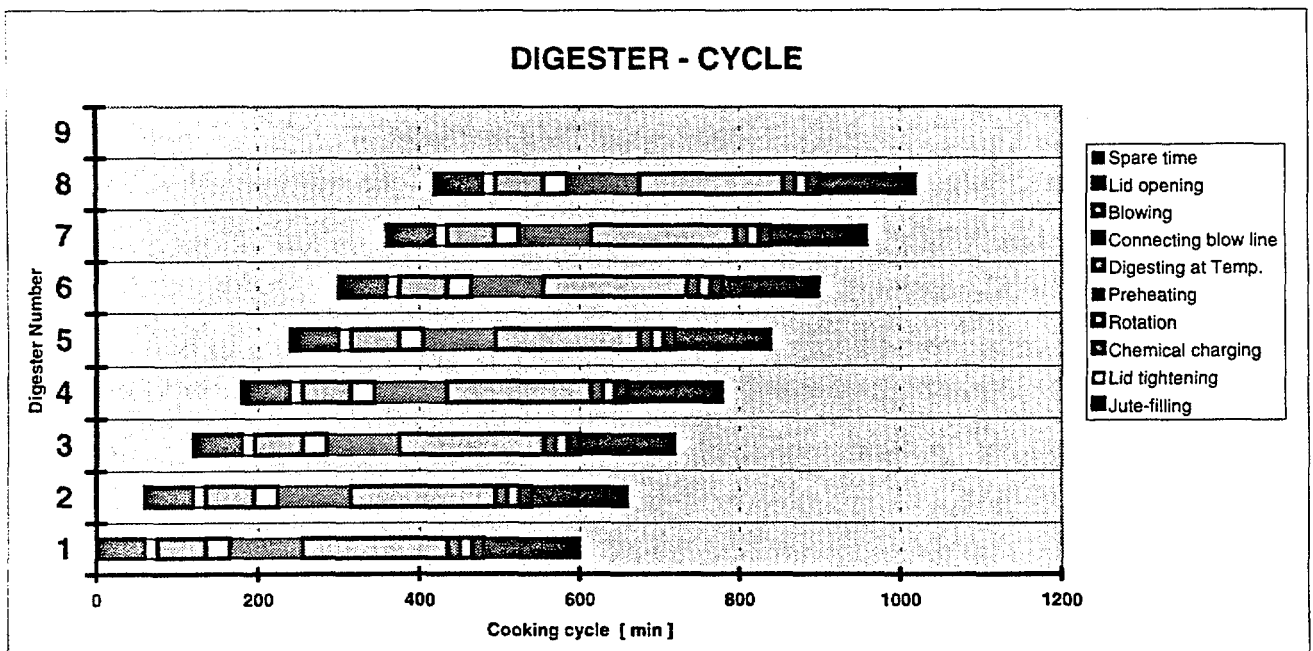
Calculation of cooking cycle	1 page
Material flow diagrams	8 pages
Steam balance	2 pages

Calculation of Cooking Cycle

Capacity, bleached	67,5	BDMTD	bleached	75,0	ADMTD
Capacity, Digester house	73,3	BDMTD	unbleached	81,4	ADMTD
Screening yield	98,0%				
Bleaching yield	94,0%				
Digester yield	62,0%				
Digester input	118	BDMTD	Batches/day required	nr.	18,47
Bulk Density	160	kgBD/m3	Batches/day available	nr.	19,20
Digester volume	40	m3			
Digester feed	6,400	BDMT/Batch			
Capacity/Digester	3,968	BDMT/Batch			

COOKING-CYCLE	
	Durat.[min] selected
Jute-filling	60,0
Lid tightening	15,0
Chemical charging	60,0
Rotation	30,0
Preheating	90,0
Digesting at Temp.	180,0
Connecting blow line	15,0
Blowing	15,0
Lid opening	15,0
Spare time	120,0
Total	600,0
Shift of Sequence	60,0
Batches/Digester and Day	2,40
Batches/Day for Production	18,47
Batches/day available	19,20

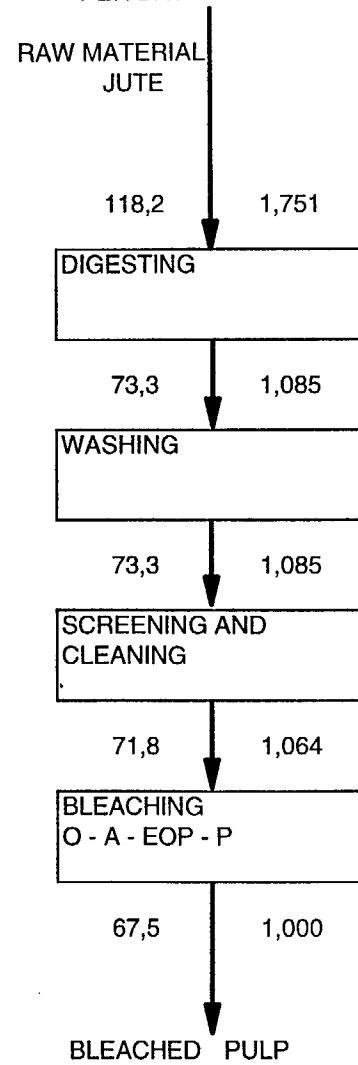
480,0 without spare time



PRELIMINARY
FIBER BALANCE DIAGRAM FOR
BLEACHED CHEMICAL PULP

Project: **TRIBENI**

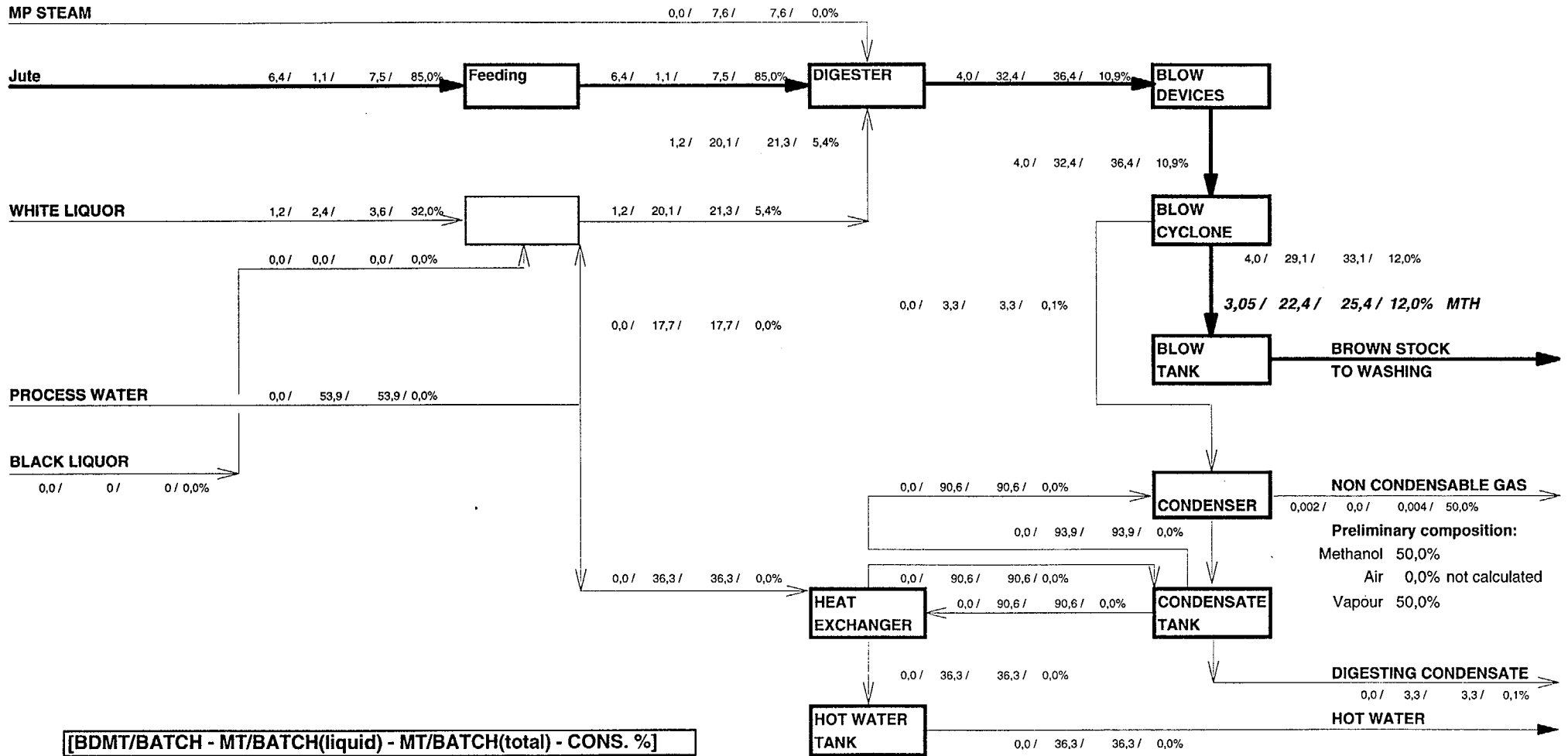
FIBRE BALANCE IN BDMT
PER DAY PER TON



COOKING PROCESS: Kraft-AQ
BLEACHING SEQUENCE: O - A - EOP - P

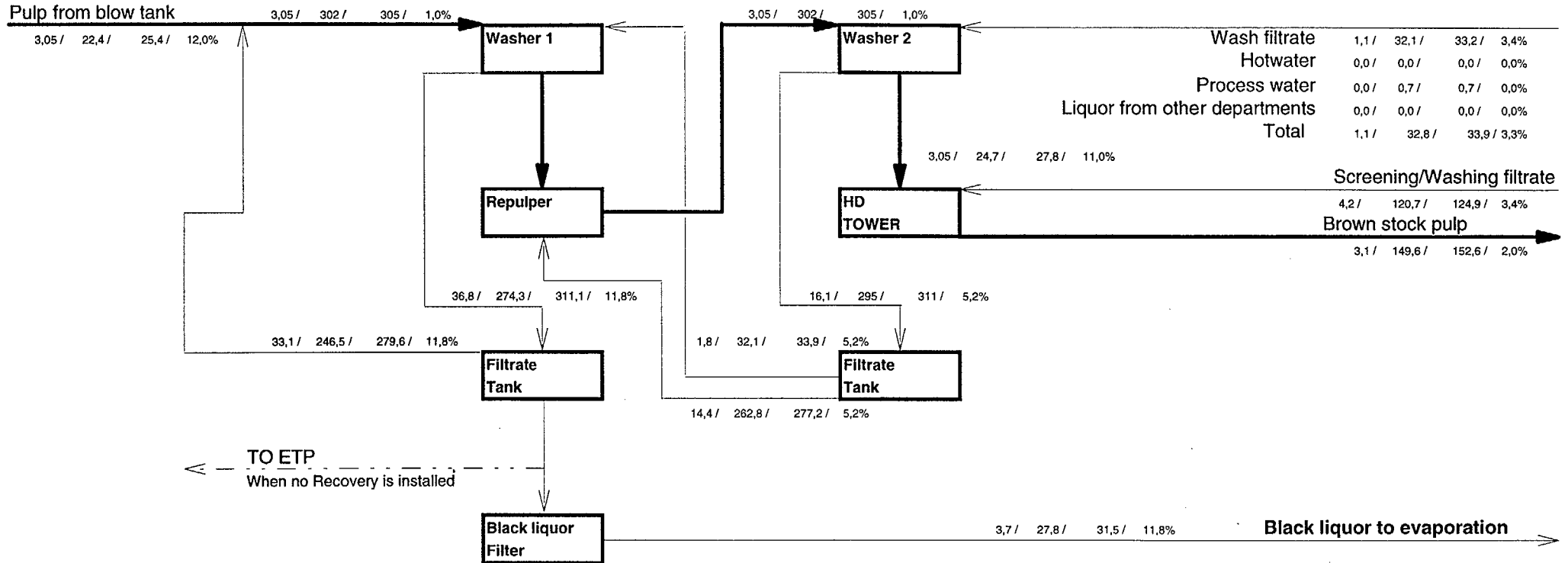
Project: **TRIBENI** ; **Jute**

TYPE OF LIQUID FOR HYDROMODUL: Water



NON CONDENSABLE GAS
 0,002 / 0,0 / 0,004 / 50,0%
Preliminary composition:
 Methanol 50,0%
 Air 0,0% not calculated
 Vapour 50,0%

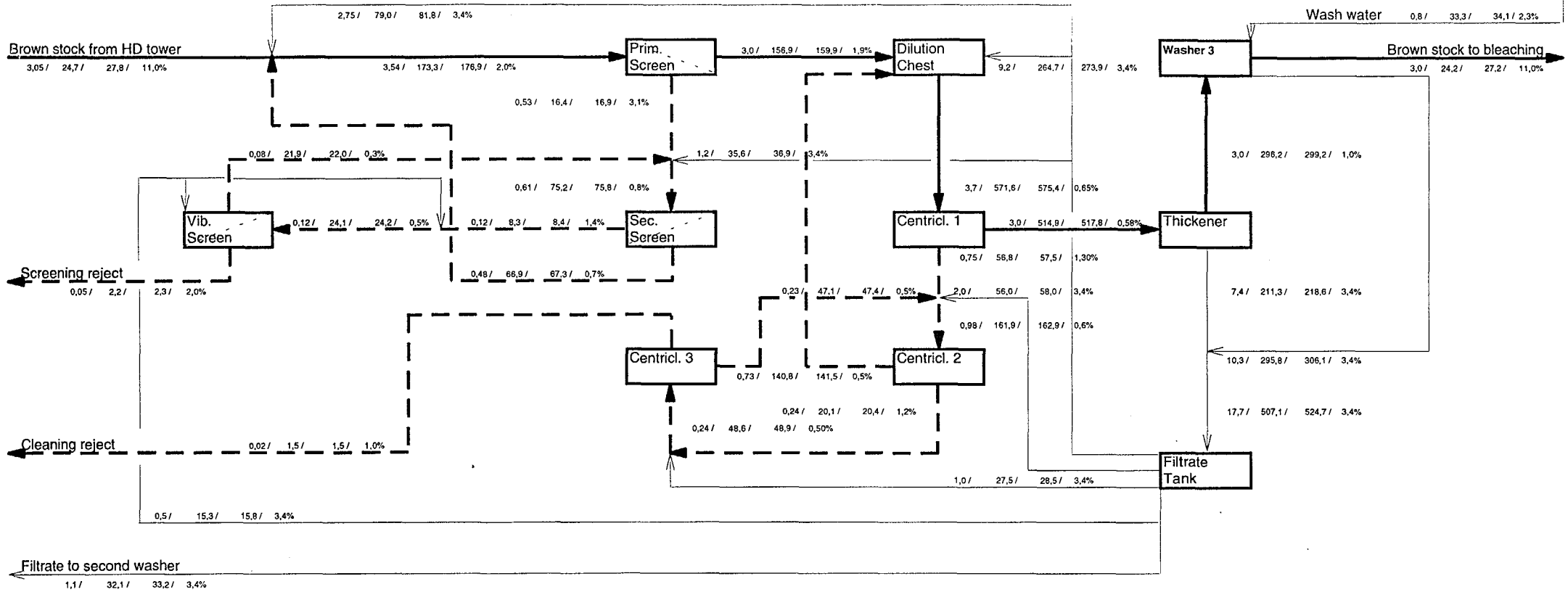
Project: **TRIBENI**
PRELIMINARY



[BDMTH/MTH(liquid)/MTH(total)/CONS. %]

Project: TRIBENI
PRELIMINARY

Oxygen delignification filtrate	0,8 /	32,1 /	32,9 /	2,4%
Hotwater	0,0 /	0,0 /	0,0 /	0,0%
Process water	0,0 /	1,2 /	1,2 /	0,0%
Liquor from other departments	0,0 /	0,0 /	0,0 /	0,0%
Wash water	0,8 /	33,3 /	34,1 /	2,3%



[BDMTH/MTH(liquid)/MTH(total)/CONS. %]

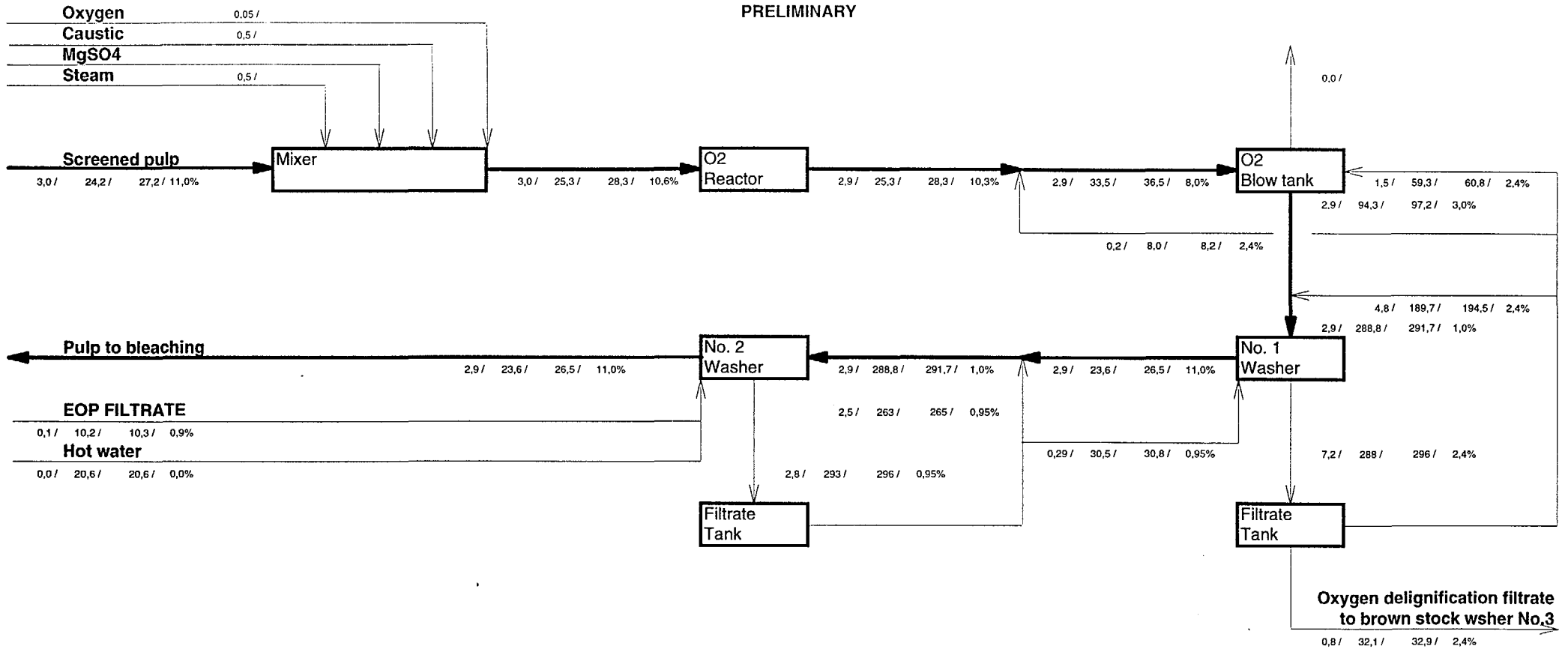
PROCESS CALCULATION

OXYGEN DELIGNIFICATION

IVA/TP/NAGA

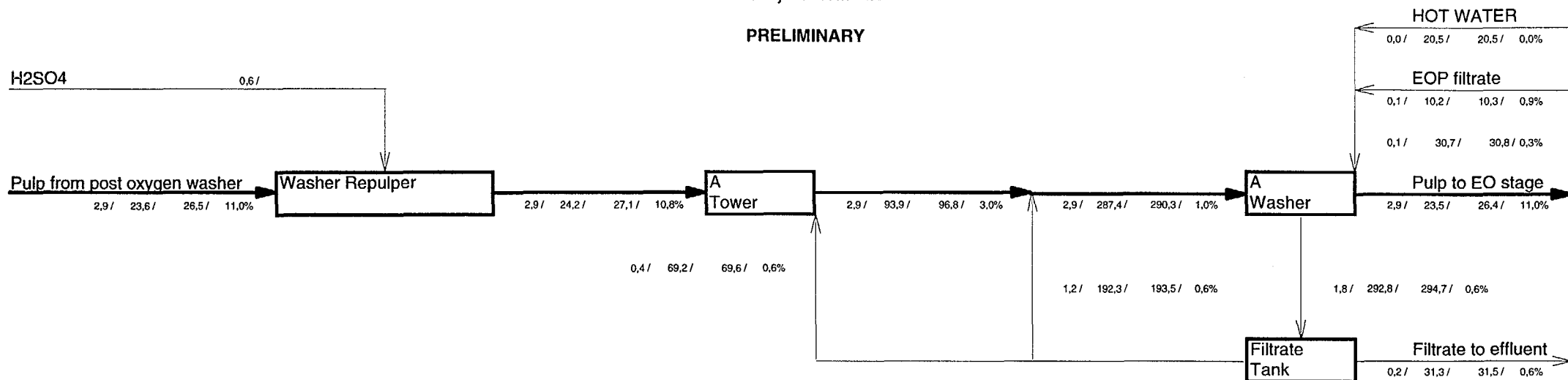
Project: TRIBENI

PRELIMINARY

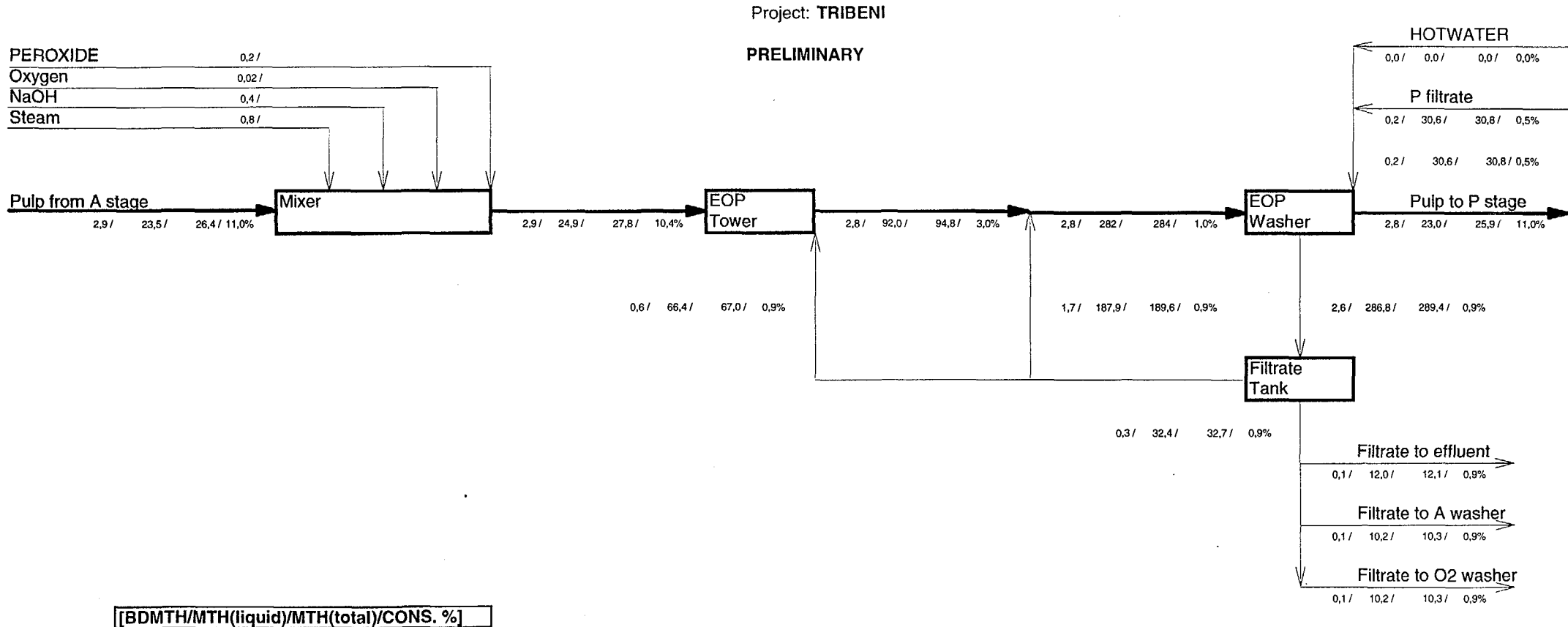


BDMTH/MTH(liquid)/MTH(total)/CONS. %]

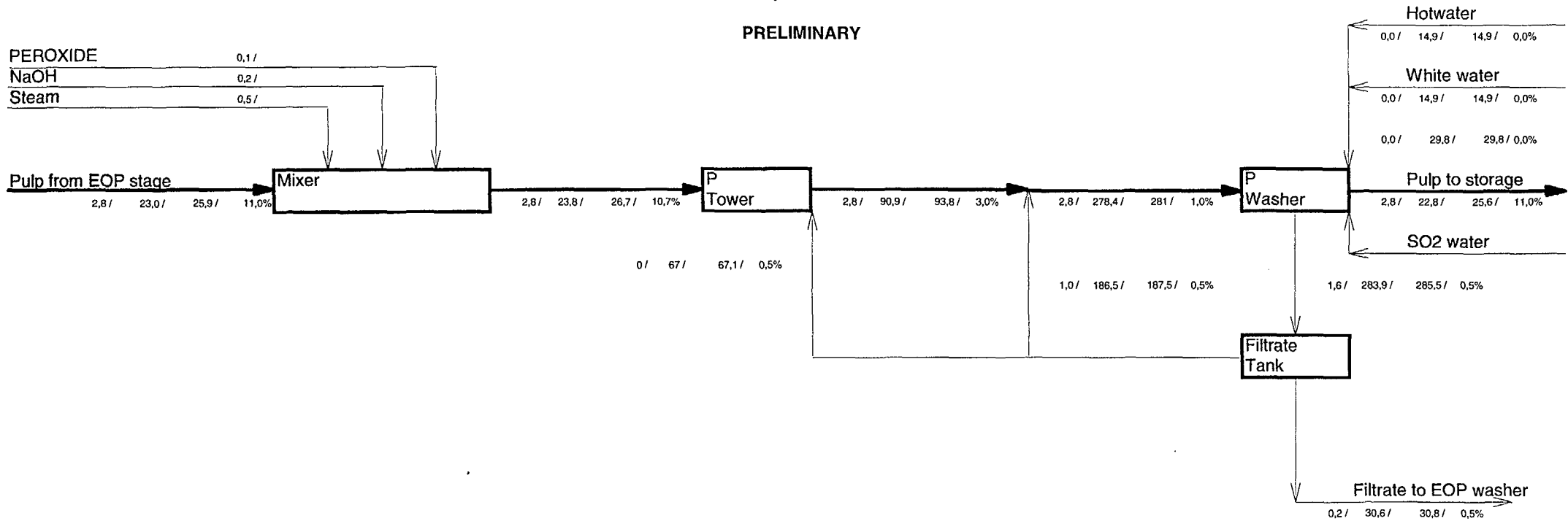
Project: **TRIBENI**
PRELIMINARY



[BDMTH/MTH(liquid)/MTH(total)/CONS. %]

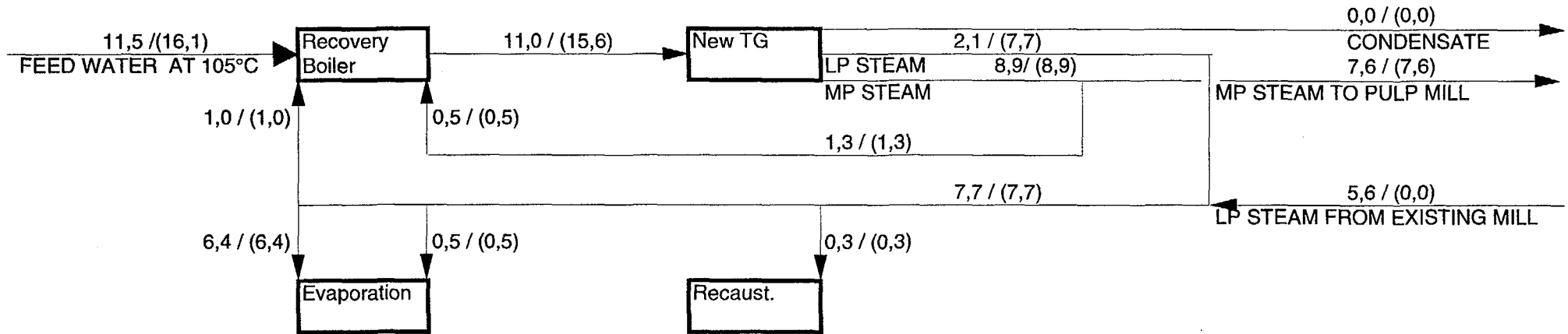


Project: TRIBENI
PRELIMINARY



[BDMTH/MTH(liquid)/MTH(total)/CONS. %]

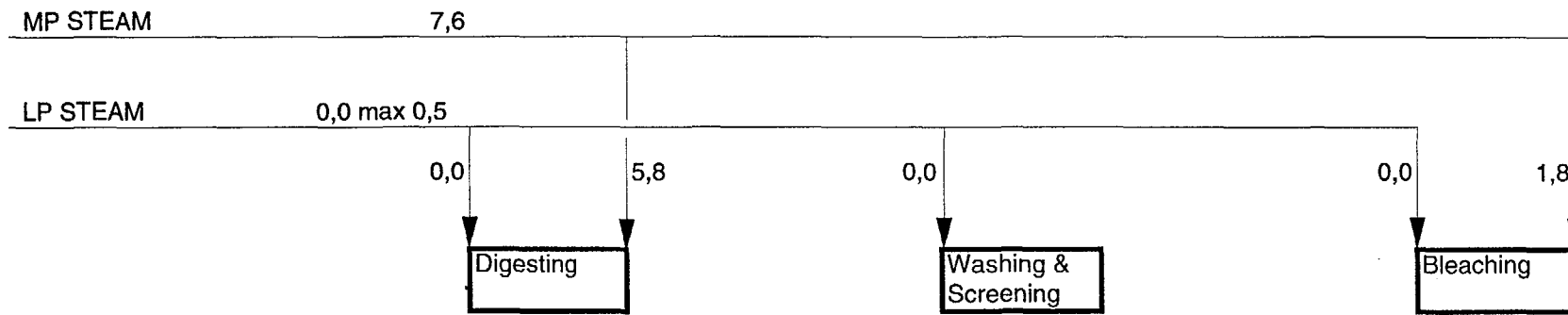
PRELIMINARY STEAM BALANCE FOR CHEMICAL RECOVERY NORMAL OPERATION



[MTH WITHOUT OIL FIRING/MTH WITH OIL FIRING]

NOTE: Recovery boiler can be operated with a load carrying fuel oil burners to cover the total requirement of the pulp mill. In this case no steam is required from the existing power plant.

PRELIMINARY STEAM BALANCE FOR FIBER LINE NORMAL OPERATION

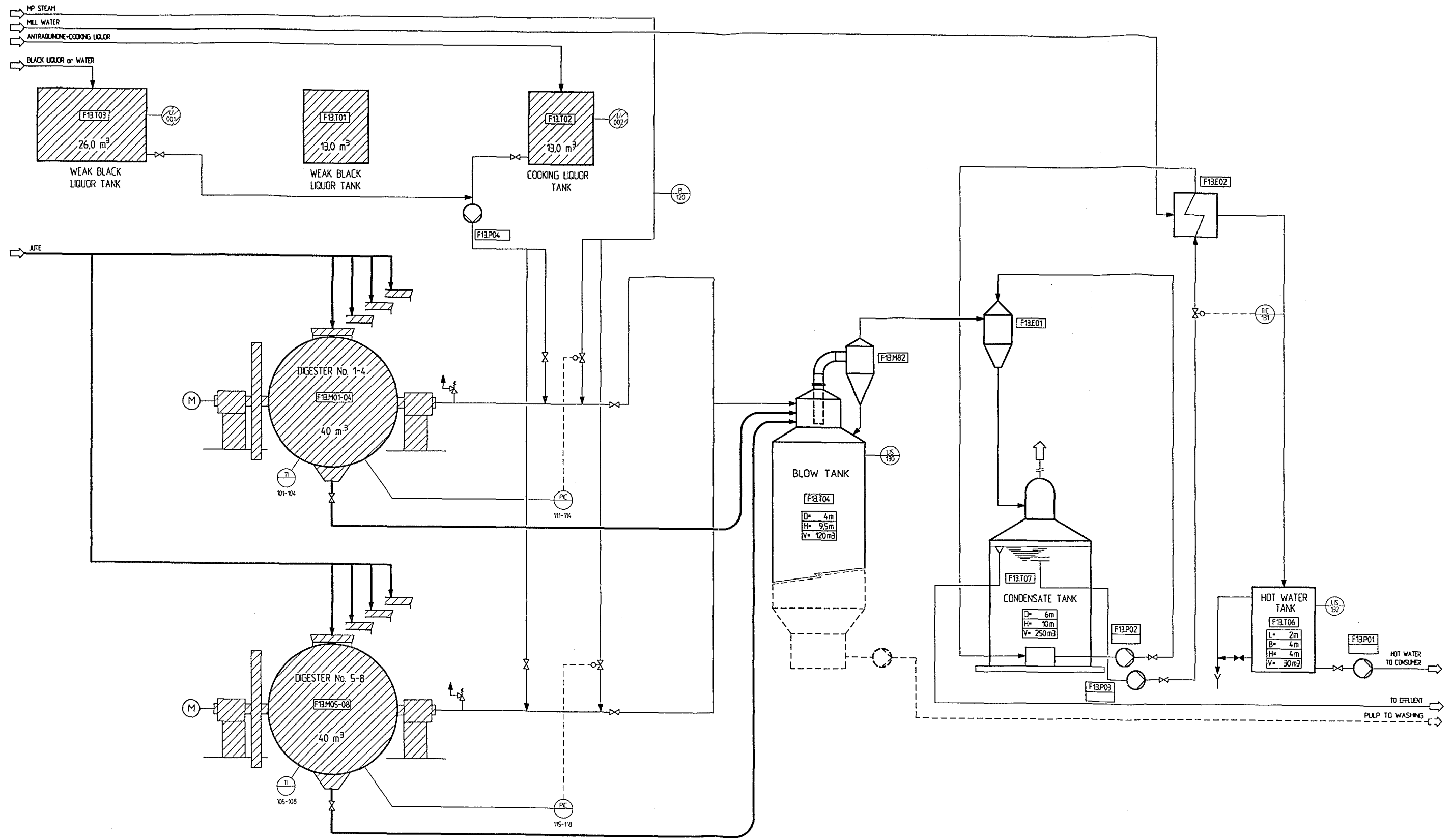
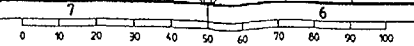


All data in MTH

5.3 Process Flow Diagrams

Attachment:

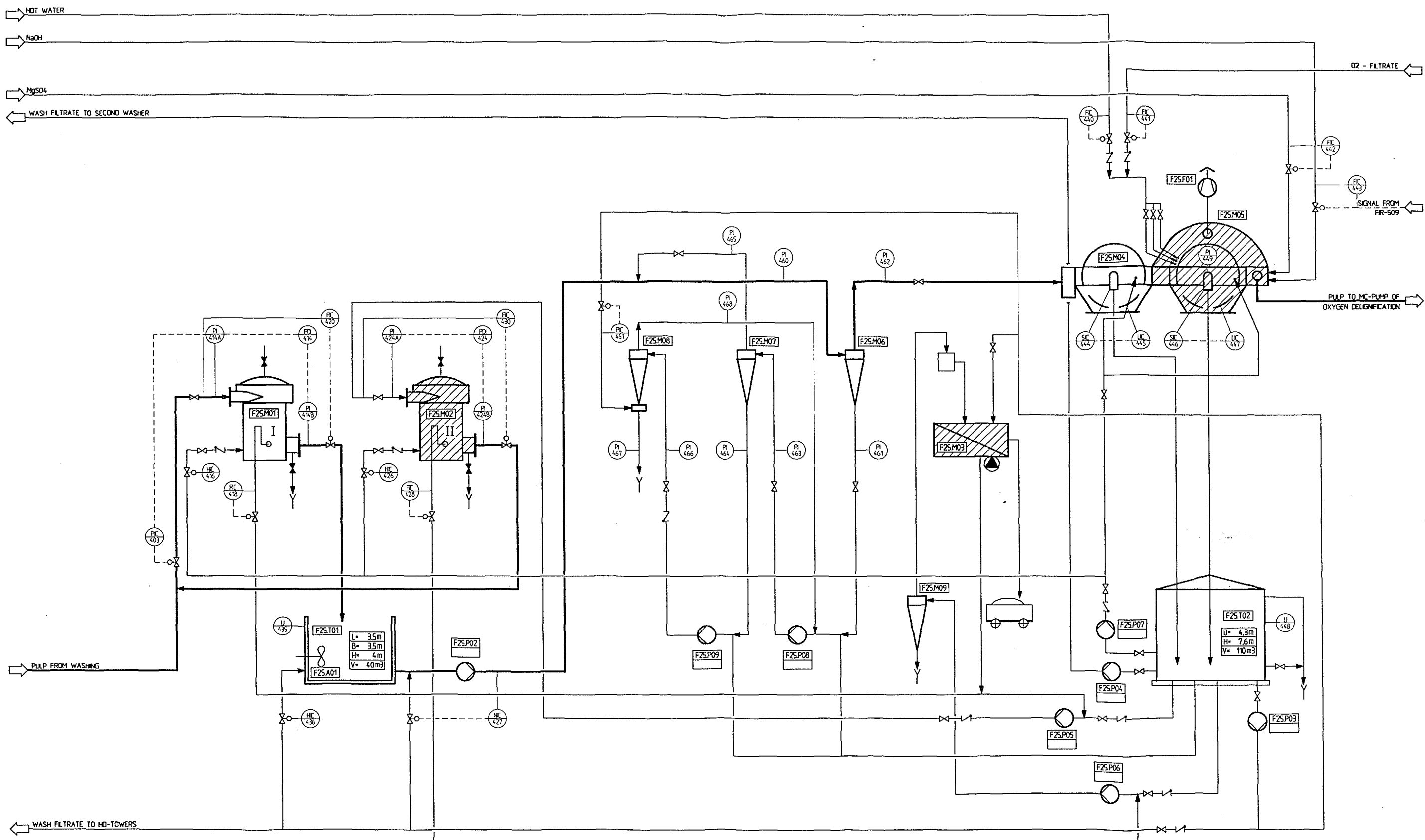
Digester System	ITC.ZF13/ZVV 2001 E	Rev. a
Washing Plant	ITC.ZF31/ZVV 2001 E	Rev. b
	ITC.ZF31/ZVV 2002 E	Rev. a
Stock Screening	ITC.ZF25/ZVV 2001 E	Rev. a
Oxygen Delignification	ITC.ZF41/ZVV 2001 E	Rev. b
	ITC.ZF41/ZVV 2002 E	Rev. b
Bleaching Plant	ITC.ZF43/ZVV 2001 E	Rev. a
	ITC.ZF43/ZVV 2002 E	Rev. b
	ITC.ZF43/ZVV 2003 E	Rev. a



LEGEND:
 [White Box] NEW EQUIPMENT
 [Hatched Box] EXISTING EQUIPMENT, USED WITH NO OR MINOR MODIFICATIONS

PRELIMINARY

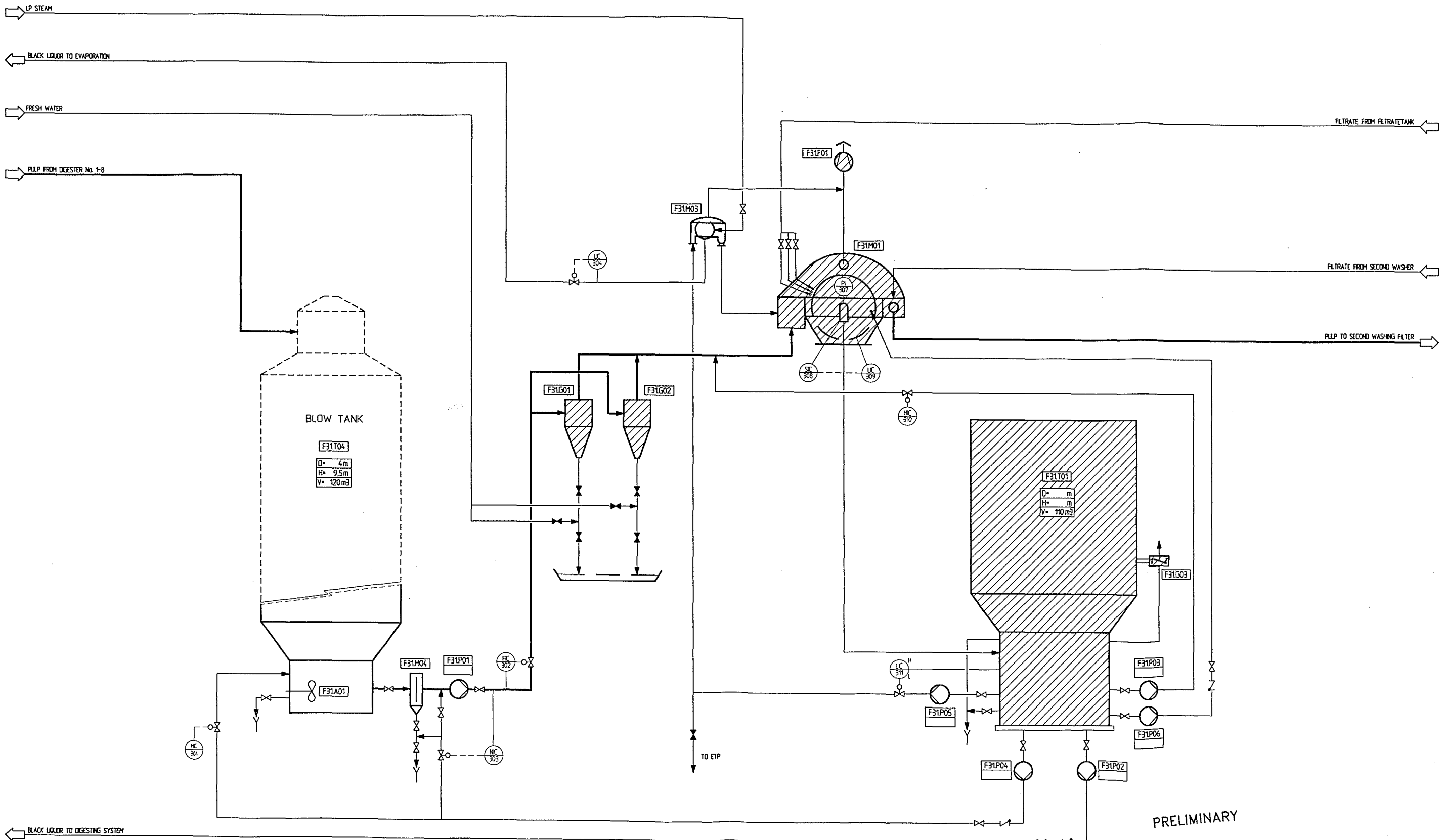
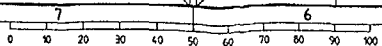
WATER IN BL. TANK ADD. AND INSTR. CHANGED		22.5.97	kn	kr
Working Revision	Aut. & No. of Mod.	Designer	Checked	Drawn
7.11.96		ESEPYOVA		
7.11.96		KREINDL		
Project/Client		Phase II : RETROFITTING DIGESTER SYSTEM		
Tribeni		Flow-sheet		
ITCZFB / ZVV 2001 E		A1		



LEGEND:
 [Empty Box] NEW EQUIPMENT
 [Hatched Box] EXISTING EQUIPMENT, USED WITH NO OR MINOR MODIFICATIONS

PRELIMINARY

a		SIGNAL FROM FR-509 ADD. & INSTR. CHANGED		26.5.97	KN	KR
Installing	Area & Pos.	Instrument	Position	Order Date	Revised by	Checked by
Drawn	7.11.96	CSEPYOVA				
Checked	7.11.96	KRENOL				
Project/Client		Phase II : RETROFITTING STOCK SCREENING		IVVA		
Drawing Title		FLOWSHEET		IVVA		
Customer/Order No.		ITCZF25 / ZV 2001 E		IVVA		

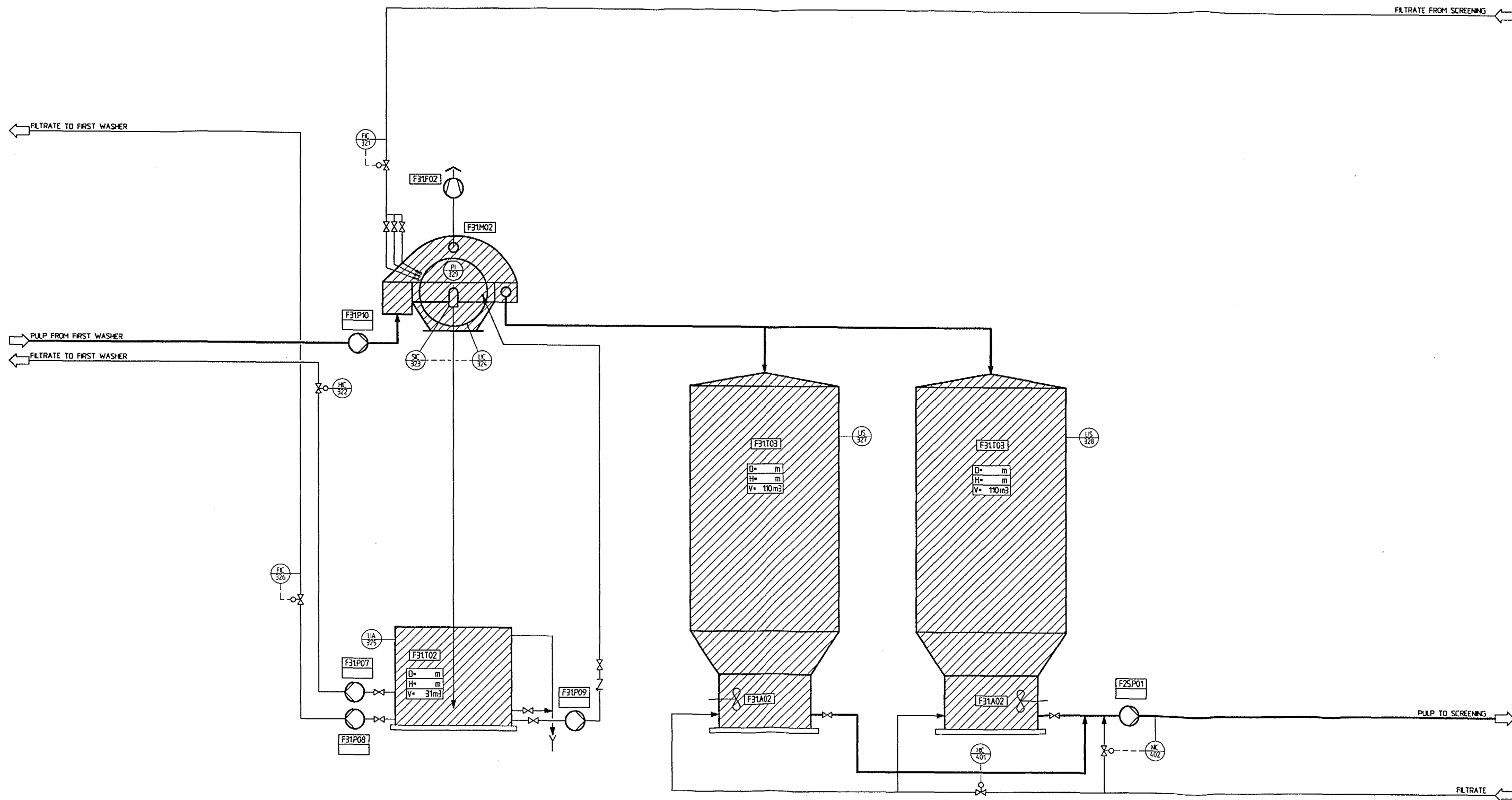
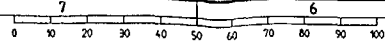


LEGEND:

- NEW EQUIPMENT
- EXISTING EQUIPMENT, USED WITH NO OR MINOR MODIFICATIONS

PRELIMINARY

b	EQUIPM. NO. ADD.	19.97	kn	kr
a	PI 307 ADD.	25.5.97	kn	kr
Interim Revision	Doc. No. at POC	Interim/ Production	Drawn Date	Checked Date
7.11.96	ESEPI/DVA			
7.11.96	KRENOL			
Project/Client		Phase II : RETROFITTING WASHING PLANT FLOWSHEET		
ACAD - PART: TRWAS1		ITCZF31 / ZVW 2001 E		

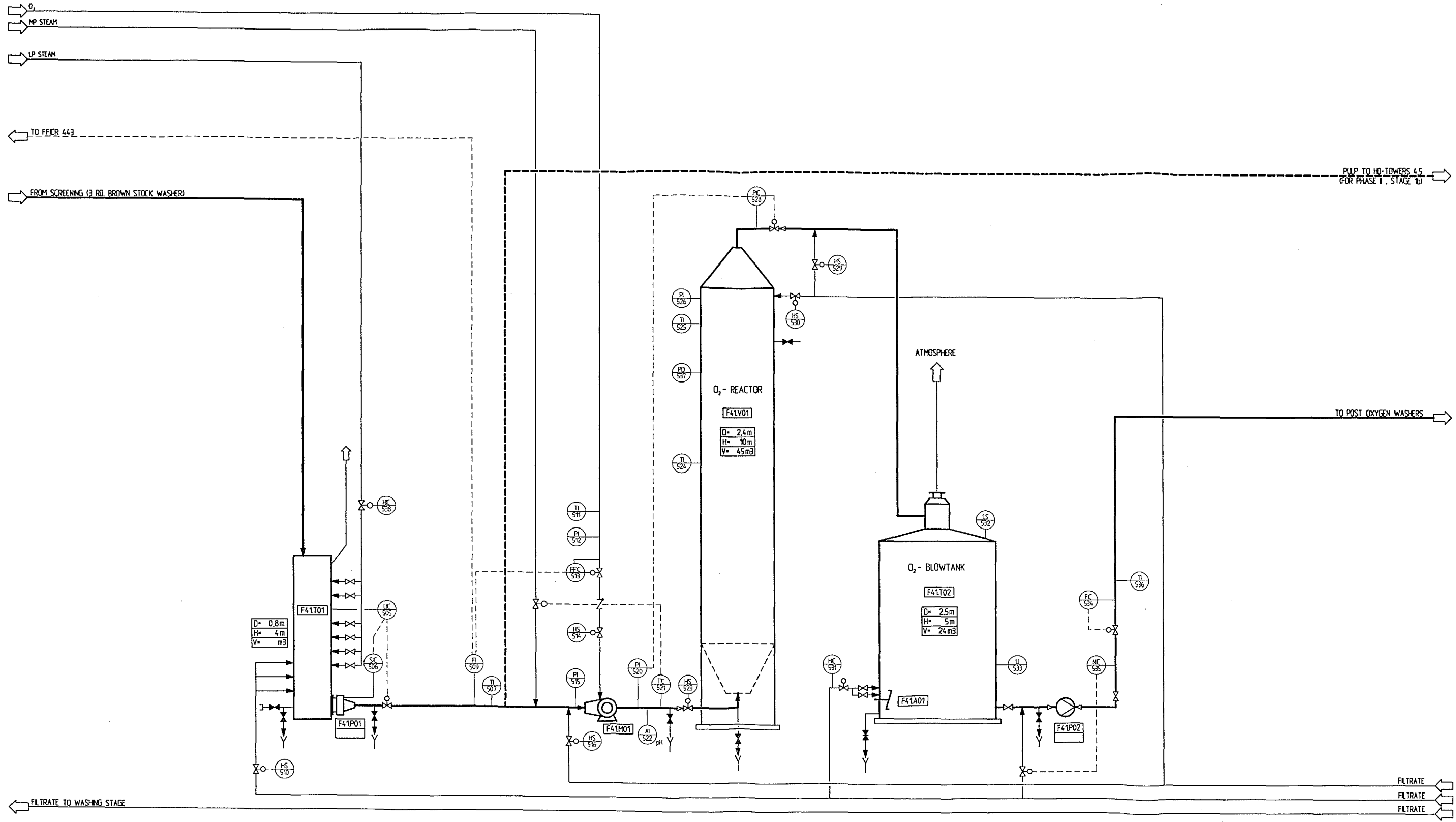
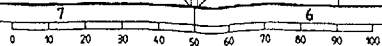


LEGEND:

- NEW EQUIPMENT
- EXISTING EQUIPMENT, USED WITH NO OR MINOR MODIFICATIONS

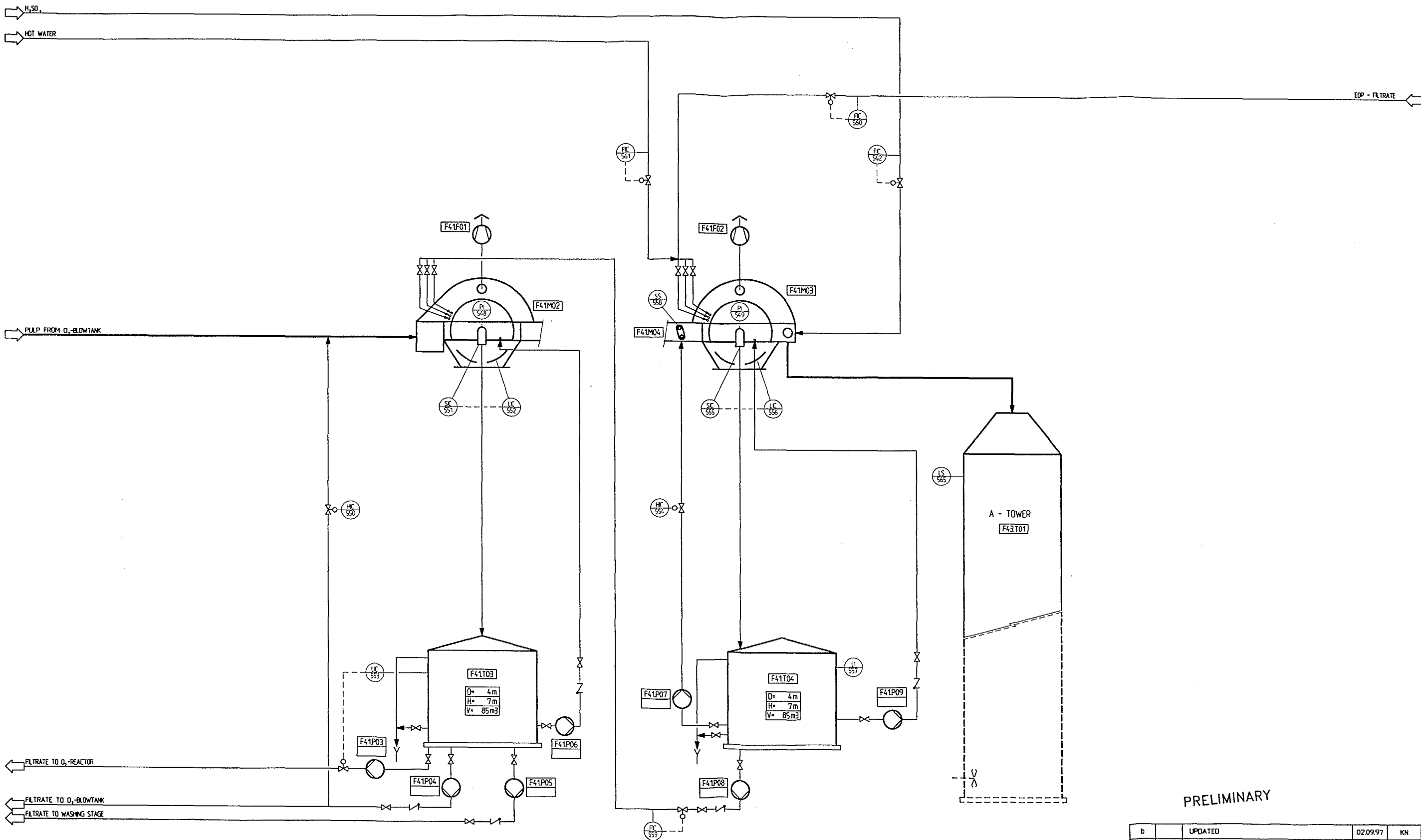
PRELIMINARY

a		INSTR. CHANGED		26.5.97	KN	KR
Intending Revision	Area & No. of Pict.	Inventor/Manufacturer		Date	Checked by	Checked by
Date	Name	Inventor/Manufacturer				
7.11.96	ESEPYOVA	Inventor/Manufacturer				
7.11.96	KRENOL	Inventor/Manufacturer				
Project/Owner		Inventor/Manufacturer		Name/Title		
TRIBENI		PHASE II : RETROFITTING WASHING PLANT		Inventor/Manufacturer		
		FLOWSHEET		Name/Title		
Customer/Doc. No.		NA-Doc. No.		Scale	Sheet No.	Number of Sheets
		ITCZF31 / ZVV 2002 E		A1	8	8



LEGEND:
 [Solid Line] NEW EQUIPMENT
 [Hatched Line] EXISTING EQUIPMENT, USED WITH NO OR MINOR MODIFICATIONS

PRELIMINARY					
b	UP DATED	19.97	KN	KR	
a	INSTR. CHANGED	26.05.97	KN	KR	
Inventory	Rev. 4. the No. of Plot	Inventory/Modification	Date	Inventory/Modification	Checked by
Design	31.10.96	CSEPYOVA			
Checked	31.10.96	KRENDL			
TRIBENI		O2 - DELIGNIFICATION		IVA	
Flowsheet		Flowsheet		Flowsheet	
Customer/Doc. No.	IVA-Doc. No.	ITCZF41 / ZVV 2001 E	Scale	Sheet	Inventory
				A1	b



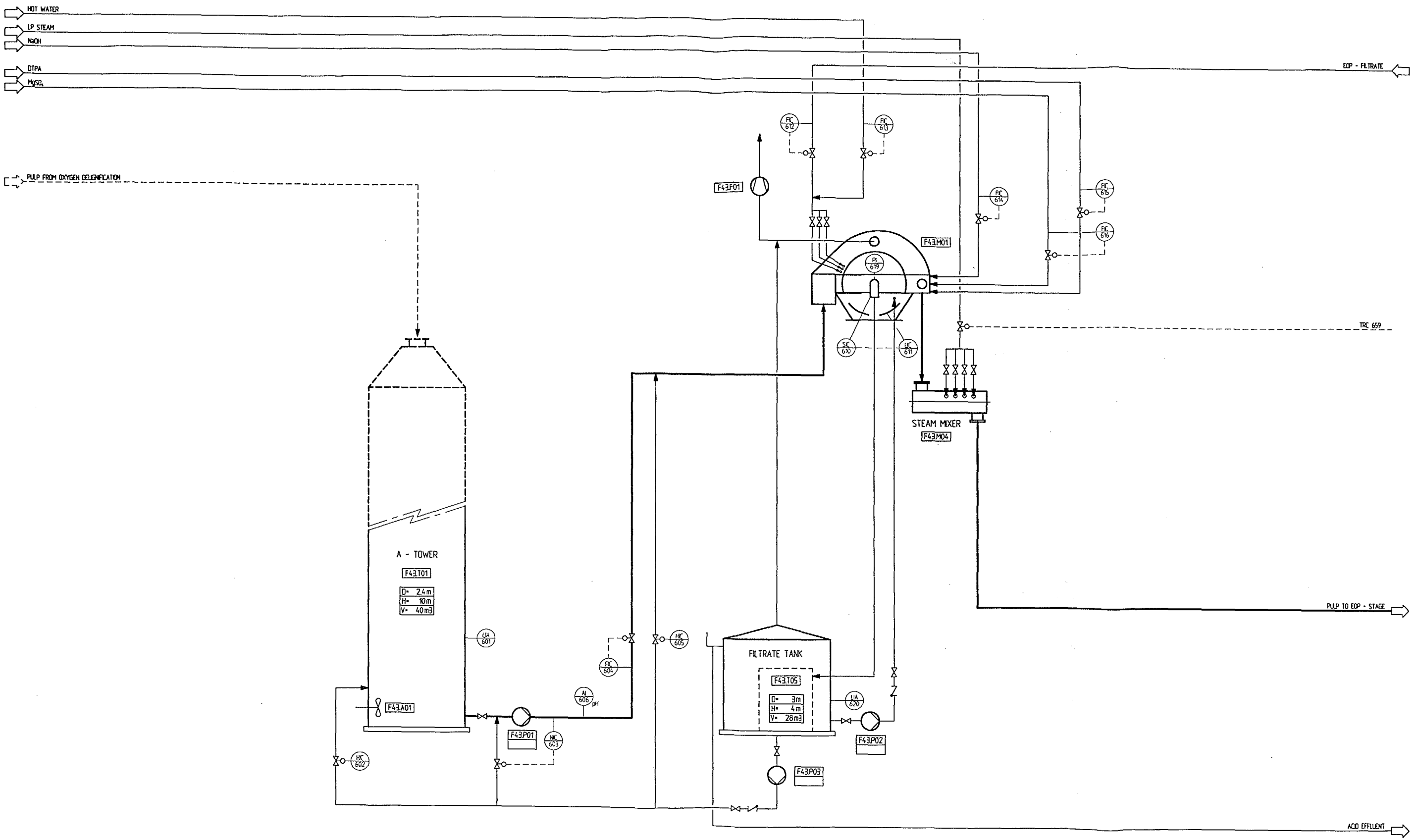
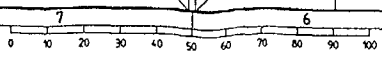
LEGEND:

- NEW EQUIPMENT
- EXISTING EQUIPMENT, USED WITH NO OR MINOR MODIFICATIONS

PRELIMINARY

0	UPDATED	02.09.97	KN	KR
1	INSTR. CHANGED	26.5.97	KN	KR
2	DESIGN			
3	CONSTRUCTION			
4	OPERATION			
5	MAINTENANCE			
6	REPAIR			
7	REPLACEMENT			
8	REMOVAL			
9	OTHER			
10	REVISION			
11	REVISION			
12	REVISION			

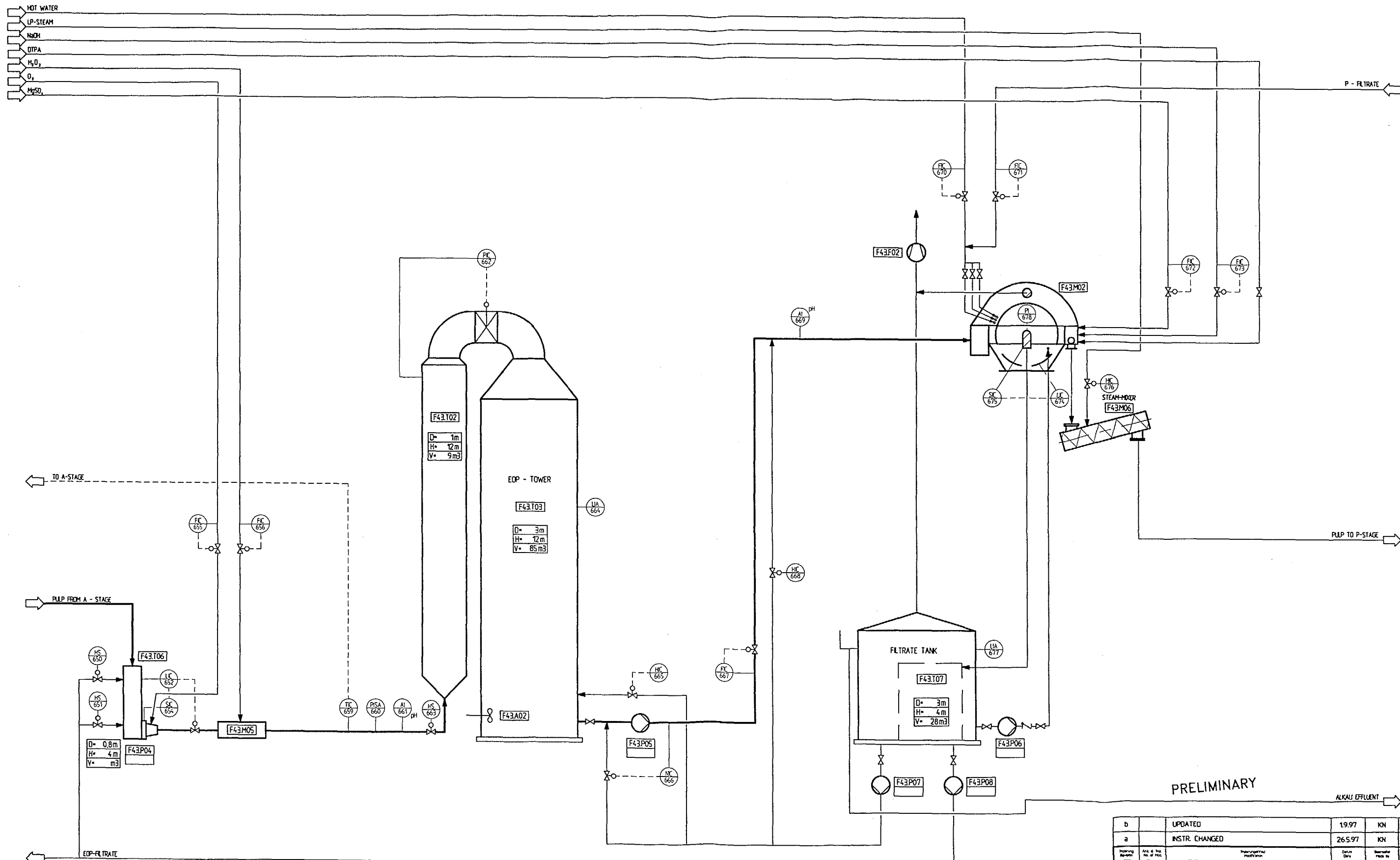
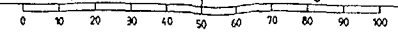
Project/Client	TRIBENI	Project/Phase	O2 - DELIGNIFICATION
Customer/Doc. No.	ITCZF41 / ZVV 2002 E	Sheet No.	A1
Scale		Author	b



LEGEND:
 NEW EQUIPMENT
 EXISTING EQUIPMENT, USED WITH NO OR MINOR MODIFICATIONS

PRELIMINARY

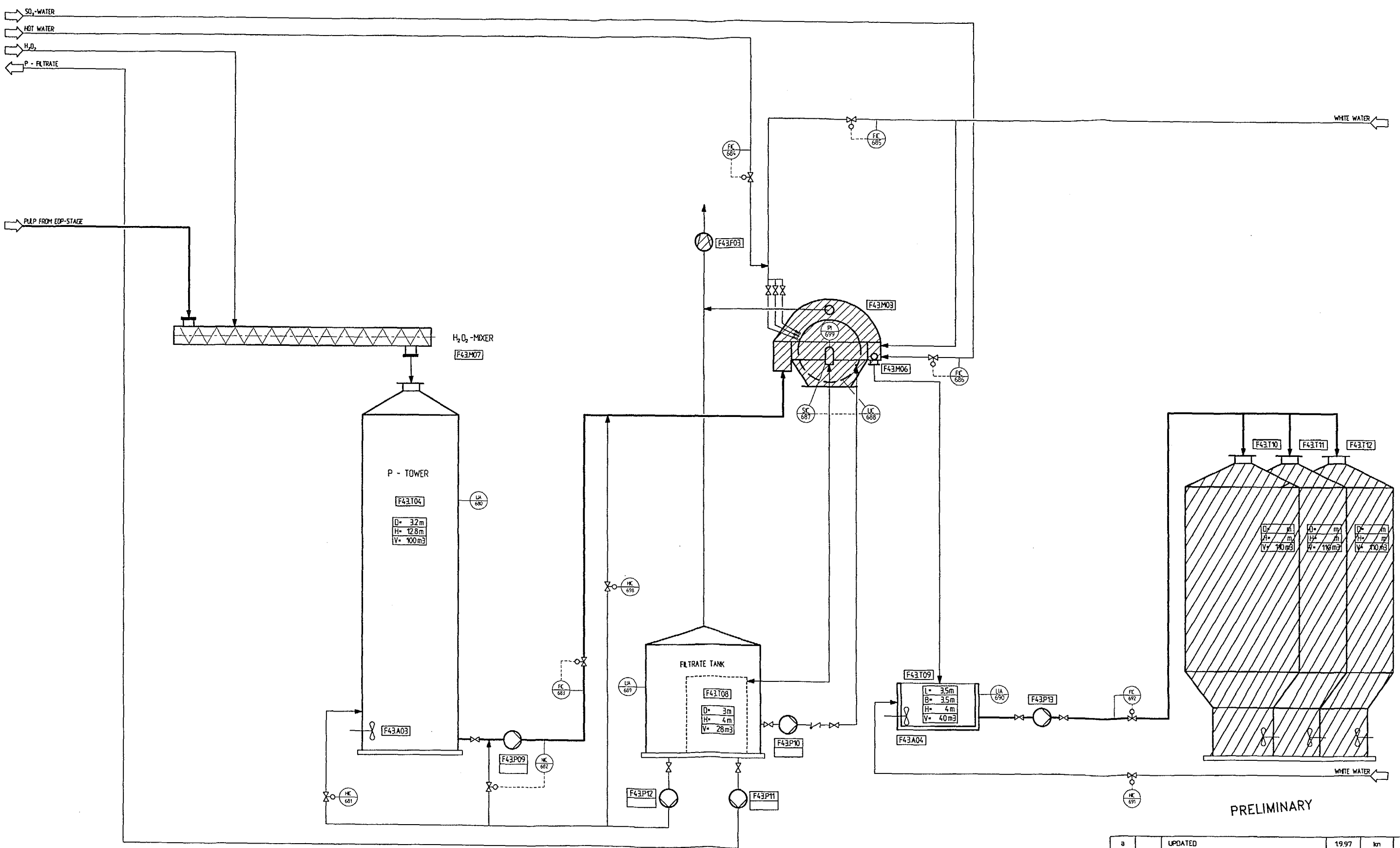
INSTR. CHANGED		26.5.97	KN	KR
Author	Appr. & No. of instr.	Instrumentation	Date	Checked by
Designer	Date	Instrumentation	Date	Checked by
Checked by	12.11.96	CSEPYOVA		
Checked by	12.11.96	KREINDL		
Customer: TRIBENI		Dept. F43		
		BLEACHING PLANT		
		A - STAGE		
		FLOWSHEET		
Customer/Order-No.		IVA-Ord.-No.		
		ITCZF43 / ZVY 2001 E		
Sheet	of	Scale	Project	
	1	A1	a	



LEGEND:
 [Empty Box] NEW EQUIPMENT
 [Hatched Box] EXISTING EQUIPMENT, USED WITH NO OR MINOR MODIFICATIONS

PRELIMINARY

b	UPDATED	19.97	KN	KR
a	INSTR. CHANGED	26.5.97	KN	KR
Project/Revision	Rev. & No. of Rev.	Project/Revision	Date	Designer
Client	Date	Designer	Checked by	Checked by
Customer	Date	Designer	Checked by	Checked by
Customer	Date	Designer	Checked by	Checked by
Project/Revision				
Customer		Dept. F43 BLEACHING PLANT EOP - STAGE FLOWSHEET		
Customer/Doc. No.	IVA-Doc. No.	Rev. No.	Rev. Date	Rev. By
		A1		b



Die vorliegende Zeichnung ist ein Entwurf. Sie ist ohne Haftung für die Richtigkeit und Vollständigkeit der Angaben zu verstehen.

- LEGEND:**
- NEW EQUIPMENT
 - EXISTING EQUIPMENT, USED WITH NO OR MINOR MODIFICATIONS

PRELIMINARY

a		UPDATED		1997	kn	kn
Inventory	Rev. 4	Rev. 1	Rev. 2	Rev. 3	Rev. 4	Rev. 5
Author	12.11.96	CSEPTOVA				
Checked	12.11.96	KRENOL				
TRIBENI Dept. F43 BLEACHING PLANT P - STAGE FLOWSHEET		IVA Industrietechnik AG Industrietechnik AG Industrietechnik AG		IVA Industrietechnik AG Industrietechnik AG		A1 a
ITCZF43/ZW 2003 E						

6. PLANT DESIGN**6.1 Mill and Plant Layout**

ITC.ZF/ZAL 2001 E	Rev. 2	Existing Plant
ITC.ZF/ZAL 2002 E	Rev. 2	Stage 1 (Digester, Heat Recovery, Screening, Cleaning, Washing)
ITC.ZF/ZAL 2003 E	Rev. 2	Stage 2 (Oxygen Delignification, Bleaching)

6.2 Mechanical Design Criteria

In general to ensure proper installation and smooth operation the same standards as already used should be taken.

In addition concerning the Digester following should be done.

Digester:

For a faster operation of the digesters it has been decided to install a new lid. The best is to bolt a new lid (similar as shown at the attached sketch from the german company Schrader), which allows to adapt the new lid without doing welding on the digester body.

The lid is connected to the digester with a bayonet and with the assistance of a lever it will be opened and closed.

In addition to adapt the new blowing system a conical discharge shall be foreseen, where a hand operated ball valve shall be installed.

Note: Details of changes are part of detail engineering and not of the prebasic study.

Attachments:

Bajonett Quick Close (Co. Schrader)

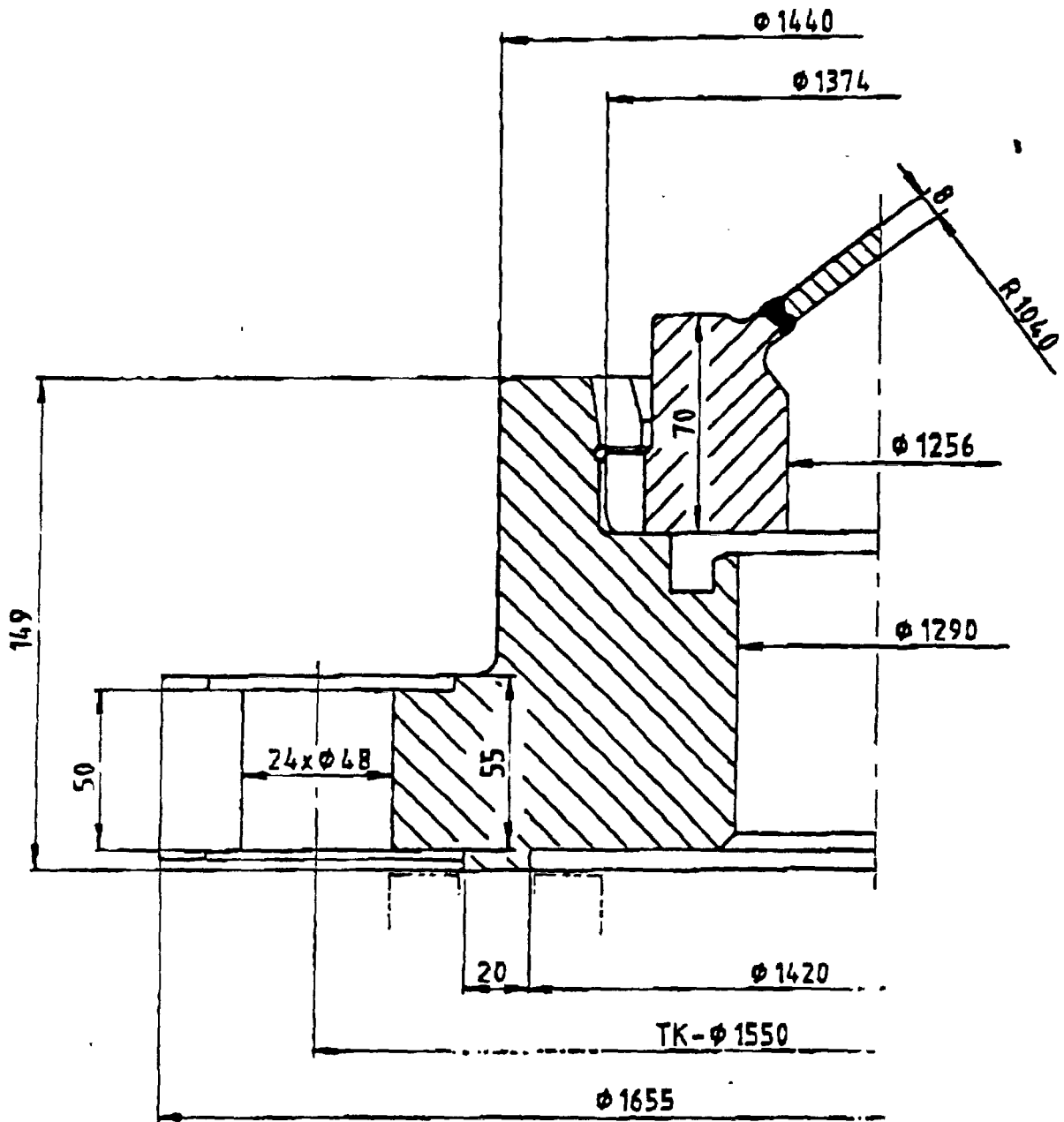
Dimension Sheet Spherical Digester

ITC.ZF13.M01/ZAM-2001 E

Inline Pump

Typical example for inline pump (ABS Scanpump)

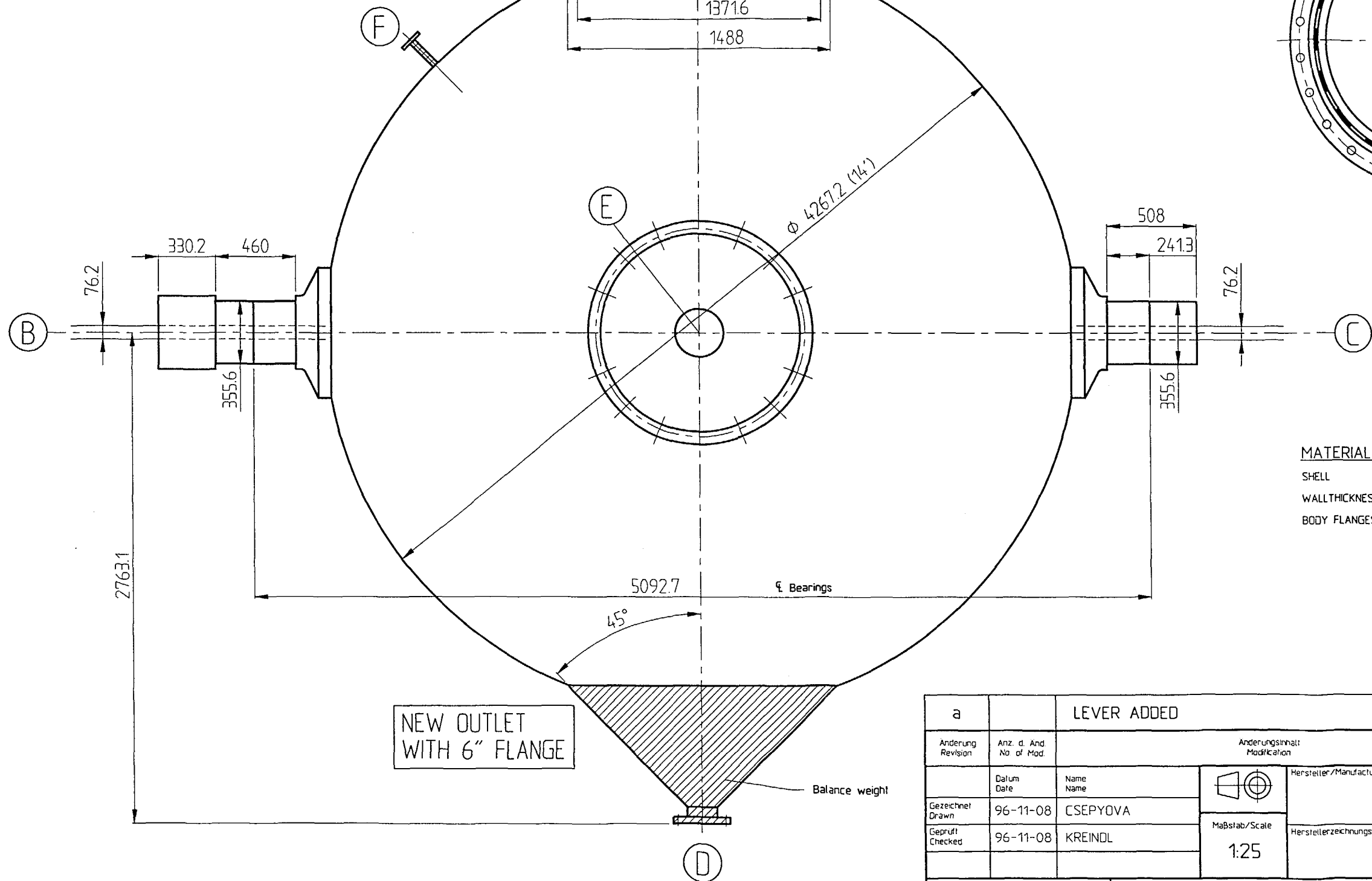
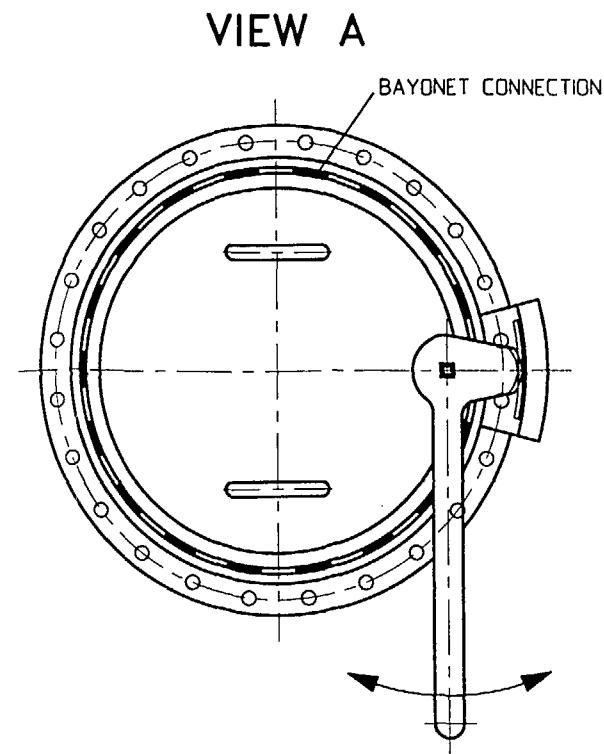
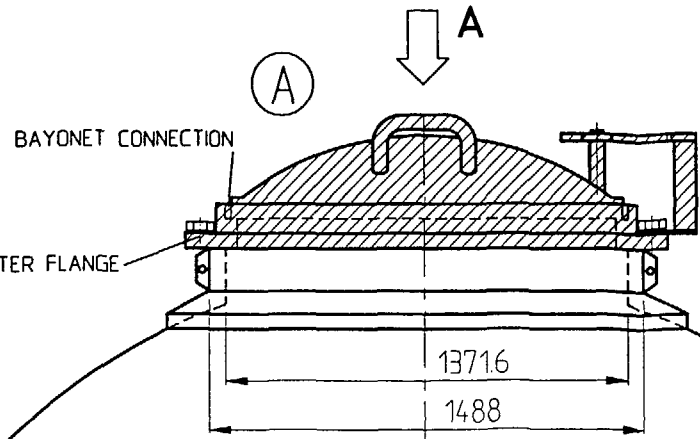
Unter Hinweis auf Paragraph 1 Ziffer 3 des
 Reichsdruckgesetzes vom 18. Juni 1901 darf diese
 Zeichnung ohne unsere Genehmigung weder
 an nach dieser Personen zur Einsicht
 noch zu anderen Zwecken übertragen werden



DIN ISO 1302						Werkstoff: Gewicht:	Mod.-Nr.:
DIN 3141 Reihe 2							
			1996 boarb. gepr.	Datum 29.11.	Name Tropmann	Benennung: Bajonett-Schnellverschluss i.φ 1290, 10bar	Maßstab: 1:2
SCHRADER VERFAHRENSTECHNIK GMBH						Zeichnungsnummer: 183 476 / 210.4	Type:
In.	Änderung	Ursprung:			Ersatz l.:	Ersatz d.:	

LIST OF NOZZLES

DEM.	NO. REQ'D	SIZE	LENGTH	RATING	FLG. TYPE	DESCRIPTION
A	1	54"				Inlet flange
B	1	3"				Blow off
C	1	3"				Liquor inlet
D	1	6"				Outlet flange
E	1					
F	1	1"				Temperature



MATERIAL SPEC'S:
 SHELL CARBON STEEL
 WALL THICKNESS 3/4" AND 7/8"
 BODY FLANGES CARBON STEEL

NEW OUTLET WITH 6" FLANGE

NEW LID WITH QUICK OPENING DEVICE

Die unbefugte bzw. bestimmungswidrige Verwendung dieser Unterlage ist nicht gestattet und wird gerichtlich verfolgt.

ACAD - PART: TRIDIG_1

REQUIRED MODIFICATIONS

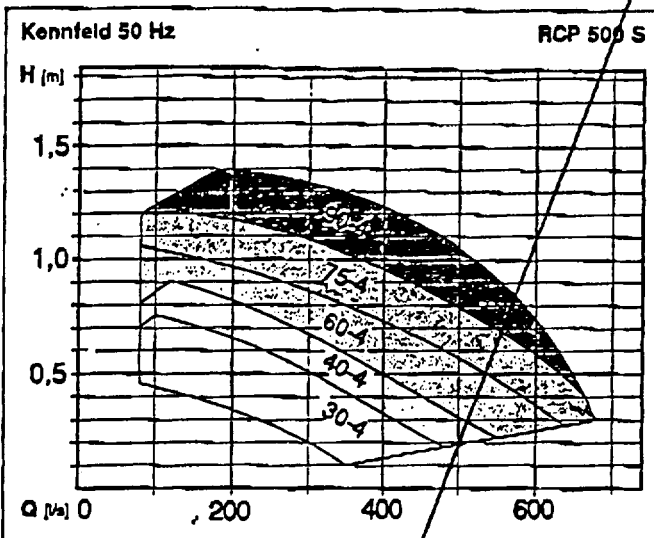
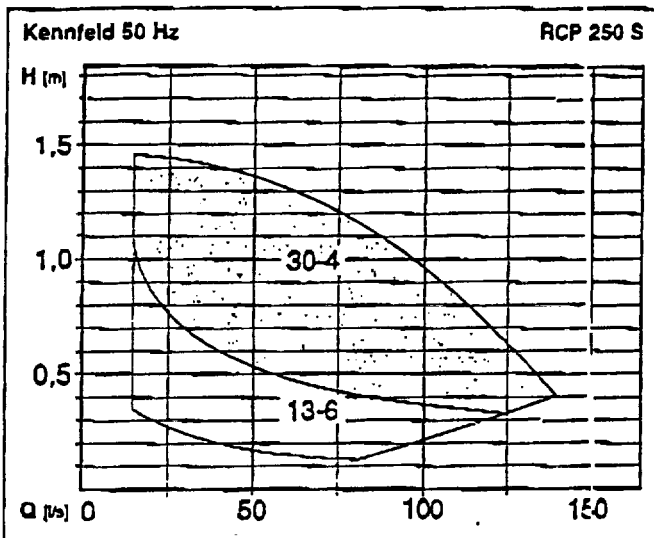
a		LEVER ADDED	97-09-19	NEU.	KREI.
Anderung/Revision	Anz. d. And. No. of Mod.	Anderungsinhalt/Modification	Datum/Date	Bearbeitet/Made by	Geprüft/Checked by
Gezeichnet/Drawn	96-11-08	CSEPYOVA	Maßstab/Scale 1:25	Hersteller/Manufacturer Herstellerzeichnung-Nr./Manufacturer Dwg. No.	
Gepflegt/Checked	96-11-08	KREINDL			
Project/Customer		Benennung/Title		Masse/Mass	
TRIBENI		DIMENSION SHEET SPHERICAL DIGESTER Dia 14' (Existing digesters)		Werkstoff/Material	
KUNDEN-Doc-No.		IVA-Doc-No.		Blatt Sheet	von of
		ITC.ZF13.M01/ZAM-2001 E		1	1
				Format Size	A3
				Anderung/Revision	a

QNT.	MATERIAL	DWG NO	ITEM	DESCRIPTION

Annex 6.2 Inline Pump

RCP 250 S

RCP 500 S



Typenübersicht

DN	Motor	Motorleistung*	
		P ₁ kW	P ₂
RCP 250 S /	13-6 mit Direktantrieb	2,06	1,30
RCP 250 S /	30-4 mit Direktantrieb	3,95	3,00

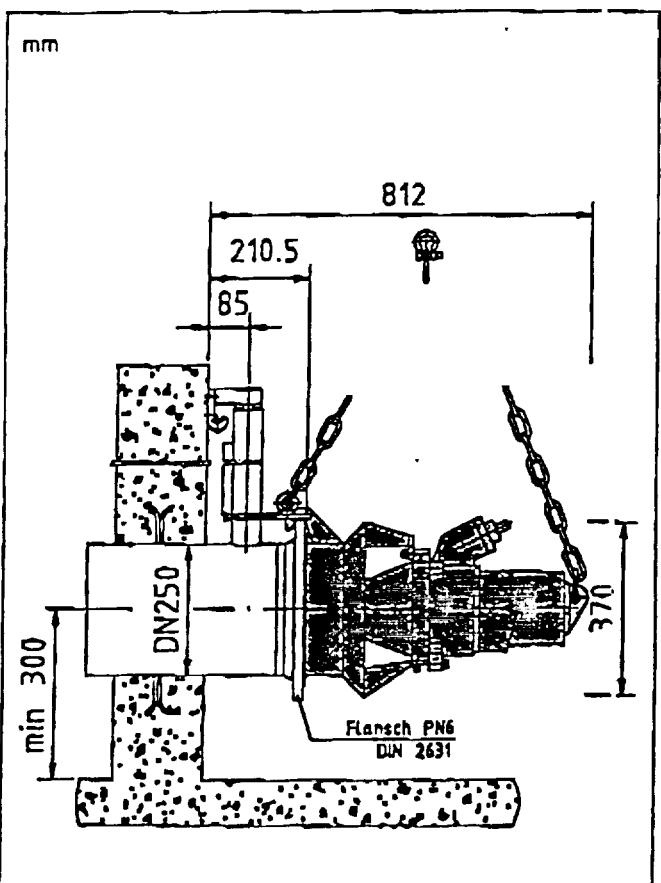
Typenübersicht

DN	Motor	Motorleistung*	
		P ₁ kW	P ₂
RCP 500 S /	30-6 mit Getriebe	3,95	3,00
RCP 500 S /	40-4 mit Getriebe	5,15	4,00
RCP 500 S /	60-4 mit Getriebe	7,45	6,00
RCP 500 S /	75-4 mit Getriebe	8,89	7,50

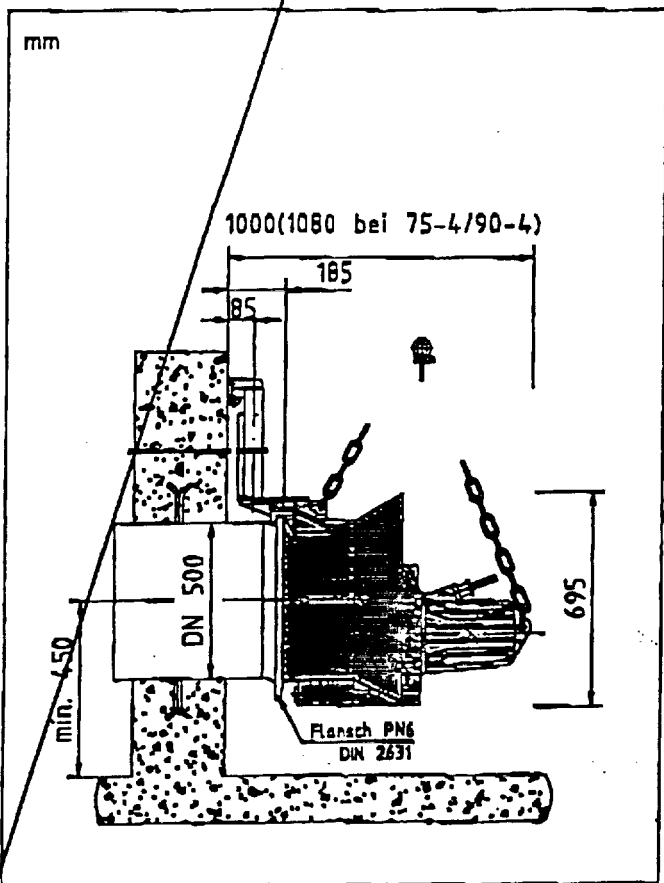
Serienmäßiger Lieferumfang:
10 m Kabel mit freiem Kabelende,
Strömungsring mit Gleitklausen und Halterung, Anschlagkette

Serienmäßiger Lieferumfang:
10 m Kabel mit freiem Kabelende,
Strömungsring mit Gleitklausen und Halterung, Anschlagkette

Baumaße RCP 250 S



RCP 500 S



P₁ = die dem Netz entnommene Wirkleistung; P₂ = die vom Netz abgegebene Wellenleistung

6.3 Piping Design Criteria

The piping material shall be supplied in accordance with DIN-standard or equivalent to international standards like ASTM, AISI etc.

The selection of piping material is based on the characteristics of the various media as well as the defined pressure and temperature ranges in the plant.

The attached piping specifications and media list should be understood as basic information for selecting the correct piping material.

In addition special consideration for following areas should be taken.

Blow Lines

One single blow line for each Digester

Material either carbon steel or stainless steel

Nominal Diameter minimum 200 mm

Elbows with a radius of 10 times diameter (= 2000 mm)

On critical areas (outlet of digester) the blow line should be flanged to easy remove and clean the blow lines in case of plugging.

Washing: General guidelines from HDO, the original supplier of the existing vacuum washer, for designing the dropleg are attached.

Attachments:

Media List - 2 sheets

Typical specifications of piping - 6 sheets

Design criteria for piping of washer seal tanks (HDO specification) - 2 sheets

Material comparison list - 20 sheets

Recommended velocities in pipes - 1 sheet

List of Media and Piping material

Medium	Piping material (DIN)
AIR	
INSTRUMENT AIR	1. 4301
COMPRESSED AIR (MILL AIR)	1.4301
CONDENSATES	
CONDENSATE CLEAN	St 37.0
CONTAMINATED PROCESS CONDENSATE	1. 4301
CHEMICALS	
NAOH	1.4301
ANTRAQUINONE	1.4301
NA ₂ S	1.4301
DEFOAMING CHEMICAL	1. 4301
OXYGEN LIQUID OR GAS	1.4301
PEROXIDE	1.4301
SULFURIC ACID (96 %)	St 37.0
SULFURIC ACID - DILUTED	1.4436 or PVC
SO ₂ - WATER	1.4436
MAGNESIUM SULFATE	1.4301
NA ₂ SO ₄	1.4301
DTPA	1.4301
EFFLUENTS	
EFFLUENT ACIDIC	FRP
EFFLUENT ALKALINE	FRP
EFFLUENT COOLING/SEALING WATER	St 37.0
FILTRATES	
FILTRATE WASHING & SCREENING	1. 4301

List of Media and Piping material

Medium	Piping material (DIN)
FILTRATE OXYGEN DELIGNIFICATION	1.4301
FILTRATE A-STAGE	FRP
FILTRATE EOP-STAGE	1.4301
FILTRATE P -STAGE	1.4301
LIQUORS	
COOKING LIQUOR	1. 4301
BLACK LIQUOR WEAK	ST 37.0
WHITE LIQUOR	1. 4301
PULP	
BROWN STOCK UNWASHED	1. 4301
BROWN STOCK WASHED	1. 4301
PULP OXYGEN-STAGE	1. 4301
PULP A-STAGE	1.4436 or FRP
PULP P-STAGE	1.4436
PULP BLEACHED	1. 4301
STEAM	
STEAM LOW PRESSURE	St 37.0
STEAM MEDIUM PRESSURE	St 35.8
WATER	
COOLING WATER	1. 4301
WATER (HOT and WARM)	1. 4301
SEALING WATER	1. 4301
MILL WATER	1. 4301

DEPT. TFS 2	REVISION	CORR. ALLWCE	FLANGE FACING	RATING	PROJECT:							
DESIGNED Wiesegger	DATE / EDITION 1996-10 / 0	1.0 mm	DIN 2526/ FORM C	PN 16	PIPING SPEC.: D 16 P							
TYPICAL SERVICE: Steam, Condensate												
Service Limit	Temp. Press.	°C bar eff.	-10 16	20 16	120 16	200 13	250 11	300 10				
Outside Diameter	21,3	26,9	33,7	42,4	48,3	60,3	76,1	88,9	114,3	139,7	168,3	
Wallthickness	2,0	2,3	2,6	2,6	2,6	2,9	2,9	3,2	3,6	4,0	4,5	
Outside Diameter	219,1	273,0	323,9	355,6	406,4	508,0	610,0	711,0	813,0	914,0	1016	
Wallthickness	4,5	5,0	5,6	5,6	6,3	6,3	6,3	7,1	8,0	10,0	10,0	
ITEM	NOMINAL BORE		RATING		DESCRIPTION							
	from mm	to mm	bar									
PIPE	15	150	Seamless, DIN 2448, material St37.0/DIN 1629									
	200	1000	Welded, DIN 2458, material St37.0/DIN 1626									
FITTINGS	ELBOW	15	25	Pulled bend, R = 5D, site manufacture, material St37.0/DIN 1629								
		32	150	Seamless, DIN 2605-1, type 3, material St37.0/DIN 1629								
		200	500	Welded, DIN 2605-1, type 3, material St37.0/DIN 1626								
		600	100	Welded, DIN 2605-2, type 3, material St37.0/DIN 1626								
FITTINGS	REDUCER	20	150	Seamless, DIN 2616-2, material St37.0/DIN 1629								
		200	1000	Welded, DIN 2616-2, material St37.0/DIN 1626								
FITTINGS	CAP	15	1000	Acc. to DIN 2617, material St37.0/DIN 1626								
		-	-	Pipe to pipe branch							Application acc. to design requirements	
		-	-	Tee seamless, DIN 2615-1, material St37.0/DIN 1629								
		-	-	Tee welded, DIN 2615-2, material St37.0/DIN 1626								
-	-	Weldolet, type standard, material C22.8/VdTÜV-Wbl.350										
FLANGE	15	1000	16	Welding neck flange, DIN 2633, material RSt37-2/DIN 17100								
BOLTING	15	1000	Hexagon bolt, with hexagon nut, EN 24014/EN 24032, material 5.6/5/ISO 898									
BASKET	15	1000	Flat ring, DIN 2690, material graphite with stainless steel insert									
VALVES	GLOBE	15	50	16	Body GS-C25/C22, seat X20Cr13, outside screw and yoke, rising stem, rising handwheel, DIN 3356, flanged, length acc. to DIN 3202/F1							
		65	400	16	Body GS-C25/C22, seat X20Cr13, outside screw and yoke, non rising handwheel, rising stem, DIN 3352, flanged, length acc. to DIN 3202/F5							
	DOUBLE-DISC-GATE	500	1000	16	Body GS-C25/C22, seat X20Cr13, outside screw and yoke, non rising handwheel, rising stem, DIN 3352, flanged, length acc. to DIN 3202/F5							
		LIFT CHECK	15	50	40	Body GS-C25/C22, seat X20Cr13, spring loaded, DIN 3230, wafer type, length DIN 3202/K4						
	DOUBLE-DISC-SWING-CHECK		65	700	16	Body GS-C25/C22, seat X20Cr13, spring loaded, DIN 3230, wafer type, length DIN 3202/K3						
800		1000	16	Special part								
PIPE SUPPORTS	acc. to VAI-Standard											
REMARKS	Inspection certificate acc. to EN 10204/3.1B for pipes, fittings and flanges, 2.2 for valves and bolts, 2.1 for all other items.											

DEPT. TFS 2	REVISION	CORR. ALLWCE	FLANGE FACING	RATING	PROJECT:							
DESIGNED Wiesegger	DATE / EDITION 1996-10 / 0	1.0 mm	DIN 2526/ FORM C	PN 25	PIPING SPEC.: E 2 5							
TYPICAL SERVICE: Steam, Condensate												
Service Limit	Temp. Press.	°C bar eff.	-10 25	20 25	120 25	200 22	250 20	300 17	350 16	400 13		
Outside Diameter	21,3	26,9	33,7	42,4	48,3	60,3	76,1	88,9	114,3	139,7	168,3	
Wallthickness	2,0	2,3	2,6	2,6	2,6	2,9	2,9	3,2	3,6	4,0	4,5	
Outside Diameter	219,1	273,0	323,9	355,6	406,4	508,0						
Wallthickness	6,3	6,3	7,1	8,0	8,8	11,0						
ITEM	NOMINAL BORE		RATING		DESCRIPTION							
	from mm	to mm	bar									
PIPE	15	500			Seamless, DIN 2448, material St35.8./DIN 17175							
F I T T I N G S	ELBOW	15 32	25 500	Pulled bend, R = 5D, site manufacture, material St35.8./DIN 17175								
	REDUCER	20	500	Seamless, DIN 2605/part 2, type 3, material St35.8./DIN 17175								
	CAP	15	500	Acc. to DIN 2617, material St35.8./DIN 17175								
	TEE	-	-	Pipe to pipe branch							Application acc. to design requirements	
	WELDOLET	-	-	Seamless, DIN 2615/part 2, material St35.8./DIN 17175								
	-	-	Type standard, material C22.8/VdTÜV-Wbl.350									
FLANGE	15 200	150 500	40 25	Welding neck flange, DIN 2635, material C22.8/VdTÜV-Wbl.350 Welding neck flange, DIN 2634, material C22.8/VdTÜV-Wbl.350								
BOLTING	15	500	Stud bolt, form L, with nut form NF, DIN 2510, material Ck35/Ck35/DIN 17240									
GASKET	15	500	Flat ring gasket, DIN 2690, material graphite with stainless steel insert									
V A L V E S	GLOBE	15	50	40	Body GS-C25/C22.8, seat X20Cr13, outside screw and yoke, rising stem. rising handwheel, DIN 3356, flanged, length acc. to DIN 3202/F1							
	FLEXI-WEDGE-GATE	65	400	25	Body GS-C25/C22.8, seat X20Cr13, outside screw and yoke, rising stem, non rising handwheel, DIN 3352, flanged, length acc. to DIN 3202/F5							
	DOUBLE-DISC-GATE	500	500	25	Body GS-C25/C22.8, seat X20Cr13, outside screw and yoke, rising stem. non rising handwheel, DIN 3352, flanged, length acc. to DIN 3202/F5							
	LIFT CHECK	15	50	40	Body GS-C25/C22.8, seat X20Cr13, spring loaded, DIN 3230, wafer type, length DIN 3202/K4							
	DOUBLE-DISC-SWING-CHECK	65	500	25	Body GS-C25/C22.8, seat X20Cr13, spring loaded, DIN 3230, wafer type, length DIN 3202/K3							
PIPE SUPPORTS	acc. to VAI-Standard											
REMARKS	Inspection certificate acc. to EN 10204/3.1B for pipes, fittings and flanges, 2.2 for valves and bolts. 2.1 for all other items.											

DEPT. TFS 2	REVISION	CORR. ALLWCE	FLANGE FACING	RATING	PROJECT:						
DESIGNED Wiesegger	DATE / EDITION 1996-10 / 0	0.0 mm	DIN 2526/ FORM C	PN 10	PIPING SPEC: V 1 0 P Z						
TYPICAL SERVICE: Pulp, Lyes											
Service Limit	Temp. Press.	°C bar eff.	-10 8,7	20 8,7	50 8,1	100 7,3	120 7,0	150 6,5			
Outside Diameter	21,3	26,9	33,7	42,4	48,3	60,3	76,1	88,9	114,3	139,7	168,3
Wallthickness	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0
Outside Diameter	219,1	273,0	323,9	355,6	406,4	508,0	610,0	711,0	813,0		
Wallthickness	2,6	2,6	2,9	2,9	3,2	3,2	4,0	4,0	4,0		
ITEM	NOMINAL BORE		RATING		DESCRIPTION						
	from mm	to mm	bar								
PIPE	10	800	Welded, DIN 2463, material 1.4301/DIN 17457								
FITTINGS	ELBOW	15	800	Welded, DIN 2605-1, type 3, material 1.4301/DIN 17457							
	REDUCER	15	800	Welded, DIN 2616-2, material 1.4301/DIN 17457							
	CAP	15	600	Acc. to DIN 2617, material 1.4301/DIN 17440							
	BRANCH CONNECTION	-	-	Pipe to pipe branch Tee welded, DIN 2615-1 or -2, material 1.4301/DIN 17457							Application acc. to design requirements
	STUB END	15 350	300 800	10 10	DIN 2642, material 1.4301/DIN 17440 Type C, VAI-Std. H422, material 1.4301/DIN 17440						
LAPPED FLANGE	15	800	10	DIN 2642, material St37-2 galvanized/DIN 17100/DIN 2444							
BOLTING	15	800	Hexagon bolt with nut, EN 24014/EN 24032, material 5.6/5/galvanized DIN ISO 898/ISO 4042								
GASKET	15	800	Flat ring, DIN 2690, material asbestos free rubber compounds (e.g. KLINGERSIL C-4500) or reinforced graphite								
VALVES	BALL	15	50	16	Body and ball 1.4301/1.4308, seat PTFE, reduced port, hand lever, DIN 3357, butt welding ends, length acc. to manufacturer's standard resp. ISO 5752 row 4						
	BUTTERFLY-CENTRIC	65	150	10	Body GGG-40, disc 1.4301/1.4308, sleeve (inliner) PTFE, hand lever, DIN 3354 wafer type, length acc. to DIN 3202/K1						
		200	500	10	See above, however gear operated						
	BUTTERFLY-ECCENTRIC PULP GATE	600	800	10	Body and disc 1.4301/1.4308, seat ring (disc) PTFE, gear operated, DIN 3354, flanged, length acc. to DIN 3202/F4						
		50	300	10	Body 1.4301/1.4308, seat integral, outside screw and yoke, rising stem, non rising handwheel, DIN 3352, wafer type, length acc. to manufacturer's standard						
	250	800	10	Body 1.4301/1.4308, seat integral, outside screw and yoke, non rising stem, non rising handwheel, DIN 3352, wafer type, length acc. to manufacturer's standard							
E S	LIFT CHECK	15	50	16	Body and disc 1.4301/1.4308, seat integral, spring loaded, DIN 3230, wafer type, length acc. to DIN 3202/K4						
	SWING CHECK	65	800	10	Body and disc 1.4301/1.4308, seat integral, tilting disc, spring loaded, DIN 3230 wafer type, length acc. to DIN 3202/K3						
PIPE SUPPORTS	acc. to VAI-Standard										
REMARKS	Inspection certificate acc. to EN 10204/3.1B for pipes, fittings, stub ends and flanges, 2.2 for bolts and valves, 2.1 for all other items.										

DEPT. TFS 2	REVISION	CORR. ALLWCE	FLANGE FACING	RATING	PROJECT:						
DESIGNED Wiesegger	DATE / EDITION 1996-10 / 0	0.0 mm	DIN 2526/ FORM C	PN 25	PIPING SPEC.: V 2 5 P Z						
TYPICAL SERVICE: Pulp, Lyes											
Service Limit	Temp Press	°C bar eff.	-10 21,8	20 21,8	50 20,4	100 18,3	120 17,6	150 16,4	170 15,8	175 15,7	200 15,0
Outside Diameter	21,3	26,9	33,7	42,4	48,3	60,3	76,1	88,9	114,3	139,7	168,3
Wallthickness	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,6	2,9	3,2
Outside Diameter	219,1	273,0	323,9	355,6	406,4	508,0					
Wallthickness	3,2	4,0	4,0	4,5	5,0	5,6					
ITEM	NOMINAL BORE		RATING		DESCRIPTION						
	from mm	to mm	bar								
PIPE	15 50	40 500	Seamless, DIN 2462, material 1.4301/DIN 17458 Welded, DIN 2463, material 1.4301/DIN 17457								
FITTINGS	ELBOW	15	40	Seamless, DIN 2605/part 1, type 3, material 1.4301/DIN 17458							
		25	150	Welded, DIN 2605/part 1, type 3, material 1.4301/DIN 17457							
		200	500	Welded, DIN 2605/part 2, type 3, material 1.4301/DIN 17457							
	REDUCER	20	40	Seamless, DIN 2616/part 2, material 1.4301/DIN 17458							
50		500	Welded, DIN 2616/part 2, material 1.4301/DIN 17457								
CAP	15	500	Acc. to DIN 2617, material 1.4301/DIN 17440								
BRANCH CONNECTION	-	-	Pipe to pipe branch								
	-	-	Tee seamless or welded, DIN 2615/part 1or 2, material 1.4301/DIN 17458/17457								
LAPPED FLANGE	15	150	40	DIN 2656, material St37-2 galvanized/DIN 17100							
	200	500	25	DIN 2655, material St37-2 galvanized/DIN 17100							
PLAIN COLLAR	15	150	40	DIN 2656, material 1.4301/DIN 17440							
	200	500	25	DIN 2655, material 1.4301/DIN 17440							
BOLTING	15	500	Hexagon bolt EN 24014, with hexagon nut, EN 24032, material 5.6/5/galvanized DIN ISO 898/ISO 4042								
GASKET	15	500	Flat ring, DIN 2690, material graphite with stainless steel insert								
VALVES	BALL	15	100	25	Body and ball 1.4301/1.4308, seating PTFE, reduced port, hand lever, DIN 3357, flanged, length DIN 3202/F1 (up to 170°C)						
	BUTTERFLY-ECCENTRIC	80	150	25	Body and disc 1.4301/1.4308, seat integral, hand lever, DIN 3354, wafer type, length acc. to DIN 3202/K1						
		200	500	25	as above, but gear operated						
LIFT CHECK	15	50	25	Body and disc 1.4301/1.4308, seat integral, spring loaded, DIN 3230, wafer type, length acc. to DIN 3202/K4							
SWING CHECK	65	500	25	Body and disc 1.4301/1.4308, seat integral, tilting disc, spring loaded, DIN 3230, wafer type, length acc. to DIN 3202/K3							
PIPE SUPPORTS	acc. to VAI-Standard										
REMARKS	Inspection certificate acc. to EN 10204/3.1B for pipes, fittings, plain collars, flanges and valves, 2.2 for bolts, 2.1 for other components.										

DEPT. TFS 2	REVISION	CORR. ALLWCE	FLANGE FACING	RATING	PROJECT:						
DESIGNED Wiesegger	DATE / EDITION 1996-10 / 0	0.0 mm	DIN 2526/ FORM C	PN 40	PIPING SPEC.: V 4 0 P Z						
TYPICAL SERVICE: Pulp, Lyes											
Service Limit	Temp. Press.	°C bar eff.	-10 34,8	20 34,8	50 32,7	100 29,3	120 28,1	150 26,3	170 25,3	175 25,1	200 23,9
Outside Diameter	21,3	26,9	33,7	42,4	48,3	60,3	76,1	88,9	114,3	139,7	168,3
Wallthickness	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,6	2,9	3,2
Outside Diameter	219,1	273,0	323,9	355,6	406,4	508,0					
Wallthickness	4,0	4,5	5,6	6,3	7,1	8,8					
ITEM	NOMINAL BORE		RATING		DESCRIPTION						
	from mm	to mm	bar								
PIPE	15	40	Seamless, DIN 2462, material 1.4301/DIN 17458								
	50	500	Welded, DIN 2463, material 1.4301/DIN 17457								
F I T T I N G	ELBOW	15	40	Seamless, DIN 2605/part 1, type 3, material 1.4301/DIN 17458							
		25	150	Welded, DIN 2605/part 1, type 3, material 1.4301/DIN 17457							
		200	500	Welded, DIN 2605/part 2, type 3, material 1.4301/DIN 17457							
	REDUCER	20	40	Seamless, DIN 2616/part 2, material 1.4301/DIN 17458							
		50	500	Welded, DIN 2616/part 2, material 1.4301/DIN 17457							
	CAP	15	500	Acc. to DIN 2617, material 1.4301/DIN 17440							
	BRANCH CONNECTION	-	-	Pipe to pipe branch							
		-	-	Tee seamless or welded, DIN 2615/part 1 or 2, material 1.4301/DIN 17458/17457							
	LAPPED FLANGE	15	500	40	DIN 2656, material St37-2 galvanized/DIN 17100						
	PLAIN COLLAR	15	500	40	DIN 2656, material 1.4301/DIN 17440						
	BOLTING	15	500	Hexagon bolt EN 24014, with hexagon nut, EN 24032, material 5.6/5/galvanized, DIN ISO 898/ISO 4042							
	GASKET	15	500	Flat ring, DIN 2690, material graphite with stainless steel insert							
V A L V E S	BALL	15	100	40	Body and ball 1.4301/1.4308, seating PTFE, reduced port, hand lever, DIN 3357, flanged, length DIN 3202/F1 (up to 170°C)						
	BUTTERFLY- ECCENTRIC	80	150	40	Body and disc 1.4301/1.4308, seat integral, hand lever, DIN 3354, wafer type, length acc. to DIN 3202/K1						
		200	500	40	as above, but gear operated						
	LIFT CHECK	15	50	40	Body and disc 1.4301/1.4308, seat integral, spring loaded, DIN 3230, wafer type, length acc. to DIN 3202/K4						
	SWING CHECK	65	500	40	Body and disc 1.4301/1.4308, seat integral, tilting disc, spring loaded, DIN 3230, wafer type, length acc. to DIN 3202/K3						
	PIPE SUPPORTS	acc. to VAI-Standard									
	REMARKS	Inspection certificate acc. to EN 10204/3.1B for pipes, fittings, plain collars, flanges and valves, 2.2 for bolts, 2.1 for other components.									

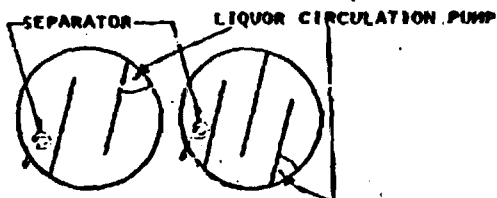
DEPT. TFS 2	REVISION	CORR. ALLWCE	FLANGE FACING	RATING	PROJECT:							
DESIGNED Wiesegger	DATE / EDITION 1996-10 / 0	0.0 mm	DIN 2526/ FORM C	PN 10	PIPING SPEC.: Y 1 0 P Z							
TYPICAL SERVICE: Pulp, Lyes												
Service Limit	Temp. Press.	°C bar eff.	-10 9,5	20 9,5	50 9,0	100 8,1	120 7,8	150 7,4				
Outside Diameter	21,3	26,9	33,7	42,4	48,3	60,3	76,1	88,9	114,3	139,7	168,3	
Wallthickness	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	
Outside Diameter	219,1	273,0	323,9	355,6	406,4	508,0	610,0	711,0	813,0			
Wallthickness	2,6	2,6	2,9	2,9	3,2	3,2	4,0	4,0	4,0			
ITEM	NOMINAL BORE from mm		to mm		RATING bar	DESCRIPTION						
PIPE	10	800	Welded, DIN 2463, material 1.4436/DIN 17457									
FITTINGS	ELBOW	15	800	Welded, DIN 2605-1, type 3, material 1.4436/DIN 17457								
	REDUCER	15	800	Welded, DIN 2616-2, material 1.4436/DIN 17457								
	CAP	15	600	Acc. to DIN 2617, material 1.4436/DIN 17440								
	BRANCH CONNECTION	-	-	Pipe to pipe branch Tee welded, DIN 2615-1 or -2, material 1.4436/DIN 17457							Application acc. to design requirements	
STUB END	15	300	10	DIN 2642, material 1.4436/DIN 17440								
	350	800	10	Type C, VAI-Std. H422, material 1.4436/DIN 17440								
LAPPED FLANGE	15	800	10	DIN 2642, material St37-2 galvanized/DIN 17100/DIN 2444								
BOLTING	15	800	Hexagon bolt with nut, EN 24014/EN 24032, material 5.6/5/galvanized DIN ISO 898/ISO 4042									
GASKET	15	800	Flat ring, DIN 2690, material asbestos free rubber compounds (e.g. KLINGERSIL C-4500) or reinforced graphite									
VALVES	BALL	15	50	16	Body and ball 1.4436, seat PTFE, reduced port, hand lever, DIN 3357, butt welding ends, length acc. to manufacturer's standard resp. ISO 5752 row 4							
	BUTTERFLY-CENTRIC	65	150	10	Body GGG-40, disc 1.4436, sleeve (inliner) PTFE, hand lever, DIN 3354, wafer type, length acc. to DIN 3202/K1							
	BUTTERFLY-ECCENTRIC PULP GATE	200	500	10	See above, however gear operated							
		600	800	10	Body and disc 1.4436, seat ring (disc) PTFE, gear operated, DIN 3354, flanged, length acc. to DIN 3202/F4							
		50	300	10	Body 1.4436, seat integral, outside screw and yoke, rising stem, non rising handwheel, DIN 3352, wafer type, length acc. to manufacturer's standard							
	350	800	10	Body 1.4436, seat integral, outside screw and yoke, non rising stem, non rising handwheel, DIN 3352, wafer type, length acc. to manufacturer's standard								
SPECIAL	LIFT CHECK	15	50	16	Body and disc 1.4436, seat integral, spring loaded, DIN 3230, wafer type, length acc. to DIN 3202/K4							
	SWING CHECK	65	800	10	Body and disc 1.4436, seat integral, tilting disc, spring loaded, DIN 3230, wafer type, length acc. to DIN 3202/K3							
PIPE SUPPORTS	acc. to VAI-Standard											
REMARKS	Inspection certificate acc. to EN 10204/3.1B for pipes, fittings, stub ends and flanges, 2.2 for bolts and valves, 2.1 for all other items.											

ES

DIMENSIONS SHOWN ARE GENERAL. SINCE DIMENSIONS VARY WITH TYPE OF MATERIAL PULPED AND PULPING PROCESS, CONSULT DORR-OLIVER ON YOUR SPECIFIC APPLICATION.

LOCATE THE OVERFLOW WEIR FROM THE FIRST STAGE FILTRATE TANK TO THE FOAM TOWER OUTSIDE THE TANK WHERE LEAKS FROM CORROSION CAN BE SEEN. LOCATE AS SHOWN.

BAFFLING FOR LARGE DIAMETER TANKS:



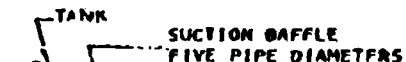
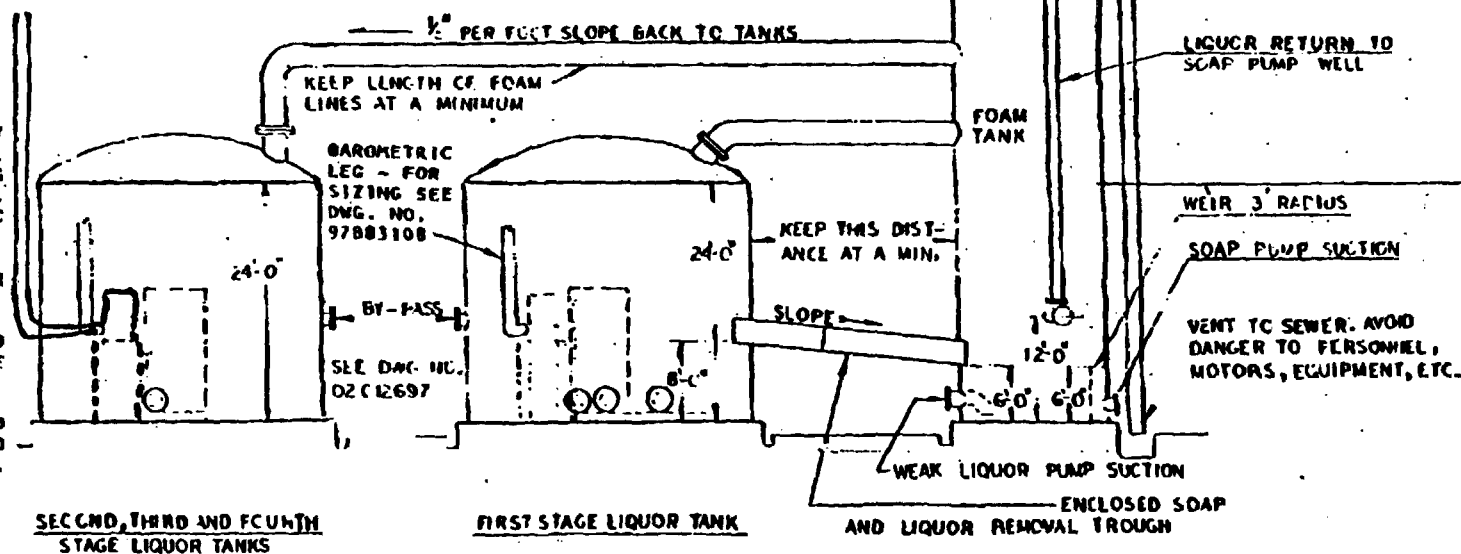
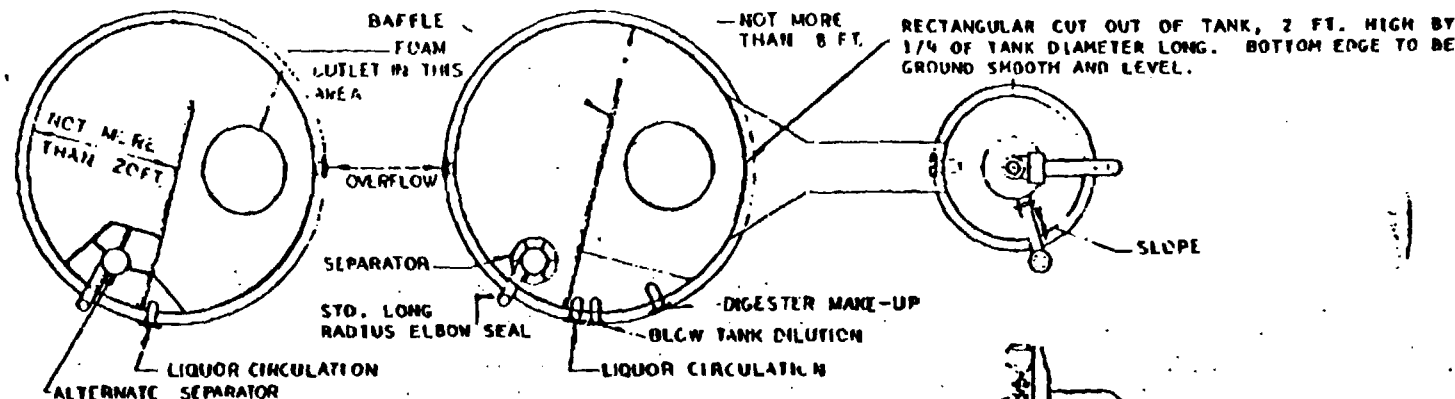
35 TO 50 FT. 50 TO 70 FT.

DROP LEGS SHOULD RUN VERTICALLY DIRECT FROM DORR-OLIVER WASHER TO THE SEPARATOR. THERE IS NO PROBLEM IN RUNNING LONG HORIZONTAL DROP LEGS WHERE NECESSARY. CONSULT DORR-OLIVER WITH YOUR SPECIFIC REQUIREMENTS.

THE DROP LEG(S) MUST ENTER THE SEPARATOR ABOVE LIQUOR LEVEL.

FOAM PIPE FROM WEAK LIQUOR TANK SHOULD ENTER FOAM TOWER ABOVE THE PIPE FROM THE STRONGER LIQUOR TANK.

FOAM TOWER SIZE BASED ON MATERIAL PULPED AND PULPING PROCESS. FOR SYSTEMS THAT DO NOT REQUIRE A FOAM TOWER SEE DRAWING NO. 02C12693.



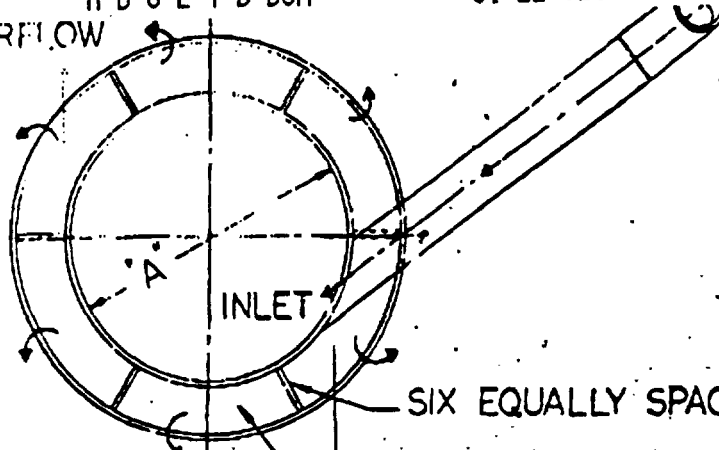
8 TO 12'

WED, 08-JAN-97 14:06

H D O L T D BOM

91 22 8210457

OVERFLOW



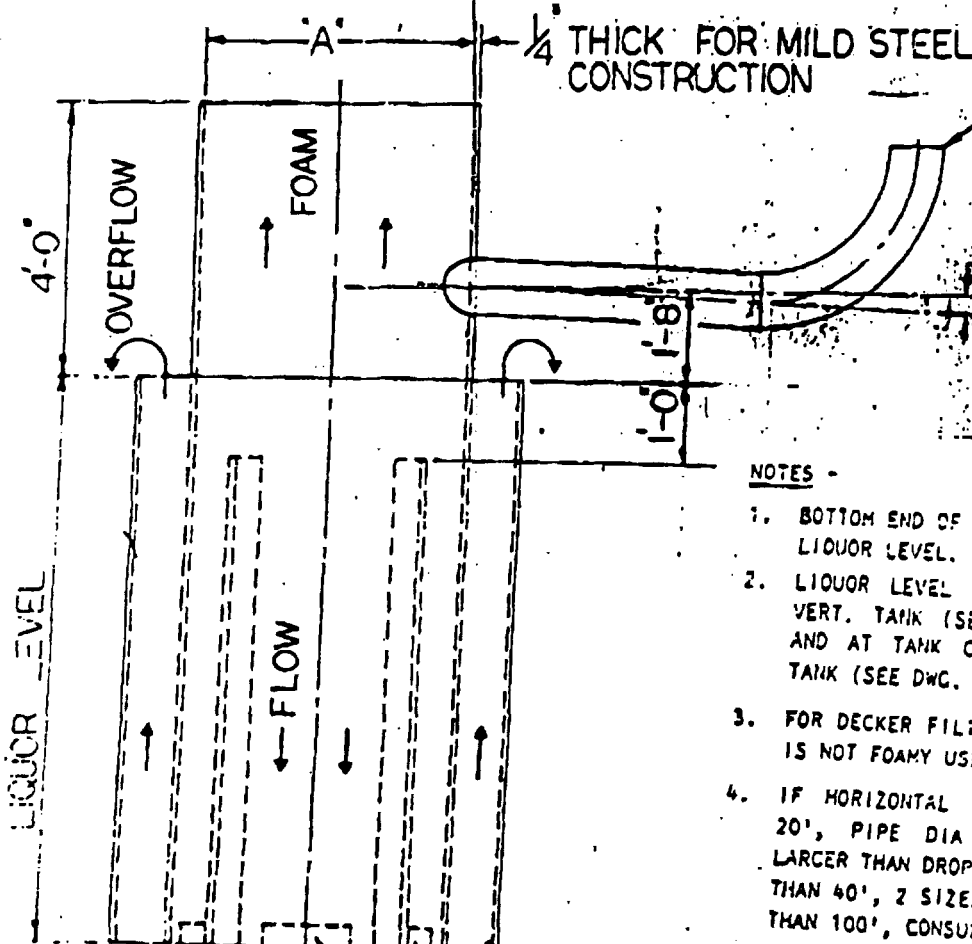
24" & 26" DIA	7'-0"	10" x 30"
20" & 22" DIA	6'-0"	10" x 24"
18" DIA	5'-0"	8" x 20"
14" & 16" DIA	4'-0"	6" x 20"
UP TO 12" DIA	3'-0"	6" x 12"
DROP LEG SIZE	A	B

SIX EQUALLY SPACED BAFFLES

SIX EQUALLY SPACED 'B' OPENINGS IN BOTTOM OF INNER CYLINDER

1/4" THICK FOR MILD STEEL CONSTRUCTION

DROP LEG, LONG RADIUS



NOTES -

1. BOTTOM END OF DROP LEG MUST BE ABOVE LIQUOR LEVEL.
2. LIQUOR LEVEL IS NORMALLY 8'-0" IN VERT. TANK (SEE DWG. NO. 02C12696) AND AT TANK CENTERLINE FOR HORIZ. TANK (SEE DWG. NO. 02C12695).
3. FOR DECKER FILTRATE AND LIQUOR THAT IS NOT FOAMY USE EVASE DESIGN.
4. IF HORIZONTAL RUN IS LONGER THAN 20', PIPE DIA MUST BE ONE SIZE LARGER THAN DROP LEG DIA. IF LONGER THAN 40', 2 SIZES LARGER. IF LONGER THAN 100', CONSULT D-O.

12" 1/4 THK. FOR MILD STEEL

2" X 2" OPENING IN OUTER SHELL FOR DRAINAGE

SIX 'B' OPENINGS FOR UNDERFLOW

SCOPE

- 1.1 This Basic Practice lists German, British, French, Italian, Belgian and Japanese ferrous material specifications which are considered equivalent to materials manufactured to ASTM Standards.
- 1.2 An asterisk (*) indicates that a decision by the purchaser is required or that additional information is furnished by the purchaser.

SUMMARY OF ADDITIONAL REQUIREMENTS

- 2.1 Table 1 lists the standards which shall be used with this Basic Practice when considering equivalents for steel plates, tubes, and structural steel.
- 2.2 Table 2 lists the names of the standards and organizations from the various countries which are referred to in this Basic Practice.

TABLE 1

STANDARDS			
ASTM Standards		ASTM Standards	
A 6	General Requirements for Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use	A 450	General Requirements for Carbon, Ferritic Alloy, and Austenitic Alloy Steel Tubes
A 20/A 20M	General Requirements for Steel Plates for Pressure Vessels		

TABLE 2

STANDARDS AND ORGANIZATIONS			
DIN (German)	Deutscher Normenausschuss	UNI (Italian)	Ente Italiano di Unificazione
WBL (German)	Verains Deutscher Eisenhüttenleute Werkstoffblatt	NBN (Belgium)	Institute Belge de Normalization
BSI (British)	British Standards Institute	JIS (Japanese)	Japanese Standards Association
AFNOR (French)	Association Francaise de Normalisation	ASTM (USA)	American Society for Testing and Materials

- 2.3 When a boiler or pressure vessel is fabricated to ASME Code Section I or VIII but does not require Code stamping, the material specifications listed may be substituted for the comparable SA specifications in those Code sections.
If Code stamping is required, the permissible substitute material shall be certified as conforming to the appropriate SA specification, in the manner prescribed by the applicable code.
- 2.4 Permissible substitutes for non-ferrous materials. Except for 70Ni 30Cr clad steel plate (ASTM A 265), non-ferrous material substitutions are not listed in this Basic Practice.
Vendor's proposals to use materials alternative to those specified shall be submitted to purchaser for approval. When materials are not specified, vendor's proposal shall be submitted to purchaser for approval by Owner's Engineer.

DEFINITION

- 3.1 "USA Specification Materials," as used in this Basic Practice, means construction materials which are manufactured to United States specifications, regardless of the location of manufacture.

USE OF THE MATERIALS SUBSTITUTES TABLE

- 4.1 The permissible substitutes for USA specification materials are listed in Table 3. In some cases, additional requirements not covered by the substitute specification must be met. These requirements are identified in the Remarks column of Table 3, with explanatory notes following the table.
- 4.2 The materials listed may be used interchangeably with the corresponding USA specification materials. Substitutions not listed must be approved by the Owner's Engineer.
- 4.3 ASTM A 6, A 20/A 20M, and A 450 cover common requirements which apply to structural steels, plates for pressure vessels, and steel tubes, respectively. Equivalent general specifications are not provided in the standards of the other countries, although certain of these general requirements are included in the individual materials specifications. In some of the substitute specifications, permissible variations in weights and dimensions differ from those in ASTM A 6, A 20/A 20M, and A 450. These differences should be taken into account when material is ordered to other than USA specifications.

PERMISSIBLE SUBSTITUTES FOR USA SPECIFICATION MATERIALS

(This BP is appropriate for attachment to Inquiry or Purchase Document)

EXXON

ER&E

BASIC PRACTICE

TABLE 3

ASTM STANDARD	GERMAN				BRITISH			BELGIAN			
	DIN Type	DIN Number	Material Number	Remarks	B.S. Number	B.S. Grade	Remarks	NBN Type	NBN Number	Remarks	
A 36 Structural Steel	St 44-2	17100	1.0044	< 1-1/2 in. (38 mm) Thick (25)	4380	43B	> 5/8 in. (16 mm) (6)	AE 255C	A21-101	—	
	St 44-2	17100	1.0044		—	—		—	—	—	—
A 48 Gray Cast Iron Castings — Class No. 25	GG20	1691	0.6020	—	1452	180	—	—	—	—	
A 53 Welded and Seamless Steel Pipe	Grade A	St 37-2	1626	1.0008	(18) Welded	3601	320	BW.S.ERW	E 37-2	630	(2)(3b)(9)
		St 35	1629	1.0308	(18) Seamless	—	—	—	—	—	—
	Grade B	St 45	1629	1.0408	(18) Seamless	3601	410	BW.S.ERW	E 42-2	630	(2)(3b)(9)
		St 42-2	1626	1.0040	(18) Welded	—	—	—	—	—	—
A 105 Carbon Steel Forgings for Piping Components	19 Mn 5	17155	1.0482	(3b)(15)	1503	221-490	—	—	—	—	
A 106 Seamless C-Steel Pipe for High Temperature Service	Grade A	St 35.8	17175	1.0305	—	3602	HFS 360	—	D 37-2	629	(3b)(9)
	Grade B	St 45.8	17175	1.0405	—	3602	HFS 410	—	D 42-2	629	(3b)(9)
28 Gray Iron Castings for Valves, Flanges and Pipe Fittings	Class A	GG 15	1691	0.6015	—	1452	Grade 150	—	—	—	—
	Class B	GG 25	1691	0.6025	—	1452	Grade 220	—	—	—	—
A 131 Structural Steel for Ships	Grade A	St 44-2	17100	1.0044	—	4360	40B	—	—	—	(3)
	Grade B	R St 44-2	17100	1.0044	(1)	4360	40B	—	—	—	(3)
	Grade D & E	St 44-3	17100	1.0144	(1)	4360	40E	—	—	—	(3)
A 134 Electric-Fusion (Arc) — Welded Steel Pipe	—	—	—	(3)	3602	SAW 410	—	—	—	—	
A 138 Electric-Fusion (Arc) — Welded Steel Pipe	Grade B	—	—	(3)	3602	SAW 410	—	—	—	—	
	Grade C	—	—	(3)	3602	SAW 410	—	—	—	—	
	—	—	—	—	—	—	—	—	—	—	
A 161 Seamless Low-C and C-Mn Steel Still Tubes for Refr- actory Service	Carbon Steel	St 35.8	17175	1.0305	—	3059	HFS 320	(31)	D 37-1	629	(3b)
	Grade T1	16 Mo 5	—	1.5423	(3a)	—	—	(3)	16 Mo 5	629	(3b)
A 167 Stainless and Heat-Resisting Cr-Ni Steel Plate, Sheet and Strip	Grade 304	X 5 CrNi 18 9	17440	1.4301	(3b)	1449	304S15	—	X 6 Ni Cr 18 10	A23-403	(3b)
	Grade 304L	X 2 CrNi 18 9	17440	1.4308	(3b)	1449	304S11	—	X 3 Ni Cr 18 10	A23-403	(3b)
	Grade 316	X 5 CrNiMo 18 10	17440	1.4401	(3b)	1449	316S31	—	—	—	—
	Grade 316L	X 2 CrNiMo 18 10	17440	1.4404	(3b)	1449	316S11	—	—	—	—
	Grade 321	X 10 CrNiTi 18 9	17440	1.4541	(3b)(17)	1449	321S31	—	X 6 Ni Cr Ti 18 10	A23-403	(3b)
	Grade 347	X 10 CrNiNb 18 9	17440	1.4550	(3b)(17)	1449	347S31	—	—	—	—
A 176 Stainless and Heat-Resisting Chromium Steel Plate, Sheet and Strip	Type 405	X 7 CrAl 13	17440	1.4002	(3b)	1449	405S17	—	—	—	—
	Type 410	X 10 Cr 13	17440	1.4008	(3b)	—	—	(3)	—	—	—
	Type 410S	X 7 Cr 13	17440	1.4000	(3a)	—	—	—	—	—	—
A 178 C-Steel Electric-Resistance- Welded Boiler Tubes	Grade A	St 37.8	17177	1.0315	(7)	3059	ERW 320	—	—	—	—
	Grade C	St 42.8	17177	1.0498	(7)	—	—	—	—	—	—
A 179 Seamless Cold Drawn Low-C Steel Heat Exchang- er and Condenser Tubes	St 35.4	1629	1.0309	—	3608	CFS 320	—	D 37-2	629	(3b)	
	St 35.8	17175	1.0305	Plus DIN 2391 (18) Gütegrad C. NBK	—	—	—	—	—	—	

EXXON

ER&E

BASIC PRACTICE

**PERMISSIBLE SUBSTITUTES FOR
USA SPECIFICATION MATERIALS**

(This BP is appropriate for attachment to Inquiry or Purchase Document)

BP18-1-1

Page 3 of 20

Rev. 3 Jan. 1985

TABLE 3 (Cont.)

ASTM STANDARD	FRENCH			ITALIAN			JAPANESE		
	AFNOR Type	NF Number	Remarks	UNI Type	UNI Number	Remarks	JIS Symbol	JIS Number	Remarks
A 36 Structural Steel	E 20-2	A35-501	—	—	—	—	SM 41A	G3106	(23)
A 48 Gray Cast Iron Castings — Class No. 25	—	—	(3)	G 20	5007	—	FC 20	G5501	—
A 53 Welded and Seamless Steel Pipe									
Grade A	—	—	(3)	Fe 35-1	663	—	STPG 38	G3454	(16)
Grade B	—	—	(3)	—	—	(3)	STPG 42	G3454	(16)
A 105 Carbon Steel Forgings for Piping Components	AF 48N	M87-508	—	Fe 5108	7748	—	SPVC2A	G3202	(22)
A 108 Seamless C-Steel Pipe for High Temperature Service									
Grade A	TU 37C	A49-213	—	C 14	5462	—	STPT 38	G3456	(16)(30)
Grade B	TU 42C	A49-213	—	C 18	5462	—	STPT 42	G3456	(16)(30)
A 128 Gray Iron Castings for Valves, Flanges and Pipe Fittings									
Class A	—	—	(3)	G 15	5007	(3b)	FC 20	G5501	—
Class B	—	—	(3)	G 22	5007	(3b)	FC 25	G5501	—
A 131 Structural Steel for Ships									
Grade A	E29.2	A35-501	—	Fe 42B	7070	—	SM 41A	G3106	—
Grade B	E29.3	A35-501	—	Fe 42C	7070	—	SM 41B	G3106	—
Grade D & E	E29.4	A35-501	(1)	Fe 42C	7070	(1)	SM 41C	G3106	(1)
A 134 Electric-Fusion (Arc) — Welded Steel Pipe	—	—	(3)	—	—	(3)	STPY 41	G3457	(18)
A 138 Electric-Fusion (Arc) — Welded Steel Pipe									
Grade B	—	—	(3)	—	—	(3)	—	—	(3)
Grade C	—	—	(3)	—	—	(3)	—	—	(3)
A 161 Seamless Low-C and C-Mn Steel Still Tubes for Refinery Service									
Carbon Steel	C 10 d	—	(3a)	C 14	5462	(3b)	STF 38	G3457	(31)
Grade T1	15 D 5	—	(3a)	16 Mo 5	5462	(3c)	STFA 12	G3467	(34)
A 167 Stainless and Heat-Resisting Cr-Ni Steel Plate, Sheet and Strip									
Grade 304	Z 6 CN 18.09	A36-209	—	X 5 Cr Ni 18 10	8317	—	SUS 304	G4304	—
Grade 304L	Z 2 CN 18.10	A36-209	—	X 2 Cr Ni 18 11	8317	—	SUS 304L	G4304	—
Grade 316	Z 6 CND 17.11	A36-209	—	X 5 Cr Ni Mo 17 12	8317	—	SUS 316	G4304	—
Grade 316L	Z 2 CND 17.13	A36-209	—	X 2 Cr Ni Mo 17 13	8317	—	SUS 316L	G4304	—
Grade 321	Z 6 CNT 17.12	A36-209	—	X 6 Cr Ni Ti 18 11	8317	—	SUS 321	G4304	—
Grade 347	Z 6 CNb 18.13	A36-209	—	X 6 Cr Ni Nb 18 11	8317	—	SUS 347	G4304	—
A 178 Stainless and Heat-Resisting Chromium Steel Plate, Sheet and Strip									
Type 405	Z 8 CA 13	A35-573	(3b)	X 8 Cr Al 13	8317	—	SUS 405	G4304	—
Type 410	Z 12 C 13	A35-573	(3b)	X 12 Cr 13	8317	—	SUS 410	G4304	—
Type 410S	Z 6 C 13	A35-573	(3b)	X 6 Cr 13	8317	—	SUS 410S	G4304	—
A 179 C-Steel Electric-Resistance- Welded Boiler Tubes									
Grade A	—	—	(3)	—	—	(3)	STB 33-EH	3461	—
Grade C	—	—	(3)	—	—	(3)	STB 42-EH	3461	—
A 179 Seamless Cold Drawn Low-C Steel Heat Exchanger and Condenser Tubes	TU 37C	A49-215	(3a)	C 14	5462	—	STB 33	G3461	(33)

**PERMISSIBLE SUBSTITUTES FOR
USA SPECIFICATION MATERIALS**

(This BP is appropriate for attachment to Inquiry or Purchase Document)



ERA E

BASIC PRACTICE

Jan. 1985

TABLE 3 (Cont.)

ASTM STANDARD	GERMAN				BRITISH			BELGIAN		
	DIN Type	DIN Number	Material Number	Remarks	B.S. Number	B.S. Grade	Remarks	NBN Type	NBN Number	Remarks
A 181 C-Steel Forgings for General Purpose Piping Class 80	St 44-2	17100	1.0044	Per Ad-Merblatt W-13 (18)	1503	221-430	--	E 37-1	830	(3b)
	Class 70	C22	17200	1.0402	--	--	--	E 52-1	830	(3b)
		18 Mn 5	--	1.0482	WBL 520 (3b)	1503	221-480	--	--	--
	20 Mn 5	--	1.1133	WBL 610 (3b) WBL 550 (3b)	--	--	--	--	--	--
A 182 Forged or Rolled Alloy Steel Pipe Flanges, Flanges and Valves for High Temperature Service	Grade F 1	18 Mo 5	--	1.5423	(3a)	1503	245-420	--	--	--
	Grade F 5	12 CrMo 19 5	--	1.7362	WBL-400 & 580(3b)	1503	625-520	--	--	--
	Grade F 6a	X 10 Cr 13	17440	1.4006	(3a)	1503	410S21	(4)	--	--
	Grade F 11	13 CrMo 44	17175	1.7335	WBL-620(3b)(8)	1503	621-480	--	--	--
	Grade F 12	13 CrMo 44	17175	1.7335	WBL-620(3b)	1503	620-540	--	--	--
	Grade F 22	10 CrMo 9 10	17175	1.7380	WBL-610(3b)	1503	622-580	--	--	--
	Grade F 304	X 5 CrNi 18 9	17440	1.4301	(3b)	1503	304S31	--	--	--
	Grade F 304H	--	--	--	(3)	1503	304S51	--	--	--
	Grade F 304L	X 2 CrNi 18 9	17440	1.4306	(3b)	1503	304S11	--	--	--
	Grade F 310	--	--	--	(3)	1503	310S31	--	--	--
	Grade F 316	X 5 CrNiMo 18 10	17440	1.4401	(3b)	1503	316S31	Also 316S33	--	--
	Grade F 316H	--	--	--	(3)	1503	316S51	--	--	--
	Grade F 316L	X 2 CrNiMo 18 10	17440	1.4404	(3b)	1503	316S11	--	--	--
	Grade F 321	X 10 CrNiTi 18 9	17440	1.4541	(3b)	1503-621	321S31	--	--	--
Grade F 347	X 10 CrNiMo 18 9	17440	1.4550	(3b)	1503	347S31	--	--	--	
A 183 Seamless C-Steel Boiler Tubes for High Pressure Service	St 35.8	17175	1.0305	--	3059	320	(27)(30)	D45	837	(27)
A 183 Alloy Steel Bolting Materials for High Temperature Service	Grade B 6	X 7 Cr 13	17440	1.4000	(3a)	1506-713	--	Cond. R(3a)	--	--
	Grade B 7	42 CrMo 4	17200	1.7225	(3c)	1506-621	A	Cond. T	42 Cr Mo 4	253-02 (3c)
		24 CrMo 5	17240	1.7258	Limited to 500°C (3c)(20)	--	--	--	--	--
	Grade B 7M	42 CrMo 4	17200	1.7225	(3c)	1506-621	A	Cond. R(20)	42 Cr Mo 4	253-02 (3a)(20)
	Grade B 8	X 5 CrNi 18 9	17440	1.4301	(3c)	1506-801	B	--	--	--
	Grade B 8C	X 10 CrNiMo 18 9	17440	1.4550	(3c)	1506-621	Nb	--	--	--
	Grade B 8M	X 5 CrNiMo 18 10	17440	1.4401	(3c)	1506-845	--	--	--	--
	Grade B 8T	X 10 CrNiTi 18 9	17440	1.4541	(3c)	1506-621	Ti	--	--	--
	Grade B 16	40 CrMoV 5 5	17240	1.7711	(3c)	1506-661	--	Order to B.S. 4862	--	--
A 184 C- and Alloy Steel Nuts for Bolts for High Temperature Service	Grade 2H	C 35	17240	1.1181	(3c)	1506-162	--	Cond. TX	--	--
	Grade 4	24 CrMo 5	17240	1.7258	(3c)	1506-240	--	Order to B.S. 4862	--	--
	Grade 6	X 7 Cr 13	17440	1.4000	(3a)	1506-713	--	Cond. R(3a)	--	--
	Grade 6F (with sulfur)	--	--	--	(3)	--	--	--	--	--
	Grade 8	X 5 CrNi 18 9	17440	1.4301	(3c)	1506-801	B	--	--	--
Grade 8M	X 5 CrNiMo 18 10	17440	1.4401	(3c)	1506-845	--	--	--	--	
A 189 Seamless Cold Drawn Intermediate Alloy Steel Heat Exchanger and Condenser Tubes	T 5	12 CrMo 19 5	--	1.7362	(3a)	3606	CFS 625	(35)	X 12 Cr Mo 5	837 (35)
	T 11	13 CrMo 44	17175	1.7335	(8)	3606	CFS 621	(35)	--	--
	T 22	10 CrMo 9 10	17175	1.7380	--	3606	CFS 622	(35)	10 Cr Mo 9 10	837 (35)
A 200 Seamless Intermediate Alloy Steel Sbl Tubes for Refinery Service	T 5	12 CrMo 19 5	--	1.7362	(3a)	3604	625	(30)(32)	X 12 Cr Mo 5	837 (32)
	T 11	13 CrMo 44	17175	1.7335	(8)	3604	621	(30)(32)	--	--
	T 22	10 CrMo 9 10	17175	1.7380	--	3506	622	(30)(32)	10 Cr Mo 9 10	837 (32)

**PERMISSIBLE SUBSTITUTES FOR
USA SPECIFICATION MATERIALS**

(This BP is appropriate for attachment to Inquiry or Purchase Document)

TABLE 3 (Cont.)

ASTM STANDARD	FRENCH			ITALIAN			JAPANESE			
	AFNOR Type	MF Number	Remarks	UNI Type	UNI Number	Remarks	JIS Symbol	JIS Number	Remarks	
A 181 C-Steel Forgings for General Purpose Piping Class 60	AF 42-2	A33 101	(3b)	Fe 4108	7748	—	SF VC1	G3202	—	
	Class 70	AF 48N	M87-508	Fe 5108	7748	—	SF VC2A	G3202	—	
A 182 Forged or Rolled Alloy Steel Pipe Flanges, Fittings and Valves for High Temperature Service	Grade F 1	Z 25 D5	M87-508	—	—	—	SFYA F1	G3203	(7b)	
	Grade F 5	Z 10 CD 5-05	M87-508	—	—	Term CM5(3a)	SFYA F5B	G3203	(7b)	
	Grade F 8a	Z 10 C 13	A35-578	(3b)	—	(3)	—	—	(3)	
	Grade F 11	15 SD 5-03	M87-508	—	25CD4	Term CM9(3a)	SFYA F11	G3203	(7b)	
	Grade F 12	15 CD 4-05	M87-508	—	13CD4	(3a)	SFYA F12	G3203	(7b)	
	Grade F 22	10 CD 9-10	M87-508	—	—	Term CMT(3b)	SFYA F22B	G3203	(7b)	
	Grade F 304	Z 6 CN 18-08	M87-508	—	X 5 Cr Ni 18 10	(3b)	SUS 304	G3214	—	
	Grade F 304H	—	—	(3)	X 8 Cr Ni 19 10	6901	(3b)	SUS 304H	G3214	
	Grade F 304L	Z 2 CN 18-10	M87-508	—	X 2 Cr Ni 18 11	6901	(3b)	SUS 304L	G3214	
	Grade F 310	—	—	(3)	X 22 Cr Ni 25 20	6901	(3b)(11)	SUS 310S	G3214	
	Grade F 318	Z 6 CND 17.11	M87-508	—	X 5 Cr Ni Mo 17 12	6901	(3b)	SUS 318	G3214	
	Grade F 316H	—	—	(3)	X 8 Cr Ni Mo 17 12	6901	(3b)	SUS 316H	G3214	
	Grade F 316L	Z 2 CND 17.12	M87-508	—	X 2 Cr Ni Mo 17 12	6901	(3b)	SUS 316L	G3214	
	Grade F 321	Z 6 CNT 18.11	M87-508	—	X 6 Cr Ni Ti 18 11	6901	(3b)	SUS 321	G3214	
	Grade F 347	Z 6 CNM 18.11	M87-508	—	X 6 Cr Ni Mo 18 11	6901	(3b)	SUS 347	G3214	
A 192 Seamless C-Steel Boiler Tubes for High Pressure Service	TU 37C	A49-213	(27)	C 14	5462	(27)	STB 35	G3461	(3)	
A 193 Alloy Steel Bolting Materials for High Temperature Service	Grade B 6	Z 12 C13	A35-574	(3a)	X 12 Cr 13	6900	(3a)	SUS 410	G4303	(3a)
	Grade B 7	42 CD 4	A35-559	(3b)	42 Cr Mo 4	7845	(3c)	SNB 7	G4107	(3a)
	Grade B 7M	42 CD 4	A35-559	(3b)(20)	42 Cr Mo 4	7845	(3c)(20)	SNB 7	G4107	(3a)(20)
	Grade B 8	Z 6 CN 18.09	A35-559	(3b)	X 5 Cr Ni 18 10	6901	(3b)	SUS 304	G4303	(3a)
	Grade B 8C	Z 6 CNM 18.10	A35-602	(3a)	X 6 Cr Ni Mo 18 11	6901	(3b)	SUS 347	G4303	(3a)
	Grade B 8M	Z 6 CND 17-12	—	(3a)	X 5 Cr Ni Mo 17 12	6901	(3b)	SUS 316	G4303	(3a)
	Grade B 8T	Z 6 CNT 18.10	A35-559	(3b)	X 6 Cr Ni Ti 18 11	6901	(3b)	SUS 321	G4303	(3a)
	Grade B 16	40 CDV 4.05	—	(3a)	—	—	Term CDV 2(3b)	SNB 16	G4107	(3a)
	A 194 C- and Alloy Steel Nuts for Bolts for High Temperature Service	Grade 2H	C 45	—	(3a)	C 45	7845	(3c)	S 45C	G4051
Grade 4		45 D 2	—	(3a)	—	—	Term T 5 BM(3b)	—	—	(3)
Grade 6		Z 12 C 13	A35-574	(3a)	X 12 Cr 13	6900	(3a)	SUS 410	G4303	(3c)
Grade 6F (with sulfur)		Z 12 CF 13	A35-574	(3a)	—	—	(3)	—	—	(3)
Grade 8		Z 6 CN 18.09	A35-605	(3a)	X 6 Cr Ni 18 10	6901	(3b)	SUS 304	G4303	(3a)
Grade 8M	Z 6 CND 17-12	—	(3a)	X 5 Cr Ni Mo 17 12	6901	(3b)	SUS 316	G4303	(3a)	
A 199 Seamless Cold Drawn Intermediate Alloy Steel Heat Exchanger and Condenser Tubes	T 5	Z 12 CD 5.05	—	(3a)	—	—	(3) Daimne 234	STBA 25	G3462	(35)
	T 11	10 CD 5.05	—	(3a)	—	—	(3) Daimne 227	STBA 23	G3462	(35)
	T 22	10 CD 9.10	—	(3a)	12 Cr Mo 9 10	5462	(10)	STBA 24	G3462	(35)
A 200 Seamless Intermediate Alloy Steel Still Tubes for Refinery Service	T 5	TU Z 12 CD 5.05	A49-213	(32)	—	—	Daimne 234(3b)	STBA 25	G3462	(32)
	T 11	TU 10 CD 5.05	A49-213	(32)	—	—	Daimne 227(3b)	STBA 23	G3462	(32)
	T 22	TU 12 CD 9.10	A49-213	(32)	12 Cr Mo 9 10	5462	(3b)	STBA 24	G3462	(32)

**PERMISSIBLE SUBSTITUTES FOR
USA SPECIFICATION MATERIALS**

(This BP is appropriate for attachment to Inquiry or Purchase Document)



ER&E

BASIC PRACTICE

TABLE 3 (Cont.)

ASTM STANDARD	GERMAN				BRITISH			BELGIAN			
	DIN Type	DIN Number	Material Number	Remarks	B.S. Number	B.S. Grade	Remarks	NBN Type	NBN Number	Remarks	
A 203 Nickel Steel Boiler Plates Grade D Grade E	10 Ni 14 —	— —	1.5637 —	WBL-880 (3a) (3)	1501-503 —	— —	— (3)	12 Ni 14 —	630 —	— —	
A 204 Mo-Steel Plates for Boiler and Other Pressure Vessels Grade A Grade B	16 Mo 5 18 Mo 5	— —	1.5423 1.5423	Order with DIN 50049-3.1C (3a) Order with DIN 50049-3.1C (3a)	1501-240 —	— —	(6) (3)	16 Mo 5 —	629 —	— —	
A 209 Seamless C-Mn Steel Boiler and Superheater Tubes Grade T 1 Grade T 18	18 Mo 5 16 Mo 5	— —	1.5423 1.5423	(3a) (3a)	— —	— —	— —	— —	— —	— —	
Seamless Medium-Carbon Steel Boiler and Superheater Tubes Grade A-1	St 45.8	17175	1.0405	—	3059	320	(3C)	245	837	(13)	
A 213 Seamless Alloy Steel Boiler and Heat Exchanger Tubes Grade T 5 Grade T 11 Grade T 12 Grade T 22 TP 304 TP 304L TP 310 TP 316 TP 316L TP 321 TP 347	12 CrMo 19.5 13 CrMo 44 13 CrMo 44 10 CrMo 9 10 X 5 CrNi 18 9 X 2 CrNi 18 9 X 12 CrNi 25 21 X 5 CrNiMo 18 10 X 2 CrNiMo 18 10 X 10 CrNiTi 18 9 X 10 CrNiNb 18 9	— 17175 17175 17175 17440 17440 — 17440 17440 17440 17440 17440	1.7362 1.7335 1.7335 1.7380 1.4301 1.4308 1.4845 1.4401 1.4404 1.4541 1.4550	(3a) (8)(32) (32) (32) (3b) (3b) WBL-470(3b) (3b) (3b) (3b) (3b) (3b)	3606 3606 3606 3606 3608 3606 — 3606 3608 3608 3608 3606	625 621 620 622 304S23 304S22 — 316S30 316S29 321S22 347S17	(3C) (3C) (3C) (3C)(32) (3C) (3C) (3) (3C) (3C) (3C) (3C) (3C)	— — — — — — — — — — — —	— — — — — — — — — — — —	— — — — — — — — — — — —	
A 214 Electric Resistance Welded Heat Exchanger and Condenser Tubes	St 37-2	1626	1.0006	(3c) ERW Only	3606	ERW30	—	207-1	629	(3b)	
A 218 C-Steel Castings Suitable for Fusion Welding for High Temperature Service WCA WCB	GS-C 25 —	17245 —	1.0819 —	— (3)	1504-161 1504-161	430 48C	— —	— —	— —	— —	
A 219 C-Steel Castings for Pressure Containing Parts Suitable for High Temperature Service WC 1 WC 8 WC 9 CS C 12 CA 15	GS-22 Mo 4 GS-17 CrMo 5.5 — GS-12 CrMo 19.5 G-X-12 CrMo 10.1 —	17245 17245 — — —	1.5419 1.7357 — 1.7363 1.7389	— — — WSL-595(3b) WSL-595(3b) (3)	1504-240 1504-621 — 1504-625 1504-629 1504-713	— — — — — —	— — — — — —	— — — — — —	— — — — — —	— — — — — —	
A 234 Wrought C- and Alloy Piping Fittings for Moderate and Elevated Temperatures Grade WP8 Grade WPC Grade WP1 Grade WPS Grade WP11 Grade WP12 Grade WP22	St 45.8 — 16 Mo 5 12 CrMo 19.5 13 CrMo 44 13 CrMo 44 10 CrMo 9 10	17175 — — 17175 17175 17175 17175	1.0405 — 1.5423 1.7362 1.7335 1.7335 1.7380	— (3) (3a) (3a) (8) — —	1503 1503 1503 1503 1503 1503 1503	221-480 221-510 245-420 625-520 621-460 620-440 622-490	(28) (28) (29) (36) (28) (28) (28)	— — — — — — —	— — — — — — —	— — — — — — —	— — — — — — —

**PERMISSIBLE SUBSTITUTES FOR
USA SPECIFICATION MATERIALS**

(This EP is appropriate for attachment to Inquiry or Purchase Document)

TABLE 3 (Cont.)

ASTM STANDARD	FRENCH			ITALIAN			JAPANESE			
	AFNOR Type	NF Number	Remarks	UNI Type	UNI Number	Remarks	JIS Symbol	JIS Number	Remarks	
A 203 Nickel Steel Boiler Plates Grade C Grade E	S 5 N	A36-208	— (3)	F8 E 285 N 14	EJ 129	—	SL 3N 25 SL 3N 28	G3127 G3127	— —	
A 204 Mo-Steel Plates for Boiler and Other Pressure Vessels Grade A Grade E	— 18 MD 405	— A36-206	— —	16 Mo 5 16 Mo 5	5669 —	— (3a)	SB 46M SB 49M	G3103 G3103	— —	
A 209 Seamless C-Mn Steel Boiler and Superheater Tubes Grade 1 Grade 2	18 MD 405	—	(3a) (3)	16 Mo 5	5462	(37) (3)	STBA 12 STBA 13	G3462 G3462	(30)(24) (30)(24)	
A 210 Seamless Medium-Carbon Steel Boiler and Superheater Tubes Grade A	TU A42-C	A49-213	(6)(13)	C 18	5462	(3b)	STB 42	G3451	(30)(24)	
A 215 Seamless Alloy Steel Boiler and Heat Exchanger Tubes Grade 1 Grade 1.1 Grade 1.2 Grade 1.3 TU 304 TU 304L TU 316 TU 316L TU 321 TU 321L	TU Z 12 CD 5.05 TU 10 CD 5.05 — TU 10 CD 9.10 TU 5 CN 18.09 TU 2 CN 18.09 TU 5 CN 17.12 TU 2 CN 17.13 TU 5 CN 18.11 TU 5 CN 18.11 TU 5 CN 18.11	A49-213 — — A49-218 A49-218 — A49-218 A49-218 A49-218 A49-218	(3a)(32) (3b)(32) — (3a)(32) (3b) (3b) (3) (3b) (3b) (3b) (3b) (3b)	— — — 12 Cr Mo 9 10 X 5 Cr Ni 18 10 X 2 Cr Ni 18 11 X 22 Cr Ni 25 20 X 5 Cr Ni Mo 17 12 X 2 Cr Ni Mo 17 12 X 5 Cr Ni Ti 18 11 X 5 Cr Ni Nb 18 11	— — — 5462 5904 5904 5904 5904 5904 5904 5904	— — — Diam 234(3b) Diam 227(3b) — Diam 235(3b) (3b) (3b) (3b)(11) (3b) (3b) (3b) (3b)	STBA 25 STBA 25 STBA 22 STBA 24 SUS 304TB SUS 304LTB SUS 316TB SUS 316LTB SUS 321TB SUS 321TB	G3462 G3462 G3462 G3462 G3463 G3463 G3463 G3463 G3463 G3463	(30)(24) (30)(24) (30)(24) (30)(24) (30)(24) (30)(24) (30)(24) (30)(24) (30)(24) (30)(24) (30)(24)	
A 214 Electric Resistance Welded Heat Exchanger and Condenser Tubes	TS 348	A49-245	—	—	—	—	STB 33-E STB 35-E	G3461 G3461	(24) (24)	
A 215 C-Steel Castings Suitable for Fusion Welding for High Temperature Service WCA WCB	A420-M A450-M	A32-055 A32-055	— —	— —	— —	— —	Temp T30(3b) Temp T60(3b)	SCPH 1 SCPH 2	G5151 G5151	— —
A 217 Alloy Steel Castings for Pressure Containing Parts Suitable for High Temperature Service WC 1 WC 5 WC 9 C 5 C 12 CA 15	— Z 05-M Z 05 CD 5 05-M Z 05 CD 9 10-M Z 15 CD 5 05-M — Z 10 C 13	A32-055 A32-055 A32-055 A32-055 — A35-578	— — — — — (3) (3)	— — — — — — —	— — — — — — —	— — — — — — —	Temp T3M(3b) Temp GCM(3b) (3) Temp GCM 5(3b) Temp GCM 8 (3)	SCPH 11 SCPH 21 — SCPH 61 — —	G5151 G5151 — G5151 — —	— — — (3) — — (3)
A 234 Wrought C and Alloy Pipe, Fittings for Moderate and Elevated Temperatures Grade WPB Grade WPC Grade WPI Grade WP 5 Grade WP 11 Grade WP 12 Grade WP 22	— TU 42 C — TU Z 12 CD 5-05 TU 6 C D 5-05 TU 6 C D 5-05 TU 10 CD 3-10	— A49-213 — A49-213 A49-213 A49-213 A49-213	(3b) (3) (3) (3b) (3b) (3b) (3b)	— C 18 16 Mo 5 — 14 Cr Mo 3 14 Cr Mo 3 12 Cr Mo 9 10	— 5462 5462 5462 5462 5462 5462	(3) (3c) (3b) (3) (3b)(8) (3c) (3c)	STPT 42 STPT 49 STPA 12 STPA 25 STPA 23 STPA 22 STPA 24	G3456 G3456 G3458 G3458 G3458 G3458 G3458	(3c) (3c) (3c) (3c) (3c) (3c) (3c)	

PERMISSIBLE SUBSTITUTES FOR
USA SPECIFICATION MATERIALS

(This BP is appropriate for attachment to Inquiry or Purchase Document)



ER&E

BASIC PRACTICE

TABLE 3 (Cont.)

ASTM STANDARD	GERMAN				BRITISH			BELGIAN		
	DIN Type	DIN Number	Material Number	Remarks	B.S. Number	B.S. Grade	Remarks	NBN Type	NBN Number	Remarks
A 240 Heat-Resisting Cr and Cr-Ni Steel Plate and Sheet for Pressure Vessels										
Type 304	X 5 CrNi 18 9	17440	1.4301	(3b)	1501	304S15		X 6 Ni Cr 18 10	A23-403	(3b)
Type 304L	X 2 CrNi 18 9	17440	1.4308	(3b)	1501	304S12		X 3 Ni Cr 18 10	A23-403	(3b)
Type 316	X 5 CrNiMo 18 10	17440	1.4401	(3b)	1501	316S18		---	---	---
Type 316L	X 2 CrNiMo 18 10	17440	1.4404	(3b)	1501	316S12		---	---	---
Type 317	---	---	---	(3b)	---	---		---	---	---
Type 317L	---	---	---	(3b)	---	---		---	---	---
Type 321	X 10 CrNiTi 18 9	17440	1.4541	(3b)	1501	321S12		X 6 Ni Cr Ti 18 10	A23-403	(3b)
Type 347	X 10 CrNiNb 18 9	17440	1.4550	(3b)	1501	347S17		---	---	---
Type 405	X 7 CrAl 13	17440	1.4002	(3b)	1501	405S17		---	---	---
Type 410	X 10 Cr 13	17440	1.4008	(3b)	---	---		---	---	---
Type 410S	X 7 Cr 13	17440	1.4000	(3b)	1501-713	---		---	---	---
Type 430	X 8 Cr 17	17440	1.4016	(3b)	---	---		---	---	---
A 252 Welded and Seamless Pipe										
Corrosion-Resisting Cr Steel Clad Plate, Sheet and Strip										
Type 405	X 7 CrAl 13	17440	1.4002	(3a)	3740	1	(3b)	---	---	---
Type 410S	X 7 Cr 13	17440	1.4000	(3a)	---	---	(3b)	---	---	---
A 264 Corrosion-Resisting Cr-Ni Steel Clad Plate, Sheet and Strip										
Type 304	X 5 CrNi 18 9	17440	1.4301	(3b)	3740	2	(3b)	---	---	---
Type 304L	X 2 CrNi 18 9	17440	1.4308	(3b)	3740	7	(3b)	---	---	---
Type 316	X 5 CrNiMo 18 10	17440	1.4401	(3b)	3740	8	(3b)	---	---	---
Type 316L	X 2 CrNiMo 18 10	17440	1.4404	(3b)	3740	8	(3b)	---	---	---
Type 317	---	---	---	(3b)	---	---	(3b)	---	---	---
Type 317L	---	---	---	(3b)	---	---	(3b)	---	---	---
Type 321	X 10 CrNiTi 18 9	17440	1.4541	(3b)	3740	3	(3b)	---	---	---
Type 347	X 10 CrNiNb 18 9	17440	1.4550	(3b)	3740	4	(3b)	---	---	---
A 265 Ni and Ni Base Alloy Clad Steel Plate 70/30 Ni-Cu	NiCu 30 Fe	17743	2.4380	Nicomax Silver(3b)	---	---	Coldchd Monel(3b)	---	---	---
A 268 C-Steel Forgings for Pressure Vessels										
Class 1	Cr 22	17200	1.1151	(3b)	1503	221-440	(15)	---	---	---
Class 4	Cr 22	17200	1.1151	(3b)	1503	221-496	(15)	---	---	---
A 269 Seamless and Welded Ferritic Stainless Steel Tubing for General Service										
Type 405	X 7 CrAl	17440	1.4002	(3b)	---	---	(3b)	---	---	---
Type 410	X 10 Cr 13	17440	1.4008	(3b)	---	---	(3b)	---	---	---
A 269 Seamless and Welded Austenitic Stainless Steel Tubing for General Service										
Type 304	X 5 CrNi 18 9	17440	1.4301	(3b)	---	---	(3b)	---	---	---
Type 304L	X 2 CrNi 18 9	17440	1.4308	(3b)	---	---	(3b)	---	---	---
Type 316	X 5 CrNiMo 18 10	17440	1.4401	(3b)	---	---	(3b)	X 6 Cr Ni Mo 17.12.2	911	---
Type 316L	X 2 CrNiMo 18 10	17440	1.4404	(3b)	---	---	(3b)	---	---	---
Type 317	---	---	---	(3b)	---	---	(3b)	---	---	---
Type 321	X 10 CrNiTi 18 9	17440	1.4541	(3b)	---	---	(3b)	X 6 Cr Ni Ti 18 10	911	---
Type 347	X 10 CrNiNb 18 9	17440	1.4550	(3b)	---	---	(3b)	X 6 Cr Ni Nb 18 10	911	---

EXXON

ER&E

BASIC PRACTICE

**PERMISSIBLE SUBSTITUTES FOR
USA SPECIFICATION MATERIALS**

(This BP is appropriate for attachment to Inquiry or Purchase Document)

BP18-1-1

Page 9 of 20

Rev. 3 Jan. 1985

TABLE 3 (Cont.)

ASTM STANDARD	FRENCH			ITALIAN			JAPANESE		
	AFNOR Type	NF Number	Remarks	UNI Type	UNI Number	Remarks	JIS Symbol	JIS Number	Remarks
A 240 Non-Ferrous Cr and Cr-Ni Steel Plate and Sheet for Pressure Vessels									
Type 304	5 CN 18-09	A36-209	—	X 5 Cr Ni 18 10	8317	(3b)	SUS 304	G3601	—
Type 304L	2 CN 18-10	A36-209	—	X 2 Cr Ni 18 11	8317	(3b)	SUS 304L	G3601	—
Type 316	5 CND 17-11	A36-209	—	X 5 Cr Ni Mo 17 12	6900	(3b)	SUS 316	G3601	—
Type 316L	2 CND 17-13	A36-209	—	X 2 Cr Ni Mo 17 12	6900	(3b)	SUS 316L	G3601	—
Type 317	—	—	—	—	—	(3)	SUS 317	G3601	—
Type 317L	2 CND 19-15	A36-209	—	—	—	(3)	SUS 317L	G3601	—
Type 321	5 CNT 18-11	A36-209	—	X 6 Cr Ni Ti 18 11	6900	(3b)	SUS 321	G3601	—
Type 347	5 CND 18-11	A36-209	—	X 5 Cr Ni Nb 18 11	6900	(3b)	SUS 347	G3601	—
Type 405	5 CA 13	A35-573	—	X 5 Cr Al 13	6900	(3b)	SUS 405	G3601	—
Type 410	5 CA 13	A35-573	(3b)	X 12 Cr 13	6900	(3a)	SUS 410	G3601	—
Type 410S	5 CA 13	A35-573	(3b)	X 6 Cr 13	6900	(3b)	SUS 410S	G3601	—
Type 430	5 CA 13	A35-573	(3b)	X 8 Cr 17	8317	(3b)	SUS 430	G3601	—
A 252 Welded and Seamless Pipe Pipes	—	—	(3)	—	—	(3)	—	—	(3)
A 253 Corrosion-Resisting Cr Steel Clad Plate, Sheet and Strip	5 CA 13	A35-573	(3b)	X 6 Cr Al 13	8317	Coclad 13 Cr/Al(3b)	SUS 405	G3601	—
Type 410S	5 CA 13	A35-573	(3b)	X 6 Cr 13	8317	Coclad 12 Cr(3b)	SUS 410S	G3601	—
A 254 Corrosion-Resisting Cr-Ni Steel Clad Plate, Sheet and Strip	5 CN 18-09	A35-573	(3b)	X 5 Cr Ni 18 10	8317	Coclad 18/B(3b)	SUS 304	G3601	—
Type 304L	2 CN 18-10	A35-573	(3b)	X 2 Cr Ni 18 11	8317	Coclad 18.8 E/C(3b)	SUS 304L	G3601	—
Type 316	5 CND 17-11	A35-573	(3b)	X 5 Cr Ni Mo 17 12	8317	Coclad 18/B/2(3b)	SUS 316	G3601	—
Type 316L	2 CND 17-12	A35-573	(3b)	X 2 Cr Ni Mo 17 12	8317	Coclad 18/B/2 E/C(3b)	SUS 316L	G3601	—
Type 317	—	—	—	—	—	—	SUS 317	G3601	—
Type 317L	2 CND 19-15	A35-573	(3b)	—	8317	Coclad 19/10/3 E/C(3b)	SUS 317L	G3601	—
Type 321	5 CNT 18-10	A35-573	(3b)	X 6 Cr Ni Ti 18 11	8317	Coclad 18/B Ti(3b)	SUS 321	G3601	—
Type 347	5 CND 18-10	A35-573	(3b)	X 5 Cr Ni Nb 18 11	8317	Coclad 18/B Nb(3b)	SUS 347	G3601	—
A 255 Ni and Ni Base Alloy Clad Steel Plate 70/30 Ni/Cu	—	—	(3)	—	—	Coclad Monel(3b)	—	—	(3)
A 256 Cr-Steel Forgings for Pressure Vessels Class 1 Class A	—	—	(3)	—	—	(3)	SPVC 1 SPVC 25	G2202 G3602	—
A 258 Seamless and Welded Formic Stainless Steel Tubing for General Service Type 405 Type 410	—	—	(3)	—	—	—	SUS 410TB	G3463	(3)
A 259 Seamless and Welded Austenitic Stainless Steel Tubing for General Service Type 304 Type 304L Type 316 Type 316L Type 317 Type 321 Type 347	TU Z 5 CN 18-10 TU Z 2 CN 18-09 TU Z 6 CND 17-11 TU Z 2 CND 17-12 TU Z 5 CNT 18-10 —	A49-230 A49-230 A49-230 A49-230 A49-230 —	— — — — — —	X 5 Cr Ni 18 10 X 2 Cr Ni 18 11 X 5 Cr Ni Mo 17 12 X 2 Cr Ni Mo 17 12 X 6 Cr Ni Ti 18 11 X 5 Cr Ni Nb 18 11	6904 6904 6904 6904 6904 6904	(3b) (3b) (3b) (3b) (3b) (3b)	SUS 304TB SUS 304LTB SUS 316TB SUS 316LTB SUS 317TB SUS 321TB SUS 347TB	G3463 G3463 G3463 G3463 G3463 G3463 G3463	— — — — — — —

PERMISSIBLE SUBSTITUTES FOR USA SPECIFICATION MATERIALS

(This BP is appropriate for attachment to Inquiry or Purchase Document)

EXXON

ER&E

BASIC PRACTICE

TABLE 3 (Cont.)

ASTM STANDARD	GERMAN				BRITISH			BELGIAN		
	DIN Type	DIN Number	Material Number	Remarks	B.S. Number	B.S. Grade	Remarks	NBN Type	NBN Number	Remarks
A 271 Seamless Austenitic Cr-Ni Steel Ssl Tubes for Refinery Service										
TP 304	X 5 CrNi 18 9	17440	1.4301	(3b)	3805	304S18	--	--	--	--
TP 304H	X 8 CrNi 18 11	--	1.4848	WBL-640(3b)	3805	304S59	--	--	--	--
TP 316	X 5 CrNiMo 18 10	17440	1.4401	(3b)	3805	316S18	--	X 6 Cr Ni Mo 17,12,2	911	--
TP 321	X 10 CrNiTi 18 9	17440	1.4541	(3b)	3805	321S18	--	X 9 Cr Ni Ti 18 10	911	--
TP 347	X 5 CrNiNb 18 10	17440	1.4550	(3b)	3805	347S18	--	X 6 Cr Ni Nb 18 10	911	--
TP 347H	X 8 CrNiNb 18 13	--	1.4981	WBL-670(3b)	3805	347S59	--	--	--	--
A 278 Stainless and Heat Resisting Steel Bars and Shapes										
Type 304	X 5 CrNi 18 9	17440	1.4301	(3b)	1501-801	B	--	--	--	--
Type 304L	X 2 CrNi 18 9	17440	1.4308	(3b)	1501-801	C	--	--	--	--
Type 310	X 12 CrNi 25 21	--	1.4845	(3a)	--	--	(3)	--	--	--
Type 316	X 5 CrNiMo 18 10	17440	1.4401	(3b)	1501-845	B	--	--	--	--
Type 316L	X 2 CrNiMo 18 10	17440	1.4404	(3b)	--	--	--	--	--	--
Type 317L	--	--	--	(3)	--	--	--	--	--	--
Type 321	X 10 CrNiTi 18 9	17440	1.4541	(3b)	1501-821	Ti	--	--	--	--
Type 347	X 10 CrNiNb 18 9	17440	1.4550	(3b)	1501-821	Nb	--	--	--	--
A 283 Low and Intermediate Tensile Strength C-Steel Plates for Structural Quality										
Grade C	US1 37-2	17100	1.0036	--	4360	408	--	AE235A	A21-101	--
Grade D	St 44-3	17100	1.0044	--	4360	43A	--	AE255A	A21-101	--
A 284 Low and Intermediate Tensile Strength C-Steel Plates for Pressure Vessels										
Grades A & B	H1	17155	1.0345	--	1501-151	380	--	E37-2	630	(2)
Grade C	H2	17155	1.0425	--	1501-151	400	--	E42-2	630	(2)
A 287 Heat-Resistant Fe-Cr, and Fe-Cr-Ni Alloy Castings for General Application										
Grade HF	G-X 40 CrNiSi 22 9	17465	1.4826	(3a)	--	--	(3)(3)	--	--	--
Grade HH	G-X 35 CrNiSi 25 12	17465	1.4837	(3a)	--	--	(3)(3)	--	--	--
Grade HK	G-X 40 CrNiSi 25 20	17465	1.4848	(3a)	--	--	(3)(3)	--	--	--
Grade HP	G-X 40 CrNiSi 35 25	17465	1.4857	(3a)	--	--	(3)(3)	--	--	--
A 299 C-Mn-Si Steel Plates for Pressure Vessels										
	WS1 355	17102	1.0566	--	--	--	(3)	D52-2	629	--
A 302 Mn-Mo and Mn-Mo-Ni Steel Plates for Pressure Vessels										
Grade A	--	--	--	(3)	--	--	(3)	--	--	--
Grade B	--	--	--	(3)	--	--	(3)	--	--	--
A 307 Low C-Steel Threaded Standard Fasteners										
Grade B	S D (St 50.11)	267	--	--	--	--	(3)	--	--	--
A 312 Seamless and Welded Austenitic Stainless Steel Pipe										
TP 304	X 5 CrNi 18 9	17440	1.4301	(3b)	3805	304S18	--	--	--	--
TP 304H	--	--	--	(3)	3805	304S59	--	--	--	--
TP 304L	X 2 CrNi 18 9	17440	1.4308	(3b)	3805	304S14	--	--	--	--
TP 310	--	--	--	(3)	--	--	--	--	--	--
TP 316	X 5 CrNiMo 18 10	17440	1.4401	(3b)	3805	316S18	--	--	--	--
TP 316H	--	--	--	(3)	3805	316S59	--	--	--	--
TP 316L	X 2 CrNiMo 18 10	17440	1.4404	(3b)	3805	316S14	--	--	--	--
TP 321	X 10 CrNiTi 18 9	17440	1.4541	(3b)	3805	321S18	--	--	--	--
TP 347	X 5 CrNiNb 18 9	--	1.4543	(3b)	3805	347S18	--	--	--	--
TP 347H	--	--	--	(3)	--	--	--	--	--	--

EXXON

ER&E

BASIC PRACTICE

**PERMISSIBLE SUBSTITUTES FOR
USA SPECIFICATION MATERIALS**

(This BP is appropriate for attachment to Inquiry or Purchase Document)

BP18-1-1

Page 11 of 20

Rev. 3 Jan. 1985

TABLE 3 (Cont.)

ASTM STANDARD	FRENCH			ITALIAN			JAPANESE		
	AFNOR Type	NF Number	Remarks	UNI Type	UNI Number	Remarks	JIS Symbol	JIS Number	Remarks
A 271 Seamless Austenitic Cr-Ni Steer Sbl Tubes for Refinery Service									
TP 304	Z 6 CN 18.08	A35-573	(3b)	X 5 Cr Ni 18 10	8804	Dalmine 913(3b)	SUS 304TF	G3457	--
TP 304H	Z 6 CN 18-10	A49-214	--	X 8 Cr Ni 19 10	8804	(3b)	SUS 304HTF	G3463	--
TP 316	Z 6 CND 17-11	A35-573	(3b)	X 5 Cr Ni Mo 17 12	8804	(3b)	SUS 316TF	G3467	--
TP 321	Z 6 CNT 18.10	A35-573	(3b)	X 6 Cr Ni Ti 18 11	8804	(3b)	SUS 321TF	G3457	--
TP 347	Z 6 CNb 18.11	A35-573	(3b)	X 6 Cr Ni Nb 18 11	8804	Dalmine 991(3b)	SUS 347TF	G3463	--
TP 347H	--	--	(3)	X 8 Cr Ni Nb 18 11	8804	(3b)	SUS 347HTF	G3463	--
A 276 Stainless and Heat Resisting Steel Bars and Shapes									
Type 304	Z 6 CN 18-8	A35-574	--	X 5 Cr Ni 18 10	8801	--	SUS 304	G4303	--
Type 304L	Z 2 CN 18-10	A35-574	--	X 2 Cr Ni 18 11	8801	--	SUS 304L	G4303	--
Type 310	--	--	(3)	X 22 Cr Ni 25 20	8801	--	--	--	(3)
Type 310S	--	--	(3)	X 6 Cr Ni 25 20	8801	--	SUS 310S	G4303	--
Type 316	Z 6 CND 17-11	A35-574	--	X 5 Cr Ni 17 13	8801	--	SUS 316	G4303	--
Type 316L	Z 2 CND 17-13	A35-574	--	X 2 Cr Ni Mo 17 12	8801	--	SUS 316L	G4303	--
Type 317L	Z 2 CND 19-15	A35-574	--	X 2 Cr Ni Mo 18 18	8801	--	SUS 317	G4303	--
Type 321	Z 6 CNT 18-10	A35-574	--	X 6 Cr Ni Ti 18 11	8801	--	SUS 321	G4303	--
Type 347	Z 6 CNb 18-10	A35-574	--	X 6 Cr Ni Nb 18 11	8801	--	SUS 347	G4303	--
A 283 Low and Intermediate Tensile Strength C-Steel Plates of Structural Quality									
Grade C	E 24-2	A35-501	--	Fe 37B	7070	--	SS 41	G3101	--
Grade D	E 28-2	A35-501	--	Fe 42B	7070	--	SS 41	G3101	--
A 285 Low and Intermediate Tensile Strength C-Steel Plates for Pressure Vessels									
Grades A & B	A 37-CP	A36-205	--	Fe 360-1KW	5869	--	--	--	(3)
Grade C	A 42-CP	A36-205	--	Fe 360-1KW	5869	--	SB 42B	G3103	--
A 287 Heat-Resistant Fe-Cr, and Fe-Cr-Ni Alloy Castings for General Application									
Grade HF	--	--	(3)	--	--	(3)	SCX 12	G5122	--
Grade HH	--	--	(3)	--	--	(3)	SCX 13	G5122	--
Grade HK	--	--	(3)	--	--	(3)	SCX 22	G5122	--
Grade HP	--	--	(3)	--	--	(3)	SCX 24	G5122	--
A 298 C-Mn-Si Steel Plates for Pressure Vessels									
	A 52-CP	A36-205	--	Fe 510-1KG	5869	(14)	SPV 36	G3115	(15)
A 302 Mn-Mo and Mn-Mo-Ni Steel Plates for Pressure Vessels									
Grade A	--	--	(3)	--	--	(3)	SBV 1A	G3119	--
Grade B	18 MD 4.05	A36-206	--	--	--	(3)	SBV 1B	G3119	--
A 307 Low C-Steel Threaded Standard Fasteners									
Grade B	--	--	(3)	--	--	(3)	SS 41	G3101	(3b)
A 312 Seamless and Welded Austenitic Stainless Steel Pipe									
TP 304	TU Z 6 CN 19-10	A49-230	--	X 5 Cr Ni 18 10	8804	(3b)	SUS 304TP	G3459	(16)
TP 304H	TU Z 6 CN 19-10	A49-214	--	X 8 Cr Ni 19 10	8804	(3b)	SUS 304HTP	G3459	(16)
TP 304L	TU Z 2 CN 19-11	A49-230	--	X 2 Cr Ni 18 11	8804	(3b)	SUS 304LTP	G3459	(16)
TP 310	--	--	--	X 22 Cr Ni 25 20	8804	(3b)(11)	SUS 310STP	G3459	(16)
TP 316	Z 6 CND 17.11	A35-573	(3b)	X 5 Cr Ni Mo 17 12	8804	(3b)	SUS 316TP	G3459	(16)
TP 316H	TU Z 6 CND 17-12	A49-230	--	X 8 Cr Ni Nb 17 12	8804	(3b)	SUS 316HTP	G3459	(16)
TP 316L	TU Z 2 CND 17-12	A49-230	--	X 2 Cr Ni Mo 17 12	8804	(3b)	SUS 316LTP	G3459	(16)
TP 321	Z 6 CNT 18.11	A49-230	--	X 6 Cr Ni Ti 18 11	8804	(3b)	SUS 321TP	G3459	(16)
TP 347	Z 6 CNb 18.11	A35-573	(3b)	X 6 Cr Ni Nb 18 11	8804	(3b)	SUS 347TP	G3459	(16)
TP 347H	--	--	--	X 8 Cr Ni Nb 18 11	8804	(3b)	SUS 347HTP	G3459	(16)

PERMISSIBLE SUBSTITUTES FOR USA SPECIFICATION MATERIALS

(This BP is appropriate for attachment to Inquiry or Purchase Document)

EXXON

ER&E

BASIC PRACTICE

TABLE 3 (Cont.)

ASTM STANDARD	GERMAN				BRITISH			BELGIAN		
	DIN Type	DIN Number	Material Number	Remarks	U.S. Number	U.S. Grade	Remarks	NSN Type	NSN Number	Remarks
A 320 Alloy Steel Bolting Material for Low Temperature Service L7 L43 B8	42 CrMo 4	17200	1.7225	(3a)	1506-621	A, Cond T	(3b)	--	--	--
	--	--	--	(3)	--	--	(3)	--	--	--
	X 5 CrNi 18 9	17440	1.4301	(3a)	1506-601	B	(3b)	--	--	--
A 325 High Strength Steel Bolts for Structural Steel Joints Type 1 Type 2	C4 35	1654	1.1172	(3c)	--	--	(3)	--	--	--
	Z2 52	1654	1.5508	(3c)	--	--	(3)	--	--	--
A 333 Seamless and Welded Pipe for Low-Temperature Service Grade 1 Grade 3 Grade 6 Grade 8	TT St 41N	--	1.0437	WBL-680(3b)	--	--	(3)	--	--	--
	10 N 14	--	1.5637	WBL-680(3b)	3603	HFS503 LT100	CAT. 2	--	--	--
	TT St 45N	--	1.0456	WBL-680(3b)	3603	HFS410 LT30	CAT. 2	--	--	--
	X 8 Ni 9	--	1.5662	WBL-680(3b)	3603	HFS590 LT196	CAT. 2	--	--	--
A 334 Seamless and Welded C- and Alloy Steel Tubes for Low-Temperature Service Grade 1 Grade 3 Grade 6 Grade 8	TT St 41N	--	1.0437	WBL-680(3b)	--	--	--	--	--	--
	10 N 14	--	1.5637	WBL-680(3b)	3603	HFS503 LT100	CAT. 2	--	--	--
	TT St 45N	--	1.0456	WBL-680(3b)	3603	HFS410 LT30	CAT. 2	--	--	--
	X 8 Ni 9	--	1.5662	WBL-680(3b)	3603	HFS590 LT196	CAT. 2	--	--	--
A 335 Seamless Ferritic Alloy Steel Pipe for High Temperature Service P 1 P 5 P 9 P 11 P 12 P 22	18 Mo 5	--	1.5423	(3a)	--	--	(3)	--	--	--
	12 CrMo 19 5	--	1.7362	WBL-590(3b)	3604	HFS625	CAT. 2	--	--	--
	--	--	--	(3)	--	HFS629- 470	CAT. 2	--	--	--
	13 CrMo 44	17175	1.7335	(8)	3604	HFS621	CAT. 2	--	--	--
	13 CrMo 44	17175	1.7335	--	3604	HFS620- 440	CAT. 2	--	--	--
P 22	10 CrMo 9 10	17175	1.7380	--	3604	HFS622	CAT. 2	--	--	--
A 350 Forged or Rolled C- and Alloy Steel Flanges, Forged Fittings, and Valves for Low Temperature Service Grade LF 1 Grade LF 2 Grade LF 3	TT 41	--	1.0437	WBL-680(3c)	1503	Z21-430	--	--	--	--
	TT StE315	17102	1.0508	(3c)	1640	WPL-0	--	--	--	--
	--	--	--	--	1503	Z21-480	--	--	--	--
	10 Ni 14	--	1.5637	WBL-680(3c)	1640	WPL-J	--	--	--	--
A 351 Austenitic Steel Castings for High Temperature Service CF 8 CF 8M CX 20 HK 40	G-X 8 CrNi 18 9	17445	1.4308	(3a)	1504-304	C15	--	--	--	--
G-X 8 CrNiMo 18 10	17445	1.4406	(3a)	1504-316	C16	--	--	--	--	
G-X 15 CrNiSi 25 20	--	1.4849	WBL-595(3b)	1504-310	C40	--	--	--	--	
G-X 40 CrNiSi 25 20	17445	1.4848	(3a)	--	--	(3)	--	--	--	
A 352 Ferritic Steel Castings for Low Temperature Service Grade LC8 Grade LC2 Grade LC3	GS-Cr24	1.1156	--	WBL-685(3b)	1504-161	480	(1)	--	--	--
	--	--	--	(3)	--	--	(3)	--	--	--
	GS-10 Ni 14	1.5636	--	WBL-685(3b)	1504-503	LT60	(1)	--	--	--
A 353 Nine Per Cent Nickel Steel Plate, Double Normalized and Tempered, for Pressure Vessels	X 8 Ni 9	--	1.5662	WBL-680(3c)	--	--	(3)	--	--	--

TABLE 3 (Cont.)

ASTM STANDARD	FRENCH			ITALIAN			JAPANESE		
	AFNOR Type	NF Number	Remarks	UNI Type	UNI Number	Remarks	JIS Symbol	JIS Number	Remarks
A 320 Alloy Steel Bolting Material for Low Temperature Service L 7 L 43 B 8	42 CD 4 40 NCD 7 Z 6 CN 18.9	A35-559 — A35-559	(3c) (3a) (3c)	42 Cr Mo 4 40 Ni Cr Mo 7 X 6 Cr Ni 18 10	7845 7845 6901	(3a) (3a) (3a)	SCM 440 SNCM 439 SUS 304	G4105 G4103 G4303	(3a) (3a) (3b)
A 325 High Strength Steel Bolts for Structural Steel Joints Type 1 Type 2	— —	— —	(3) —	— —	— —	(3) —	S30C —	G4051 —	(3a) —
A 333 Seamless and Welded Pipe for Low-Temperature Service Grade 1 Grade 3 Grade 8 Grade 8	TU 42 BT TU 16 N 14 TU 42 BT TU Z 11 N 9	A48-230 A48-230 A48-230 A48-230	— (3c) — (8)	C 15 18 Ni 14 C 20 X 12 Ni 09	5949 5949 5949 5949	(6) Seamless Only Seamless Only Seamless Only Seamless Only	STPL 39 STPL 48 — STPL 70	G3460 G3460 — G3460	(18) (18) (3) (18)
A 334 Seamless and Welded C- and Alloy Steel Tubes for Low-Temperature Service Grade 1 Grade 3 Grade 8 Grade 8	TU 42 BT TU 16 N 14 TU A 42 BT TU Z 11 N 9	A48-230 A48-230 A48-230 A48-230	(32) (29) (29) (8)	C 15 18 Ni 14 C 20 12 X Ni 09	5949 5949 5949 5949	(6) Seamless Only Seamless Only Seamless Only Seamless Only	STBL 39 STBL 46 — STBL 70	G3464 G3464 — G3464	— — (3) —
A 335 Seamless Ferritic Alloy Steel Pipe for High Temperature Service P 1 P 5 P 9 P 11 P 12 P 22	TU 15 D 3 TU Z 12 CD 5-05 TU Z 10 CD 9 TU 10 CD 5.06 — TU 10 CD 9.10	A48-213 A48-213 A48-213 A48-213 — A48-213	— — — — (3) —	16 Mo 5 — — 14 Cr Mo 3 12 Cr Mo 9 10	5462 — — 5462 5462	— Daimine 234(3b) — Daimine 227(3b) (3b) (3b)	STPA 12 STPA 25 STPA 26 STPA 23 STPA 22 STPA 24	G3458 G3458 G3458 G3458 G3458 G3458	(18) (18) (18) (18) (18) (18)
A 350 Forged or Rolled C- and Alloy Steel Flanges, Forged Fittings, and Valves for Low Temperature Service Grade LF 1 Grade LF 2 Grade LF 3	AF 48 N AF 48 AFN 14	M87-508 M87-508 M87-508	— (1) (8)(1)	Fe 410 D Fe 510 D —	7746 7746 —	(3a) (3a)(14) —	SFL 1 SFL 2 SFL 3	G3205 G3205 G3205	— — —
A 351 Austenitic Steel Castings for High Temperature Service CF 8 CF 8M CX 20 HK 40	Z 6 CN 20.11 — Z 12 CNS 25.20 —	A35-578 — A35-578 —	(3b) (3) (3b) (3)	X 6 Cr Ni 18 10 X 6 Cr Ni Mo 17 12 — —	— — — —	Tem G2 AU 18(3b) Tem G6 AU 18(3b) (3) (3)	SCS 13 A SCS 14 A SCS 18 SCH 22	G5121 G5121 G5121 G5122	— — (3) —
A 352 Ferritic Steel Castings for Low Temperature Service Grade LC8 Grade LC2 Grade LC3	FB-M — —	A32-052 — —	— — (3)	— — —	— — —	Tem T80(3b) — Tem GN 3(3b)	SCPL 1 SCPL 21 SCPL 31	G5152 G5152 G5152	— — —
A 353 Nine Per Cent Nickel Steel Plate, Double Normalized and Tempered, for Pressure Vessels	9 Ni-490	A36-208	—	Fe E 490 Ni 36	EU 129	(5)(12)	—	—	(3)

PERMISSIBLE SUBSTITUTES FOR USA SPECIFICATION MATERIALS

(This BP is appropriate for attachment to Inquiry or Purchase Document)

EXXON

ERAE

BASIC PRACTICE

TABLE 3 (Cont.)

ASTM STANDARD	GERMAN				BRITISH			BELGIAN		
	DIN Type	DIN Number	Material Number	Remarks	B.S. Number	B.S. Grade	Remarks	NBN Type	NBN Number	Remarks
A 368 Electric-Fusion Welded Austenitic Cr-Ni Alloy Steel Pipe for High-Temperature Service										
Grade 304	X 5 CrNi 18 9	17440	1.4301	(3b)	3605	304S25	LWHT(3b)	--	--	--
Grade 310	X 12 CrNi 25 21	--	1.4845	WBL-470(3b)	--	--	(3)	--	--	--
Grade 316	X 5 CrNiMo 18 10	17440	1.4401	(3b)	3605	316S26	LWHT(3b)	--	--	--
Grade 321	X 10 CrNiTi 18 9	17440	1.4541	(3b)(17)	3605	321S22	LWHT(3b)	--	--	--
Grade 347	X 10 CrNiNb 18 9	17440	1.4550	(3b)(17)	3605	347S17	LWHT(3b)	--	--	--
A 387 Cr-Mo Steel Plates for Boilers and Other Pressure Vessels										
Grade 5 Class 1	12 CrMo 19 5	--	1.7362	WBL-590(3a)	--	--	(3)	--	--	--
Grade 5 Class 2	12 CrMo 19 5	--	1.7362	(3)(2)	--	--	(3)	--	--	--
Grade 11 Class 1	--	--	--	(3)	1501-621	A	(3)	--	--	--
Grade 11 Class 2	--	--	--	(3)	1501-621	A	(3)	--	--	--
Grade 12 Class 1	13 CrMo 44	17155	1.7335	(3)(1)	1501-620	27A	(3)	14 Cr Mo 45	630	--
Grade 12 Class 2	13 CrMo 44	17155	1.7335	(3)(2)	1501-620	31A	(3)	--	--	--
Grade 21 Class 1	--	--	--	(3)	--	--	(3)	--	--	--
Grade 21 Class 2	--	--	--	(3)	--	--	(3)	--	--	--
Grade 22 Class 1	10 CrMo 9 10	--	1.7380	(3)	1501-622	31A	(3)	12 Cr Mo 9 10	629	--
Grade 22 Class 2	10 CrMo 9 10	--	1.7380	(3)	1501-622	31A	(3)	--	--	--
A 386 Ferritic Ductile Iron Pressure Castings for Elevated Temperatures										
A 403 Wrought Austenitic Stainless Steel Pipe Fittings										
A 414 Carbon Steel Sheets for Pressure Vessels										
Grade B	HI	17155	1.0345	--	1501-151	380	--	E37-2	630	--
Grade D	HI	17155	1.0425	--	1501-151	400	--	E37-2	630	--
Grade C	HI	17155	1.0435	--	1501-151	430	--	E42-2	630	--
A 428 Centrifugally Cast Ferritic Alloy Steel Pipe for High- Temperature Service										
CP 1	--	--	--	(3)	--	--	(3)	--	--	--
CP 12	GS-17 CrMo 55	17245	1.7357	(3)	--	--	(3)	--	--	--
CP 22	GS-18 CrMo 9 10	--	1.7379	(3a)	--	--	(3)	--	--	--
A 442 C-Steel Plates with Improved Transition Properties										
Grade 55	TT St 41N	--	1.0437	WBL-680	1501-161	400	--	E37-2	630	--
Grade 60	--	--	--	(3)	1501-161	430	--	E42-2	630	--
A 447 Ni-Fe Alloy Castings for High Temperature Service Type II										
	G-X 35 CrNi 25 12	--	1.4831	WBL-595(3a)	--	--	(3)	--	--	--
A 451 Centrifugally Cast Austenitic Steel Pipe for High Temperature Service										
Grade CPF 8	G-X 6 CrNi 18 9	17445	1.4308	(3b)	4534	1	(3)	--	--	--
Grade CPF 8C	G-X 7 CrNiMo 18 9	17445	1.4552	(3b)	--	--	(3)	--	--	--
Grade CPF 8M	G-X 6 CrNiMo 18 9	17445	1.4408	(3b)	4534	3	(3)	--	--	--
Grade CPF 20	G-X 15 CrNi 25 20	--	1.4840	WBL-595(3b)	4534	7	(3)	--	--	--
A 508 Quenched and Tempered Vacuum Treated C- and Alloy Steel Forgings for Pressure Vessels										
Class 1	--	--	--	(3)	--	--	(3)	--	--	--
Class 2	22 NiMoCr 37	--	1.6751	WBL-640(3b)	--	--	(3)	--	--	--
Class 3	20 MnMoNi 55	--	1.6310	WBL-640(3b)	--	--	(3)	--	--	--

**PERMISSIBLE SUBSTITUTES FOR
USA SPECIFICATION MATERIALS**

(This BP is appropriate for attachment to Inquiry or Purchase Document)

TABLE 3 (Cont.)

ASTM STANDARD	FRENCH			ITALIAN			JAPANESE		
	AFNOR Type	NF Number	Remarks	UNI Type	UNI Number	Remarks	JIS Symbol	JIS Number	Remarks
A 358 Electric-Fusion Welded Austenitic Cr-Ni Alloy Steel Pipe for High-Temperature Service									
Grade 304	Z 6 CN 18.00	A36-209	(3b)	X 6 Cr Ni 18 10	8317	(3b)	SUS 304 TPY	G3468	--
Grade 310	--	A36-209	--	X 22 Cr Ni 25 20	6900	(3b)(11)	SUS 310S TPY	G3468	--
Grade 316	Z 6 CNd 17.11	A36-209	(3b)	X 6 Cr Ni Mo 17 12 2	8317	(3b)	SUS 316 TPY	G3468	--
Grade 321	Z 6 CNT 18.10	A36-209	(3b)	X 6 Cr Ni Ti 18 10	8317	(3b)	SUS 321 TPY	G3468	--
Grade 347	Z 6 CN Nb 18.10	A36-209	(3b)	X 6 Cr Ni Nb 18 10	8317	(3b)	SUS 347 TPY	G3468	--
A 387 Cr-Mo Steel Plates for Boilers and Other Pressure Vessels									
Grade 5 Class 1	Z 10 CD 5.05	A36-206	(3a)	--	--	Falck Macro 50(3b)	SCMV 8	G4109	--
Grade 5 Class 2	Z 10 CD 5.05	A36-206	(3a)	--	--	--	--	--	--
Grade 11 Class 1	--	--	(3)	--	--	--	SCMV 3	G4109	(3)
Grade 11 Class 2	--	--	(3)	--	--	--	--	--	(3)
Grade 12 Class 1	15 CD 4.05	A36-206	(3a)	14 Cr Mo 4	5869	(5)	SCMV 2	G4109	(3)
Grade 12 Class 2	15 CD 4.05	A36-206	(3a)	14 Cr Mo 4S	5869	(5)	--	--	(3)
Grade 21 Class 1	--	--	(3)	--	--	--	SCMV 5	G4109	(3)
Grade 21 Class 2	--	--	(3)	--	--	--	--	--	(3)
Grade 22 Class 1	10 CD 9.10	A36-206	(3a)	12 Cr Mo 9 10	5869	(5)	SCMV 4	G4109	(3)
Grade 22 Class 2	10 CD 9.10	A36-206	(3a)	12 Cr Mo 9 10	5869	(5)	--	--	(3)
A 396 Ferritic Ductile Iron Pressure Castings for Elevated Temperatures	--	--	(3)	--	--	(3)	--	--	(3)
A 403 Wrought Austenitic Stainless Steel Flange Frings	--	--	(3)	--	--	(3)	--	--	(3)
A 414 Carbon Steel Sheets for Pressure Vessels									
Grade B	A 37-CP	A36-205	--	Fe 3403	6684-70	--	SB 42	G3103	--
Grade C	A 42-CP	A36-205	--	Fe 3703	6684-70	(6)	SB 42	G3103	(3)
Grade D	A 48-CP	A36-205	--	Fe 4203	6684-70	--	--	--	(3)
A 428 Centrifugally Cast Ferritic Alloy Steel Pipe for High- Temperature Service									
CP 1	--	--	(3)	--	--	--	SCPH-11CF	G5202	--
CP 12	--	--	(3)	--	--	--	SCPH-21CF	G5202	--
CP 22	--	--	(3)	--	--	--	SCPH-32CF	G5202	--
A 442 C-Steel Plates with Improved Transition Properties									
Grade 55	A 37-AP	A36-205	(14)	Fe 360-2XG	5869	--	--	--	(3)
Grade 60	A 42-AP	A36-205	(14)	Fe 410-2XG	5869	--	SPV 24	G3115	--
A 447 Cr-Ni-Fe Alloy Castings for High Temperature Service Type II	--	--	(3)	--	--	(3)	--	--	(3)
A 451 Centrifugally Cast Austenitic Steel Pipe for High Temperature Service									
Grade CPF 8	--	--	(3)	--	--	--	--	--	(3)
Grade CPF 8C	--	--	(3)	--	--	--	--	--	(3)
Grade CPF 8M	--	--	(3)	--	--	--	--	--	(3)
Grade CPK 20	--	--	(3)	--	--	--	--	--	(3)
A 508 Quenched and Tempered Vacuum Treated C- and Alloy Steel Forgings for Pressure Vessels									
Class 1	--	--	(3)	--	--	(3)	--	--	(3)
Class 2	--	--	(3)	--	--	(3)	--	--	(3)
Class 3	--	--	(3)	--	--	(3)	--	--	(3)

PERMISSIBLE SUBSTITUTES FOR USA SPECIFICATION MATERIALS

(This BP is appropriate for attachment to Inquiry or Purchase Document)

EXXON

ER&E

BASIC PRACTICE

TABLE 3 (Cont.)

ASTM STANDARD	GERMAN				BRITISH			BELGIAN		
	DIN Type	DIN Number	Material Number	Remarks	B.S. Number	B.S. Grade	Remarks	NBN Type	NBN Number	Remarks
A 515 Carbon Steel Plates for Pressure Vessels for Intermediate and Higher Temperature Service										
Grade 55	HI	17155	1.0425	--	1501-181	380	--	D37-2	629	--
Grade 60	HIH	17155	1.0435	--	1501-181	400	--	D42-2	629	--
Grade 65	HIY	17155	1.0445	--	1501-181	430	--	D47-2	629	--
Grade 70	19 Mn 5	17155	1.0485	--	--	--	(3)	D52-2	629	--
A 516 Carbon Steel Plates for Pressure Vessels for Moderate and Lower Temperature Service										
Grade 55	A St 41	17135	1.0426	--	1501-224	360	--	E37-2	630	--
Grade 60	A St 45	17135	1.0436	--	1501-224	400	--	E42-2	630	--
Grade 65	A St 45	17135	1.0436	--	--	--	(3)	E47-2	630	--
Grade 70	A St 52	17135	1.0843	--	--	--	(3)	E52-2	630	--
A 536 Ductile Iron Castings Grade 60-40-18	--	--	--	(3)	--	--	(3)	--	--	--
A 537 Low-Si Steel Plates, Heat Treated, for Pressure Vessels										
Class 1	19 Mn 5	17155	1.0485	(3)	1501-224	480	(3)	E32-2	630	(3)
Class 2	--	--	--	(3)	--	--	(3)	--	--	--
A 542 Chromium-Molybdenum Steel Plates, Quenched and Tempered, for Pressure Vessels										
Class 4	--	--	--	(3)	--	--	(3)	--	--	--
A 553 Nine Per Cent Nickel Steel Plate, Quenched and Tempered, for Pressure Vessels										
Type 1	--	--	--	(3)	--	--	(3)	--	--	--
A 560 Chromium Nickel Alloy Castings										
Grade 50 Cr-50 Ni	--	--	--	(3)	--	--	(3)	--	--	--
Grade 60 Cr-40 Ni	--	--	--	(3)	--	--	(3)	--	--	--
Grade 50 Cr-50 Ni-Co	--	--	--	(3)	--	--	(3)	--	--	--
A 568 Hot Rolled C-Steel Sheets, Commercial Quality	US1 37-2	1623-2	1.0112.5	--	1449	HR 34/20	--	--	--	--
A 570 Hot Rolled C-Steel Sheets, Strip, Structural Quality										
Grade 30	US1 37-2	17100	1.0036	--	1449	HR 34/20	(3)	AE235C	A21-101	--
Grade 36	US1 37-2	17100	1.0036	--	1449	HR 37/23	(3)	AE255C	A21-101	--
Grade 40	US1 44-2	17100	1.0044	--	1449	HR 43/25	(3)	AE295C	A21-101	--
A 573 Structural Carbon Steel Plates of Improved Toughness										
Grade 65	St 44-3	17100	1.0144	--	4360	43E	--	--	--	(3)
Grade 70	St 52-3	17100	1.0570	--	--	--	(3)	--	--	--
A 608 Centrifugally Cast High Alloy Tubing for Pressure Application at High Temperatures										
Grade HK 40	--	--	--	(3)	4534	6	--	--	--	--
A 611 Cold Rolled Carbon Structural Steel Sheet										
Grade B	--	--	--	(3)	--	--	(3)	--	--	--
Grade C	St 12	1623-1	1.0030	(3)	--	--	(3)	--	--	--
Grade D	--	--	--	(3)	--	--	(3)	--	--	--

**PERMISSIBLE SUBSTITUTES FOR
USA SPECIFICATION MATERIALS**

(This BP is appropriate for attachment to Inquiry or Purchase Document)

TABLE 3 (Cont.)

ASTM STANDARD	FRENCH			ITALIAN			JAPANESE		
	AFNOR Type	NF Number	Remarks	UNI Type	UNI Number	Remarks	JIS Symbol	JIS Number	Remarks
A 515 Carbon Steel Plates for Pressure Vessels for Intermediate and Higher Temperature Service Grade 55 Grade 60 Grade 65 Grade 70	A 37-CP A 42-CP A 48-CP A 52-CP	A36-205 A36-205 A36-205 A36-205	(14) (14) (14) (14)	Fe 360-1KW Fe 410-1KW Fe 460-1KW Fe 510-1KW	5869 5869 5869 5869	(14) (14) (14) (14)	— SB 42 SB 46 SB 49	— G3103 G3103 G3103	(3) — — —
A 518 Carbon Steel Plates for Pressure Vessels for Moderate and Lower Temperature Service Grade 55 Grade 60 Grade 65 Grade 70	A 37-AP A 42-AP A 48-AP A 52-AP	A36-205 A36-205 A36-205 A36-205	(14) (14) (14) (14)	Fe 360-2KG Fe 410-2KG Fe 460-2KG Fe 510-2KG	5869 5869 5869 5869	(14) (14) (14) (14)	— SGV 42 SGV 46 SGV 49	— G3118 G3118 G3118	(3) — — —
A 538 Ductile Iron Castings Grade 60-40-18	—	—	(3)	—	—	(3)	—	—	(3)
A 537 C-Mn-Si Steel Plates, Heat Treated, for Pressure Vessels Class 1 Class 2	A 52-FP —	A36-205 —	(21) (3)	Fe 510-2KG —	5869 —	(14) (3)	SPV 36N SPV 46Q	G3115 G3115	— —
A 542 Chromium-Molybdenum Steel Plates, Quenched and Tempered, for Pressure Vessels Class 4	—	—	(3)	—	—	(3)	—	—	(3)
A 553 Nine Per Cent Nickel Steel Plate, Quenched and Tempered, for Pressure Vessels Type I	Z 8 NG 9	A36-208	—	Fe E 585 Ni 36	EU 129	—	SL 9 N 60	G3127	—
A 560 Chromium-Nickel Alloy Castings Grade 50 Cr-50 Ni Grade 60 Cr-40 Ni Grade 50 Cr-50 Ni-Cb	— — —	— — —	(3) (3) (3)	— — —	— — —	(3) (3) (3)	— — —	— — —	(3) (3) (3)
A 569 Hot Rolled C-Steel Sheets, Commercial Quality	E 24-1	A36-101	—	Fe 3403	6684	—	SPHC	G3131	—
A 570 Hot Rolled C-Steel Sheets and Strip, Structural Quality Grade 30 Grade 36 Grade 40	E 24-2 E 24-2 E 26-2	A35-501 A35-501 A35-501	— (5) (5)	Fe 34C3 Fe 37C3 Fe 42C3	6684 6684 6684	— — —	SS 34 SS 41 SS 41	G3101 G3101 G3101	— (5) (6)
A 573 Structural Carbon Steel Plates of Improved Toughness Grade 65 Grade 70	— E 26-3	— A35-501	(3) —	Fe E 460-2KG Fe 510-2KG	5869 5869	— —	SGV 46 SGV 49	G3118 G3118	— —
A 608 Centrifugally Cast High Alloy Tubing for Pressure Application at High Temperatures Grade HK 40	—	—	(3)	—	—	(3)	—	—	(3)
A 611 Cold Rolled Carbon Structural Steel Sheet Grade B Grade C Grade D	— — —	— — —	(3) (3) (3)	— — —	— — —	(3) (3) (3)	SPCC-80 SPCC-4 SPCC-1	G3141 G3141 G3141	(3) (3) (3)

PERMISSIBLE SUBSTITUTES FOR USA SPECIFICATION MATERIALS

(This BP is appropriate for attachment to Inquiry or Purchase Document)

EXXON

ER&E

BASIC PRACTICE

TABLE 3 (Cont.)

ASTM STANDARD	GERMAN				BRITISH			BELGIAN		
	DIN Type	DIN Number	Material Number	Remarks	B.S. Number	B.S. Grade	Remarks	NBN Type	NBN Number	Remarks
A 815 Deformed Bar—Steel Bars for Concrete Reinforcement Grade 40 Grade 60	— B St 42/50 RU	— 486	— 1.0403	— (5)	4449 4449	M81 80	(8) (8)	— —	— —	— —
A 833 Normalized High-Strength Low-Alloy Structural Steel Grade A Grade C Grade E	TS6 315 TS6 355 TS6 420	17102 17102 17102	1.0508 1.0568 1.8912	— — —	— 4380 4380	— 500 55E	(9) — —	— — —	— — —	— — —
A 845 Five Per Cent Nickel, Specialty Heat Treated	—	—	—	(3)	—	—	—	—	—	—
A 871 Electric-Fusion Welded Pipe for Atmospheric and Lower Temperatures	—	—	—	(3)	—	—	(3)	—	—	(3)
A 872 Electric-Fusion-Welded Pipe for High-Pressure Service at Moderate Temperatures	—	—	—	(3)	—	—	(3)	—	—	(3)
A 878 C-Steel Bars Hot-Rolled Special Quality	—	—	—	(3)	—	—	(3)	—	—	(3)
A 891 Electric-Fusion-Welded C- and Alloy Steel Pipe for High Temperatures	—	—	—	(3)	—	—	(3)	—	—	(3)
A 743 Corrosion-Resistant Fe-Cr, Fe-Cr-Ni and Ni-Base Alloy Castings for General Application Grade CF-8 Grade CF-8M Grade CA-20 Grade CA-15 Grade CA-6NM	G-X8 CrNi 18 9 G-X8 CrNiMo 18 10 G-X15 CrNi 25 20 G-X 12 Cr 14 —	17445 17445 — 17445 —	1.4308 1.4408 1.4840 1.4008 —	(3a) (3a) WBL-595(3b) (3a) (3)	1504-304 1504-316 1504-310 1504-420 1504-425	C15 C16 C20 C28 C11	— — — — (3c)	— — — — —	— — — — —	— — — — —

TABLE 3 (Cont.)

ASTM STANDARD	FRENCH			ITALIAN			JAPANESE		
	AFNOR Type	NF Number	Remarks	UNI Type	UNI Number	Remarks	JIS Symbol	JIS Number	Remarks
A 615 Deformed Billet—Steel Bars for Concrete Reinforcement Grade 40 Grade 60	Fe E 40 Fe E 50	35-018 35-018	— (6)	Fe B 40 Fe B 50	6407 6407	— (6)	SD 30 SD 40	G3112 G3112	— (6)
A 633 Normalized High-Strength Low-Alloy Structural Steel Grade A Grade C Grade E	E 355 FPI E 375 FPI E 420 FPI	A36-201 A36-201 A36-201	(21) (21) (21)	— — —	— — —	(3) (3) (3)	SLA 33A SLA 37 —	G3126 G3126 —	— — (3)
A 645 Five Per Cent Nickel, Specially Heat Treated	—	—	—	Fe E 360 Ni 20	EU 129	(3c)	—	—	—
A 671 Electric-Fusion Welded Pipe for Atmospheric and Lower Temperatures	—	—	(3)	—	—	(3)	—	—	(3)
A 672 Electric-Fusion-Welded Pipe for High-Pressure Service at Moderate Temperatures	—	—	(3)	—	—	(3)	—	—	(3)
A 673 C-Steel Bars Hot-Rolled Special Quality	—	—	(3)	—	—	(3)	—	—	(3)
A 681 Electric-Fusion-Welded C- and Alloy Steel Pipe for High Temperatures	—	—	(3)	—	—	(3)	—	—	(3)
A 743 Corrosion Resistant Fe-Cr, Fe-Cr-Ni and Ni-Base Alloy Castings for General Application Grade CF-8 Grade CF-8M Grade CX-20 Grade CA-15 Grade CA-6NM	Z 6 CN 19.10 Z 6 CND 17.11 Z 12 CN 25.20 Z 12 C 13 —	— A35-586 A35-586 A35-586 —	(3a) (3a) (3a) (3a) (3)	X 6 Cr Ni 18 10 X 5 Cr Ni Mo 17 12 X 22 Cr Ni 25 20 X 12 Cr 13 —	6900 6900 6900 6900 —	(3a) (3a) (3a)(11) (3a) (3)	SCS 13A SCS 14A SCS 16 SCS 1 —	G5121 G5121 G5121 G5121 —	— — — — (3)

EXPLANATORY NOTES:

- (1) Specify impact tests per ASTM Standard.
- (2) Siemens-Martin (open-hearth), basic oxygen or electric furnace only.
- (3) Normally available to or will be furnished to ASTM Standard.
- (3a) Specify mechanical properties, tests and inspection in accordance with ASTM Standard.
- (3b) Test and inspect the product to ASTM Standard except for chemical analysis and mechanical properties of the steel.
- (3c) Specify heat treatment, test requirements and inspection in accordance with ASTM Standard.
- (4) Specify tempering heat treatment per ASTM Standard.
- (5) Specify type and strength required.
- (6) Recognize lower minimum tensile or yield strength of substitute steel in design or specify minimum tensile and yield strengths per ASTM Standard.
- (7) Order with DIN 50 049 Inspection Certificate C and Quality Grade III
- (8) Specify chromium content of 1% minimum.
- (9) Available in sizes up to 8 in. (200 mm) diameter.
- (10) Specify hardness not to exceed ASTM limits.
- (11) Specify carbon content of 0.15% maximum.
- (12) Specify heat treatment per ASTM Standard.
- (13) Specify maximum hardness of 79 HRB or 143 HB.
- (14) Specify silicon content of 0.15 to 0.4%.
- (15) Specify silicon content of 0.35% maximum.

PERMISSIBLE SUBSTITUTES FOR USA SPECIFICATION MATERIALS

(This BP is appropriate for attachment to Inquiry or Purchase Document)

EXXON

ER&E

BASIC PRACTICE

EXPLANATORY NOTES (Cont)

- (16) Pipe dimensions are different from those of USA Standards.
- (17) Specify carbon content of 0.08% maximum.
- (18) The temperature limitation of 300°C (572°F) established for this material by German regulations does not necessarily apply for applications outside Germany.
- (19) Specify ASTM A 285 or equivalent JIS steel plate except where steel plate Standards A 36, A 570, A 611, and A 283, or JIS equivalents are acceptable. For all grades, specify qualification of welding procedure and hydrostatic test per ASTM Standard.
- (20) Specify maximum hardness of 99 HRB or 235 HB.
- (21) Specify silicon content of 0.15-0.50%.
- (22) Specify maximum hardness of 187 HB.
- (23) Consider differences in dimensions and tolerances.
- (24) Specify hardness test per supplementary requirement Z1.1 of JIS Standard.
- (25) Specify silicon content of 0.15 to 0.40% for plates over 1-1/2 in. (38 mm) thick.
- (26) Specify mechanical properties and heat treatment per JIS G3201-SF50.
- (27) Specify maximum hardness of 137 HB or 77 HRB.
- (28) Specify maximum hardness of 197 HB.
- (29) Specify maximum hardness of 90 HRB or 190 HB.
- (30) Specify seamless.
- (31) Specify maximum hardness of 137 HB.
- (32) Specify maximum hardness of 163 HB or 85 HRB.
- (33) Specify seamless, cold drawn, and annealed to maximum hardness of 72 HRB.
- (34) Specify maximum hardness of 150 HB.
- (35) Specify cold drawn and maximum hardness of 85 HRB.
- (36) Specify maximum hardness of 217 HB.
- (37) Specify maximum hardness of 146 HB or 80 HRB.
- (38) Specify maximum hardness of 143 HB or 79 HRB.

Revision Memo

9/68	Original Issue
1/73	Revision 1
1/75	Revision 2
1/85	Rev. 3

Par. 1.1 clarifies scope of coverage to ferrous materials. Table 2 revises titles of ASTM A 6 and A 20/A 20M (reflecting use of latest standards). New Par. 2.4 stipulates approval procedure for non-ferrous material substitutions. Table 3 updates ASTM and permissible U.K., European, and Japanese material substitutions; also, Notes have been revised accordingly. Editorial changes: Par. 4.1 and 4.3 have minor editorial changes.

RECOMMENDED VELOCITIES IN PIPE

Medium		Preliminary Velocities (m/sec)
Water		2,5 - 3
Steam	MD	25 - 35
	ND	18 - 25
Condensate		1,5 - 2,5
Air		12 - 20
Liquor		2 - 2,5
Pulp Consistency	up to 2 %	2,4 - 2,8
	up to 3 %	1,3 - 1,8
	up to 4 %	0,9 - 1,2
	up to 5 %	0,6 - 0,8
	6 % or more	less than 0,6
Vapours		10 m/s

As suction velocity max. 1 - 1,5 m/sec. is recommended.

6.4 Electrical Design Criteria

6.4.1 General

6.4.1.1 Introduction

The following electrical design criteria are to be understood as a general guideline for the electrical system of the pulp mill and may be adapted to fit the actual standards of the mill.

6.4.1.2 Standards and Regulations

All electrical equipment shall meet the standards and regulations VDE, DIN, IEC or the corresponding regulations required in India.

6.4.1.3 Nominal Voltage Levels and Frequency

AC 3 x kV \pm 5 % High voltage of the feeder for the whole mill and
supply voltage of HV-motors - if applicable

AC 3 x 415 V \pm 5 % Supply voltage of motors depending on existing
high voltage

AC 3 x 415 V \pm 5 % Supply voltage of frequency converters

AC 3 x 415 V \pm 1 % Output voltage of Uninterruptable Power Supply
system (UPS)

Frequency: 50 cps \pm 0,2 Hz

6.4.1.4 Safety Measures

AC kV HV-system:..... low-resistance grounded - if applicable

AC 415 V system:..... TN-C and TN-C-S system according to IEC364-3

AC 415 V system:..... TN-C-S system according to IEC364-3

6.4.1.5 Description of Power Supply Principles

6.4.1.5.1 Details:

The high voltage switchgear (if necessary) shall be equipped with incoming, transformer- and motor-outgoing cubicles in order to supply power to distribution transformers and HV-motors. For improving power factor to better than 0.85, HV switchgears shall be equipped with power factor correction equipment (capacitors).

The LV-switchgears shall be designed for voltage levels of 415 V for power supply to LV-motors.

Distribution transformers as well as connected 415 V LV-switchgears shall be installed within the plant sections in order to enable short cable length to motors and other consumers.

For power supply to the DCS and other important systems, an Uninterruptable Power Supply system (UPS) shall be foreseen.

As far as possible, all motors shall be designed as 3-phase squirrel cage motors and starting direct on line. For variable speed drives, frequency converters shall be provided.

For monitoring and supervision, electrical switchgears, transformers, UPS and others shall be connected to the DCS. Motors shall be operated automatically via DCS, other feeders (transformers etc.) shall be operated manually.

6.4.2 Equipment Specification

6.4.2.1 Low Voltage Switchgears

6.4.2.1.1 Low Voltage Distribution Switchgears and MCC's

General

Designed as factory assembled metal enclosed switchgears for installation in closed, well ventilated electrical rooms.

Supply voltage: 3 x 415 V/50 cps, 4-wire

Control voltage: 115 up to 230 V/50 cps, line to neutral

Degree of protection: IP40

Short circuit rating, busbar-rating and rating of incomer circuit breaker shall be chosen according to the distribution-transformer to which they are associated.

Each switchgear shall consist of:

- Incomer cubicle(s)
- the necessary outgoing cubicles, housing:
withdrawable motor starters and
fix installed circuit breaker feeders for:
power factor correction equipment, remote subdistributors,
package-units (electrical equipment which is direct bonded to mechanical)
distributors for other loads (control systems, ventilation etc.)

Incoming Cubicles:

Each incomer cubicle shall essentially consist of:

- 1 Suitable rated withdrawable triple pole air circuit-breaker with manual closing mechanism and direct acting overcurrent and short circuit trip devices (subdistributors which are fed by other distributors shall be equipped with a manual operated load switch only)
- 1 set of current transformers
- 2 voltmeter with change over-switches
- 3 ammeters, one with average value indication
- 1 kWh-integrator
- 1 suitable rated control voltage transformer 415/240 V \pm 2 x 2.5%
- 1 set of circuit breakers for control voltage transformer and voltage metering

Motor Starter and Outgoing Feeder Cubicles:

Each individual motor starter cubicle shall essentially consist of:

- the horizontally main bus bar section
- the vertically busbar section
- the vertically cable section
- the withdrawable motor-starters
- the interface department with devices for bus-connection devices to the DCS and current transducers for analog input signals

Withdrawable Motor Starters:

Shall essentially consist of:

- 1 Suitable rated triple pole air circuit-breaker with manual closing mechanism and direct acting short circuit and thermal overload trip device
- 1 suitable rated triple pole contactor (for reversible motor starters a second contactor is provided which shall be electrically interlocked with the other contactor so that both cannot be closed at one and the same time)
- 1 fuse for control circuit
- 1 current transformer .../1 Ampere for all drives with continuous operation, or respectively where a current measurement is necessary for the process
- 1 interposing relays if necessary
- 1 terminal-strip with all terminals for power, control and measurement

Outgoing Feeders Units:

Each outgoing feeder shall essentially consist of

- 1 suitable rated withdrawable moulded case circuit breaker with manual closing mechanism and direct acting short circuit and thermal overload trip device
- 1 set of terminals and where necessary:
- 1 current transformer

6.4.2.1.2 High Voltage Motors - not applicable

6.4.2.1.3 Power Factor Correction

General:

Shall be provided for each 415 V-switchgear and designed as metal enclosed cubicles for indoor installation with:

- individual three phase or single phase capacitors with fitted discharge-resistors
- equipment for switching the groups, consisting of molded case circuit breakers and air break-contactors
- reactors to protect capacitors against harmonics (where necessary)
- multi stage capacitor control relay for automatic and manual control and power factor and operating stage indication.

Above mentioned cubicles shall be located in the same switchroom as the motor switch gear to which they are associated. Depending on the brand of LV-switchgears, the power factor correction equipment may directly be installed within the LV-switchgears.

Rating of capacitors: Depending on the final design, respectively power balance of switchgears.

6.4.2.2 Uninterruptable Power Supply (UPS)

Provided for back up of the digital process control system (DCS). Designed as factory assembled metal enclosed cabinets, for installation in closed, well ventilated electrical rooms.

The UPS shall consist of

- rectifier
- converter
- static by-pass switch
- maintenance bypass switch (manually operated)
- lead-acid batteries (to be installed the battery room)
- control and monitoring devices
- AC-distribution switchgear

Technical Data:

Supply voltage:..... 415/240 V, 50 cps, 3phase resp. single phase

Nominal output voltage:..... 115 up to 230 V, 50 cps, single phase

Nominal power output:..... see below

Capacity: for backing up a power gap of 30 minutes

6.4.2.3 Local Controls

6.4.2.3.1 Local Control Stations

To enable a local testing and inspection operation some drives shall be equipped with local switches.

The switches have the following functions:

a. Selector switch (sequence switch)

- Zero position (lockable)
Drive cannot be switched on

- Automatic operation

In this position, the drive is prepared for automatic start by the control system.

- Local/single operation

The drive is prepared for non interlocked local operation. In this position, however, the electric drive monitoring (cutoff relay) remains operating.

b. Reversing switch

For reversing and/or bi-directional operation, an additional selector switch for forward/backward operation is provided. This switch becomes only effective in position "local operation" of the sequence switch.

Design Protection: IP 65

6.4.2.3.2 *Tripping Wire-Switches - not applicable*

6.4.2.3.3 *Speed Monitors*

Conveyors shall be - where necessary - speed monitored at the return-station. If the belt shall not come up to speed in time respectively if the belt is broken, this shall be detected by the speed sensor resulting in switching off of the motor and initiating an alarm.

Design: - local installed speed sensors, monitoring relay, if necessary shall be installed in the electrical room
- with contacts for control

6.4.2.3.4 *Start Warning Systems - not applicable*

6.4.2.3.5 *Emergency Stop Push Buttons*

Where necessary, emergency stop push buttons shall be provided for special machinery.

6.4.2.4 Cables

6.4.2.4.1 Design of Signal Cables

Screened Leads for mA-signals, setpoint-potentiometers etc.

VDE-type: YSLCY, nominal voltage 300/500 V

6.4.2.4.2 Design of Low Voltage Power Cable

Standard cable for indoor and outdoor installation.

6.4.2.4.3 Control Voltage Cable

Standard cable for indoor and outdoor installation.

6.5 Instrumentation and Control Design Criteria

6.5.1. General

The following general design criteria shall be understood as a guideline for designing the instrumentation properly.

The equipment described in the following items may be changed during the detail design depending upon the subsupplier's standard and the process requirements.

The recommended scope of instruments is shown in the attached instrument list sheet 1-22.

6.5.2. Field Instruments

6.5.2.1 Control Valves

Control valves shall generally be operated pneumatically by means of piston or diaphragm actuators as appropriate to the type of valve and for the service specified. Control valves shall be equipped with an electro-pneumatic positioner with the signal 4-20 mA. The air supply to the valves shall be 5 to 6 bar g.

On-Off valves shall generally be operated pneumatically by means of a piston or diaphragm actuators as appropriate to the type of valve and for the service specified. On-Off valves shall be equipped with a solenoid valve and a limit switch for open and closed position. The air supply to the valves shall be 5 to 6 bar g.

The type of body design and inner throttling assembly shall be chosen to suit each service application and in all cases the material of construction shall be equal to or of superior quality than those specified for the piping standard and shall suit the process conditions.

Control valves for steam service shall generally be of globe type with a design for easy in-line inspection and maintenance. Body material shall be of carbon steel whereas the seat and cone shall be of 316 SS or equal.

Positioning actuators shall be fitted to provide accurate control and high stroking speed.

Control valves for process water and liquor shall generally be of the butterfly type with tight shut-off. The bodies shall be of ductile iron with replaceable moulded liner with integral seat and 316 SS disc or suitable for the media. Piston type actuators shall be fitted and for modulating service E/P-positioner additionally.

Control valves for stock shall generally be a ball sector type or full bore type. Bodies and balls shall be of stainless steel or suitable for the media respectively with seat rings of stellite and gland packings of PTFE. Positioning actuators shall be fitted in order to provide accurate control at high modulating speeds. Shut-off valves for stock shall be of the slide type offering full bore flow and tight shut-off with knife-edge slide seat-in against an internal seal. Valve bodies shall be cast steel with spindle and knife-edged slide of SS or suitable for the media. Actuation shall be by means of a pneumatic cylinder.

6.5.2.2 Transmitters

All significant and important physical and mechanical measurements which are going to be processed shall be transduced into a DC unit signal of 4-20 mA. All transmitters where applicable shall be of the two-wire system.

6.5.2.3 Pressure-measurements

Pressure transmitters shall be designed to withstand an overpressure of 1.25-times the nominal pressure. DP-cell pressure transmitters shall be designed to withstand a single-side full static load. The normal operational measuring value shall be around 50-80 % of the full measuring range (scale). The erection of the transmitters shall be in a suitable location near the process connection tapping point.

6.5.2.4 Level-measurements

Level transmitters

Normally DP-cell pressure transmitters shall be used for the level measurement and shall be designed to withstand an overpressure of 1.25-times the nominal pressure. For aggressive and dirty media two types of level transmitters shall be used, either with plane diaphragm or with extended diaphragm. Normally the flange type (according to DIN or ANSI) with a size of ND 80 or flange size of 3" are used in order to mount them directly to the tank nozzle.

Radioactive level transmitters shall be applied where applicable and necessary.

Capacitive or conductive level measurements shall be applied where applicable and necessary.

6.5.2.5 Temperature-measurements

For all measurements of temperature Resistance Thermometers shall be used. Wherever possible RTD or Thermocouples with built-in transmitters in the connection head shall be applied. These types of sensor-transmitters are of the two wire circuit with a signal of 4-20 mA. Generally the RTD shall be wired with the 3-wire connection.

RTD's or Thermocouples are generally fitted into thermowells either of screw-in or weld-in protection-tubes to serve as mechanical protection and for easy exchange of defective elements during operation.

6.5.2.6 Flow-measurements

For flow measurements the magnetic flowmeter shall normally be applied. The material for lining and electrodes as well as the decision whether AC- or DC-field shall be used, shall depend on the media and process conditions.

The nominal size of the magnetic flowmeter shall be chosen in a way that the velocity is between 1.5 to 4 m/sec.

For steam service the orifice or venturi nozzle in connection with a DP-cell transmitter shall be applied. The circuit generally is a two-wire circuit with the signal 4-20 mA.

For gases such as oxygen the vortex type sensors / transmitters are applied according to the process requirements. The circuit is (generally) a two-wire circuit with the signal 4-20 mA.

Variable area flowmeters shall be applied where applicable and necessary. These types of instruments are fitted into the pipeline between flanges. The float and the transmitter are magnetically linked. The circuit is (generally) a two-wire circuit with the signal 4-20 mA.

6.5.2.7 Consistency-measurements

For the measurement of consistency blade sensor consistency transmitters shall be applied. These types shall have an output signal of 4-20 mA.

6.5.3. Installation

- * Signal converters shall be housed in field boxes, if the protection is less than IP65.
- * The supply air for control valves shall come from an instrument air manifold with 6 or 10 outputs shall be of a solid type made of SS with weld on shut off valves and shall be freely mounted without field boxes and located centrally for a group of valves (instrument air consumers).
- * Shielded cables shall be used for the instrument signal cabling. Instrument cable bridges and trays must be separate from other cables 220 volt A.C. or power cables.
- * The erection of the transmitters shall be in a suitable location near the process connection tapping point.

6.5.4. Distributed Control System (DCS)

For a modern, reliable, accurate operation of the pulp mill a distributed control system shall be installed. A proposal of the DCS-Lay Out is shown in the enclosure. As there are many different systems available the following is to understood as a guideline for selecting the proper DCS- System.

The DCS-System shall have following features:

- Distributed controllers capable of independently controlling single and / or multiloop analog and / or discrete processes.
- Controller input / output capable of interfacing analog and discrete signals to the system.
- Operator consoles consisting of video display units, keyboards and related devices, capable of accepting control commands from the operator and displaying process status history in alphanumeric and a variety of graphic formats.

- A redundant data communications highway connecting all the system components in various mill areas and capable of being interfaced to one or more computers for management information and programmable controller systems.
- The basic element used for process control shall be a microprocessor-based digital controller. The controller shall contain algorithms that are user-configurable and tuneable to suit the process. The controller shall allow for on-line configuration changes.
- Control algorithms shall include, but not necessarily be limited to the following:
 - PID control
 - High limit
 - Low limit
 - High alarm
 - Low alarm
 - Deviation alarm
 - Set-point entry limiting
 - Cascade
 - Ratio
 - Bias
 - Multiply
 - Divide
 - Square root extraction
 - Signal characterization
 - High select
 - Low select
 - External feedback for tracking.
For cascade loops, the secondary controller shall give the signal for the tracking to the primary controller.
 - Integration
 - And logic
 - Or logic
 - Not logic
 - Nor logic
 - Nand logic
 - Timer logic
- The controller shall be able to communicate through a data highway to respond to information requests from other parts of the system.

- The controller shall be modular and hierarchical in design, so that the failure and/or replacement of any module does not affect the operational status of other modules at the same or higher level.
- Video monitors used in operator consoles shall be for X-windows techniques.
- The system shall provide per operator control console with the following displays:
 - **Overview:**
A graphic representation of the plant operation showing the major process areas with important process parameters data, alarms, motor status, etc. It shall also enable the operator to access directly various mill areas.
 - **Areas:**
A graphic representation of a process area which shall allow the operator to monitor, control, start/stop motors and access other displays up, down or laterally in the display hierarchy.
 - **Loop:**
A loop display to enable the operator to zoom into a particular single control loop display for fine tuning purposes.
 - **Trend:**
Real time trending with adjustable time based for process variables. The number of variables to be shown per page, shall be the Vendor's standard.
 - **Alarm:**
Alarm display summary showing alarms in the order of their occurrence. (All displays shall have some method to indicate an alarm condition).
- The operator keyboard shall perform the process control commands for the following functions:
 - On/off control
 - Automatic/manual mode control
 - Remote manual output
 - Set-point change
 - Start/stop pumps and motors
 - Acknowledge audible alarms
 - Select trending parameters

- Call up alarm summaries or reports
- Access any display in the display hierarchy
- Print a display

- The engineering keyboard shall be used for controller configuration, display formatting, and loop tuning. These functions shall be under key lock or otherwise inaccessible to the operator.

- The alarm system regarding critical alarms shall be detected by external hardware and shall enter the system as discrete inputs. All other alarms shall be detected by the system examining the analog input/output values, and shall be displayed on all displays containing that loop, by means of colour changes, flashing symbols, etc.

- On alarm, a flashing back-lit indication shall appear regardless of which display is on the screen. Alarms shall be acknowledged via the keyboard. When the alarm is displayed and acknowledged it shall remain displayed until the alarm condition is rectified.

- The system shall include self-diagnostics to alert any malfunctions of the physical and/or logical components of the system, this shall be alarmed as a "System Status Alarm".

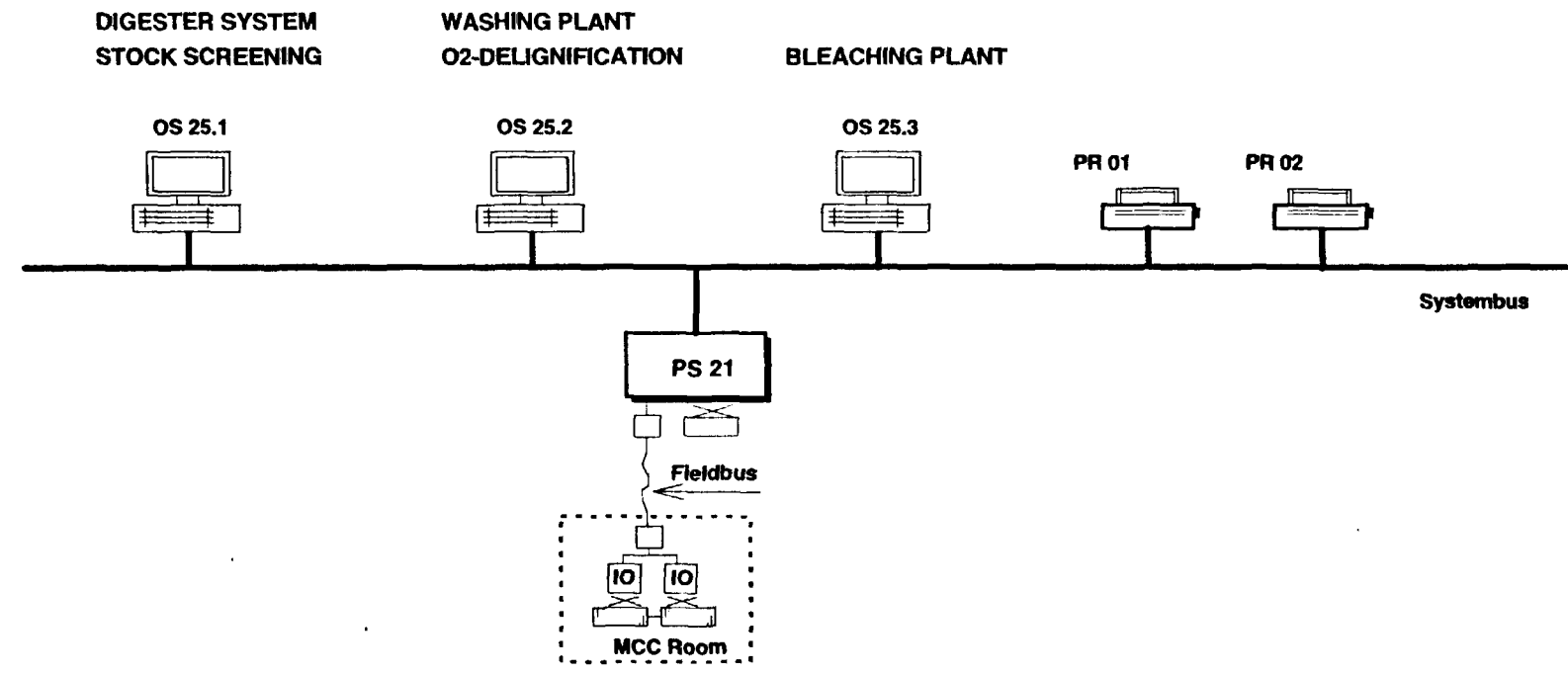
- The system shall generate automatically a hard copy of all alarms as they occur and are rectified.

- The required hardware and software for the generation of the necessary customized interactive graphic displays shall be provided for the project.

- The printer shall use standard edge-perforated Z-fold "computer" paper and shall be adjustable for printable paper widths from 8.5 to 14 inches (plus one (1) inch allowance for removable edge perforations).

- Configuration shall be accomplished by responding to questions asked by the system, by filling in the blanks in a table, or some equally simple technique. Configuration mode shall be under key protection, to prevent changes from being made by unauthorized personnel.

DCS-LAY OUT FIBRE LINE



	Loc. IO	Rem. IO
AI	134	29
AO	91	
DI	21	180
DO	9	90

IMPCO-VOEST-ALPINE

PULPING TECHNOLOGIES GmbH

Title:

INSTRUMENT LISTDepartment: **13**
DIGESTER SYSTEM

Plant:

TRIBENI
FIBRE LINE

TAG-NO.	QNT	INSTRUMENT	ISA	LOC *)	REMARK	REV
13-LI-001	1	LEVEL INDICATOR	LI001	F	EXISTING	
13-LI-002	1	LEVEL INDICATOR	LI002	F	EXISTING	
13-TI-101	1	AI		DCS		
	1	P1100-TEMP-TRANSM	TT101	F		
13-TI-102	1	AI		DCS		
	1	P1100-TEMP-TRANSM	TT102	F		
13-TI-103	1	AI		DCS		
	1	P1100-TEMP-TRANSM	TT103	F		
13-TI-104	1	AI		DCS		
	1	P1100-TEMP-TRANSM	TT104	F		
13-TI-105	1	AI		DCS		
	1	P1100-TEMP-TRANSM	TT105	F		
13-TI-106	1	AI		DCS		
	1	P1100-TEMP-TRANSM	TT106	F		
13-TI-107	1	AI		DCS		
	1	P1100-TEMP-TRANSM	TT107	F		
13-TI-108	1	AI		DCS		
	1	P1100-TEMP-TRANSM	TT108	F		
13-PIC-111	1	AI		DCS		
	1	AO		DCS		
	1	P-TRANSMITTER	PT111	F		
	1	CTRL-SEAT-VLV	PV111	F		
13-PIC-112	1	AI		DCS		
	1	AO		DCS		
	1	P-TRANSMITTER	PT112	F		
	1	CTRL-SEAT-VLV	PV112	F		

*)CR..Control Room, LP...Local Panel, P...Panel, F ... Field, R ... Rack, MCC ...Motor Control Center, DCS ... Distributed Control System

Des.: Achberger

Check: Heiden

Drawing Number:

Revision:

Page: 1

Date: 27.05.1997

Date: 27.05.1997

from 22

IMPCO-VOEST-ALPINE

PULPING TECHNOLOGIES GmbH

Title:

INSTRUMENT LISTDepartment: **13**
DIGESTER SYSTEM

Plant:

TRIBENI
FIBRE LINE

TAG-NO.	QNT	INSTRUMENT	ISA	LOC *)	REMARK	REV
13-PIC-113						
	1	AI			DCS	
	1	AO			DCS	
	1	P-TRANSMITTER	PT113		F	
	1	CTRL-SEAT-VLV	PV113		F	
13-PIC-114						
	1	AI			DCS	
	1	AO			DCS	
	1	P-TRANSMITTER	PT114		F	
	1	CTRL-SEAT-VLV	PV114		F	
13-PIC-115						
	1	AI			DCS	
	1	AO			DCS	
	1	P-TRANSMITTER	PT115		F	
	1	CTRL-SEAT-VLV	PV115		F	
13-PIC-116						
	1	AI			DCS	
	1	AO			DCS	
	1	P-TRANSMITTER	PT116		F	
	1	CTRL-SEAT-VLV	PV116		F	
13-PIC-117						
	1	AI			DCS	
	1	AO			DCS	
	1	P-TRANSMITTER	PT117		F	
	1	CTRL-SEAT-VLV	PV117		F	
13-PIC-118						
	1	AI			DCS	
	1	AO			DCS	
	1	P-TRANSMITTER	PT118		F	
	1	CTRL-SEAT-VLV	PV118		F	
13-PI-120						
	1	AI			DCS	
	1	P-TRANSMITTER	PT120		F	
13-LIS130						
	1	AI			DCS	
	1	L-TRANSMITTER	LT130		F	
13-TIC-131						
	1	AI			DCS	
	1	AO			DCS	
	1	Pt100-TEMP-TRANSM	TT131		F	
	1	CTRL-VBALL-VLV	TV131		F	

*)CR..Control Room, LP...Local Panel, P...Panel, F ... Field, R ... Rack, MCC ...Motor Control Center, DCS ... Distributed Control System

Des.: Achberger Check: Heiden Drawing Number: Revision: Page: 2
Date: 27.05.1997 Date: 27.05.1997 from 22

IMPCO-VOEST-ALPINE <hr/> PULPING TECHNOLOGIES GmbH		Title: INSTRUMENT LIST Department: 13 DIGESTER SYSTEM			Plant: TRIBENI FIBRE LINE	
TAG-NO.	QNT	INSTRUMENT	ISA	LOC *)	REMARK	REV
13-LIS-132						
	1	AI			DCS	
	1	L-TRANSMITTER	LT132	F		

*)CR..Control Room, LP...Local Panel, P...Panel, F ... Field, R ... Rack, MCC ...Motor Control Center, DCS ... Distributed Control System						
Des.:	Achberger	Check:	Heiden	Drawing Number:	Revision:	Page: 3
Date:	27.05.1997	Date:	27.05.1997			from 22

IMPCO-VOEST-ALPINE

PULPING TECHNOLOGIES GmbH

Title:

INSTRUMENT LISTDepartment: 25
STOCK SCREENING

Plant:

TRIBENI
FIBRE LINE

TAG-NO.	QNT	INSTRUMENT	ISA	LOC *)	REMARK	REV
25-PIC-403						
	1	AO			DCS	
	1	CTRL-BALL-VLV	PV403		F	
25-PDI-414						
	1	SOFTWARE FUNCTION			DCS	
25-PI-414A						
	1	AI			DCS	
	1	P-TRANSMITTER	PT414A		F	
	1	1:1-TRANSMITTER	PT414A.1		F	
25-PI-414B						
	1	AI			DCS	
	1	P-TRANSMITTER	PT414B		F	
	1	1:1-TRANSMITTER	PT414B.1		F	
25-HIC-416						
	1	AO			DCS	
	1	CTRL-VBALL-VLV	HV416		F	
25-FIC-418						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE418		F	
	1	MAG-FLOW-CONVERTER	FT418		F	
	1	CTRL-BALL-VLV	FV418		F	
25-FIC-420						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE420		F	
	1	MAG-FLOW-CONVERTER	FT420		F	
	1	CTRL-VBALL-VLV	FV420		F	
25-PDI-424						
	1	SOFTWARE FUNCTION			DCS	
25-PI-424A						
	1	AI			DCS	
	1	P-TRANSMITTER	PT424A		F	
	1	1:1-TRANSMITTER	PT424A.1		F	
25-PI-424B						
	1	AI			DCS	
	1	P-TRANSMITTER	PT424B		F	
	1	1:1-TRANSMITTER	PT424B.1		F	
25-HIC-426						
	1	AO			DCS	
	1	CTRL-VBALL-VLV	HV426		F	

*)CR..Control Room, LP...Local Panel, P...Panel, F ... Field, R ... Rack, MCC ...Motor Control Center, DCS ... Distributed Control System

Des.: Achberger

Check: Heiden

Drawing Number:

Revision:

Page: 4

Date: 27.05.1997

Date: 27.05.1997

from 22

IMPCO-VOEST-ALPINE

PULPING TECHNOLOGIES GmbH

Title:

INSTRUMENT LISTDepartment: **25**
STOCK SCREENING

Plant:

TRIBENI
FIBRE LINE

TAG-NO.	QNT	INSTRUMENT	ISA	LOC *)	REMARK	REV
25-NIC-427						
	1	AI			DCS	
	1	AO			DCS	
	1	CONSISTENCY TRANSM	NT427		F	
	1	CTRL-VBALL-VLV	NV427		F	
25-FIC-428						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE428		F	
	1	MAG-FLOW-CONVERTER	FT428		F	
	1	CTRL-BALL-VLV	FV428		F	
25-FIC-430						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE430		F	
	1	MAG-FLOW-CONVERTER	FT430		F	
	1	CTRL-VBALL-VLV	FV430		F	
25-LI-435						
	1	AI			DCS	
	1	L-TRANSMITTER	LT435		F	
25-HIC-436						
	1	AO			DCS	
	1	CTRL-VBALL-VLV	HV436		F	
25-FIC-440						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE440		F	
	1	MAG-FLOW-CONVERTER	FT440		F	
	1	CTRL-VBALL-VLV	FV440		F	
25-FIC-441						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE441		F	
	1	MAG-FLOW-CONVERTER	FT441		F	
	1	CTRL-VBALL-VLV	FV441		F	
25-FIC-442						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE442		F	
	1	MAG-FLOW-CONVERTER	FT442		F	
	1	CTRL-BALL-VLV	FV442		F	

*)CR...Control Room, LP...Local Panel, P...Panel, F... Field, R... Rack, MCC...Motor Control Center, DCS... Distributed Control System

Des.: Achberger	Check: Heiden	Drawing Number:	Revision:	Page: 5
Date: 27.05.1997	Date: 27.05.1997			from 22

IMPCO-VOEST-ALPINE

PULPING TECHNOLOGIES GmbH

Title:

INSTRUMENT LISTDepartment: **25**
STOCK SCREENING

Plant:

TRIBENI
FIBRE LINE

TAG-NO.	QNT	INSTRUMENT	ISA	LOC *)	REMARK	REV
25-FFIC-443						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE443	F		
	1	MAG-FLOW-CONVERTER	FT443	F		
	1	CTRL-BALL-VLV	FV443	F		
25-SIC-444						
	1	AI			DCS	
	1	AO			DCS	
	1	FREQUENCY CONVERTER	SY444		MCC ELECTRICAL DELIVERY	
25-LIC-445						
	1	AI			DCS	
	1	L-TRANSMITTER	LT445	F		
25-SIC-446						
	1	AI			DCS	
	1	AO			DCS	
	1	FREQUENCY CONVERTER	SY446		MCC ELECTRICAL DELIVERY	
25-LIC-447						
	1	AI			DCS	
	1	L-TRANSMITTER	LT447	F		
25-LI-448						
	1	AI			DCS	
	1	L-TRANSMITTER	LT448	F		
25-PI-449						
	1	AI			DCS	
	1	P-TRANSMITTER	PT449	F		
25-PIC-451						
	1	AI			DCS	
	1	AO			DCS	
	1	P-TRANSMITTER	PT451	F		
	1	1:1-TRANSMITTER	PT451.1	F		
	1	CTRL-VBALL-VLV	PV451	F		
25-PI-460						
	1	PRESSURE GAUGE	PI460	F		
	1	1:1-TRANSMITTER	PT460.1	F		
25-PI-461						
	1	PRESSURE GAUGE	PI461	F		
	1	1:1-TRANSMITTER	PT461.1	F		
25-PI-462						
	1	PRESSURE GAUGE	PI462	F		
	1	1:1-TRANSMITTER	PT462.1	F		

*)CR..Control Room, LP...Local Panel, P...Panel, F ... Field, R ... Rack, MCC ...Motor Control Center, DCS ... Distributed Control System

Des.: Achberger Check: Heiden Drawing Number: Revision: Page: 6
Date: 27.05.1997 Date: 27.05.1997 from 22

IMPCO-VOEST-ALPINE

PULPING TECHNOLOGIES GmbH

Title:

INSTRUMENT LISTDepartment: **25**
STOCK SCREENING

Plant:

TRIBENI
FIBRE LINE

TAG-NO.	QNT	INSTRUMENT	ISA	LOC *)	REMARK	REV
25-PI-463						
	1	PRESSURE GAUGE	PI463	F		
	1	1:1-TRANSMITTER	PT463.1	F		
25-PI-464						
	1	PRESSURE GAUGE	PI464	F		
	1	1:1-TRANSMITTER	PT464.1	F		
25-PI-465						
	1	PRESSURE GAUGE	PI465	F		
	1	1:1-TRANSMITTER	PT465.1	F		
25-PI-466						
	1	PRESSURE GAUGE	PI466	F		
	1	1:1-TRANSMITTER	PT466.1	F		
25-PI-467						
	1	PRESSURE GAUGE	PI467	F		
	1	1:1-TRANSMITTER	PT467.1	F		
25-PI-468						
	1	PRESSURE GAUGE	PI468	F		
	1	1:1-TRANSMITTER	PT468.1	F		

*)CR..Control Room, LP...Local Panel, P...Panel, F ... Field, R ... Rack, MCC ...Motor Control Center, DCS ... Distributed Control System

Des.: Achberger	Check: Heiden	Drawing Number:	Revision:	Page: 7
Date: 27.05.1997	Date: 27.05.1997			from 22

IMPCO-VOEST-ALPINE

PULPING TECHNOLOGIES GmbH

Title:

INSTRUMENT LISTDepartment: **31**
WASHING PLANT

Plant:

TRIBENI
FIBRE LINE

TAG-NO.	QNT	INSTRUMENT	ISA	LOC *)	REMARK	REV
31-HIC-301						
	1	AO			DCS	
	1	CTRL-VBALL-VLV	HV301		F	
31-FIC-302						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE302		F	
	1	MAG-FLOW-CONVERTER	FT302		F	
	1	CTRL-BALL-VLV	FV302		F	
31-NIC-303						
	1	AI			DCS	
	1	AO			DCS	
	1	CONSISTENCY TRANSM	NT303		F	
	1	CTRL-VBALL-VLV	NV303		F	
31-LIC-304						
	1	AI			DCS	
	1	AO			DCS	
	1	L-TRANSMITTER	LT304		F	
	1	CTRL-BALL-VLV	LV304		F	
31-PI-307						
	1	AI			DCS	
	1	P-TRANSMITTER	PT307		F	
31-SIC-308						
	1	AI			DCS	
	1	AO			DCS	
	1	FREQUENCY CONVERTER	SY308		MCC ELECTRICAL DELIVERY	
31-LIC-309						
	1	AI			DCS	
	1	L-TRANSMITTER	LT309		F	
31-HIC-310						
	1	AO			DCS	
	1	CTRL-BUTT-VLV	HV310		F	
31-LIC-311						
	1	AI			DCS	
	1	AO			DCS	
	1	L-TRANSMITTER	LT311		F	
	1	CTRL-VBALL-VLV	LV311		F	

*)CR...Control Room, LP...Local Panel, P...Panel, F... Field, R... Rack, MCC...Motor Control Center, DCS... Distributed Control System

Des.: Achberger	Check: Heiden	Drawing Number:	Revision:	Page: 8
Date: 27.05.1997	Date: 27.05.1997			from 22

IMPCO-VOEST-ALPINE

PULPING TECHNOLOGIES GmbH

Title:

INSTRUMENT LISTDepartment: **31**
WASHING PLANT

Plant:

TRIBENI
FIBRE LINE

TAG-NO.	QNT	INSTRUMENT	ISA	LOC *)	REMARK	REV
31-FIC-321						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE321		F	
	1	MAG-FLOW-CONVERTER	FT321		F	
	1	CTRL-VBALL-VLV	FV321		F	
31-HIC-322						
	1	AO			DCS	
	1	CTRL-BUTT-VLV	HV322		F	
31-SIC-323						
	1	AI			DCS	
	1	AO			DCS	
	1	FREQUENCY CONVERTER	SY323		MCC ELECTRICAL DELIVERY	
31-LIC-324						
	1	AI			DCS	
	1	L-TRANSMITTER	LT324		F	
31-LI-325						
	1	AI			DCS	
	1	L-TRANSMITTER	LT325		F	
31-FIC-326						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE326		F	
	1	MAG-FLOW-CONVERTER	FT326		F	
	1	CTRL-VBALL-VLV	FV326		F	
31-LIS-327						
	1	AI			DCS	
	1	L-TRANSMITTER	LT327		F	
31-LIS-328						
	1	AI			DCS	
	1	L-TRANSMITTER	LT328		F	
31-PI-329						
	1	AI			DCS	
	1	P-TRANSMITTER	PT329		F	
31-HIC-401						
	1	AO			DCS	
	1	CTRL-VBALL-VLV	HV401		F	

*)CR..Control Room, LP...Local Panel, P...Panel, F ... Field, R ... Rack, MCC ...Motor Control Center, DCS ... Distributed Control System

Des.: Achberger Check: Heiden Drawing Number: Revision: Page: 9
Date: 27.05.1997 Date: 27.05.1997 from 22

IMPCO-VOEST-ALPINE <hr/> PULPING TECHNOLOGIES GmbH		Title: INSTRUMENT LIST Department: 31 WASHING PLANT		Plant: TRIBENI FIBRE LINE		
TAG-NO.	QNT	INSTRUMENT	ISA	LOC *)	REMARK	REV
31-NIC-402						
	1	AI			DCS	
	1	AO			DCS	
	1	CONSISTENCY TRANSM	NT402		F	
	1	CTRL-VBALL-VLV	NV402		F	

*)CR..Control Room, LP...Local Panel, P...Panel, F... Field, R... Rack, MCC...Motor Control Center, DCS... Distributed Control System

Des.: Achberger	Check: Heiden	Drawing Number:	Revision:	Page: 10
Date: 27.05.1997	Date: 27.05.1997			from 22

IMPCO-VOEST-ALPINE

PULPING TECHNOLOGIES GmbH

Title:

INSTRUMENT LISTDepartment: **41**
O2-DELIGNIFICATION

Plant:

TRIBENI
FIBRE LINE

TAG-NO.	QNT	INSTRUMENT	ISA	LOC *)	REMARK	REV
41-LIC-505						
	1	AI			DCS	
	1	AO			DCS	
	1	L-TRANSMITTER	LT505		F	
	1	CTRL-VBALL-VLV	LV505			
41-SIC-506						
	1	AI			DCS	
	1	AO			DCS	
	1	FREQUENCY CONVERTER	SY506		MCC ELECTRICAL DELIVERY	
41-TI-507						
	1	AI			DCS	
	1	PT100-TEMP-TRANSM	TT507		F	
41-FI-509						
	1	AI			DCS	
	1	MAG-FLOW-TUBE	FE509		F	
	1	MAG-FLOW-CONVERTER	FT509		F	
41-HS-510						
	2	DI			DCS	
	1	DO			DCS	
	1	O/C-VBALL-VLV	HV510			
41-TI-511						
	1	AI			DCS	
	1	PT100-TEMP-TRANSM	TT511		F	
41-PI-512						
	1	AI			DCS	
	1	P-TRANSMITTER	PT512		F	
41-FFIC-513						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE513		F	
	1	MAG-FLOW-CONVERTER	FT513		F	
	1	CTRL-SEAT-VLV	FV513		F	
41-HS-514						
	2	DI			DCS	
	1	DO			DCS	
	1	O/C-SEAT-VLV	HV514			
41-PI-515						
	1	AI			DCS	
	1	P-TRANSMITTER	PT515		F	

*)CR..Control Room, LP...Local Panel, P...Panel, F ... Field, R ... Rack, MCC ...Motor Control Center, DCS ... Distributed Control System

Des.: Achberger Check: Heiden Drawing Number: Revision: Page: 11
Date: 27.05.1997 Date: 27.05.1997 from 22

IMPCO-VOEST-ALPINE <hr/> PULPING TECHNOLOGIES GmbH	Title:	INSTRUMENT LIST Department: 41 O2-DELIGNIFICATION	Plant:
			TRIBENI FIBRE LINE

TAG-NO.	QNT	INSTRUMENT	ISA	LOC *)	REMARK	REV
41-HS-516						
	2	DI			DCS	
	1	DO			DCS	
	1	O/C-VBALL-VLV	HV516			
41-PI-520						
	1	AI			DCS	
	1	P-TRANSMITTER	PT520		F	
41-TIC-521						
	1	AI			DCS	
	1	AO			DCS	
	1	Pt100-TEMP-TRANSM	TT521		F	
	1	CTRL-SEAT-VLV	TV521		F	
41-AI-522						
	1	AI			DCS	
	1	FILTRATE PISTON SAMPLER	AE522		F	
	1	PH-SENSOR	AE522		F	
	1	PH-TRANSMITTER	AT522		F	
41-HS-523						
	2	DI			DCS	
	1	DO			DCS	
	1	O/C-GATE-VLV	HV523		F	
41-TI-524						
	1	AI			DCS	
	1	Pt100-TEMP-TRANSM	TT524		F	
41-TI-525						
	1	AI			DCS	
	1	Pt100-TEMP-TRANSM	TT525		F	
41-PI-526						
	1	AI			DCS	
	1	P-TRANSMITTER	PT526		F	
41-PIC-528						
	1	AI			DCS	
	1	AO			DCS	
	1	P-TRANSMITTER	PT528		F	
	1	CTRL-BALL-VLV	PV528		F	
41-HS-529						
	2	DI			DCS	
	1	DO			DCS	
	1	O/C-VBALL-VLV	HV529			

*)CR..Control Room, LP...Local Panel, P...Panel, F ... Field, R ... Rack, MCC ...Motor Control Center, DCS ... Distributed Control System				
Des.:	Achberger	Check:	Heiden	Drawing Number:
Date:	27.05.1997	Date:	27.05.1997	Revision:
				Page: 12
				from 22

IMPCO-VOEST-ALPINE

PULPING TECHNOLOGIES GmbH

Title:

INSTRUMENT LISTDepartment: **41**
O2-DELIGNIFICATION

Plant:

TRIBENI
FIBRE LINE

TAG-NO.	QNT	INSTRUMENT	ISA	LOC *)	REMARK	REV
41-HS-530						
	2	DI			DCS	
	1	DO			DCS	
	1	O/C-VBALL-VLV	HV530			
41-HIC-531						
	1	AO			DCS	
	1	CTRL-VBALL-VLV	HV531		F	
41-LS-532						
	1	DI			DCS	
	1	LEVEL SWITCH	LS532		F	
41-LI-533						
	1	AI			DCS	
	1	L-TRANSMITTER	LT533		F	
41-FIC-534						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-CONVERTER				
	1	MAG-FLOW-TUBE	FE534		F	
	1	CTRL-VBALL-VLV	FV534		F	
41-NIC-535						
	1	AI			DCS	
	1	AO			DCS	
	1	CONSISTENCY TRANSM	NT535		F	
	1	CTRL-VBALL-VLV	NV535		F	
41-TI-536						
	1	AI			DCS	
	1	Pt100-TEMP-TRANSM	TT536		F	
41-PDI-537						
	1	AI			DCS	
	1	DP-TRANSMITTER	PDT537		F	
41-HIC-538						
	1	AO			DCS	
	1	CTRL-SEAT-VLV	HV538		F	
41-PI-548						
	1	AI			DCS	
	1	P-TRANSMITTER	PT548		F	
41-PI-549						
	1	AI			DCS	
	1	P-TRANSMITTER	PT549		F	

*)CR..Control Room, LP...Local Panel, P...Panel, F ... Field, R ... Rack, MCC ...Motor Control Center, DCS ... Distributed Control System

Des.: Achberger Check: Heiden Drawing Number: Revision: Page: 13
Date: 27.05.1997 Date: 27.05.1997 from 22

IMPCO-VOEST-ALPINE

PULPING TECHNOLOGIES GmbH

Title:

INSTRUMENT LISTDepartment: **41**
O2-DELIGNIFICATION

Plant:

TRIBENI
FIBRE LINE

TAG-NO.	QNT	INSTRUMENT	ISA	LOC *)	REMARK	REV
41-HIC-550						
	1	AO			DCS	
	1	CTRL-BUTT-VLV	HV550		F	
41-SIC-551						
	1	AI			DCS	
	1	AO			DCS	
	1	FREQUENCY CONVERTER	SY551		MCC ELECTRICAL DELIVERY	
41-LIC-552						
	1	AI			DCS	
	1	L-TRANSMITTER	LT552		F	
41-LIC-553						
	1	AI			DCS	
	1	AO			DCS	
	1	L-TRANSMITTER	LT553		F	
	1	CTRL-VBALL-VLV	LV553		F	
41-HIC-554						
	1	AO			DCS	
	1	CTRL-BUTT-VLV	HV554		F	
41-SIC-555						
	1	AI			DCS	
	1	AO			DCS	
	1	FREQUENCY CONVERTER	SY555		MCC ELECTRICAL DELIVERY	
41-LIC-556						
	1	AI			DCS	
	1	L-TRANSMITTER	LT556		F	
41-LI-557						
	1	AI			DCS	
	1	L-TRANSMITTER	LT557		F	
41-SS-558						
	1	DI			DCS	
	1	SPEED SWITCH	SS558		F	
41-FIC-559						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE559		F	
	1	MAG-FLOW-CONVERTER	FT559		F	
	1	CTRL-VBALL-VLV	FV559		F	

*)CR..Control Room, LP...Local Panel, P...Panel, F ... Field, R ... Rack, MCC ...Motor Control Center, DCS ... Distributed Control System

Des.: Achberger Check: Heiden Drawing Number: Revision: Page: 14
Date: 27.05.1997 Date: 27.05.1997 from 22

IMPCO-VOEST-ALPINE

PULPING TECHNOLOGIES GmbH

Title:

INSTRUMENT LISTDepartment: **41**
O2-DELIGNIFICATION

Plant:

TRIBENI
FIBRE LINE

TAG-NO.	QNT	INSTRUMENT	ISA	LOC (*)	REMARK	REV
41-FIC-560						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE560	F		
	1	MAG-FLOW-CONVERTER	FT560	F		
	1	CTRL-VBALL-VLV	FV560	F		
41-FIC-561						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE561	F		
	1	MAG-FLOW-CONVERTER	FT561	F		
	1	CTRL-VBALL-VLV	FV561	F		
41-FIC-562						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE562	F		
	1	MAG-FLOW-CONVERTER	FT562	F		
	1	CTRL-SEAT-VLV	FV562	F		
41-LS-565						
	1	DI			DCS	
	1	LEVEL SWITCH	LS565	F		

*)CR..Control Room, LP...Local Panel, P...Panel, F ... Field, R ... Rack, MCC ...Motor Control Center, DCS ... Distributed Control System

Des.: Achberger

Check: Heiden

Drawing Number:

Revision:

Page: 15

Date: 27.05.1997

Date: 27.05.1997

from 22

IMPCO-VOEST-ALPINE

PULPING TECHNOLOGIES GmbH

Title:

INSTRUMENT LISTDepartment: **43**
BLEACHING PLANT

Plant:

TRIBENI
FIBRE LINE

TAG-NO.	QNT	INSTRUMENT	ISA	LOC *)	REMARK	REV
43-LI-601						
	1	AI			DCS	
	1	L-TRANSMITTER	LT601		F	
43-HIC-602						
	1	AO			DCS	
	1	CTRL-VBALL-VLV	HV602		F	
43-NIC-603						
	1	AI			DCS	
	1	AO			DCS	
	1	CONSISTENCY TRANSM	NT603		F	
	1	CTRL-VBALL-VLV	NV603		F	
43-FIC-604						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-CONVERTER				
	1	MAG-FLOW-TUBE	FE604		F	
	1	CTRL-VBALL-VLV	FV604		F	
43-HIC-605						
	1	AO			DCS	
	1	CTRL-BUTT-VLV	HV605		F	
43-AI-606						
	1	AI			DCS	
	1	PH-SENSOR	AE606		F	
	1	PH-TRANSMITTER	AT606		F	
43-SIC-610						
	1	AI			DCS	
	1	AO			DCS	
	1	FREQUENCY CONVERTER	SY610		MCC ELECTRICAL DELIVERY	
43-LIC-611						
	1	AI			DCS	
	1	L-TRANSMITTER	LT611		F	
43-FIC-612						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE612		F	
	1	MAG-FLOW-CONVERTER	FT612		F	
	1	CTRL-VBALL-VLV	FV612		F	

*)CR..Control Room, LP...Local Panel, P...Panel, F ... Field, R ... Rack, MCC ...Motor Control Center, DCS ... Distributed Control System

Des.: Achberger Check: Heiden Drawing Number: Revision: Page: 16
Date: 27.05.1997 Date: 27.05.1997 from 22

IMPCO-VOEST-ALPINE

PULPING TECHNOLOGIES GmbH

Title:

INSTRUMENT LISTDepartment: **43**
BLEACHING PLANT

Plant:

TRIBENI
FIBRE LINE

TAG-NO.	QNT	INSTRUMENT	ISA	LOC *)	REMARK	REV
43-FIC-613						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE613		F	
	1	MAG-FLOW-CONVERTER	FT613		F	
	1	CTRL-VBALL-VLV	FV613		F	
43-FIC-614						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE614		F	
	1	MAG-FLOW-CONVERTER	FT614		F	
	1	CTRL-BALL-VLV	FV614		F	
43-FIC-615						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE615		F	
	1	MAG-FLOW-CONVERTER	FT615		F	
	1	CTRL-BALL-VLV	FV615		F	
43-FIC-616						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE616		F	
	1	MAG-FLOW-CONVERTER	FT616		F	
	1	CTRL-BALL-VLV	FV616		F	
43-PI-619						
	1	AI			DCS	
	1	P-TRANSMITTER	PT619		F	
43-LI-620						
	1	AI			DCS	
	1	L-TRANSMITTER	LT620		F	
43-HS-650						
	2	DI			DCS	
	1	DO			DCS	
	1	O/C-VBALL-VLV	HV650			
43-HS-651						
	2	DI			DCS	
	1	DO			DCS	
	1	O/C-VBALL-VLV	HV651			

*)CR...Control Room, LP...Local Panel, P...Panel, F ... Field, R ... Rack, MCC ...Motor Control Center, DCS ... Distributed Control System

Des.: Achberger Check: Heiden Drawing Number: Revision: Page: 17
Date: 27.05.1997 Date: 27.05.1997 from 22

IMPCO-VOEST-ALPINE

PULPING TECHNOLOGIES GmbH

Title:

INSTRUMENT LISTDepartment: **43**
BLEACHING PLANT

Plant:

TRIBENI
FIBRE LINE

TAG-NO.	QNT	INSTRUMENT	ISA	LOC (*)	REMARK	REV
43-LIC-652						
	1	AI			DCS	
	1	AO			DCS	
	1	L-TRANSMITTER	LT652		F	
	1	CTRL-VBALL-VLV	LV652			
43-SIC-654						
	1	AI			DCS	
	1	AO			DCS	
	1	FREQUENCY CONVERTER	SY654		MCC ELECTRICAL DELIVERY	
43-FIC-655						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE655		F	
	1	MAG-FLOW-CONVERTER	FT655		F	
	1	CTRL-BALL-VLV	FV655		F	
43-FIC-656						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE656		F	
	1	MAG-FLOW-CONVERTER	FT656		F	
	1	CTRL-SEAT-VLV	FV656		F	
43-TIC-659						
	1	AI			DCS	
	1	AO			DCS	
	1	PH100-TEMP-TRANSM	TT659		F	
	1	CTRL-SEAT-VLV	TV659		F	
43-PIS-660						
	1	AI			DCS	
	1	P-TRANSMITTER	PT660		F	
43-AI-661						
	1	AI			DCS	
	1	FILTRATE PISTON SAMPLER	AE661		F	
	1	PH-SENSOR	AE661		F	
	1	PH-TRANSMITTER	AT661		F	
43-PIC-662						
	1	AI			DCS	
	1	AO			DCS	
	1	P-TRANSMITTER	PT662		F	
	1	CTRL-BALL-VLV	PV662		F	

*)CR..Control Room, LP...Local Panel, P...Panel, F ... Field, R ... Rack, MCC ...Motor Control Center, DCS ... Distributed Control System

Des.: Achberger Check: Heiden Drawing Number: Revision: Page: 18
Date: 27.05.1997 Date: 27.05.1997 from 22

IMPCO-VOEST-ALPINE

PULPING TECHNOLOGIES GmbH

Title:

INSTRUMENT LISTDepartment: **43**
BLEACHING PLANT

Plant:

TRIBENI
FIBRE LINE

TAG-NO.	QNT	INSTRUMENT	ISA	LOC *)	REMARK	REV
43-HS-663						
	2	DI			DCS	
	1	DO			DCS	
	1	O/C-GATE-VLV	HV663		F	
43-LI-664						
	1	AI			DCS	
	1	L-TRANSMITTER	LT664		F	
43-HIC-665						
	1	AO			DCS	
	1	CTRL-VBALL-VLV	HV665		F	
43-NIC-666						
	1	AI			DCS	
	1	AO			DCS	
	1	CONSISTENCY TRANSM	NT666		F	
	1	CTRL-VBALL-VLV	NV666		F	
43-FIC-667						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE667		F	
	1	MAG-FLOW-CONVERTER	FT667		F	
	1	CTRL-VBALL-VLV	FV667		F	
43-HIC-668						
	1	AO			DCS	
	1	CTRL-BUTT-VLV	HV668		F	
43-AI-669						
	1	AI			DCS	
	1	PH-SENSOR	AE669		F	
	1	PH-TRANSMITTER	AT669		F	
43-FIC-670						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE670		F	
	1	MAG-FLOW-CONVERTER	FT670		F	
	1	CTRL-VBALL-VLV	FV670		F	
43-FIC-671						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE671		F	
	1	MAG-FLOW-CONVERTER	FT671		F	
	1	CTRL-VBALL-VLV	FV671		F	

*)CR..Control Room, LP...Local Panel, P...Panel, F ... Field, R ... Rack, MCC ...Motor Control Center, DCS ... Distributed Control System

Des.: Achberger Check: Heiden Drawing Number: Revision: Page: 19
Date: 27.05.1997 Date: 27.05.1997 from 22

IMPCO-VOEST-ALPINE

PULPING TECHNOLOGIES GmbH

Title:

INSTRUMENT LISTDepartment: **43**
BLEACHING PLANT

Plant:

TRIBENI
FIBRE LINE

TAG-NO.	QNT	INSTRUMENT	ISA	LOC *)	REMARK	REV
43-FIC-672						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE672		F	
	1	MAG-FLOW-CONVERTER	FT672		F	
	1	CTRL-BALL-VLV	FV672		F	
43-FIC-673						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE673		F	
	1	MAG-FLOW-CONVERTER	FT673		F	
	1	CTRL-BALL-VLV	FV673		F	
43-LIC-674						
	1	AI			DCS	
	1	L-TRANSMITTER	LT674		F	
43-SIC-675						
	1	AI			DCS	
	1	AO			DCS	
	1	FREQUENCY CONVERTER	SY675		MCC ELECTRICAL DELIVERY	
43-HIC-676						
	1	AO			DCS	
	1	CTRL-SEAT-VLV	HV676		F	
43-LI-677						
	1	AI			DCS	
	1	L-TRANSMITTER	LT677		F	
43-PI-678						
	1	AI			DCS	
	1	P-TRANSMITTER	PT678		F	
43-LI-680						
	1	AI			DCS	
	1	L-TRANSMITTER	LT680		F	
43-HIC-681						
	1	AO			DCS	
	1	CTRL-VBALL-VLV	HV681		F	
43-NIC-682						
	1	AI			DCS	
	1	AO			DCS	
	1	CONSISTENCY TRANSM	NT682		F	
	1	CTRL-VBALL-VLV	NV682		F	

*)CR..Control Room, LP...Local Panel, P...Panel, F ... Field, R ... Rack, MCC ...Motor Control Center, DCS ... Distributed Control System

Des.: Achberger Check: Heiden Drawing Number: Revision: Page: 20

Date: 27.05.1997 Date: 27.05.1997

from 22

IMPCO-VOEST-ALPINE

PULPING TECHNOLOGIES GmbH

Title:

INSTRUMENT LISTDepartment: 43
BLEACHING PLANT

Plant:

TRIBENI
FIBRE LINE

TAG-NO.	QNT	INSTRUMENT	ISA	LOC *)	REMARK	REV
43-FIC-683						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE683		F	
	1	MAG-FLOW-CONVERTER	FT683		F	
	1	CTRL-VBALL-VLV	FV683		F	
43-FIC-684						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE684		F	
	1	MAG-FLOW-CONVERTER	FT684		F	
	1	CTRL-VBALL-VLV	FV684		F	
43-FIC-685						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE685		F	
	1	MAG-FLOW-CONVERTER	FT685		F	
	1	CTRL-VBALL-VLV	FV685		F	
43-FIC-686						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE686		F	
	1	MAG-FLOW-CONVERTER	FT686		F	
	1	CTRL-VBALL-VLV	FV686		F	
43-SIC-687						
	1	AI			DCS	
	1	AO			DCS	
	1	FREQUENCY CONVERTER	SY687		MCC ELECTRICAL DELIVERY	
43-LIC-688						
	1	AI			DCS	
	1	L-TRANSMITTER	LT688		F	
43-LI-689						
	1	AI			DCS	
	1	L-TRANSMITTER	LT689		F	
43-LI-690						
	1	AI			DCS	
	1	L-TRANSMITTER	LT690		F	
43-HIC-691						
	1	AO			DCS	
	1	CTRL-VBALL-VLV	HV691		F	

*)CR..Control Room, LP...Local Panel, P...Panel, F ... Field, R ... Rack, MCC ...Motor Control Center, DCS ... Distributed Control System

Des.: Achberger Check: Heiden Drawing Number: Revision: Page: 21
Date: 27.05.1997 Date: 27.05.1997 from 22

IMPCO-VOEST-ALPINE PULPING TECHNOLOGIES GmbH		Title: INSTRUMENT LIST Department: 43 BLEACHING PLANT			Plant: TRIBENI FIBRE LINE	
TAG-NO.	QNT	INSTRUMENT	ISA	LOC *)	REMARK	REV
43-FIC-692						
	1	AI			DCS	
	1	AO			DCS	
	1	MAG-FLOW-TUBE	FE692		F	
	1	MAG-FLOW-CONVERTER	FT692		F	
	1	CTRL-VBALL-VLV	FV692		F	
43-HIC-698						
	1	AO			DCS	
	1	CTRL-BUTT-VLV	HV698		F	
43-PI-699						
	1	AI			DCS	
	1	P-TRANSMITTER	PT699		F	

*)CR..Control Room, LP...Local Panel, P...Panel, F ... Field, R ... Rack, MCC ...Motor Control Center, DCS ... Distributed Control System						
Des.:	Achberger	Check:	Heiden	Drawing Number:	Revision:	Page: 22
Date:	27.05.1997	Date:	27.05.1997			from 22

7.0 PROJECT EXECUTION

7.1 Time Schedule

7.2 List of Potential Suppliers

7.3 Equipment List

Attachments:

Time Schedule for Stage 1 and Stage 2

Equipment List - 12 Pages

PROPOSED TIME SCHEDULE for Phase II

Rev:1 Date: 29.5.97



Project: TRIBENI - Retrofitting Concept

MONTH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	
Stage 1: Retrofitting Digester, Washing, Screening and Cleaning																												
PROCESS ENGINEERING	■																											
DETAIL ENGINEERING	■																											
Plant & Mechanical Engineering	■	■	■	■	■																							
Engineering Piping			■	■																								
Engineering Electric			■	■	■	■																						
Engineering Instrumentation/DCS				■	■	■																						
Civil guide drawings			■	■	■	■																						
Detail Civil Engineering			■	■	■	■																						
MANUFACTURING			■																									
SHIPMENT								■																				
CIVIL WORKS					■																							
ERECTION									■																			
MECHANICAL COMPLETION															■													
START UP															■													

PROPOSED TIME SCHEDULE for PHASE II

Rev: 1 Date: 29.5.97



Project: TRIBENI - Retrofitting Concept

MONTH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Stage 2: Implementation of Oxygen Delignification and Bleaching																											
PROCESS ENGINEERING	—																										
DETAIL ENGINEERING	—																										
Plant & Mechanical Engineering	—																										
Engineering Piping	—																										
Engineering Electric	—																										
Engineering Instrumentation/DCS	—																										
Civil guide drawings	—																										
Detail Civil Engineering	—																										
MANUFACTURING	—																										
SHIPMENT	—																										
CIVIL WORKS	—																										
ERECTION	—																										
MECHANICAL COMPLETION	—																										
START UP	—																										
Remark: Due to Basic Engineering already prepared for Stage 1 the overall time schedule will be shorter																											

7.2 List of potential suppliers

Designation	Supplier (outside India)	Supplier (India)
Digester Lid	Schrader Verfahrenstechnik GmbH/D	Nathani International
Vacuum Filter	Beloit Corporation/USA Sunds Defibrator AB/S A. Ahlstrom Corporation/SF	Hindustan Dorr-Oliver Ltd.
Atmospheric Tanks		Devi Hi-Tech Engineers Pvt. Ltd. Goutami Engineering Aims India Profen Filters Pvt. Ltd. Jord Engineers India Ltd. Tungabadhara Machinery & Tools Ltd.
Pressurized Vessels		Kakati Karshak Ind. Pvt. Ltd. Sri Venkateswara Industries Swetha Engineering Ltd. Hindustan Dorr Oliver Ltd. Larsen & Toubro Ltd. Devi Hi-Tech Engineers Pvt. Ltd. Goutami Engineering Maschinen Fabrik (India) Pvt.Ltd.
Pumps	ABS-Scanpump AB/S Andritz Refinersysteme GmbH/A A. Ahlstrom Corporation/SF	Larsen & Toubro Ltd. Devi Hi-Tech Engineers Pvt Ltd. KSB Pumps Mather & Platt Stork Pump (I) Ltd. Kirloskar Brothers Ltd.
Screw Conveyors		Hindustan Dorr Oliver Ltd. Larsen & Toubro Ltd. Devi Hi-Tech Engineers Pvt. Ltd. Jord Engineers India Ltd. EMCO-KCP Ltd. Tungabadhara Machinery & Tools Ltd. Remi Process Plant & Machinery Ltd.

7.2 List of potential suppliers

Designation	Supplier (outside India)	Supplier (India)
Heat Exchangers		Larsen & Toubro Ltd. Devi Hi-Tech Engineers Pvt. Ltd. Jord Engineers India Ltd. Reliance Heat Transfer Pvt. Ltd. Maschinen Fabrik (India) Pvt.Ltd.
Agitators	Scaba AB/S A. Ahlstrom Corporation/SF	Hindustan Dorr Oliver Ltd. Larsen & Toubro Ltd. Devi Hi-Tech Engineers Pvt. Ltd. Profen Filters Pvt. Ltd. Jord Engineers India Ltd. Tungabadhara Machinery & Tools Ltd. Jessop & Co. Ltd. Servall Engineering Works Remi Process Plant & Machinery Ltd.
MC Pumps	Andritz Refinersysteme GmbH/A A. Ahlstrom Corporation/SF	
Oxygen Generation	Voest-Alpine Industriean- lagenbau GmbH/A EVT-Mahler GmbH/D Air Products (UK) Ltd./UK	
Pressure Screens	Beloit Corporation/USA Sunds Defibrator AB/S A. Ahlstrom Corporation/SF	
Centrifugal Cleaner	Noss AB/S Celleco Hedemora AB/S Krebs Engineers/USA	
Black Liquor Filter	Beloit Corporation/USA ÖMV AB/S	Hindustan Dorr-Oliver Ltd.
Chemical Mixer	Beloit Corporation/USA Kenics Corporation/USA A. Ahlstrom Corporation/SF Komax Systems, Inc./USA	Hindustan Dorr Oliver Ltd. Larsen & Toubro Ltd. Devi Hi-Tech Engineers Pvt. Ltd. EMCO-KCP Ltd. Servall Engineering Works

7.2 List of potential suppliers

Designation	Supplier (outside India)	Supplier (India)
Chemical Recovery		
Evaporation	A. Ahlstrom Corporation/SF Austrian Energy & Environ- ment SGP/Waagner-Biro GmbH/A A.H. Lundberg Associates Inc./USA	
Recovery Boiler	A. Ahlstrom Corporation/SF ABB Power Generation Segment/CDN Tampella Power Asia Pacific Pte. Ltd./SING Babcock & Wilcox/CDN	Thermax Tungabadhara Machinery & Tools Ltd.
Recaustizing	Goslin-Birmingham/USA EIMCO/BRD A. Ahlstrom Corporation/SF	Hindustan Dorr-Oliver Ltd.

LIST OF POTENTIAL SUPPLIERS (INDIA)

AIMS INDIA PVT. LTD.

212/A Jodhpur Park

700068 CALCUTTA

INDIA

Tel.No. 0091/33/4733983

Fax No. 0091/33/4733206

ANDREW YULE & CO LTD.

8, Clive Row

700 001 CALCUTTA

INDIA

Tel.No. ---

Fax No. ---

DEVI HI-TECH ENGINEERS PVT. LTD.

2-54, Kakateeya Nagar, Habsiguda

500 007 HYDERABAD

INDIA

Tel.No. 0091/40/673 458

Fax No. 0091/40/672 110

EMCO-KCP LTD.

Ramakrishna Building, 2, Victoria Crescent Road
Opp. Commander-in-Chief Road

600 105 MADRAS

INDIA

Tel.No. 0091/

Fax No. 0091/

FLAKT INDIA LTD.

Jhalkura, Maheshtala

Buz Buz, 24 Paragnas (South)

--- **WEST BENGAL**

INDIA

Tel.No. ---

Fax No. ---

GOUTAMI ENGINEERING

Nachran Industrial Area

501 507 HYDERABAD

INDIA

Tel.No. ---

Fax No. ---

HINDUSTAN DORR-OLIVER LIMITED

Dorr-Oliver House, Chakala

Andheri (East)

400099 BOMBAY

INDIA

Tel.No. 0091/22/8325541

Fax No. 0091/22/8365659

HINDUSTAN DORR-OLIVER LIMITED

Dohil Chambers 46, Nehru Place

110019 NEW DELHI

INDIA

Tel.No. 0091/11/6412039

Fax No. 0091/11/6422856

LIST OF POTENTIAL SUPPLIERS (INDIA)

JESSOP & Co., LTD.
A Subsidiary of BBUNL
21 & 22, Jessore Road

700 028 CALCUTTA
INDIA

Tel.No. 0091/33/551-5437
Fax No. 0091/33/551-2868

KAKATI KARSHAK INDUSTRIES
PRIVATE LTD.
Nachram Industrial Area

500 076 HYDERABAD
INDIA

Tel.No. 0091/40/853104, 05
Fax No. 0091/40/671980

KSB PUMPS

30, Circus Avenue

700 026 CALCUTTA
INDIA

Tel.No. 0091/40/5418-5177
Fax No. 0091/40

MASCHINEN FABRIK (INDIA) PVT. LTD.

11/45, Panditya Road

700 029 CALCUTTA
INDIA

Tel.No. 0091/474/9975
Fax No. 0091/474/7762

JORD ENGINEERS INDIA LTD.

506, Marble Arch, Race Course Road

390007 BARODA
India

Tel.No. 0091/265/334683
Fax No. 0091/265/334680

KIRLOSKAR BROTHERS LTD.

No. 2, Shantiniketan Building, 2nd Floor
8, Camac Street

700 017 CALCUTTA
INDIA

Tel.No. 0091/
Fax No. 0091/

LARSEN & TOUBRO LIMITED
Engineering Project & Equipment Group
1B, Park Plaza, 71, Park Street

700 016 CALCUTTA
INDIA

Tel.No. 0091/293251-54
Fax No. 0091/33/2449705

MATHER & PLATT

11, R.N. Mukherjee Road

700 001 CALCUTTA
INDIA

Tel.No. 0091/248/5650-5659
Fax No. 0091/248

LIST OF POTENTIAL SUPPLIERS (INDIA)

NATHANI INTERNATIONAL

E-302, Kailash Apartment
293 Bellasis Road
400 008 BOMBAY
INDIA

Tel.No. 0091/22/308/1832
Fax No. 0091/22/308/

PROFEN FILTERS PVT. LTD.

10/D, High Way Common Centre
Danilimda
-- **AHMEDABAD**
INDIA

Tel.No. 0091/79/
Fax No. 0091/79/535 8668

RELIANCE HEAT TRANSFER PVT. LTD.

46, Veer Nariman Road, Fort

400 001 BOMBAY
INDIA

Tel.No. 0091/22/204 7004
Fax No. 0091/22/

RELIANCE HEAT TRANSFER PVT. LTD.

14-C, Everest House, 46-C Chowringhee Road
46-C Chowringhee Road
700 071 CALCUTTA
INDIA

Tel.No. 0091/242/8456
Fax No. 0091/242/

REMI PROCESS PLANT & MACHINERY LTD.

Plot No. 11, Cama Industrial Estate
Goregeon (East)
400 063 BOMBAY
INDIA

Tel.No. 0091/22/
Fax No. 0091/22/873 6858

SERVALL ENGINEERING WORKS

Bharathi Park VII Cross

641911 COIMBATORE
INDIA

Tel.No. 0091/422/441284
Fax No. 0091/422/440077

SRI VENKATESWARA INDUSTRIES

18 & 18/A-1, K.R. Puram Road
Ganapathy P.O.
641 006 COIMBATORE
INDIA

Tel.No. 0091/422/572930
Fax No. 0091/422/571619

STORK PUMP (I) LTD.

Survey No. 320 Odhav

382 410 AHMEDABAD
INDIA

Tel.No. 0091/272/870 311
Fax No. 0091/272/873 184

LIST OF POTENTIAL SUPPLIERS (INDIA)

SWETHA ENGINEERING LTD.

*Plot No. 1961-B, Asiad Colony
Vijaya Complex, 2nd Floor
600 101 MADRAS, Anna Nagar West
INDIA*

Tel.No. 0091/44/6268366

Fax No. 0091/44/6268377

THERMAX Ltd.

*Park Plaza, Block 6A
71, Park Street
700 016 CALCUTTA
INDIA*

Tel.No. 0091/29-2423

Fax No.

TUNGABADHARA MACHINERY & TOOLS LTD.

Flat No. 802&804, Kushal Towers

*500 004 HYDERABAD
INDIA*

Tel.No. 0091/40/

Fax No. 0091/40/203 100

LIST OF POTENTIAL SUPPLIERS (outside INDIA)

A. AHLSTROM CORPORATION

Sentnerikuja 2

**SF-00441 HELSINKI
FINLAND**

Tel.No. 00358/9/503-911
Fax No. 00358/9/562-6927

ABB Power Generation
Combustion Service Division
200 Chisholm Drive

**L9T 5E7 MILTON, Ontario
USA**

Tel.No. 001/905/875-4500
Fax No. 001/905/875-4624

ABS-SCANPUMP AB

P.O.Box 2053
**S-431 02 MÖLNDAL
SWEDEN**

Tel.No. 0046/31/836300
Fax No. 0046/31/184906

ANDRITZ REFINERSYSTEME GMBH

Innstraße 23

**A-1200 WIEN
ÖSTERREICH**

Tel.No. 0222/33113-0
Fax No. 0222/3325398

A.H. LUNDBERG Associates, Inc.

3015 112th Avenue N.E., Suite 200

**WA 98004 BELLEVUE, Washington
USA**

Tel.No. 001/206/827/2250
Fax No. 001/206/827/2224

ABB Power Generation Segment

1410 Blair Place, Suite 600

**K1J 9B9 GLOUCESTER, Ontario
CANADA**

Tel.No. 001/613/747-5110
Fax No. 001/613/747-5880

AIR PRODUCTS (UK) Ltd.
Standard Equipment Group
Molesey Road, Hersham Place
Walton-on-Thames
**KT12 4RZ SURREY
GREAT BRITAIN**

Tel.No. 0044/1932/249200
Fax No. 0044/1932/249565

**AUSTRIAN ENERGY & ENVIRONMENT
SGP/WAAGNER-BIRO GMBH
Siemensstraße 89**

**A-1211 WIEN
ÖSTERREICH**

Tel.No. 0222/25045-0
Fax No. 0222/25045-157

LIST OF POTENTIAL SUPPLIERS (outside INDIA)

BABCOCK & WILCOX
International Division

N1R 5V3 CAMBRIDGE, Ontario
CANADA

Tel.No. 001/519/621-2130
Fax No. 001/519/622-2409

BABCOCK & WILCOX INTERNATIONAL
Power Generation Group
20 S. Van Buren Avenue

44203-0351 BARBERTON, Ohio
USA

Tel.No. 001/330/753-4511
Fax No. 001/330/860-1886

BELOIT CORPORATION
Beloit Pulping
150 Burke Street

NH 03060-4788 NASHUA
USA

Tel.No. 001/603/882-2711
Fax No. 001/603/595-0035

CELLECO HEDEMORA AB

Hans Stahles Väg

S-147 80 TUMBA
SWEDEN

Tel.No. 0046/8/530 664 00
Fax No. 0046/8/530 656 25

EIMCO Zweigniederlassung der
Baker Hughes (Deutschland) GmbH
Gothaer Straße 4

D-40880 RATINGEN
BRD

Tel.No. 0049/2102/9454-0
Fax No. 0049/2102/9454-20

EVT - Mahler GmbH

Augsburgerstraße 708

D-70329 STUTTGART
BRD

Tel.No. 0049/711/91702
Fax No. 0049/711/9171966

GOSLIN-BIRMINGHAM

3401 8th Avenue North

35222 BIRMINGHAM, Alabama
USA

Tel.No. 001/205/324-7511
Fax No. 001/205/251-0375

KENICS CORPORATION

Kenics Park

01845 NORTH ANDOVER, Massachusetts
USA

Tel.No. 001/617/687-0101
Fax No. ---

LIST OF POTENTIAL SUPPLIERS (outside INDIA)

KOMAX SYSTEMS, INC.

1947 E. 223rd Street

**90810 LONG BEACH, California
USA**

Tel.No. 001/213/830-4320

Fax No. ---

KREBS ENGINEERS

1205 Chrysler Dr.,

**CA-94025 MENLO PARK
USA**

Tel.No. 001/415/325-0751

Fax No. 001/415/326-7048

NOSS AB

Ingeltag 1

**S-60102 NORRKÖPING
SCHWEDEN**

Tel.No. 0046/11/231500

Fax No. 0046/11/135923

ÖMV AB

Mekaniska Verkstad

P.O. Box 416

**S-89128 ÖRNSKÖLDSVIK
SWEDEN**

Tel.No. 0046/

Fax No. 0046/66058278

SCABA AB

Box 2018

**S-183 02 TÄBY
SWEDEN**

Tel.No. 0046/8/76802

Fax No. 0046/8/768 5 1 4 1

SCHRADER

VERFAHRENSTECHNIK GMBH

Schleebergstraße 12

**D-59306 ENNIGERLOH
BRD**

Tel.No. 0049/2524/266-0

Fax No. 0049/2524/266-50

SUNDS DEFIBRATOR AB

**S-85194 SUNDSVALL
SCHWEDEN**

Tel.No. 0046/60/

Fax No. 0046/60/567527

TAMPELLA POWER

ASIA PACIFIC PTE LTD

230 Orchard Road, 09-234/236 Faber House

**0923 SINGAPORE
SINGAPORE**

Tel.No. 0065/732/2100

Fax No. 0065/732/2133

LIST OF POTENTIAL SUPPLIERS (outside INDIA)

VOEST-ALPINE Industrieanlagenbau GmbH

Turmstraße 44

A-4031 LINZ
ÖSTERREICH

Tel.No. 0043/70/6592-9677

Fax No. 0043/70/6980-6303

TRIBENI Retrofitting Concept PHASE II				Status: FINAL		Rev: 2		
Equipment List						Date: Aug.97		
Item	Description	Pcs	Main Dimensions/ Capacities	Mat.	Supplied from		Weight	Remarks
					Local Cost in '000 Ind. Rs.	Imported Cost in US \$	tons	
ZF13 Digester System								
ZF13M01-08	Spherical Digester	8	Dia 14 ft;Volume 40 m3 each	CS	-	-	-	existing, modifications at lid and discharge
ZF13M01-08	Spherical Digester	8	Lid and Discharge modification		2.400			
ZF13M82	Blow Tank Cyclone	1	Dia 2,5 x 4,0 m	CS	140		4	
ZF13E01	Blow Steam Condenser	1	Capacity 24 t/h vapours; inlet temp. 105 °- outlet temp. 90 °	CS	400		2,5	
ZF13E02	Heat exchanger	1	Capacity 100 m3/h condensate; inlet temp. 90°- outlet temp. 70°; Cooling medium water inlet temperature 20 °;approx. 150 m2 surface area	CS/SS	500		2	
ZF13P01	Hot Water Pump	1	90 m3/h, 35 m WC, 1500 rpm	CS	160		0,5	
ZF13P02	Condensate Pump	1	450 m3/h, 20 m WC, 1500 rpm	CS	800		0,7	
ZF13P03	Condensate Pump	1	110 m3/h, 20 m WC, 1500 rpm	CS	200		0,4	
ZF13P04	Cooking Liquor Pump	1	60 m3/h, 50 m WC, 1500 rpm	CS/SS	150		0,6	
ZF13T01	Weak Black Liquor Tank	1	not applicable	CS	-	-	-	existing/ not more used
ZF13T02	Cooking Liquor Tank	1	13 m3	CS	-	-	-	existing
ZF13T03	Weak Black Liquor Tank	1	26 m3	CS	-	-	-	existing Wash Water Tank

TRIBENI Retrofitting Concept PHASE II				Status: FINAL		Rev: 2		
Equipment List						Date: Aug.97		
Item	Description	Pcs	Main Dimensions/ Capacities	Mat.	Supplied from		Weight tons	Remarks
					Local Cost in '000 Ind. Rs.	Imported Cost in US \$		
ZF13T04	Blow Tank	1	Dia 4 x 9,5 m / 120 m3	SS	3.200		20	
ZF13T06	Hot Water Tank	1	2,0m x 4,0 m x 4,0 m/ 30 m3	Concrete			-	
ZF13T07	Condensate Tank	1	Dia 6,0m x 10,0 Height/250 m3	SS	2.300		14	
SUBTOTAL					10.250	0	45	

TRIBENI Retrofitting Concept PHASE II				Status:	FINAL		Rev:	2
Equipment List						Date:	Aug.97	
Item	Description	Pcs	Main Dimensions/ Capacities	Mat.	Supplied from		Weight	Remarks
					Local Cost in '000 Ind. Rs.	Imported Cost in US \$		
ZF 25 SCREENING PLANT								
ZF25M01	Primary Centrifugal Screen	1	Capacity: 100 BDMTD, Inlet consistency 2.0 - 2.5 %	SS		65.000	1,8	
ZF25M02	Secondary Centrifugal Screen	1	Ahlstrom M400- 120 HP	SS	-	-	-	use existing Ahlstrom M 400 - 120 HP 0,3 mm slots
ZF25M03	Vibrating Screen	2	1,5 m2 /each	SS	-	-	-	existing, change hole size from 4 mm to 2 mm
ZF25M04	Thickener	1	6,5 ft x 8 ft	SS	1.500		7	
ZF25M05	Vacuum Drum Filter	1	8ft x 8 ft washer	SS	-	-	-	existing Brown stock washer from PM 1 +2 side
ZF25M06	Cleaner Stage 1	1	Capacity 100 BDMTD; Inlet consistency 0,6 - 0,7 %	SS		30.000		
ZF25M07	Cleaner Stage 2	1		SS		in M06 incl.		
ZF25M08	Cleaner Stage 3	1		SS		in M06 incl.		
ZF25M09	Sand Cleaner	1	Capacity 3,5 BDMTD; Inlet consistency 0,5 - 0,8 %	SS	150		1	
ZF25A01	Pulp Chest Agitator	1		SS	350		0,7	
ZF25F01	Hood Extraction Fan	1	25 Nm3/min, 100 mm WC	CS	110		0,1	
ZF25P01	Primary Screen Feed Pump	1	170 m3/h, 25 m WC, 1500 rpm	SS	280		0,5	
ZF25P02	Cleaner Feed Pump	1	600 m3/h, 20 m WC, 1500 rpm	SS	800		0,7	

TRIBENI Retrofitting Concept PHASE II					Status: FINAL		Rev: 2	
Equipment List							Date: Aug.97	
Item	Description	Pcs	Main Dimensions/ Capacities	Mat.	Supplied from		Weight	Remarks
					Local Cost in '000 Ind. Rs.	Imported Cost in US \$	tons	
ZF25P03	Filtrate Pump	1	400 m3/h, 20 m WC, 1500 rpm	SS	320		0,5	
ZF25P04	Filtrate Pump	1	35 m3/h, 20 m WC, 1500 rpm	SS	65		0,3	
ZF25P05	Secondary Screen Feed Pump	1	90 m3/h, 20 m WC, 1500 rpm	SS	110		0,3	
ZF25P06	Tertiary Screen Feed Pump	1	25 m3/h, 20 m WC, 1500 rpm	SS	30		0,3	
ZF25P07	Decker Wire Wash Pump	1	25 m3/h, 60 m WC, 1500 rpm	SS	60		0,3	
ZF25P08	Cleaner feed pump	1	200 m3/h, 20 m WC, 1500 rpm	SS	320		0,5	
ZF25P09	Cleaner feed pump	1	60 m3/h, 30 m WC, 1500 rpm	SS	150		0,5	
ZF25T01	Screen Accept Tank	1	3,5 m x 3,5 m x 4,0 m/ 40 m3	Concrete	-		-	
ZF25T02	Filtrate Tank	1	Dia 4,3m x 7,6m Height/110 m3	SS	1.100		6,8	
SUBTOTAL					5.345	95.000	21	

TRIBENI Retrofitting Concept PHASE II				Status: FINAL		Rev: 2		
Equipment List						Date: Aug.97		
Item	Description	Pcs	Main Dimensions/ Capacities	Mat.	Supplied from		Weight tons	Remarks
					Local Cost in '000 Ind. Rs.	Imported Cost in US \$		
ZF 31 BROWN STOCK WASHING								
ZF31M01	Vacuum Drum Filter	1	Use existing 8ft x 8 ft washer	SS	-	-	-	Existing Chlorine Washer, shall be lifted by approx. 1 m
ZF31M02	Vacuum Drum Filter	1	Use existing 8ft x 8 ft washer	SS	-	-	-	Existing Brown Stock Washer
ZF31M03	Black Liquor Filter	1	Drum Type Capacity 25 m3/h Black Liquor	CS/SS		46.800	0,8	
ZF31M04	Tramp Material Separator	1	Dia 1,0 m , Height 1,2 m	SS			0,6	
ZF31A01	Blow Tank Agitator	1		SS	500		0,7	
ZF31A02	HD Tower Agitator	2		SS	-		-	existing
ZF31F01	Hood Extraction Fan	1			-		-	existing
ZF31F02	Hood Extraction Fan	1	25 Nm3/min, 100 mm WC	CS	110		0,1	
ZF31G01	Sand Separating Cyclone	1	8 " Dia	SS	-	-	-	existing 800 l/min at 3 % Consistency each
ZF31G02	Sand Separating Cyclone	1	8 " Dia	SS	-	-	-	existing 800 l/min at 3 % Consistency each
ZF31G03	Foam Breaker	1		CS	300		0,9	
ZF31P01	Brown Stock Pump	1	120 m3/h, 25 m WC, 1500 rpm	SS	200		0,5	
ZF31P02	Black Liquor Pump	1	30 m3/h, 25 m WC, 1500 rpm	SS	70		0,3	

TRIBUNI Retrofitting Concept PHASE II					Status:	FINAL		Rev:	2
Equipment List							Date:	Aug.97	
Item	Description	Pcs	Main Dimensions/ Capacities	Mat.	Supplied from		Weight tons	Remarks	
					Local Cost in '000 Ind. Rs.	Imported Cost in US \$			
ZF31P03	First Washer Headbox Dilution Pump	1	220 m3/h, 20 m WC, 1500 rpm	SS	330		0,6		
ZF31P04	Dilution Pump	1	85 m3/h, 20 m WC, 1500 rpm	SS	150		0,4		
ZF31P05	Black Liquor Filter Feed Pump	1	30 m3/h, 20 m WC, 1500 rpm	SS	60		0,3		
ZF31P06	Wire Cleaning Pump	1	25 m3/h, 60 m WC, 1500 rpm	SS	70		0,3		
ZF31P07	Second Washer Headbox Dilution Pump	1	300 m3/h, 18 m WC, 1500 rpm	SS	480		0,6		
ZF31P08	First Washer Shower Feed Pump	1	35 m3/h, 30 m WC, 1500 rpm	SS	80		0,3		
ZF31P09	Wire Cleaning Pump	1	25 m3/h, 60 m WC, 1500 rpm	SS	60		0,3		
ZF31P10	Second Washer Stock Feed Pump	1	340 m3/h	SS	550		0,6	Inline propeller type	
ZF31T01	First Washer Filtrate Tank	1	Existing HD Tower V = 110 m3	Concrete	-		-	existing, modification required	
ZF31T02	Second Washer Filtrate Tank	1	Approx. 1,2x 5 x4 = 31,5 m3		-		-	existing	
ZF31T03	HD Tower	2	Existing HD Tower V=110 m3 each	Concrete	-		-	existing	
SUBTOTAL					2.960	46.800	7		

TRIBENI Retrofitting Concept PHASE II

Status: FINAL

Rev: 2

Equipment List

Date: Aug.97

Item	Description	Pcs	Main Dimensions/ Capacities	Mat.	Supplied from		Weight tons	Remarks
					Local Cost in '000 Ind. Rs.	Imported Cost in US \$		
ZF 41 OXYGEN DELIGNIFICATION								
ZF41M01	Oxygen Mixer	1		SS		28.600	1,4	
ZF41M02	Vacuum Drum Filter	1	8ft x 8 ft washer	SS	2.500		8,8	
ZF41M03	Vacuum Drum Filter	1	8ft x 8 ft washer	SS	2.500		8,8	
ZF41M04	Intermediate Submerged Repulper	1		SS	900		1,5	
ZF41A01	Agitator	1		SS	400		0,7	
ZF41F01	Hood Extraction Fan	1	25 Nm3/min, 100 mm WC	CS	110		0,1	
ZF41F02	Hood Extraction Fan	1	25 Nm3/min, 100 mm WC	CS	110		0,1	
ZF41P01	Medium Consistency Pump	1	40 m3/h, 100 m WC	SS		84.500	0,7	
ZF41P02	Stock Pump	1	120 m3/h, 25 m WC; C= 2,5 %	SS	250		0,5	
ZF41P03	Filtrate Pump	1	30 m3/h, 100 m WC	SS	80		0,3	
ZF41P04	Filtrate Pump	1	300 m3/h, 25 m WC	SS	490		0,6	
ZF41P05	Washer Shower Feed Pump	1	35 m3/h, 30 m WC, 1500 rpm	SS	80		0,3	

TRIBENI Retrofitting Concept PHASE II				Status:	FINAL		Rev:	2
Equipment List						Date:	Aug.97	
Item	Description	Pcs	Main Dimensions/ Capacities	Mat.	Supplied from		Weight	Remarks
					Local Cost in '000 Ind. Rs.	Imported Cost in US \$	tons	
ZF41P06	Wire Cleaning Pump	1	25 m3/h, 60 m WC, 1500 rpm	SS	60		0,3	
ZF41P07	Filtrate Pump	1	300 m3/h, 20 m WC	SS	480		0,6	
ZF41P08	Washer Shower Feed Pump	1	35 m3/h, 30 m WC, 1500 rpm	SS	80		0,3	
ZF41P09	Wire Cleaning Pump	1	25 m3/h, 60 m WC, 1500 rpm	SS	60		0,3	
ZF41V01	Oxygen Reactor	1	Dia 2,4m x 10,0 Height/45 m3	SS	1.700		13	
ZF41T01	Stand Pipe for MC-Pump ZF41P01	1	Dia 0,8 m x 4,0 Height	SS	75		0,9	
ZF41T02	O2-Blow Tank	1	Dia 2,5m x 5,0 Height/24 m3	SS	350		2	
ZF41T03	Filtrate Tank	1	Dia 4,0m x 7,0m Height/85 m3	SS	920		5,7	
ZF41T04	Filtrate Tank	1	Dia 4,0m x 7,0m Height/85 m3	SS	920		5,7	
SUBTOTAL					12.065	113.100	53	

TRIBENI Retrofitting Concept PHASE II					Status: FINAL		Rev: 2	
Equipment List							Date: Aug.97	
Item	Description	Pcs	Main Dimensions/ Capacities	Mat.	Supplied from		Weight tons	Remarks
					Local Cost in '000 Ind. Rs.	Imported Cost in US \$		
ZF43 BLEACHING PLANT								
ZF43.M01	A-Washer	1	8ft x 8 ft washer	SS	2.500		8,8	
ZF43.M02	EOP-Washer	1	8ft x 8 ft washer	SS	2.500		8,8	
ZF43.M03	P-Washer	1	8ft x 8 ft washer	SS	-	-	-	Existing Chlorine Washer from PM 1 + 2 side
ZF43.M04	Steam Mixer	1		SS	600		1,1	
ZF43.M05	Oxygen Mixer	1		SS		28.600	1,4	
ZF43.M06	Steam Mixer	1		SS	600		1,1	
ZF43.M07	Peroxide Mixer	1		SS	800		0,8	
ZF43.A01	Agitator	1		SS	500		0,7	
ZF43.A02	Agitator	1		SS	550		0,7	
ZF43.A03	Agitator	1		SS	600		0,7	
ZF43.A04	Agitator	1		SS	650		0,7	
ZF43.F01	Hood Extraction Fan	1	25 Nm3/min, 100 mm WC	SS	110		0,1	
ZF43.F02	Hood Extraction Fan	1	25 Nm3/min, 100 mm WC	SS	110		0,1	
ZF43.F03	Hood Extraction Fan	1			-	-	-	existing

TRIBENI Retrofitting Concept PHASE II

Status: **FINAL**

Rev: **2**

Equipment List

Date: **Aug.97**

Item	Description	Pcs	Main Dimensions/ Capacities	Mat.	Supplied from		Weight tons	Remarks
					Local Cost in '000 Ind. Rs.	Imported Cost in US \$		
ZF43.P01	Stock pump	1	120 m3/h, 25 m WC; C= 2,5 %	SS	250		0,5	
ZF43.P02	Wire Cleaning Pump	1	25 m3/h, 60 m WC, 1500 rpm	SS	60		0,3	
ZF43.P03	Filtrate pump	1	300 m3/h, 25 m WC, 1500 rpm	SS	480		0,6	
ZF43.P04	Medium Consistency Pump	1	40 m3/h, 100 m WC	SS		84.500	0,7	
ZF43.P05	Stock pump	1	120 m3/h, 25 m WC; C= 2,5 %	SS	250		0,5	
ZF43.P06	Wire Cleaning Pump	1	25 m3/h, 60 m WC, 1500 rpm	SS	60		0,3	
ZF43.P07	Filtrate pump	1	300 m3/h, 25 m WC, 1500 rpm	SS	480		0,6	
ZF43.P08	Washer Shower Feed Pump	1	35 m3/h, 30 m WC, 1500 rpm	SS	80		0,3	
ZF43.P09	Stock pump	1	120 m3/h, 25 m WC; C= 2,5 %	SS	250		0,5	
ZF43.P10	Wire Cleaning Pump	1	25 m3/h, 60 m WC, 1500 rpm	SS	60		0,3	
ZF43.P11	Washer Shower Feed Pump	1	35 m3/h, 30 m WC, 1500 rpm	SS	80		0,3	
ZF43.P12	Filtrate pump	1	300 m3/h, 25 m WC, 1500 rpm	SS	480		0,6	
ZF43.P13	Stock pump	1	80 m3/h, 25 m WC; C=4,0 %	SS	180		0,5	
ZF43.T01	A-Tower	1	Dia 2,4m x 10,0 Height/40 m3	SS	1.260		6	
ZF43.T02	EOP-Pre-tower		Dia 1,0m x 12,0m Height/9 m3	SS	590		2	
ZF43.T03	EOP-Tower	1	Dia 3,0m x 12m Height/85 m3	SS	1.900		11	

TRIBUNI Retrofitting Concept PHASE II				Status: FINAL		Rev: 2		
Equipment List						Date: Aug.97		
Item	Description	Pcs	Main Dimensions/ Capacities	Mat.	Supplied from		Weight	Remarks
					Local Cost in '000 Ind. Rs.	Imported Cost in US \$	tons	
ZF43.T04	P-Tower	1	Dia 3,2m x 12,8 m Height/100 m3	SS	2.100		13	
ZF43.T05	Filtrate tank	1	Dia 3,0m x 4,0 m Height/28 m3	SS	460		2,7	
ZF43.T06	Stand Pipe	1	Dia 0,8 m x 4,0m Height	SS	150		0,9	
ZF43.T07	Filtrate tank	1	Dia 3,0m x 4,0 m Height/28 m3	SS	450		2,7	
ZF43.T08	Filtrate tank	1	Dia 3,0m x 4,0 m Height/28 m3	SS	450		2,7	
ZF43.T09	Stock Chest	1	3,5 m x 3,5 m x 4,0 m/ 40 m3	Concrete	-		-	
ZF43.T10	HD-Storage tower	1	existing/ 110 m3	Concrete	-		-	
ZF43.T11	HD-Storage tower	1	existing/ 110 m3	Concrete	-		-	
ZF43.T12	HD-Storage tower	1	existing/ 110 m3	Concrete	-		-	
SUBTOTAL					19.590	113.100	72	

TRIBENI Retrofitting Concept PHASE II				Status: FINAL		Rev: 2		
Equipment List						Date: Aug.97		
Item	Description	Pcs	Main Dimensions/ Capacities	Mat.	Supplied from		Weight	Remarks
					Local Cost in '000 Ind. Rs.	Imported Cost in US \$	tons	
OXYGEN GENERATION PLANT								
	Inlet Filter	1				x)	
	Air compressor	1				x)	
	Air cooler	1				x)	
	Water separator	1				x)	
	Air buffer vessel	1				x)	
	Adsorber vessel	2				x)	
	Valve skid	1				x)	
	Oxygen buffer vessel	1				x)	
	Instrumentation	1				x)	
	Panel	1				x)	
	Oxygen Analyzer	1				x)	
	Compressor	1				x)	
	Piping	1				x)	
	Cabling	1				x)	
SUBTOTAL					0	400.000	0	

8. BASIC FIGURES FOR CALCULATION OF OPERATING COST**GENERAL****Raw material, Chemicals, Utilities**

As a basis actual purchasing cost for raw material and chemicals have been used. For utilities the corresponding cost figures has been given by Tribeni.

Manpower

The estimated manpower has been based on IVA's experience for the operation of such plant.

Only operating personnel has been considered, e.g.:

- maintenance personnel
- administration personnel
- laboratory personnel etc.

Attachment:

Spreadsheet: Basic figures for calculation of operating cost.

8. Basic Figures for calculation of operating cost (Phase II)

Case A: Jute Cost Ind. Rs. 14.000

Capacity 63,0 BDMTD	Working days 350		Production 22.050	
70,0 ADMTD	350		24.500	
Description	Consumption/ BDMT Bleached Pulp	Unit Price	Cost per Unit in Ind. Rs.	Ind. Rs./ BDMT Bleached Pulp
1. Raw Material				
Jute (with 10 % moisture)	1,72 BDMT	ADT	14.000	26.756
2. Chemicals				
Digesting, Washing, Screening, Cleaning				
NA2SO4		t	8.040	N.A.
NaOH (100 %)	250,0 kg 3)	t	16.500	4.125
Na2S(100 %)	60,0 kg 3)	t	17.000	1.020
Antraquinone	1,0 kg	t	170.000	170
Defoamer		t	40.000	0
Oxygen Delignification, Bleaching				
Oxygen	25,0 kg	t	9.000	225
NaOH (100 %)	39,0 kg	t	16.500	644
Magnesium sulphate	4,0 kg	t	5.150	21
Peroxide	41,0 kg	t	30.000	1.230
DTPA	4,0 kg	t	10.000	40
H2SO4 (Sulfuric Acid 100 %)	10,5 kg	t	2.000	21
Sulfamic Acid		t	24.000	N.A.
SO2	3,0 kg	t	10.350	31
Utilities				
Electric power	610	KWh	2,1	1.280
Process water	25	m3	0,7	18
Steam MP (10 bar)	3	t	293,0	879
Steam LP (5 bar)	-	t	293,0	N.A.
Mill air	150	Nm3	0,1	15
SUB TOTAL MATERIAL COST				36.474

8. Basic Figures for calculation of operating cost (Phase II)

Case A: Jute Cost Ind. Rs. 14.000

Capacity	Working days	Production
63,0 BDMTD	350	22.050
70,0 ADMTD	350	24.500

PERSONNEL COST				
Digesting, Washing, Screening, Cleaning	Manpower		Ind. Rs./year	Ind. Rs./ BDMT Bleached Pulp
Pulp mill Superintendent	1		200.000,0	9,1
Superintendent Assistant	1		150.000,0	6,8
Supervisor	4		100.000,0	18,1
Operator	4		75.000,0	13,6
Helper	16		50.000,0	36,3
Oxygen Delignification, Bleaching				
Pulp mill Superintendent	see above			N.A.
Superintendent Assistant	see above			N.A.
Supervisor	1		100.000,0	4,5
Operator	4		75.000,0	13,6
Helper	8		50.000,0	18,1
SUBTOTAL PERSONNEL COST				120

TOTAL PRODUCTION COST (MATERIAL + PERSONNEL)	36.594
---	---------------

Remarks:

- 1) Only direct operating personnel included - no provisions for maintenance, laboratory, quality control etc.
- 2) Shift personnel has been calculated as follows:
(Required personnel per shift X 3 shifts + 15 % Off relieve) + 15 % Leave Relieve
- 3) The chemicals cost for digesting can be reduced when installing a Chemical Recovery System

8. Basic Figures for calculation of operating cost (Phase II)

Case B: Jute Cost Ind. Rs. 7.000

Capacity 63,0 BDMTD	Working days 350		Production 22.050	
70,0 ADMTD	350		24.500	
Description	Consumption/ BDMT Bleached Pulp	Unit Price	Cost per Unit in Ind. Rs.	Ind. Rs/ BDMT Bleached Pulp
1. Raw Material				
Jute (with 10 % moisture)	1,72 BDMT	ADT	7.000	13.378
2. Chemicals				
Digesting, Washing, Screening, Cleaning				
NA ₂ SO ₄		t	8.040	N.A.
NaOH (100 %)	250,0 kg 3)	t	16.500	4.125
Na ₂ S(100 %)	60,0 kg 3)	t	17.000	1.020
Antraquinone	1,0 kg	t	170.000	170
Defoamer		t	40.000	0
Oxygen Delignification, Bleaching				
Oxygen	25,0 kg	t	9.000	225
NaOH (100 %)	39,0 kg	t	16.500	644
Magnesium sulphate	4,0 kg	t	5.150	21
Peroxide	41,0 kg	t	30.000	1.230
DTPA	4,0 kg	t	10.000	40
H ₂ SO ₄ (Sulfuric Acid 100 %)	10,5 kg	t	2.000	21
Sulfamic Acid		t	24.000	N.A.
SO ₂	3,0 kg	t	10.350	31
Utilities				
Electric power	610	KWh	2,1	1.280
Process water	25	m ³	0,7	18
Steam MP (10 bar)	3	t	293,0	879
Steam LP (5 bar)	-	t	293,0	N.A.
Mill air	150	Nm ³	0,1	15
SUB TOTAL MATERIAL COST				23.096

8. Basic Figures for calculation of operating cost (Phase II)

Case B: Jute Cost Ind. Rs. 7.000

Capacity 63,0 BDMTD	Working days 350		Production 22.050
70,0 ADMTD	350		24.500

PERSONNEL COST				
Digesting, Washing, Screening, Cleaning	Manpower		Ind. Rs./year	Ind. Rs./ BDMT Bleached Pulp
Pulp mill Superintendent	1		200.000,0	9,1
Superintendent Assistant	1		150.000,0	6,8
Supervisor	4		100.000,0	18,1
Operator	4		75.000,0	13,6
Helper	16		50.000,0	36,3
Oxygen Delignification, Bleaching				
Pulp mill Superintendent	see above			N.A.
Superintendent Assistant	see above			N.A.
Supervisor	1		100.000,0	4,5
Operator	4		75.000,0	13,6
Helper	8		50.000,0	18,1
SUBTOTAL PERSONNEL COST				120

TOTAL PRODUCTION COST (MATERIAL + PERSONNEL)	23.216
---	---------------

Remarks:

- 1) Only direct operating personnel included - no provisions for maintenance, laboratory, quality control etc.
- 2) Shift personnel has been calculated as follows:
(Required personnel per shift X 3 shifts + 15 % Off relieve) + 15 % Leave Relieve
- 3) The chemicals cost for digesting can be reduced when installing a Chemical Recovery System

9. INVESTMENT COST ESTIMATION

GENERAL

Notes

- ad 1) For cost estimation of the main equipment (local and imported) following has been used:
- Information from ITC Tribeni
 - Information from OSPAK
 - IVA's database
 - Inquiries from Suppliers
- ad 2) During the project execution it will be unavoidable that some additional equipment may be needed or must be modified. For this reason a percentage of the equipment cost has been used as reserve.
- ad 3,4,5) These items has been estimated as a certain percentage of the equipment cost and are derived from similar mills.
- ad 6) Instrumentation and DCS has been calculated as per instrument list shown under item 6 on european basis.
- ad 8,9,10,11
12,13) These items has been estimated as a certain percentage of the equipment cost and are derived from similar mills.
- ad 14) Cost estimation given by ITC - see Annexes

In general for auxiliary equipment like Electric, Instrumentation, Piping it has been assumed that these will be new.

It may be possible to use e.g. pumps, motors or some valves and instruments, however, this has to be checked during the project execution. It should be considered that this small items can create more difficulties and shall stand during initial start-up.

Imported Equipment

The given cost in Indian Rupiahs is based on an exchange rate of
1 USD = 35 Ind. Rs.

For these goods no tax, duties and other customs related items has been considered.

Attachment:

Spreadsheet: Investment cost estimation.

9. Investment cost estimation (Phase II)

Pos.	Department	Assumption for estimate	Estimated investment
1	Main Equipment, ex Works	see Equipmentlist	70,1 Mio Ind. Rs.
1.1	Main Equipment (imported)		19,9 Mio Ind. Rs.
1.2	Main Equipment (locally)		50,2 Mio Ind. Rs.
2	Reserve	approx. 5% of equipment cost	3,5 Mio Ind. Rs.
3	Steel structure	approx. 5% of equipment cost	3,5 Mio Ind. Rs.
4	Piping	approx. 10% of equipment cost	7,0 Mio Ind. Rs.
5	Electric	approx. 12% of equipment cost	8,4 Mio Ind. Rs.
6	Instrumentation and DCS		30,0 Mio Ind. Rs.
7	Total equipment cost (1- 6)		122,5 Mio Ind. Rs.
8	Engineering; Project Management	approx. 10% of equipment cost	12,0 Mio Ind. Rs.
9	Spare parts for two years, start-up & commissioning	approx. 4% of equipment cost	5,0 Mio Ind. Rs.
10	Packing and transportation ex works to site	approx. 4% of equipment cost	5,0 Mio Ind. Rs.
11	Training	approx. 2% of equipment cost	2,0 Mio Ind. Rs.
12	Erection	approx. 11% of equipment cost	13,0 Mio Ind. Rs.
12.1	Dismanteling of old Equipment	3%	
12.2	Installation of new Equipment	8%	
13	Supervision of erection/ startup, commissioning	approx. 4% of equipment cost	5,0 Mio Ind. Rs.
14	Civil works	acc. ITC Information	12,0 Mio Ind. Rs.
14.1	Breaking of existing Buildings		
14.2	New Building		
15	Subtotal 8 - 14		54,0 Mio Ind. Rs.
16	Total 7 + 15		176,5 Mio Ind. Rs.

10. ANNEX

10.1 Description Oxygen Generation Plant

10.2 Description Chemical Recovery System

10.3 Cost Information Received from Tribeni

10.1 Description Oxygen Generation Plant

PROCESS DESCRIPTION

1. GENERAL

The adsorption technology is a physical separation process which uses the different adsorption affinities of gases to a microporous solid substance, the so-called adsorbent. Nitrogen, for example, has a higher adsorption capacity to some zeolite molecular sieves than oxygen.

This characteristic is used with the Pressure Swing Adsorption (PSA) or Vacuum Swing Adsorption (VSA) plants for the generation of oxygen.

The main advantages of this process are the ambient working temperature which results in low stresses to equipment and adsorbent material and the low specific power consumption.

The PSA-plant consists of the main equipment: air compressor, and 2 absorber vessels filled with adsorbent material. For higher delivery pressures a booster oxygen compressor is foreseen.

Each adsorber operates on an alternating cycle of adsorption and regeneration, thus always a continuous oxygen product flow is achieved.

The PSA-Plant works according to the following process steps:

2. ADSORPTION

Air will be sucked from outside by air compressor. Compressed and back-cooled air is fed at ambient temperature to the 2 Pressure-Swing-Adsorption (PSA)-vessels.

Each of the adsorbers is filled with drying agent and molecular sieve.

The moisture and carbon dioxide in the air are removed by drying agent, nitrogen is adsorbed by the molecular sieve filling. The remaining, oxygen-rich product gas leaves the adsorber at the outlet and is fed to the oxygen buffer.

Before the adsorption capacity for nitrogen is depleted, the adsorption process is interrupted so that no nitrogen can break through at the adsorber outlet.

3. REGENERATION

3.1 Depressurization

The exhausted adsorber is regenerated by means of depressurization using the pressure difference at atmosphere in order to remove the adsorbed gases H_2O , CO_2 , N_2 from the adsorbent bed. The waste gas is sent to atmosphere.

3.2 Refilling

Afterwards the regenerated adsorber is refilled with part of the recycled oxygen. The adsorber is then ready for the next adsorption step.

4. PLANT CONTROL

4.1 General

The plant is designed for automatic, selfsupervising 24h-operation.

The time cycle sequence of the adsorption- and regeneration process and the supervision of the process parameters is done by a free programmable logic control system. In case of a failure the plant will be switched automatically in his fall safe position.

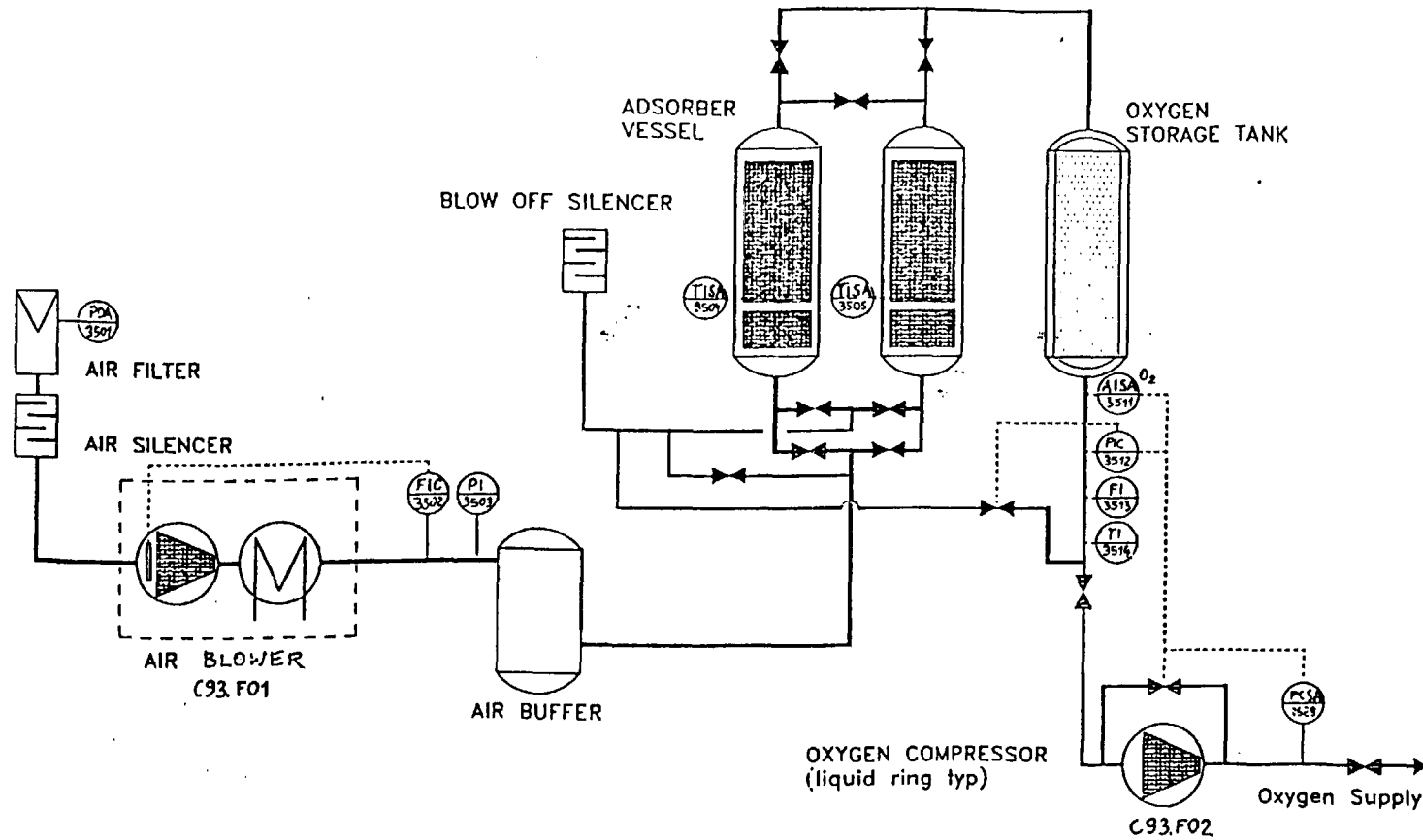
TECHNICAL DATA

Product gas:	
Capacity Design:	63 Nm ³ /h product oxygen i.e. 58 Nm ³ /h pure oxygen = 2,0 tons/day pure oxygen
Capacity Average:	1,5 tons/day pure oxygen
Composition:	O ₂ 93 % by vol.
Ar	4,5 % by vol.
N ₂	2,5 % by vol.
H ₂ O	acc. to dewpoint ~ 60°C degrees celsius (0°C, 1,013 bar)
Delivery pressure:	8 bar (abs) downstream oxygen booster compressor
Outlet temperature:	appr. 35°C

EQUIPMENT LIST

- 1 inlet air filter
- 1 non-lubricated air compressor
- 1 water cooled process air cooler
- 1 water separator
- 1 air buffer vessel
- 2 adsorber vessels
- 1 set of adsorber fillings
- 1 valve skid
- 1 set of pneumatic actuated butterfly valves, incl. necessary instrumentation and cabling
- 1 oxygen buffer vessel
- Instrumentation and safety devices
- 1 control and power panel
with PLC, motor starter, mimic diagram, alarm annunciator, necessary controllers
- 1 oxygen analyzer
- 1 non-lubricated one stage oxygen booster compressor incl. electric motor
- 1 set of interconnecting piping for the valve skid, the adsorbers, the air compressor, the process air buffer vessel and the oxygen buffer vessel (prefabricated, loose supply)
- 1 set of interconnecting cabling for the valve skid, the adsorbers, the air compressor, the process air buffer vessel and the oxygen buffer vessel

Die Untertitel bzw. Leistungsbeschreibung
Verwendung dieser Unterlagen ist nicht
gestattet und wird genehmigt verweigert



PRELIMINARY

WP-2500-01 Revision	2 of 10 No. of Mod.	WP-2500-01 Modifikation	Datum Date	Bearbeiter Made by	Gepr. Ztl. Checked by
Gezeichnet Drawn	97-04-15	kn		Hersteller/Manufacturer	
Gepr. Ztl. Checked	97-04-16	kr		Herstellerzeichnung/Manufacturer Draw No.	
Project/Customer		Benennung/Title			Masse/Phase
TRIBENI		PHASE II - RETROFITTING O ₂ GENERATION			
		FLOWSHEET			Werkstoff/Material
Kunden/Customer-Doc-No.		VAH-Doc-No.			Blatt Sheet
		ITC.ZC93 / ZVV 2001 E			von of
					Formel Size
					WP-2500-01 Revision
					1
					A3
					-

10.2 Chemical Recovery System

This system consists of:

Evaporation plant

Recovery boiler

Recausticising plant

Lime reburning system (optional)

GENERAL PROCESS DESCRIPTION

The chemicals required for the cooking process are regenerated and thus reactivated after having been used in the digester. Chemicals losses in the cycle are made-up by the addition of caustic soda/sodium carbonate and sodium sulphate.

Black liquor from the pulp washing contains used pulping chemicals and dissolved organic substances. In the evaporation plant, black liquor is concentrated to approx. 60 %.

The thickened black liquor (strong black liquor) is burnt in the recovery boiler. The molten chemicals, mainly consisting of sodium carbonate and sodium sulphite as well as sodium sulphate, are discharged at the bottom of the furnace. The smelt flows out to the dissolving tank, where it is dissolved in weak white liquor (WWL) to make green liquor (GL), which is pumped to the recausticizing plant for white liquor preparation.

An electrostatic precipitator is to be installed to recover the valuable sodium chemicals from the flow gases. This is of great importance not only in chemicals recovery but also for controlling air pollution.

Part of the steam required for the process is provided by the recovery boiler. The rest of the steam is generated in a power boiler. The generated steam can also be used for power generation.

In the recausticizing plant green liquor is converted into an active cooking chemical - white liquor - for further use as cooking liquor.

Green liquor, primarily sodium carbonate is converted into caustic soda by using burnt lime. The white liquor contains crystallised calcium carbonate - lime mud - which is removed by clarification. The lime mud is washed with condensate from the evaporation plant, thickened again and stored in the lime mud storage tank. The filtrate is weak white liquor and is used in the dissolving tank.

Prewashed lime mud is pumped to a vacuum filter, dewatered and washed with hot water to remove sodium chemicals.

The lime mud can be reburnt to quick lime in a rotary lime kiln together with lime stone, if it would be installed.

EVAPORATION PLANT

1. GENERAL

The design capacity of the evaporation plant should be min. 35 tons/hr evaporated water. The dry solids content of the heavy black liquor after the evaporation plant should be 60 %.

Particular aspect with non-wood liquor evaporation is high viscosity and serious scaling on the heat transfer surfaces on the liquor side due to silica and large colloidal lignin macro-molecules. In the evaporation plant the scaling aspect has to be taken in consideration and the first and the second effect should be cleaned during normal operation.

The evaporation plant should be a five stage evaporator and to be designed to give the full design evaporation capacity when 4 of the 5 evaporator units are in operation, while the first or the second effect is shut off for washing. During normal operation the evaporation plant works as 5-effect evaporator with 5-effect steam economy.

2. EVAPORATOR UNITS

The main equipment of the evaporation plant consists of five Free Flow Falling Film evaporator units. The heating elements of the evaporator units can be designed as tube or plate heat exchanger. In case of tube exchanger the system can be falling film or rising film evaporator. In case of lammellen (plate) a falling film evaporator can be selected.

The vapour is condensed inside the elements in case of plate heat exchangers and outside the tubes in case of tube heat exchanger.

The secondary vapour is released from the boiling liquor film immediately upon the generation and it escapes from the elements to the vapour body and further to the next effect, where it acts as heating medium.

3. LIQUOR FLOW

The weak liquor from the feed liquor tank is pumped to the forth effect. The liquor is then pumped through the evaporator from effect 4 to effect 5 and then to 3. From effect 3 it is pumped to effect 2 and 1 in counter current flow against the vapour flow. The heavy black liquor is discharged from the effect 1 (or effect 2 when effect 1 is in wash) and is flashed to atmospheric conditions in the flash vessel.

Black liquor circulation pump has to be provided for at least effect 2 and 3. The final number of offered circulation units depends on supplier's recommendation. The liquor circulation flow is very large compared to the evaporation rate. This ensures that the heating surface is always adequately wetted and no dry-boiling occurs in any of the units.

4. STEAM / VAPOUR FLOW

The live steam is fed to the unit effect 1 (or effect 2 when effect 1 is in wash). A small portion of the primary condensate can be pumped to the live steam pipeline for live steam desuperheating.

The liquor film is boiling on the surface of the heating elements and the released vapour is led through a separator to the next effect, where it acts as a heating medium.

Because the vapour released from the liquor contains small amount of non-condensable gases, a vent is necessary from the condensing side of each unit. In average 0,5 % of the vapour is vented. The vent is accomplished with the jet steam ejector vacuum system. The vents are led to the vacuum system via the surface condenser, where the vapour in the vent is condensed as completely as possible to reduce the suction flow to the vacuum system.

The vapour from the fifth effect is condensed in the surface condenser system.

5. CONDENSATE FLOW

The primary condensate from the first effect (i.e. effect 2 when effect 1 is in wash) is flashed in a level vessel. The generated steam is condensed in the effect 3.

The secondary condensate from each effect is expanded to the next effect. The secondary condensate from the evaporator effect 2 to 5 are mixed with the secondary condensate from the surface condenser. The secondary condensate tank operates as a level tank for the secondary condensate.

6. LIQUOR SIDE-WASH

As most serious scaling occurs in the first and the second effect, they can be washed with condensate or with a chemical cleaning agent (caustic or acid) on the liquor side without disturbing the normal evaporator operation.

The evaporation plant is to be designed for operation with four of the five evaporator effects in evaporation while one is washed.

Piping for feeding the evaporator effect 1 and 2 with the chemical cleaning agent, free of choice, should be foreseen. The washing with chemical cleaning agent can be foreseen to operate with manual valves in pipelines to and from the units. The washing with condensate is to be foreseen with automatically operated valves. The isolation valves in the vapour lines to be foreseen with automatically operated valves.

The wash with condensate goes as follows:

The unit to be washed is drained from liquor with the circulation pump. When the unit is empty the vapour valve to the elements will close. The unit will be flushed with condensate which is automatically routed to the unit.

To minimise the effluent from the wash, the washing can be done batch wise by entering a measured quantity of condensate or washing chemical to the unit for circulation. The batch wise wash can then be repeated as required.

The frequency of washing will be determined by operating experience. During the wash the evaporator is vented with a small fan so that gases, which are formed in reaction between the washing solution and the organic deposits, can be transported to destruction.

7. VACUUM SYSTEM

The vacuum in the evaporator will be maintained with two stage jet ejector system.

Hogging jet ejector is included for speedy start-up evacuation of the evaporation plant.

8. TECHNICAL DATA

Basic Data

Evaporation plant for evaporation of black liquor from a soda process bagasse pulp mill.

Process Data

		Design	Balance (Operation)
Evaporation capacity	t/h	34,8	27,8
Weak Black Liquor From Digester Plant			
Dry solids	BDMT/day	100	89
DS-content	% DS	10	11
Flow rate	t/h	41,7	34
Temperature	°C	70 - 80	70 - 80

		Design	Balance (Operation)
Heavy Black Liquor			
Flow rate	t/h	6,9	6,2
DS-content	% DS	60	60
Temperature	°C	~ 103	~ 103
Live Steam Consumption			
t/t evaporated water	5 effects	0,23	
	4 effects	0,29	
Pressure	bar (a)	4 - 5	
Temperature	°C	~ 160	
Cooling Water For Surface Condensers			
m ³ /t evaporated water		~ 13	
Temperature in/out	°C	35/45	
Pressure	bar (a)	6	
Motive Steam For Vacuum Ejectors			
Flow rate	t/h	~ 0,5	
Pressure	bar (a)	12	

CHEMICAL RECOVERY BOILER

The recovery boiler represents the main item of the chemical recovery system where the concentrated black liquor is burnt in order to recover the chemicals used in the cooking process. The green liquor produced is then transferred to the recausticizing plant, where it is reacting with burnt lime to produce white liquor for the process.

The main components of the boiler system are the boiler itself, the air and flue gas system, the electrostatic precipitator and the green liquor handling system.

The boiler unit should be designed and fabricated in accordance with the DIN boiler and pressure vessel code, JIS-, ASME code or other code for pressure vessels.

The pressure parts are of suspended design with natural circulation, equipped with drum and economiser of vertical tube design.

The furnace walls consists of seal-welded finned tubes which form a membrane construction. The lower part of the furnace is made of composite tube. Mineral wool blankets provide insulation against heat emission by radiation.

To protect the superheater from furnace radiation and to cool the flue gases down to the superheater inlet temperature, the upper part of the furnace is equipped with screen tubes which are of finned tubes welded together thus forming a solid construction against chemical build-up falling from the superheater. The screen tubes rise to the drum and from a heat transferring surface with parallel flow and wide tube spacing.

The drum is equipped with manholes and stub tubes for valves and piping. The steam drum has an inlet pipe for feed water, piping for continuous blow down, cyclones equipped with feed water spray and steam dryer.

The screen tubes and the boiler tubes are fastened into the drums by expanding.

The economiser is located behind the actual boiler in one pass. It is constructed of vertical steel tubes which are welded to the headers.

The cleanness of the heating surfaces is maintained with retractable soot-blowers whose wall boxes and lances are equipped with high pressure steam rinsing.

Automatic sequential programmable control panel will be furnished with the soot-blower to control the operation.

The boiler is equipped with rapid drain equipment by which the water can be drained from the boiler in 20 minutes in case of emergency.

The strong black liquor from the evaporating plant is pumped at appr. 60 % solids to the mixing tank. From the mixing tank concentrated black liquor is pumped to the liquor burners via an indirect steam heater.

The black liquor is sprayed into the boiler furnace by guns. A charbed is maintained in the bottom of the furnace and the smelt flows to the dissolving tank through water cooled smelt spouts.

In order to shatter the smelt flow the discharging point is equipped with steam nozzles. The resulting green liquor will be pumped to the causticizing department. Vent gases generated in the dissolving tank are led above the roof through a weak white liquor scrubber.

The combustion air divided into primary and secondary air (including tertiary air), is supplied by a motor driven forced draft fan.

The primary and secondary air is heated to min. 150°C by a LP and MP steam heater.

The boiler unit is also equipped with auxiliary and load corring fuel oil burrels.

2-4 % excess oxygen are maintained in the flue gas for combustion control.

The cooled down flue gases leaving the economiser are entering an electrostatic precipitator for recovering the remaining inorganic particles carried with the gas flow.

The precipitator is a plate-type collector with horizontal gas flow in a steel casing with flat bottom.

The unit has two electrostatic lines with three fields each with transformer-rectifier for each field. The voltage is automatically adjusted to the possible maximum value to achieve an optimum collection efficiency. The internal equipment consists essentially of the discharge system and the collecting electrodes which are continuously cleaned by motor-driven-aping mechanism. The dry dust is discharged to the mixing tank, where the dust is mixed with black liquor and further transferred to the liquor guns.

The required draft in the flue gas system will be maintained by an induced draft fan.

TECHNICAL DATA

Design Data

Type:	Single drum, top supported natural circulation outdoor.
Capacity:	
Normale rate:	89 tDS/day
Maximum continuous rating:	100 tDS/day
Steam at Super Heater Outlet:	
Pressure:	min. 45 bar(a))
Temperature:	max. 450 °C ± 10
Design pressure:	In accordance with Boiler Standards
Feed water temperature to feedwater tank:	105 °C
Black Liquor:	
Pulping process:	Kraft - AQ
Raw material:	Jute
Dry solids concentration from evaporation:	60 %
Temperature:	100 °C
HHV of dry solids:	12,0 MJ/kgDS

Raw black liquor analysis (received from ITC Tribeni on December 16, 1996)

Preliminary

pH	-	11,7
Total Solids	% w/w	16,0
- do -	% w/w	17,2
Suspended Solids	% w/w	0,007
Active Alkali, Na ₂ O	gpl	3,3
Total Alkali, Na ₂ O	gpl	35,6
Inorganics as NaOH	% w/w	30,1
Organics	% w/w	69,9
Silica	% w/w	0,55
Inerts	% w/w	Nil
Chlorides	% w/w	Nil
Sulphur	% w/w	1,30
Carbon	% w/w	39,6
Hydrogen	% w/w	4,0
Nitrogen	% w/w	2,2
Oxygen (by difference)	% w/w	36,4
Calorific value	cals/gm	3507

Viscosity in CPS at various Temperature

Preliminary

Solid % w/w	at 60 °C	at 90 °C
Original	Too low	Too low
45	21,3	8,5
60	436	50

Fuel Oil:

Oil quality:	Bunker C
Net calorific heat value	40 MJ/kg
Viscosity at 50 °C	max. 350 cSt
Sulphur content weight	max. 2,8 %

Combustion Air and Flue Gas

Combustion Air

Ambient Air Temperature:

* For performance calculation and guarantees	30 °C
* Design maximum	40 °C

Air Temperature After Preheater:

* Primary air	min. 150 °C
* Secondary air	min. 150 °C

Flue Gas:

* After economizer	165 °C
* O ₂ -content	3 % vol. in dry flue gas after the economizer

Electrostatic Precipitator:

Dust loading at precipitator (normal cubic metre dry gas):

* Inlet	approx. 15 g/m ³
* Outlet	150 mg/m ³

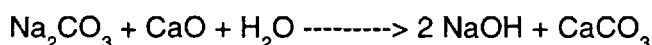
Feed Water Quality:

Feed water and bolt water quality will be based on the standards.

RECAUSTICIZING PLANT

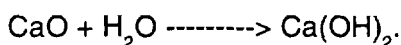
1. GENERAL CAUSTICIZING REACTION

In the recausticizing plant sodium carbonate (Na_2CO_3) reacts with calcium hydroxide ($\text{Ca}(\text{OH})_2$) to sodium hydroxide (NaOH) and calcium carbonate (CaCO_3) according to the formula



Sodium carbonate is brought into the plant with the green liquor.

Calcium oxide comes into the plant as burnt lime and reacts first with water of the green liquor, forming calcium hydroxide



This calcium hydroxide reacts later on with sodium carbonate to sodium hydroxide.

The process is continuous and most efficient at a temperature of approx. 100°C.

2. PROCESS DESCRIPTION

Green liquor is fed from the dissolving tank to the green liquor clarifier. The dregs from the bottom of the clarifier are pumped directly to a precoat dregs filter for washing and dewatering. The dregs filter is meant to function continuously and the dregs are removed from the system to a container.

The quantity of the green liquor are measured before the slaker and lime is added at need.

From the slaker-classifier the lime milk is led to the causticizers which allow minimum 2,5 hours retention time before filtering.

From the last causticizer the lime milk is led to a feed tank from where it is pumped to a clarifier for white liquor filtration and lime mud thickening. The white liquor is stored in the upper part of the clarifier. The lime mud is thickened in the bottom of the clarifier and removed at a consistency of approx. 30% (nonsoluble) to dilution.

Diluted lime mud is pumped to an other clarifier for lime mud washing and thickening. The weak white liquor is stored in the upper part of the clarifier. The washed and thickened lime mud is removed from the bottom at a consistency of approx. 30 % (nonsoluble) to a storage tank.

From the lime mud storage tank the lime mud is diluted and pumped to lime mud precoat filter for the final washing and dewatering. The filtrate is pumped to the lime mud collecting box.

The lime mud receiving screw conveyor after the lime mud filter has different flight directions at half of its total length and is movable along the filter discharge blade. This design allows to feed the lime mud either to a kiln feed system (up to 100 % of total mud amount) and the rest amount or up to 100 % to the disposal system.

3. TECHNICAL DATA

Basic Data

White Liquor Production:

Balance:	195 m ³ /d
Design Capacity:	230 m ³ /d

Process Data

Active alkali concentration as NaOH:	110 g/l
Causticizing degree:	80 %
Suspended solids in clarified white liquor:	100 mg/l
Lime mud dry content after filter:	50 %
Alkali content as NaOH in washed lime mud:	< 1,0 %
Burnt lime quality:	min. 80 %

10.3 Cost Information Received from Tribeni



R&D/UNDP/KNB/3953 **THROUGH COURIER SERVICE** May 15, 1997

Mr. Gerhard Kreindl
Project Manager
IVA Pulping Technologies GmbH
TurmstraBe 44, P.O. Box 4
A-4031 Linz
AUSTRIA.

Dear Mr. Kreindl,

Some feedback from us are overdue. We have now received them from Mr. Kapoor (Our Civil Dept.) and Mr. R.K. Ray (Project Dept.) and the same are enclosed herewith for your kind perusal.

Regarding tanks, TTD does not use CS tanks. Instead Mill practice is to have MS/MS with FRP lining/SS 304 as the case may be. Price quoted for them are as follows :

Material	Material Cost/Kg (Rs.)	Electrode Cost, Fabrication and Erection /Kg (Rs.)	Total/Kg Cost (Rs.)
MS	28.00	7.00	35.00
SS 304	150.00	12.00	162.00

In quoting for pumps (cost given in the attached list), it is considered that impeller & shaft are made of SS, remaining parts, i. e. volute casing and bearing casing are of CS.

None of the equipments in the list exists in our Mill inventory.

Please revert if any further clarification is required.

with regards,

Yours sincerely,



(K.N. Basu)

Encls: as stated.

ASSTT. MANAGER - R&D

ESTIMATED COST

State I

Rs. in Lacs

1.	<u>Breaking Breakers Nos. 5 & 6</u> (including Breakers dismantling, columns etc. required)		
	12 x 11.2 M = 134.40 M ²	@ Rs.1000/- for M ²	1.35
2.	<u>New Foundations</u>		
2.1	Blow Tank (120 M ³) 4 MO x 9.5 M Ht. (160 T)		1.50
2.2	Hot Water Tank (30 M ³) 2 x 4 M x 4 M Ht. (40 T) RCC		0.60
2.3	Condensate Tank (250 M ³) 6 MO x 10 M Ht. (300 T)		2.00
2.4	Misc. Pump foundations, agitators, cyclone etc.	6 Nos.	0.90

	Total	<u>Rs. 6.35 Lacs</u>

Stage IIA. i) Breaking Breaker Nos. 6, 7 & 8 (50% floor)
@ +5.1 level

Rs. in Lacs

@ 5.1 level - 22 x 11.2 x 50%	123.20 M ²	
Roof Truss - 22 x 11.2 x 100%	246.40 M ²	
(@ +12.0 level)		
@ Rs. 1000/- per M ²	369.60 M ²	3.70
<u>ii) New RCC Floor @ + 12 level/ +5.1 level</u>		
+ 5.1 level - 22 x 11.2 x ½	123.20 M ²	
+12.0 level - 22 x 11.2	246.40 M ²	
@ Rs. 6500/- per M ²	369.60 M ²	24.02
<u>iii) New Roof Truss @ + 20 level</u>		
+ 20 level - 22 x 11.2	246.40 M ²	
@ Rs. 3000/- per M ²		7.40
<u>iv) Crane</u>		
		5.00
	Total	Rs. <u>40.12</u> lacs

B. Foundations etc.a) @ Zero level

i) Agitator/pumps	13 Nos. @ 0.15	1.95
ii) Screen Accept Tank (40 M ³)	3.5 x 3.5 x 4 M Ht. RCC	4.00
iii) Filtrate Tank (160 M ³)	4.3 Ø x 7.6 Ht. (140T)	1.50
iv) O ₂ Mixer/Stands Joint	2 x 0.15	0.30
v) O ₂ Reactor (45 M ³)	2.4 Ø x 10.0 Ht. (60T)	0.75
vi) O ₂ Blow Tank (24 M ³)	2.5 Ø x 5.0 Ht. (30T)	0.40

b) @ + 5.0 level/ +12 level

i) @ + 5.0 level Pr./Sec. Centrifugal Screens & Vib. Screen)	3 Nos. @ 0.20	0.60
ii) @ + 12 level Slusher (5' x 8') (35 T)		0.50
iii) @ + 12 level Vacc. Drum Filter (8' x 8') (50T)		0.60
iv) @ + 12 level Cleaners-Sand Cleaners	4 Nos. @ 0.15	0.60

Total Rs. 11.20 lacsTotal A & B = Rs. 51.32 Lacs.

Stage III

		Rs. in Lacs
A. 1) Breaking Breaker Nos. 9 to 12		
<u>(including floor @ 5.1 level & Roof)</u>		
Floor @ + 5.1 level	28 x 11.2 = 313.6 M ²	
Roof @ +12.0 level	28 x 11.2 = 313.6 M ²	
	<u>@ Rs. 1000/- per M²</u>	<u>627.2 M²</u>
		6.27
ii) New Floor @ +12 level	28x11.2 = 313.6M ²	@ Rs. 6500/- per M ²
		20.38
iii) New Roof Truss @ +20 level	28x11.2 = 313.6 M ²	@ Rs. 3000/- per M ²
		9.41
	Total <u>Rs. 36.06</u>

B. Zero level Foundations

i) Filtrate Pump & Misc. Pumps	20 Nos. @ 0.15 lac each	3.00
ii) Filtrate Tank	4 M ϕ x 7 M Ht. (85 M ³) - 100 Tons	1.20
iii) Filtrate Tank	4 M ϕ x 7 M Ht. (85 M ³) - 100 Tons	1.20
iv) O ₂ Mixer, Stands Joints, Agitator	-	
	6 Nos. @ 0.15 lacs each	0.90
v) A-Tower	2.4 M ϕ x 10 M Ht. 40 M ³ (55 T)	0.50
vi) EOP - Pre Towers	1.0 M ϕ x 12 M Ht. 9M ³ (20 T)	0.30
vii) EOP - Tower	3.0 ϕ x 12 M Ht. 85 M ³ (120 T)	1.00
viii) P-Tower	3.2 ϕ x 12.8 M Ht. 100 M ³ (125 T)	1.00
ix) Filtrate Tank	3.0 ϕ x 4.0 Ht. 28 M ³ (35 T) 3 Nos x Rs. 0.75	2.25

C. + 12 M level

i) Vac. Drum Filters	8'x 8' Washers (50T)	
	2 Nos. x @ Rs. 0.50	1.00
ii) A-Washer, EOP/P Washers	8' x 8' Washers (50 T)	
	3 Nos. x @ Rs. 0.50	1.50
iii) Steam Mixer/Peroxide Mixer	3 Nos. @ Rs. 0.10	0.30

Total Rs. 14.15 lacs

Total A + B + C = Rs. 50.21 Lacs.

Stage IVA. @ Zero level

Rs. in Lacs

Pumps 9 Nos. @ Rs. 0.15 each 1.35

B. @ + 12 level

i) Pump 1 No. @ Rs. 0.15 each 0.15

ii) Black Liquor Filter (25 M³/Hr) 0.20Total Rs. 1.70 LacsAPPROXIMATE ESTIMATED COST

	Rs. in Lacs
Stage I	6.35
Stage II	51.32
Stage III	50.21
Stage IV	1.70
	<u>109.58</u>
Diversion of Cables/Pipes (Civil jobs)	4.00
	<u>113.58</u>
Contingencies	6.42
	<u>120.00</u>
Total	Rs. <u>120.00</u> Lacs

The estimated cost is subject to modification after receipt of detailed Engineering/Foundation Drawings.

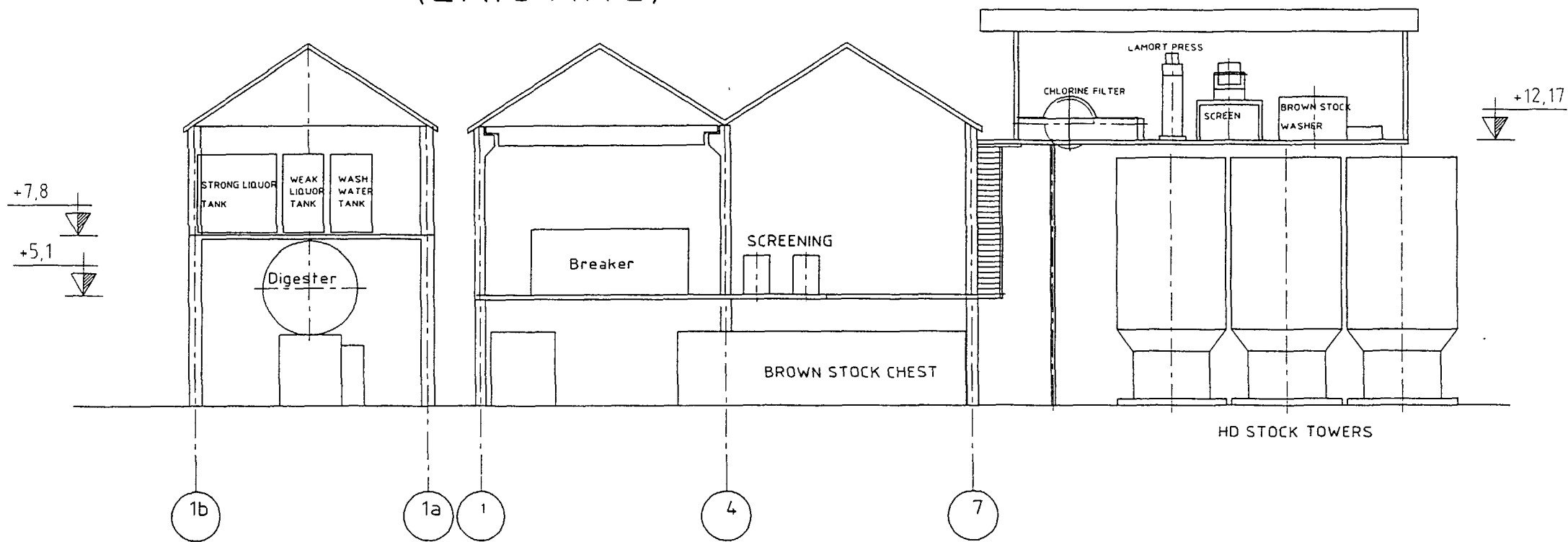
<u>Description of Equipment</u>	<u>Item No.</u>	<u>Cost</u> <u>Rs.in Lacs</u>	
Hot Water Pump - 90 m3/h, 35 m WC, 1500 rpm Motor	ZF13PO1	each	0.30
		each	0.25
Condensate Pump - 450 m3/h, 20 m WC, 1500 rpm Motor	ZF13PO2	each	1.50
		each	1.00
Condensate Pump - 110 m3/h, 20 M WC, 1500 rpm Motor	ZF13PO3	each	0.40
		each	0.30
Cooking Liquor Pump - 60 m3/h, 50 m WC, 1500 rpm Motor	ZF13PO4	each	0.50
		each	0.30
Primary Screen Feed Pump - 170 m3/h, 25 m WC, 1500 rpm Motor	ZF25PO1	each	1.00
		each	0.50
Cleaner Feed Pump - 500 m3/h, 20 M WC, 1500 rpm Motor	ZF25PO2	each	2.00
		each	1.20
Filtrate Pump - 200 m3/h, 20 m WC, 1500 rpm Motor	ZF25PO3	each	0.50
		each	0.40
Filtrate Pump - 35 m3/h, 20 m WC, 1500 rpm Motor	ZF25PO4	each	0.40
		each	0.30
Secondary Screen Feed Pump - 60 m3/h, 20 m WC, 1500 rpm Motor	ZF25PO5	each	0.75
		each	0.40
Decker Wire Wash Pump - 25 m3/h, 60 m WC, 1500 rpm Motor	ZF25PO7	each	0.40
		each	0.30
Cleaner Feed Pump - 200 m3/h, 20 m WC, 1500 rpm Motor	ZF25PO8	each	1.50
		each	0.50
Cleaner Feed Pump - 90 m3/h, 30 m WC, 1500 rpm Motor	ZF25PO9	each	1.00
		each	0.40
Brown Stock Pump - 120 m3/h, 25 m WC, 1500 rpm Motor	ZF31PO1	each	1.20
		each	0.50

<u>Description of the Equipment</u>	<u>Item No.</u>	<u>P/2 Cost Rs. in Lacs</u>	
Black Liquor Pump - 30 m ³ /h, 25 m WC, 1500 rpm Motor	ZF31PO2	each	0.40
		each	0.30
First Washer Headbox Dilution Pump - 220 m ³ /h, 20 m WC, 1500 rpm Motor	ZF31PO3	each	0.50
		each	0.40
Dilution Pump - 85 m ³ /h, 20 m WC, 1500 rpm Motor	ZF31PO4	each	0.40
		each	0.30
Black Liquor Filter Feed Pump - 25 m ³ /h, 20 m WC, 1500 rpm Motor	ZF31PO5	each	0.40
		each	0.30
Wire Cleaning Pump - 25 m ³ /h, 60 m WC, 1500 rpm Motor	ZF31PO6	each	0.40
		each	0.30
Second Washer Headbox Dilution Pump - 300 m ³ /h, 18 m WC, 1500 rpm Motor	ZF31PO7	each	0.50
		each	0.40
First Washer Shower Feed Pump - 35 m ³ /h, 30 m WC, 1500 rpm Motor	ZF31PO8	each	0.40
		each	0.30
Wire Cleaning Pump - 25 m ³ /h, 60 m WC, 1500 rpm Motor	ZF31PO9	each	0.40
		each	0.30
Medium Consistency Pump - 40 m ³ /h, 100 m WC Motor	ZF41PO1	each	1.50
		each	0.50
Stock Pump - 120 m ³ /h, 25 m WC, C=2,5% Motor	ZF41PO2	each	1.50
		each	0.50
Filtrate Pump - 30 m ³ /h, 100 m WC Motor	ZF41PO3	each	0.50
		each	0.30

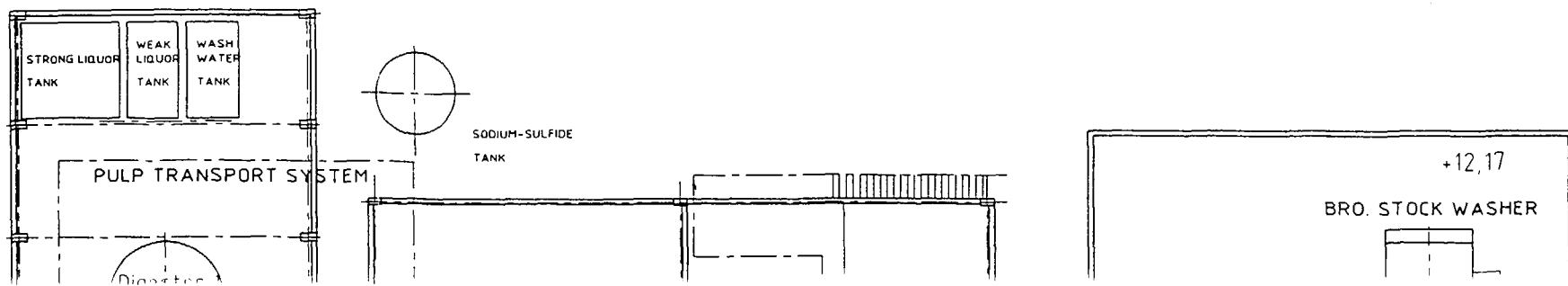
<u>Description of the Equipment</u>	<u>Item No.</u>	<u>Cost</u> <u>Rs. in Lacs</u>	
Filtrate Pump - 300 m ³ /h, 25 m WC Motor	ZF41PO4	each	1.20
		each	0.50
Washer Shower Feed Pump - 35 m ³ /h, 30 m WC, 1500 rpm Motor	ZF41PO5	each	0.50
		each	0.35
Wire Cleaning Pump - 25 m ³ /h, 60 m WC, 1500 rpm Motor	ZF41PO6	each	0.50
		each	0.30
Filtrate Pump - 300 m ³ /h, 20 m WC Motor	ZF41PO7	each	1.20
		each	0.50
Washer Shower Feed Pump - 35 m ³ /h, 30 m WC, 1500 rpm Motor	ZF41PO8	each	0.50
		each	0.40
Wire Cleaning Pump - 25 m ³ /h, 60 m WC, 1500 rpm Motor	ZF41PO9	each	0.80
		each	0.50
Stock Pump - 120 m ³ /h, 25 m WC, C=2,5% Motor	ZF43PO1	each	1.20
		each	0.50
Wire Cleaning Pump - 25 m ³ /h, 60 m WC, 1500 rpm Motor	ZF43PO2	each	0.50
		each	0.30
Filtrate Pump - 300 m ³ /h, 25 m WC, 1500 rpm Motor	ZF43PO3	each	1.20
		each	0.50
Medium Consistency Pump - 40 m ³ /h, 100 m WC Motor	ZF43PO4	each	1.50
		each	0.50
Stock Pump - 120 m ³ /h, 25 m WC, C=2,5% Motor	ZF43PO5	each	1.50
		each	0.50
Wire Cleaning Pump - 25 m ³ /h, 60 m WC, 1500 rpm Motor	ZF43PO6	each	0.50
		each	0.30
Filtrate Pump - 300 m ³ /h, 25 m WC, 1500 rpm Motor	ZF43PO7	each	1.20
		each	0.50

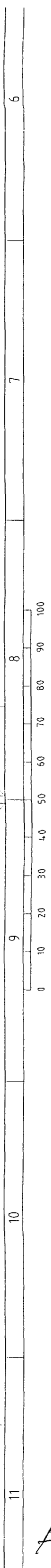
<u>Description of the Equipment</u>	<u>Item No.</u>	<u>Cost</u>	
		<u>Rs. In Lacs</u>	
Washer Shower Feed Pump - 35 m ³ /h, 30 m WC, 1500 rpm Motor	ZF43PO8	each	0.50
		each	0.30
Stock Pump - 120 m ³ /h, 25 m WC, C=2,5% Motor	ZF43PO9	each	1.50
		each	0.50
Wire Cleaning Pump - 25 m ³ /h, 60 m WC, 1500 rpm Motor	ZF43P10	each	0.50
		each	0.30
Washer Shower Feed Pump - 35 m ³ /h, 30 m WC, 1500 rpm Motor	ZF43P11	each	0.50
		each	0.30
Filtrate Pump - 300 m ³ /h, 25 m WC, 1500 rpm Motor	ZF43P12	each	1.20
		each	0.50
Stock Pump - 80 m ³ /h, 25 m WC, C=4,0% Motor	ZF43P13	each	1.20
		each	0.50

SECTION A - A (EXISTING)

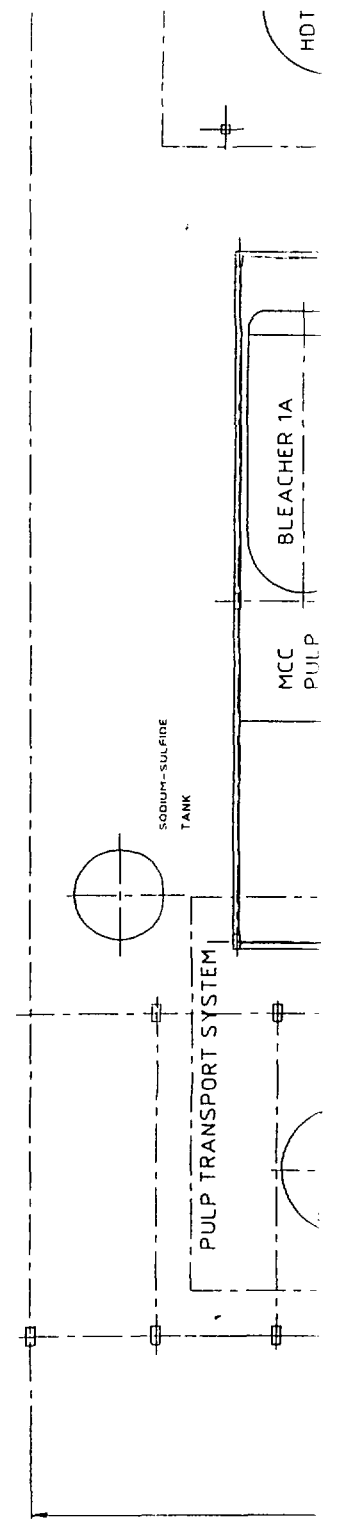


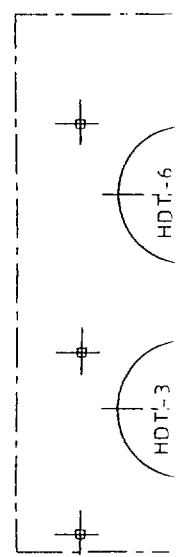
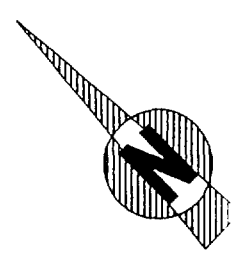
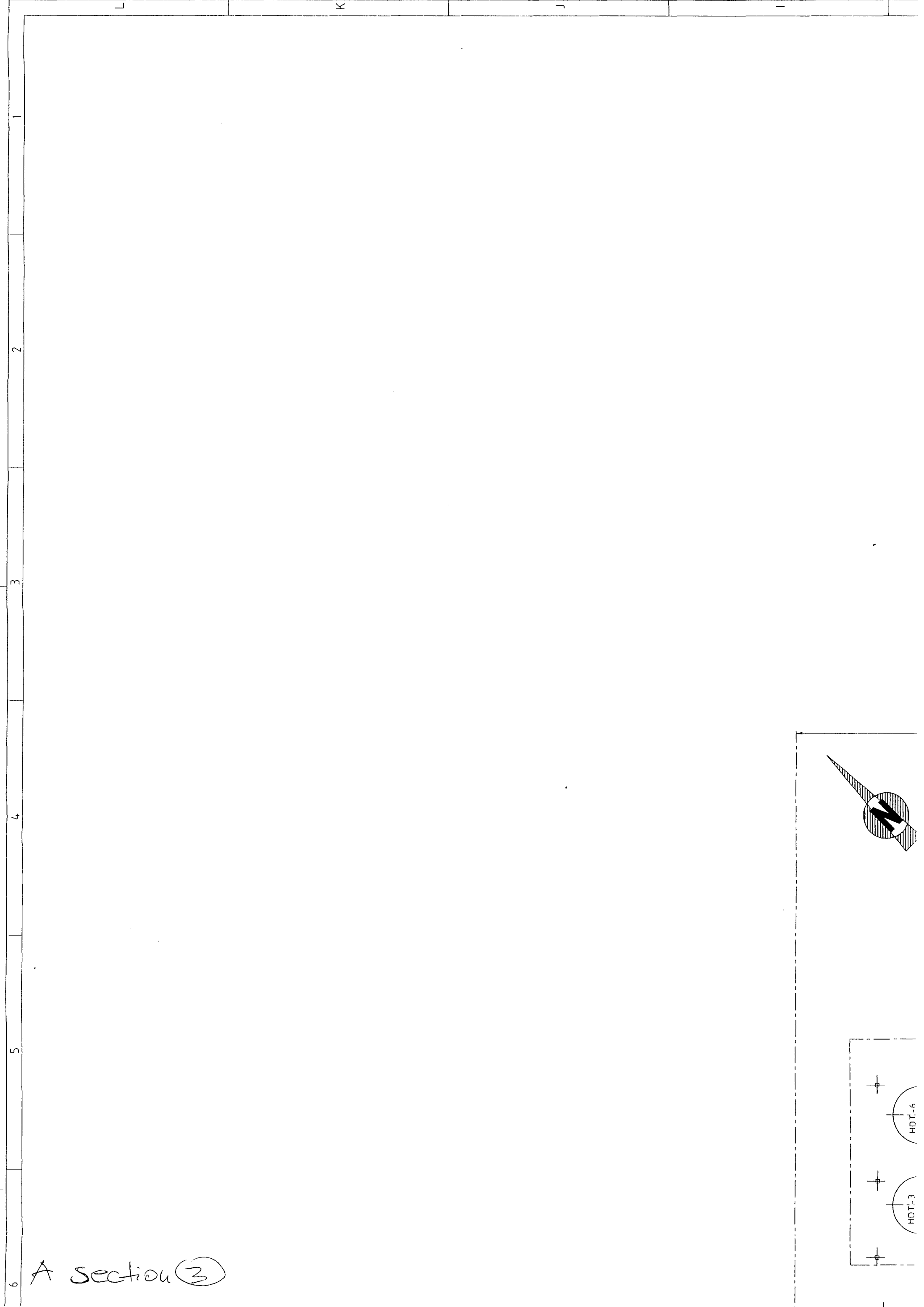
A section ①



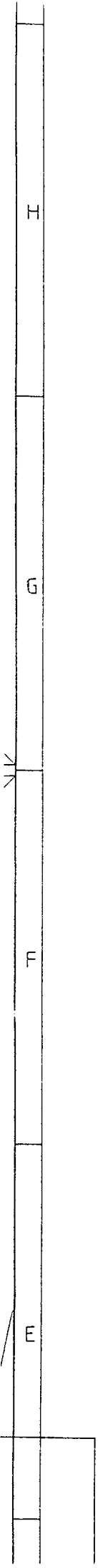


A section ②

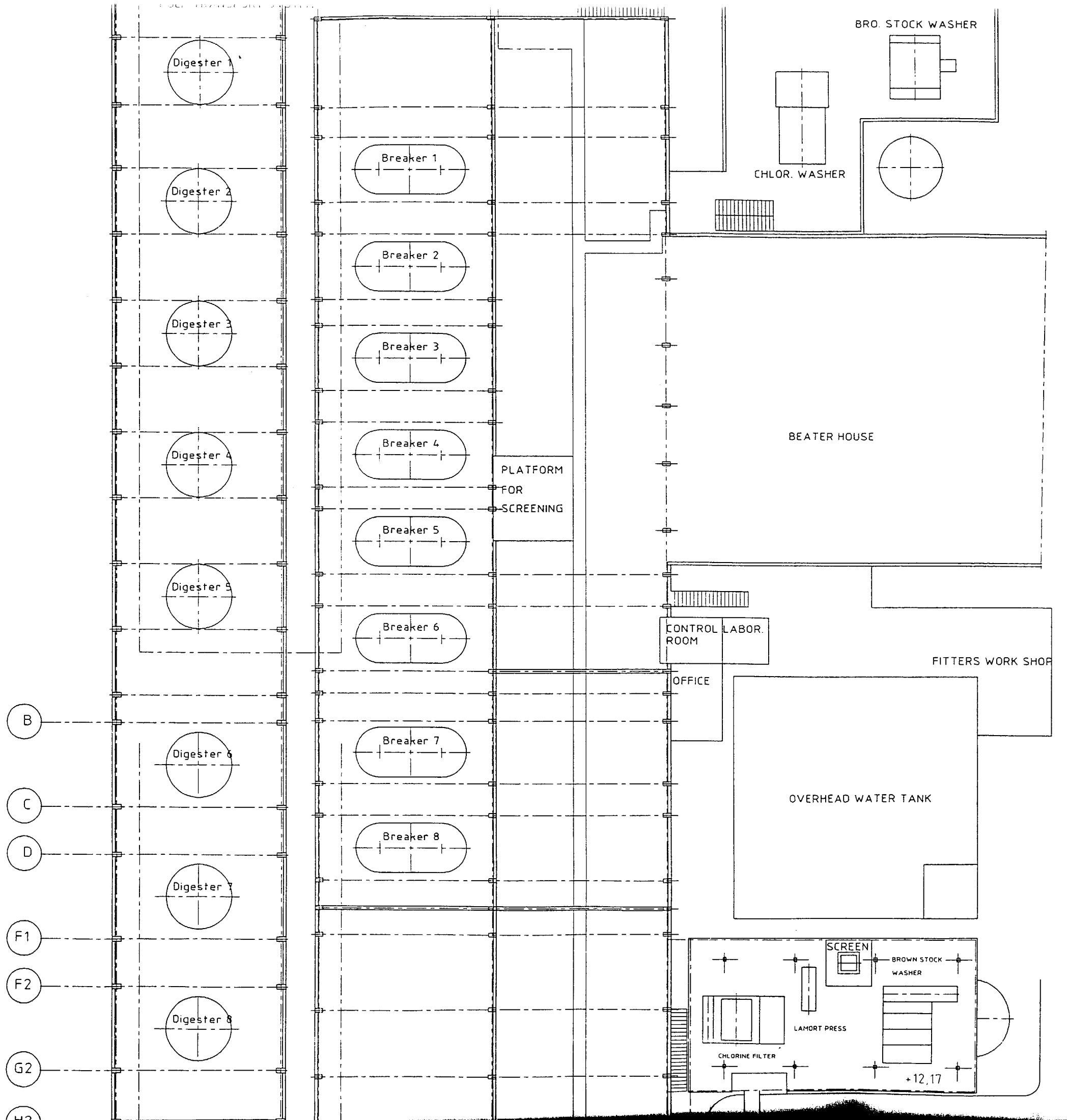




A section (3)



A Section 4



ENGINEERING BLOCK

Digester 1

Digester 2

Digester 3

Digester 4

Digester 5

Digester 6

Digester 7

Digester 8

Breaker 1

Breaker 2

Breaker 3

Breaker 4

Breaker 5

Breaker 6

Breaker 7

Breaker 8

PLATFORM FOR SCREENING

CHLOR. WASHER

BRO. STOCK WASHER

BEATER HOUSE

CONTROL LABOR. ROOM

OFFICE

FITTERS WORK SHOP

OVERHEAD WATER TANK

SCREEN

BROWN STOCK WASHER

LAMORT PRESS

CHLORINE FILTER

+12,17

B

C

D

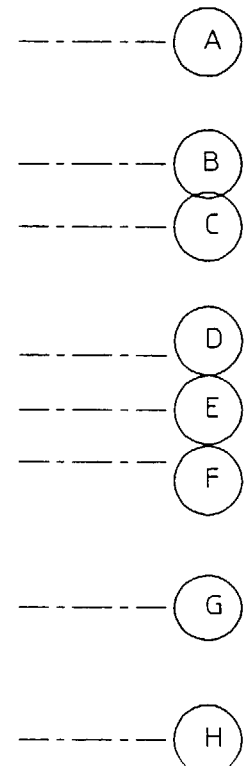
F1

F2

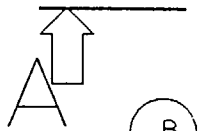
G2

F3

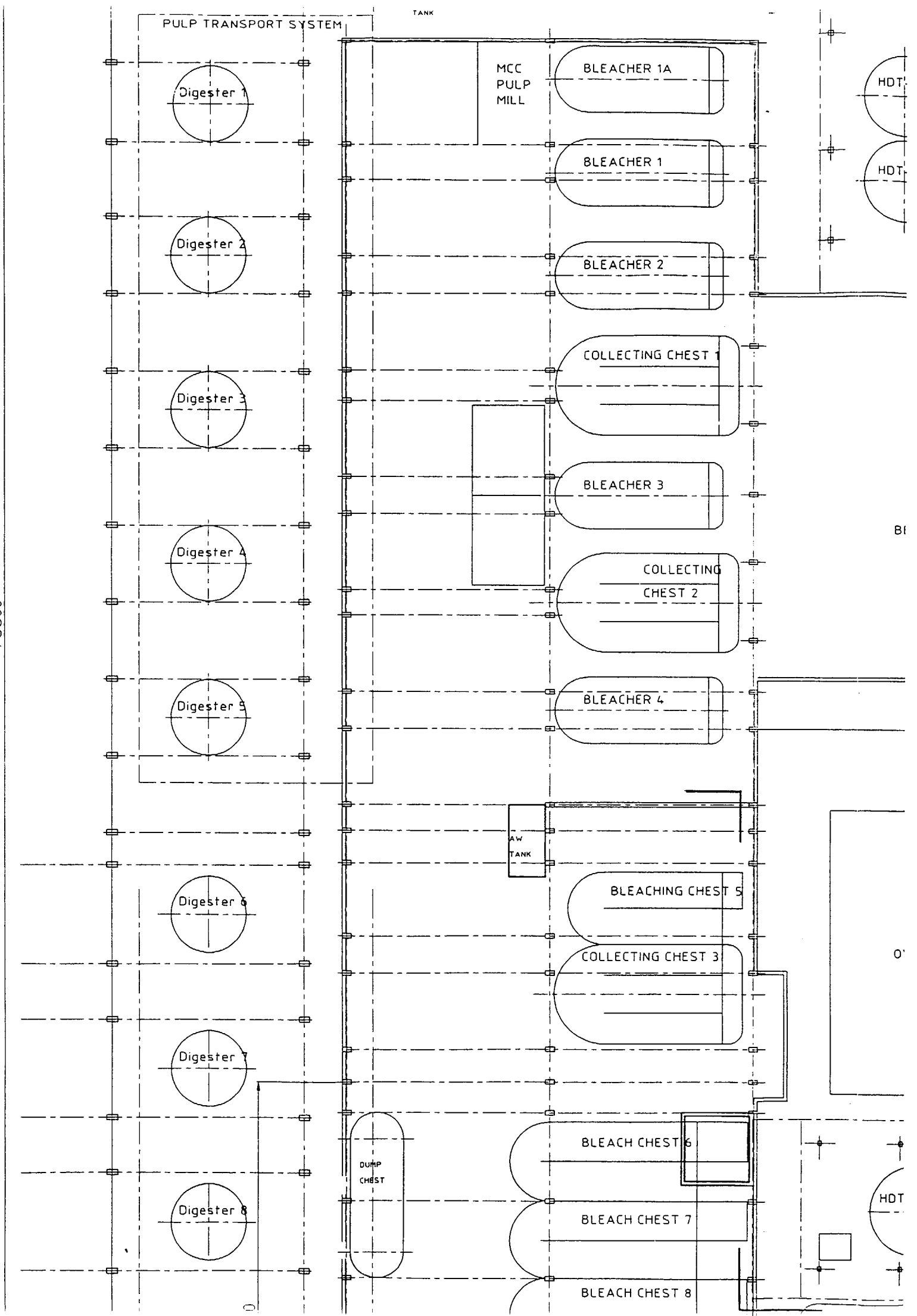
A Section 5



ENGINEERING
BLOCK



78800



A section ⑥

I

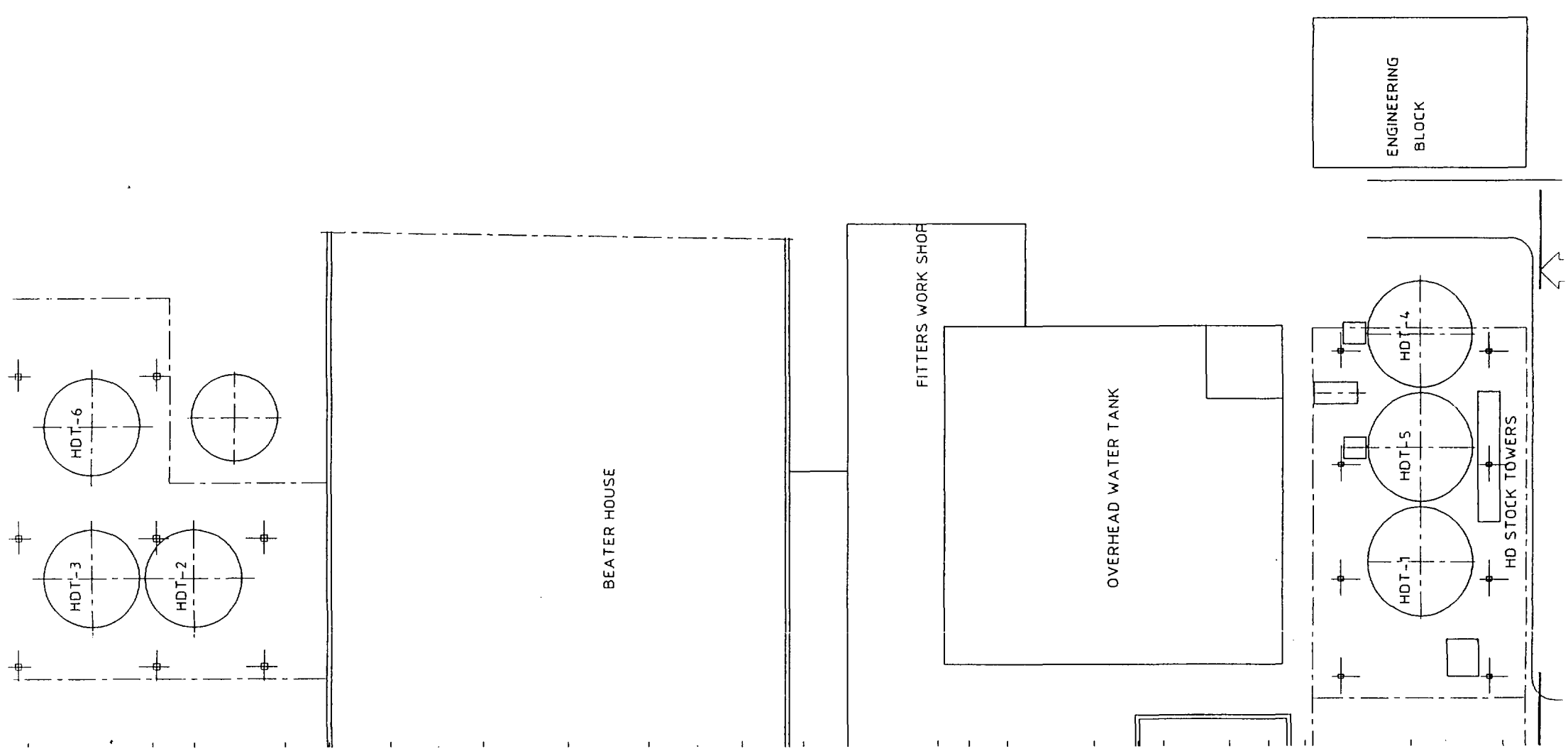
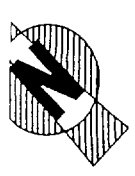
G

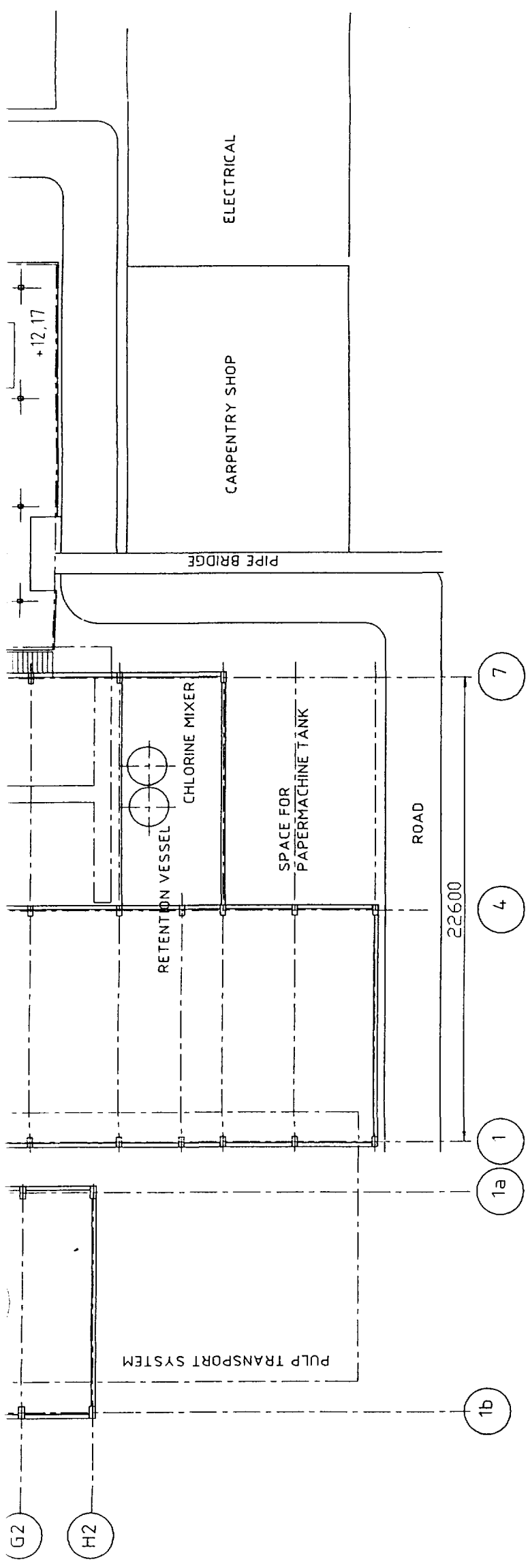
F

E

A B C D E F G H

92400

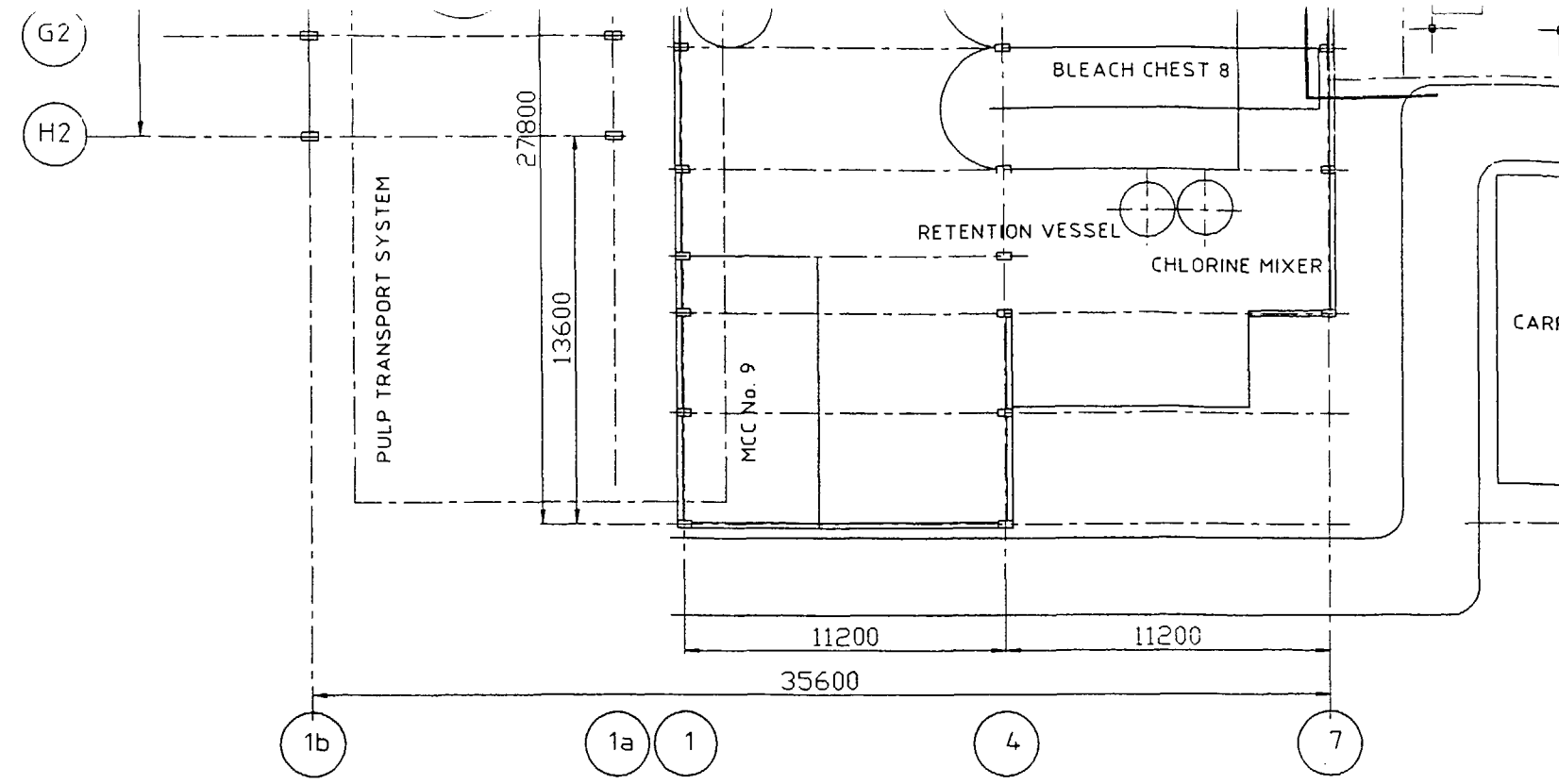
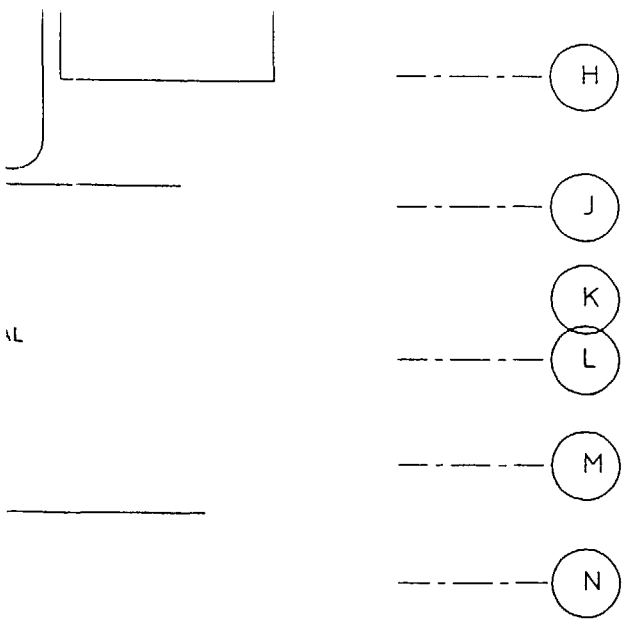




ELEVATION FLOOR +5.1m +7.85

A section ⑦

Die unbefugte bzw. bestimmungswidrige
Verwendung dieser Unterlage ist nicht
gestattet und wird gerichtlich verfolgt.

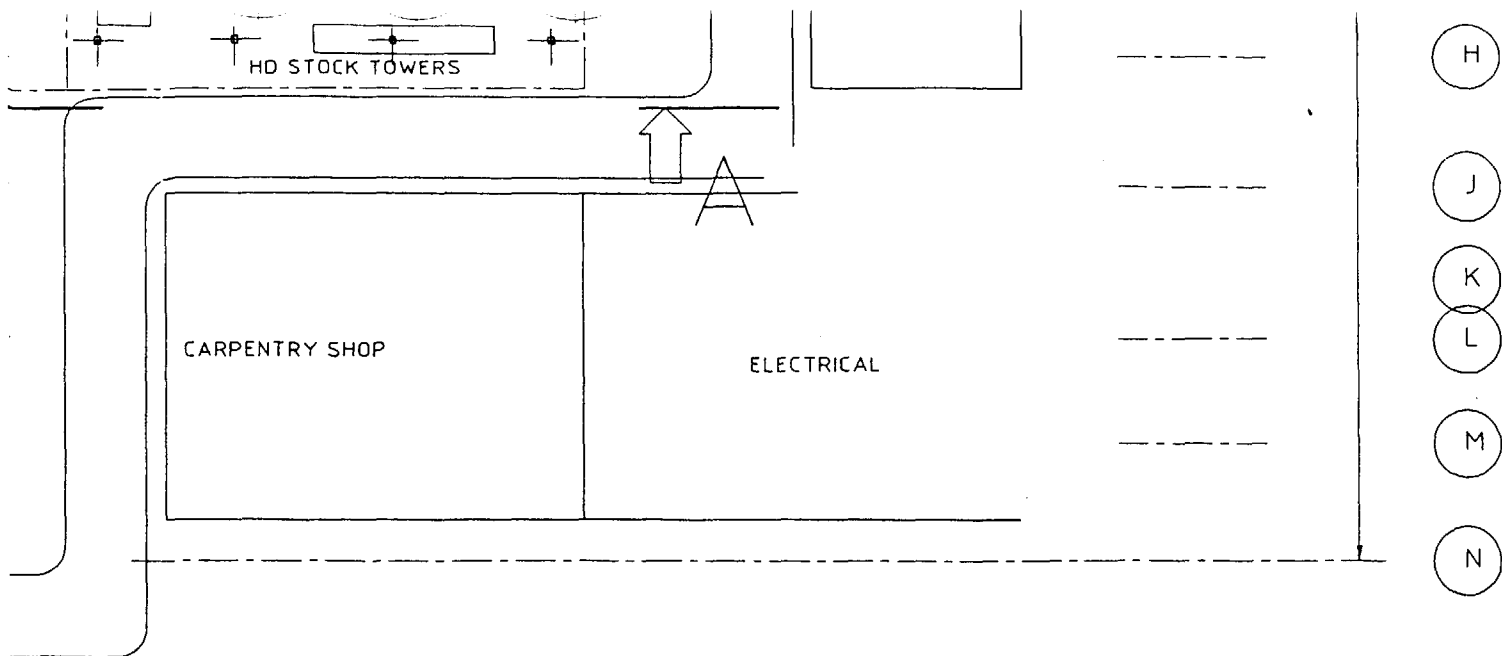


7.85m + 12.0m + 12.17m

ELEVATION GROUND

A Section 8

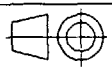





A Section 9

GROUND FLOOR

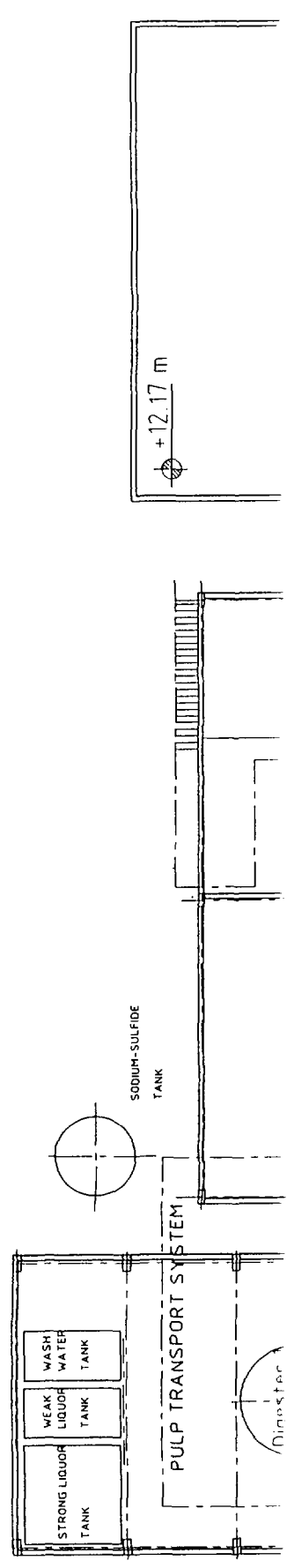
EXISTING PLANT

2		EQUIPMENT ADDED			15.8.97	kn	kr
1		REVISION			15.1.97	kn	kr
Anderung Revision	Anz. d. And. No. of Mod.	Anderungsinhalt Modification			Datum Date	Bearbeitet Made by	Geprüft Checked by
	Datum Date	Name Name		Hersteller/Manufacturer			
Gezeichnet Drawn	29-10-1996	KN		Maßstab/Scale 1:250	Herstellerzeichnungs-Nr./Manufacturer Dwg. No.		
Geprüft Checked	29-10-1996	KR			 IMPCO-VOEST-ALPINE Pulping Technologies GmbH		
Projekt/Customer		Benennung/Title			Masse/Mass		
TRIBENI		RETROFITTING PHASE 2 PULP MILL LAYOUT					
Kunden/Customer-Doc-No.		IVA-Doc-No.			Blatt Sheet	von of	Format Size
		ITC.ZF/ZAL 2001 E					A0
							Anderung Revision
							2

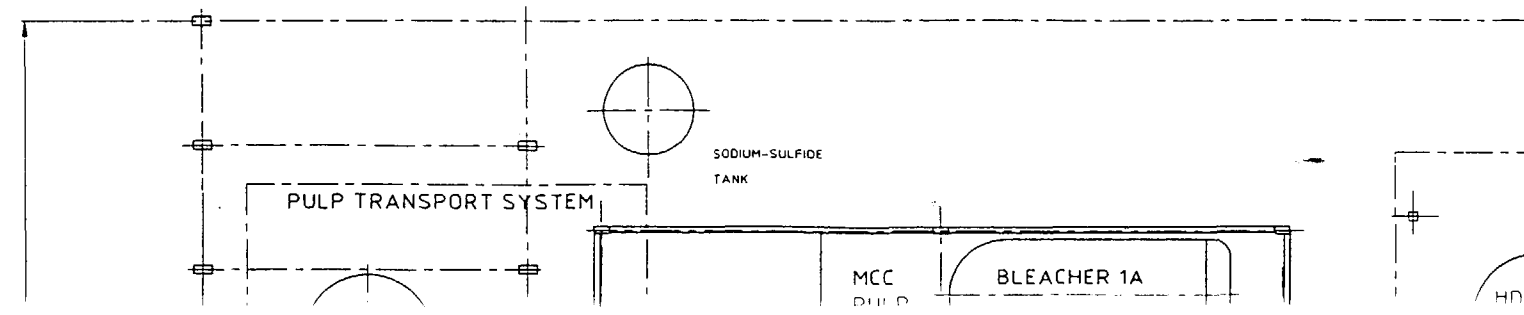
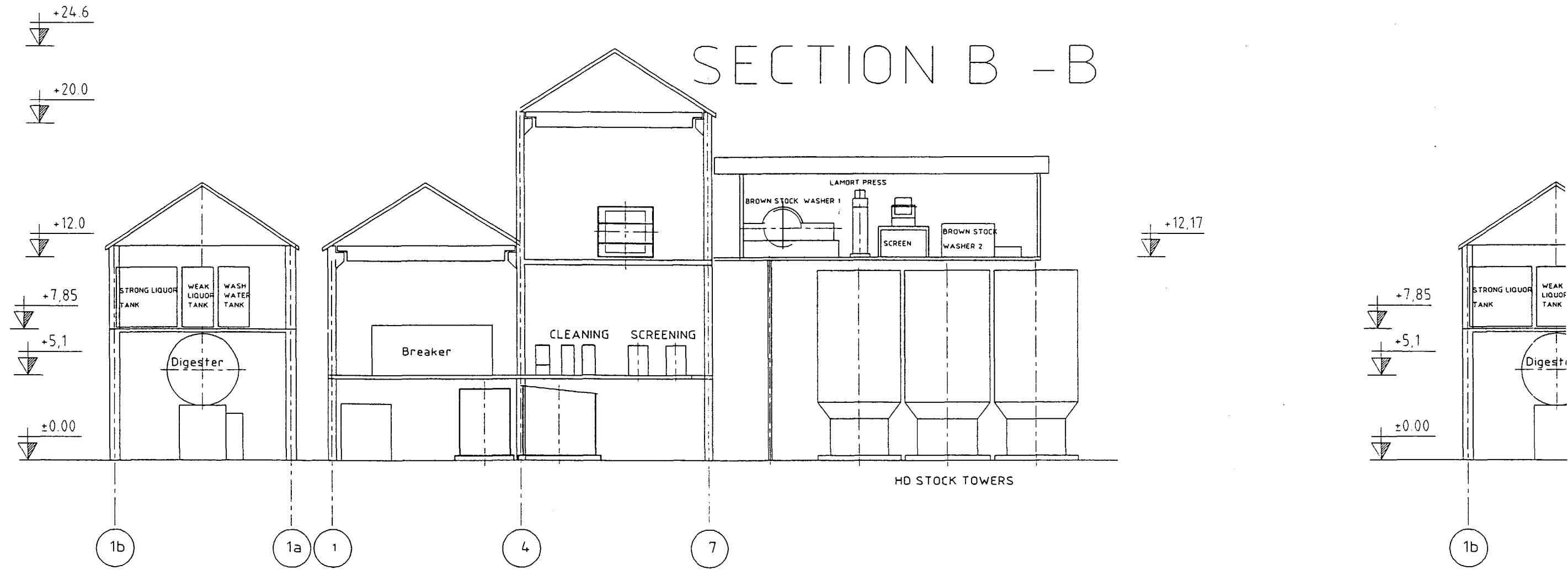
- LAYER 9 EXISTING BUILDING BEAM 1-4
- LAYER 8 EXISTING BREAKER
- LAYER 7 PHASE 2
- LAYER 5 DELETE EXIST CHLOR. & BROWN ST. WASHER
- LAYER 3 DELETE EXIST EQUIPM.
- LAYER 2 NEW EQUIPMENT

11
12
13
14
15
16

B section (1)

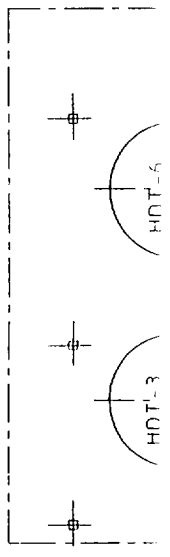
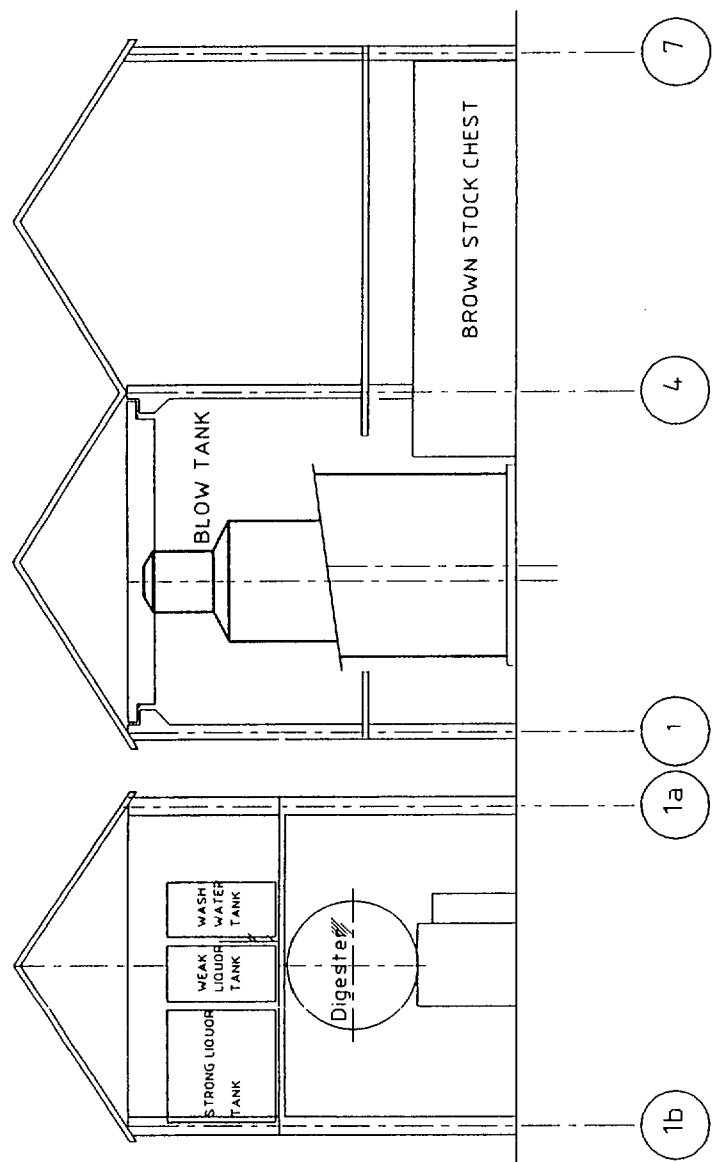


B Section 2



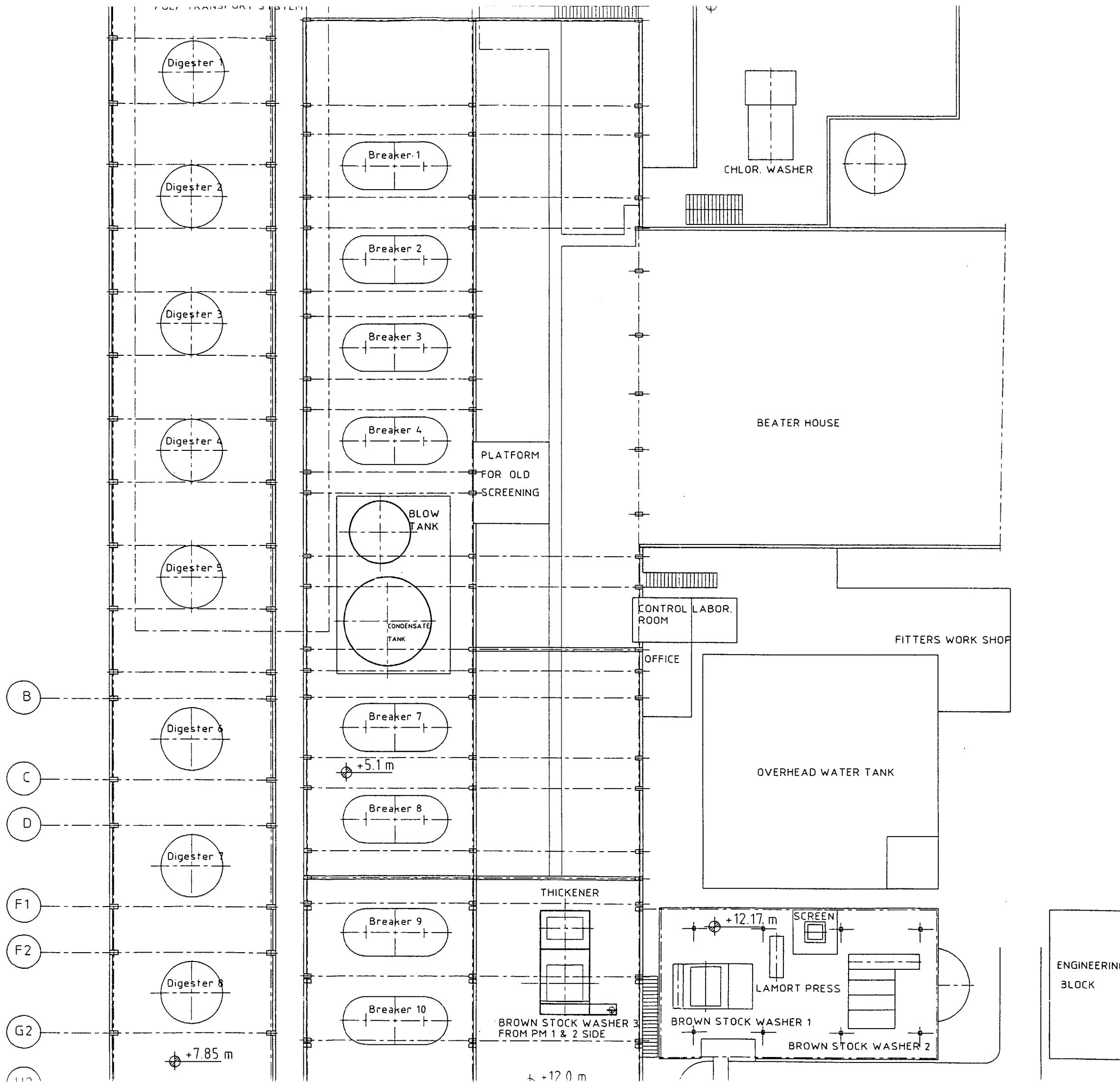
B section ③

SECTION C-C



B Section (4)

H
G
F
E



Digester 1

Digester 2

Digester 3

Digester 4

Digester 5

Digester 6

Digester 7

Digester 8

Breaker 1

Breaker 2

Breaker 3

Breaker 4

BLOW TANK

CONDENSATE TANK

Breaker 7

Breaker 8

Breaker 9

Breaker 10

PLATFORM FOR OLD SCREENING

CONTROL LABOR. ROOM

OFFICE

CHLOR. WASHER

BEATER HOUSE

FITTERS WORK SHOP

OVERHEAD WATER TANK

THICKENER

BROWN STOCK WASHER 3 FROM PM 1 & 2 SIDE

BROWN STOCK WASHER 1

BROWN STOCK WASHER 2

LAMORT PRESS

SCREEN

ENGINEERING BLOCK

+7.85 m

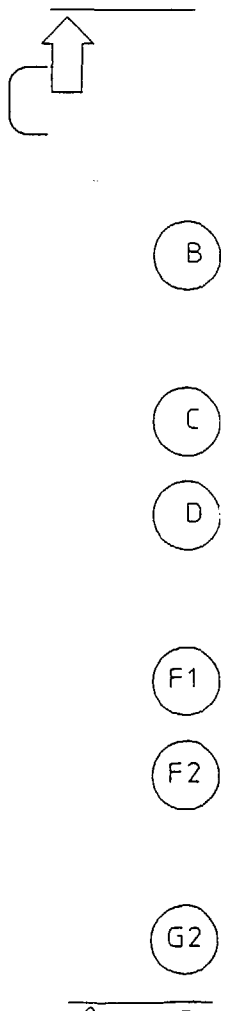
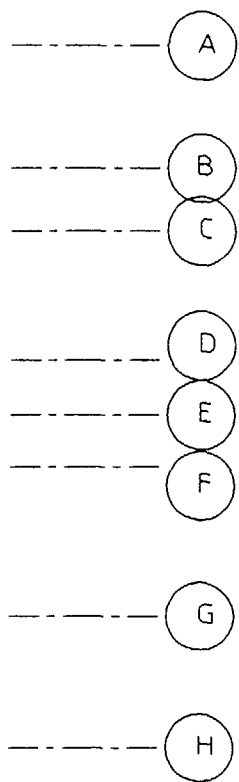
+5.1 m

+12.0 m

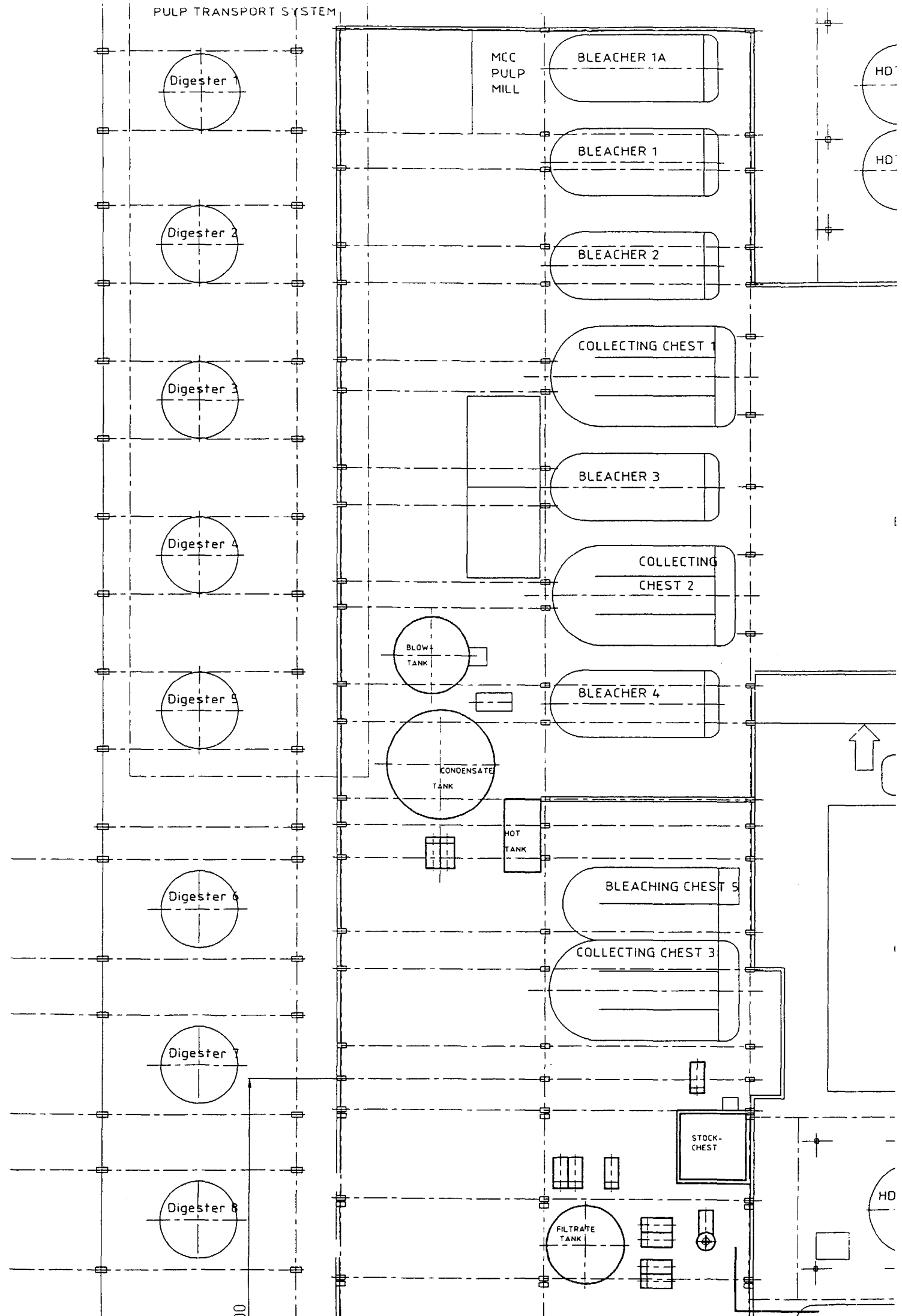
+12.17 m

B SECTION 5

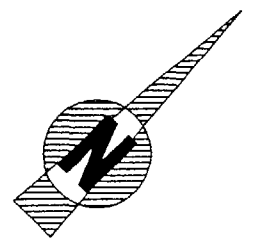
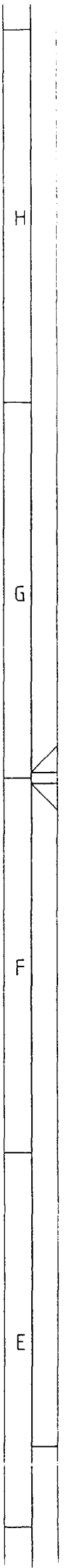
ENGINEERING
BLOCK



78800



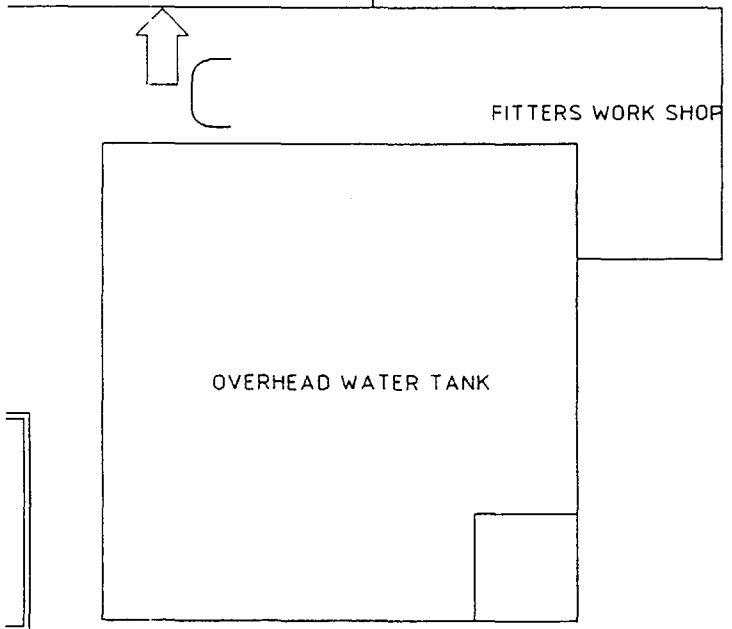
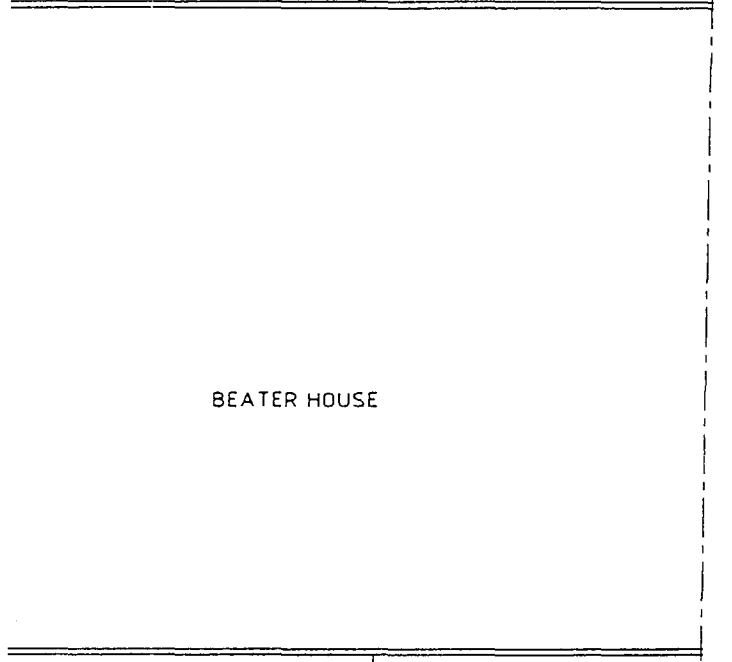
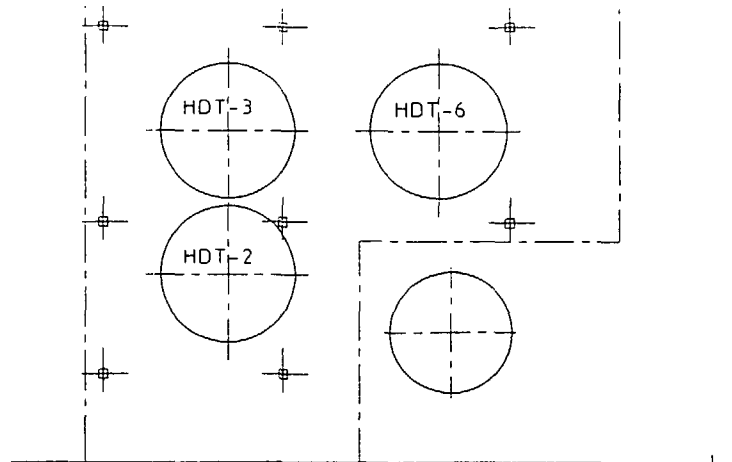
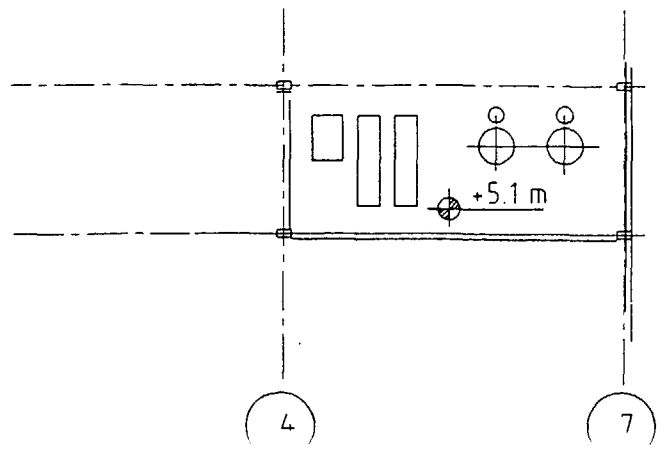
B Section 6



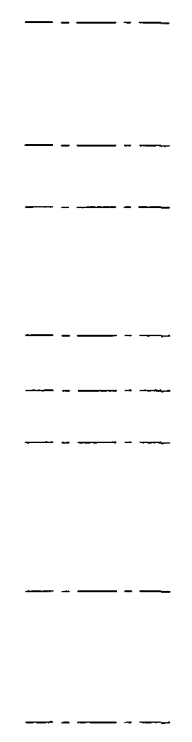
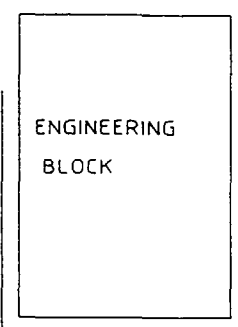
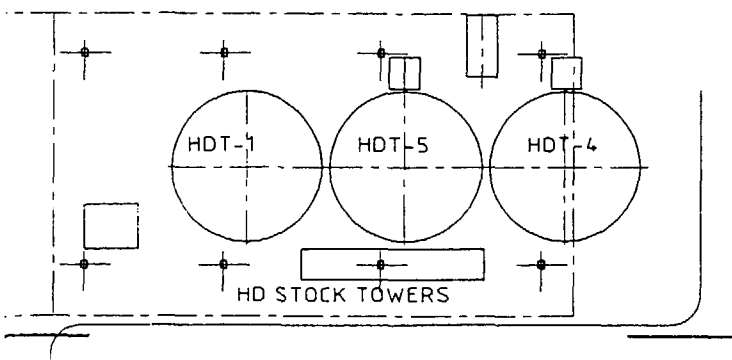
92400

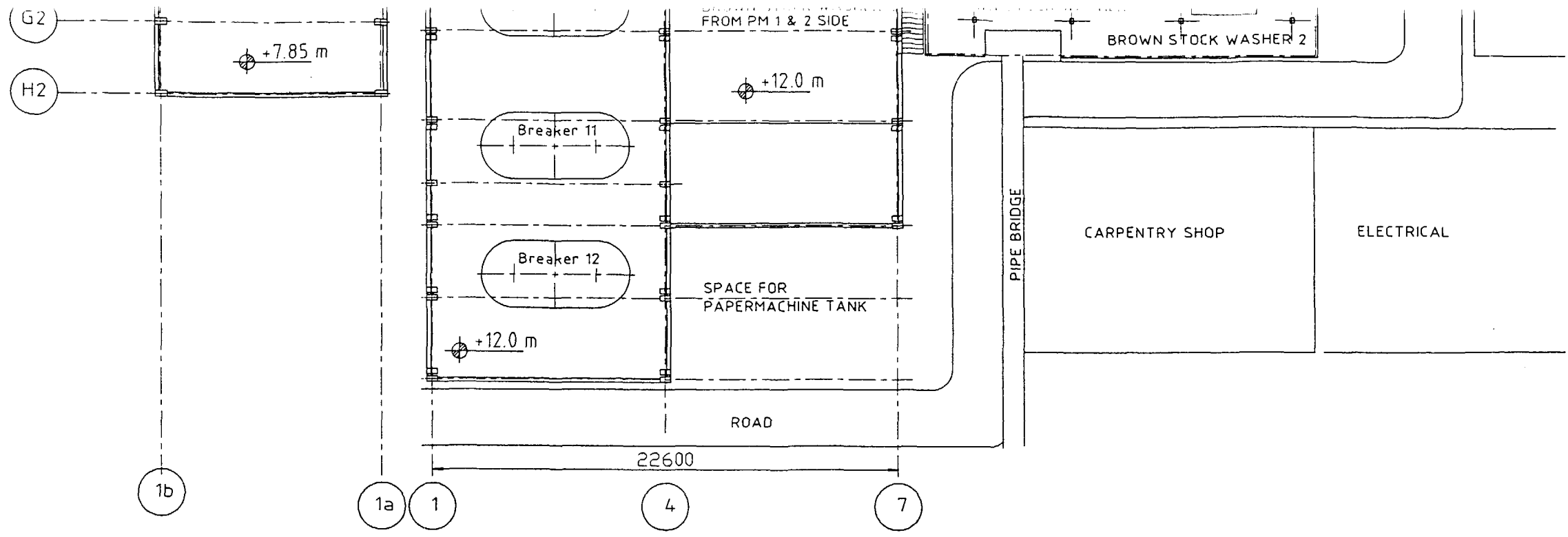
- (A)
- (B)
- (C)
- (D)
- (E)
- (F)
- (G)
- (H)

SCREENING AREA
ELEVATION 5.1 m



FITTERS WORK SHOP





ELEVATION FLOOR +5.1m +7.85

Die unbefugte bzw. bestimmungswidrige Verwendung dieser Unterlage ist nicht gestattet und wird gerichtlich verfolgt.

B
A
Section 7

ACAD - PART:TRIFIB2

16

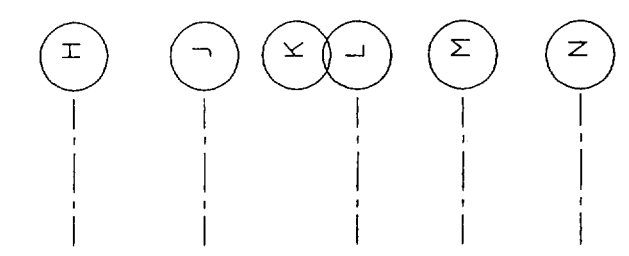
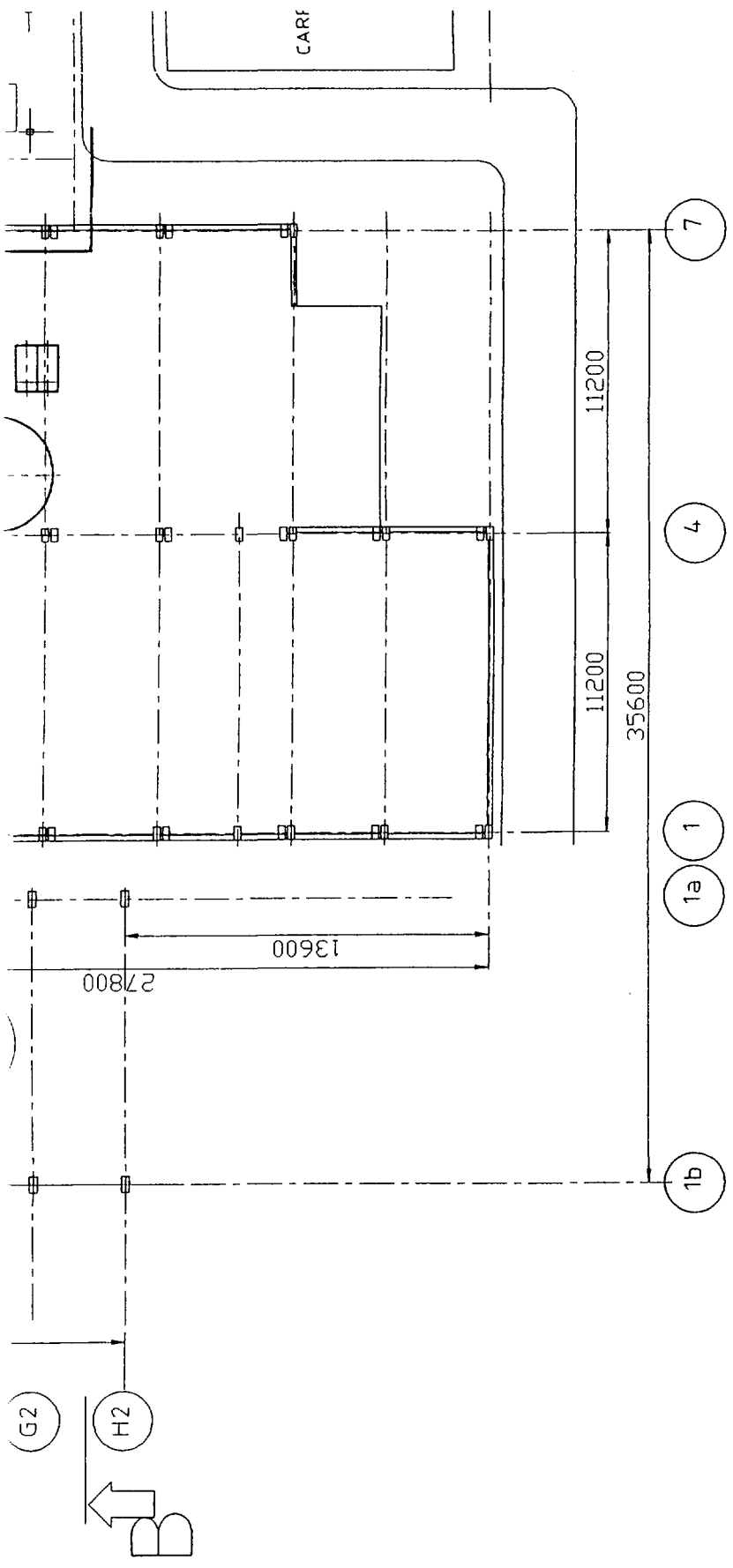
15

14

13

12

11

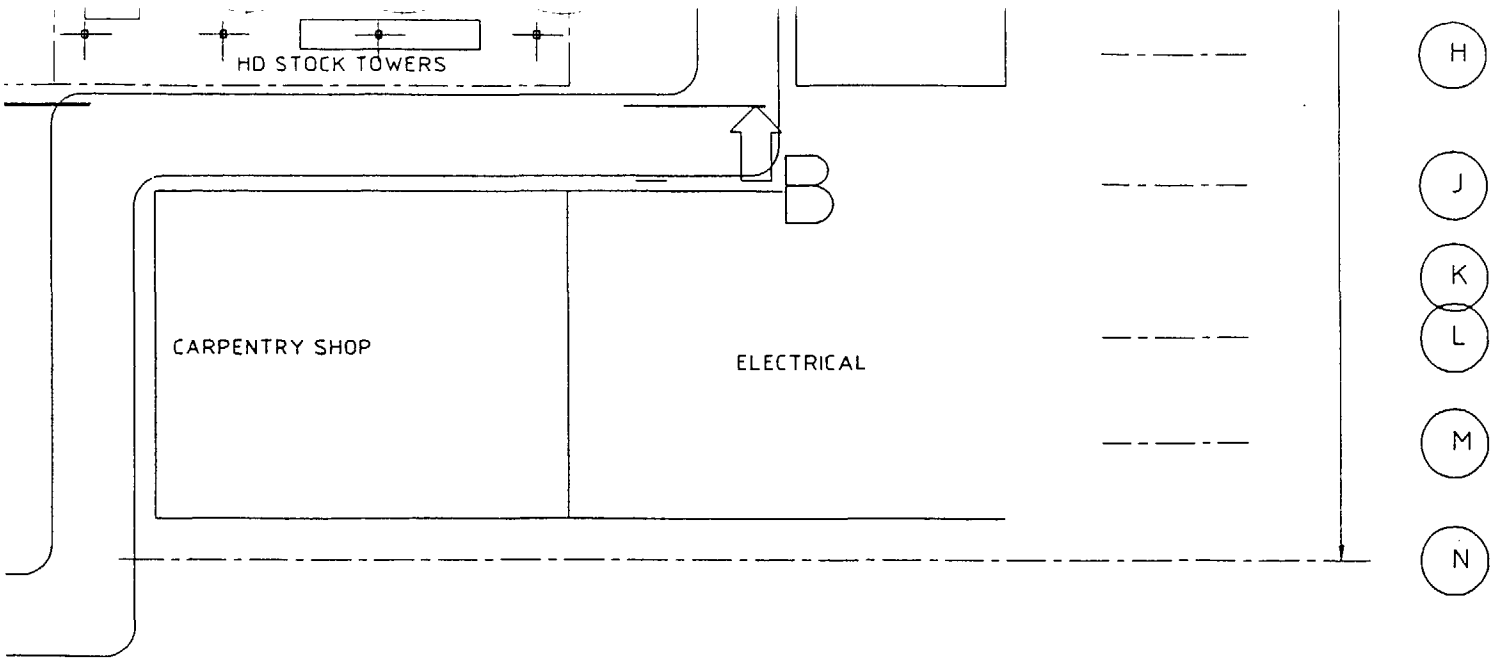


ELEVATION GROUN

7.85m +12.0m +12.17m

B section ⑧



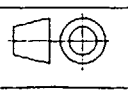



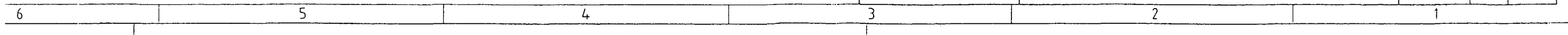
B Section ①

OUND FLOOR

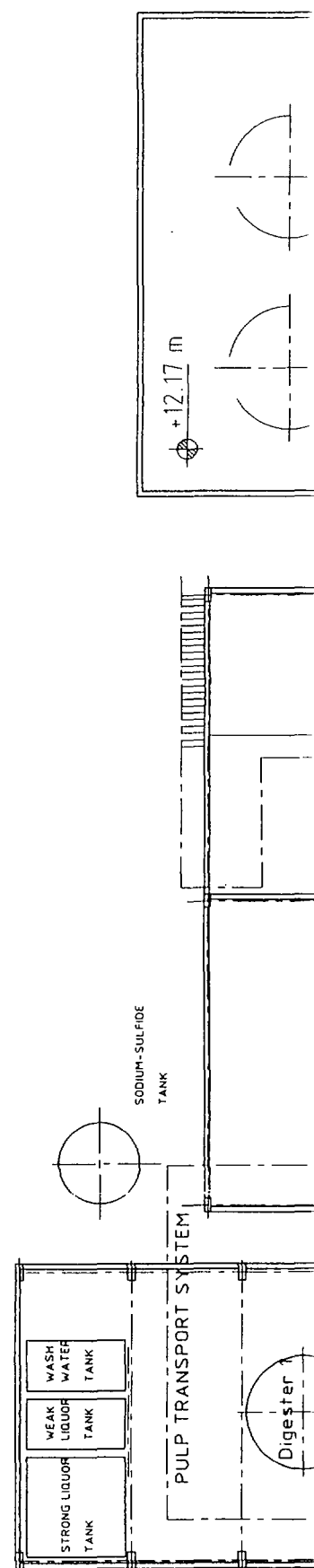
STAGE 1 NEW BLOW TANK, HEAT RECOVERY, WASHING, SCREENING & CLEANING

- LAYER 9 EXISTING BUILDING BEAM 1-4
- LAYER 8 EXISTING BREAKER
- LAYER 7 PHASE 2
- LAYER 5 DELETE EXIST CHLOR. & BROWN ST. WASHER
- LAYER 3 DELETE EXIST EQUIPM.
- LAYER 2 NEW EQUIPMENT

2		EQUIPMENT UPDATED		15.8.97	kn	kr	
1		REVISION		15.1.97	kn	kr	
Änderung Revision	Anz. d. Änd. No. of Mod.	Änderungsinhalt Modification		Datum Date	Bearbeitet Made by	Geprüft Checked by	
	Datum Date	Name Name		Hersteller/Manufacturer		 IVA IMPCO-VOEST-ALPINE Pulping Technologies GmbH	
Gezeichnet Drawn	29-10-1996	KN		Maßstab/Scale	Herstellerzeichnungs-Nr./Manufacturer Dwg. No.		
Geprüft Checked	29-10-1996	KR			1:250		
Projekt/Customer		Benennung/Title			Masse/Mass		
TRIBENI		RETROFITTING PHASE 2 PULP MILL LAYOUT					
Kunden/Customer-Doc-No.:		IVA-Doc-No.:			Blatt Sheet	von of	
		ITC.ZF/ZAL 2002 E			Format Size	Änderung Revision	
					A0	2	

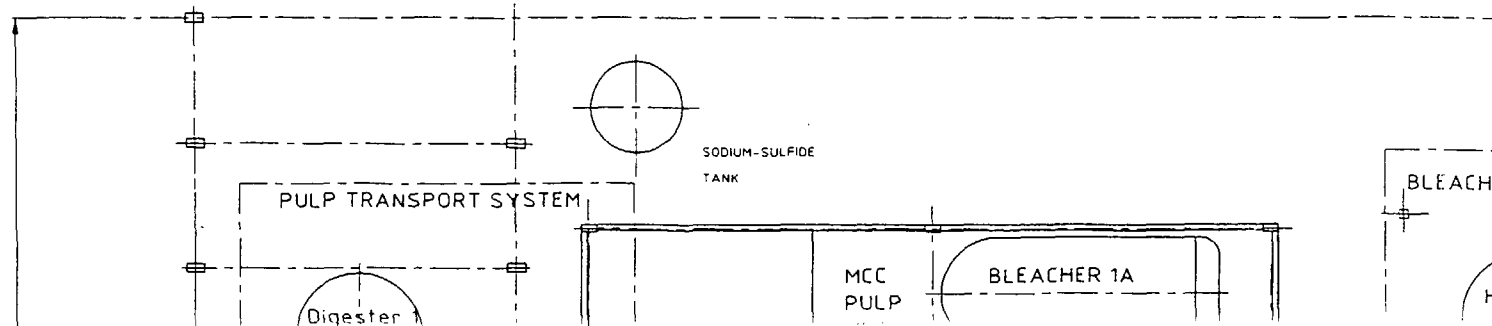
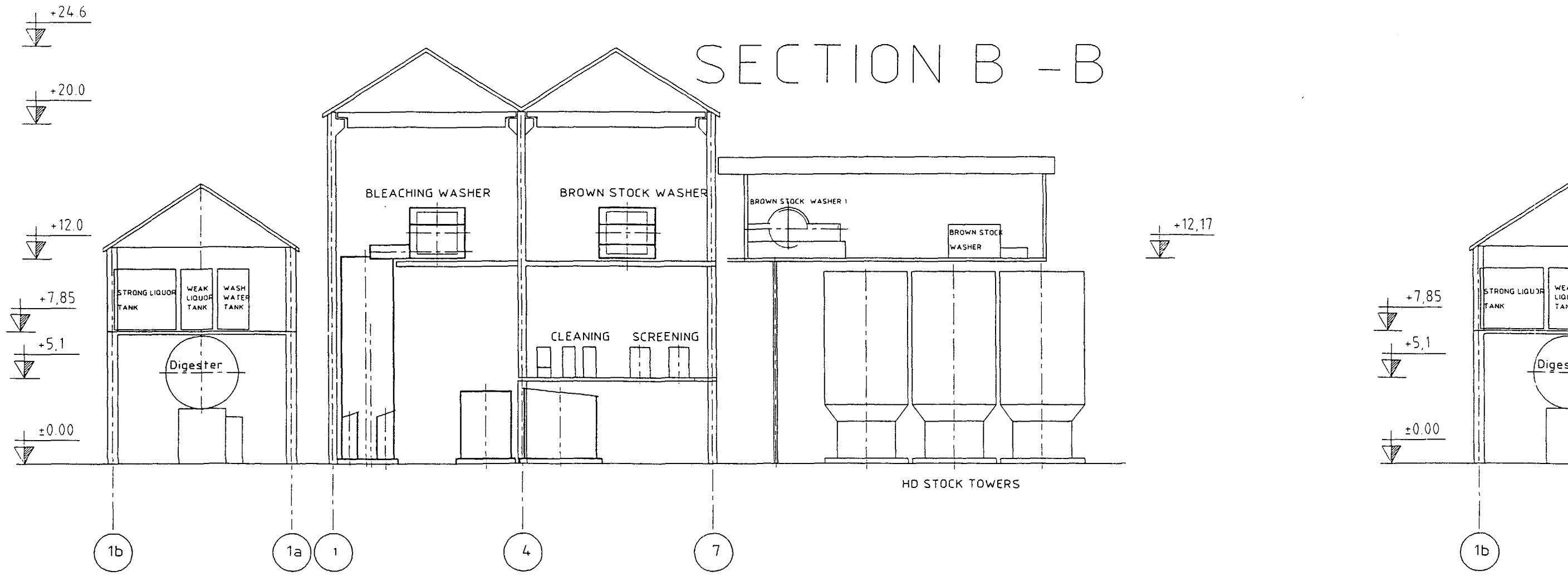


C section ①



Section 2

SECTION B - B



6

5

4

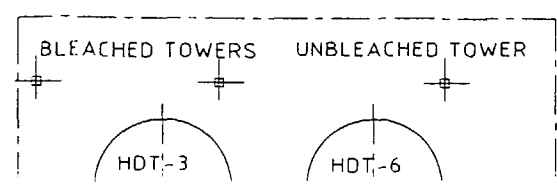
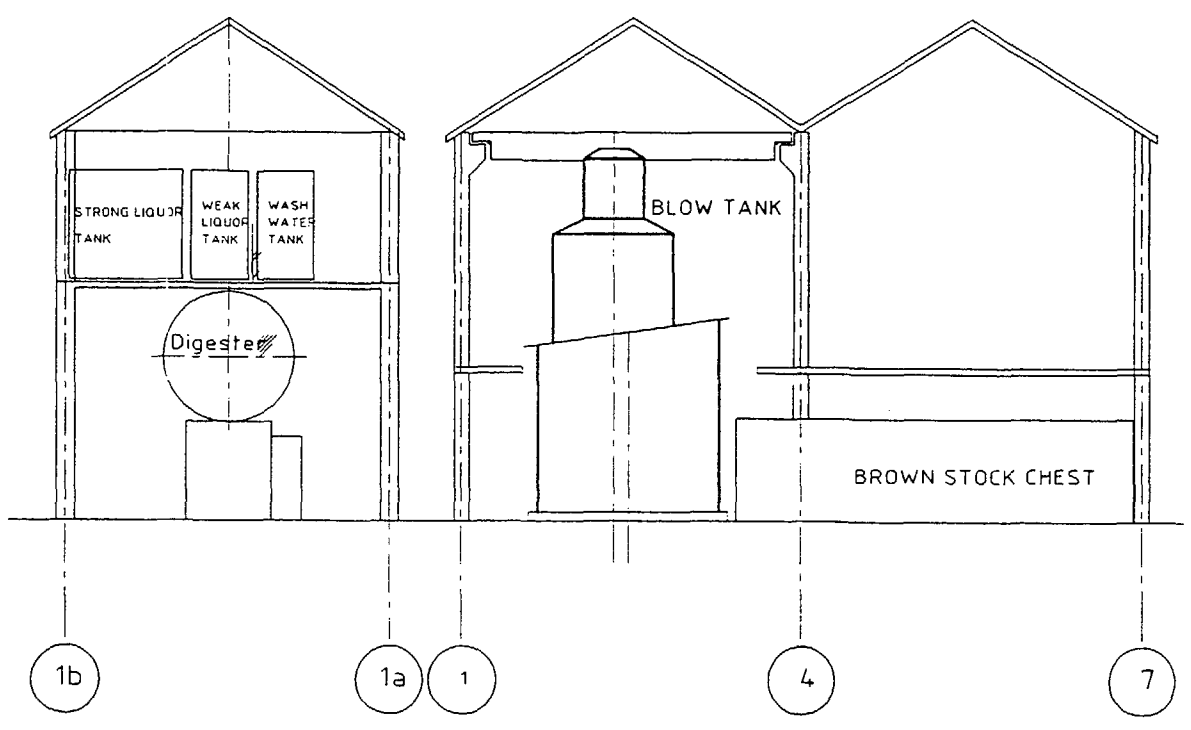
3

2

1

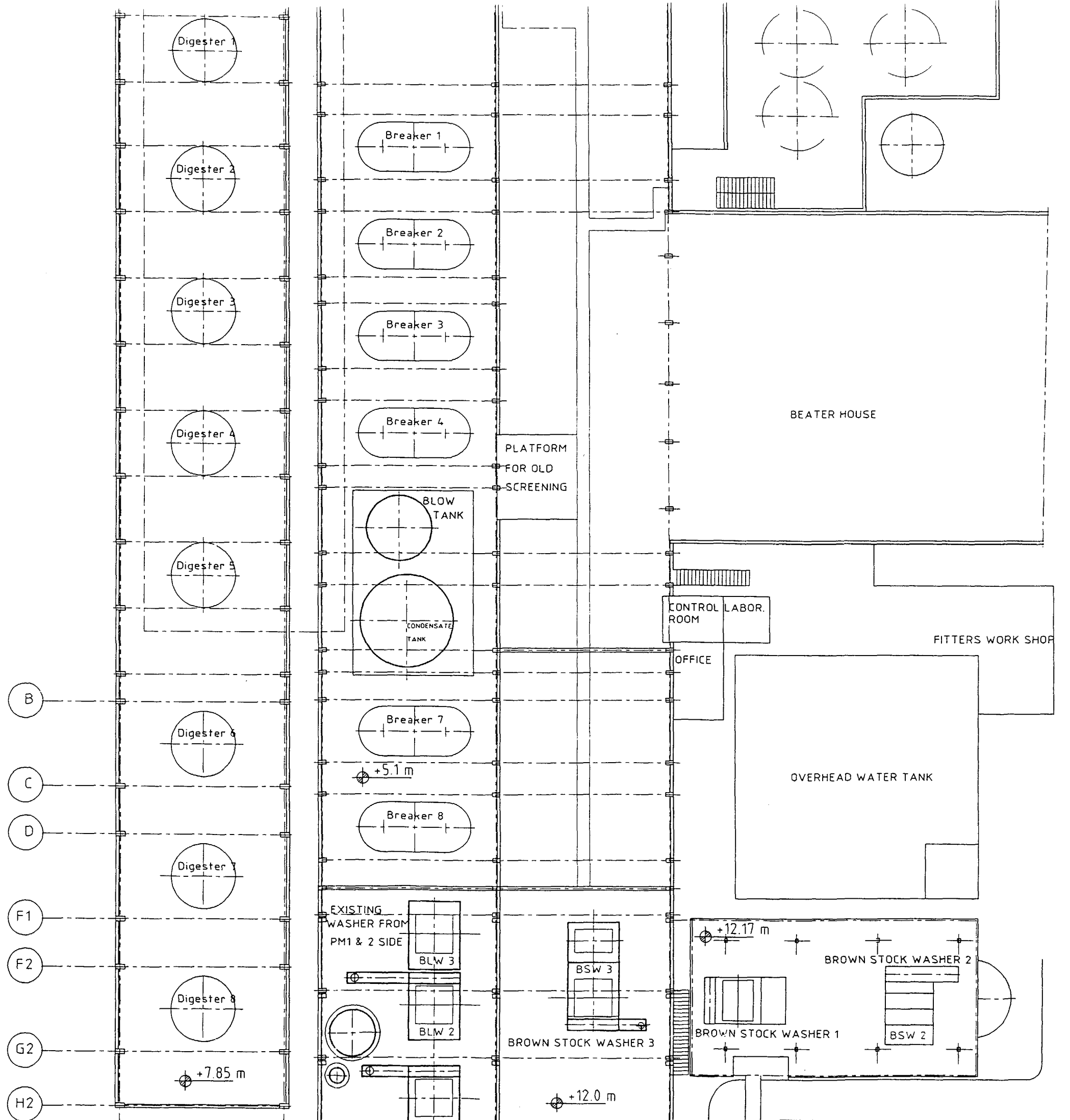
SECTION C-C

C Section 3



C Section 4

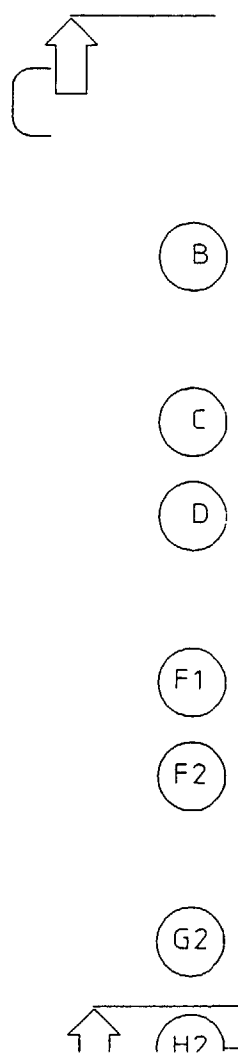
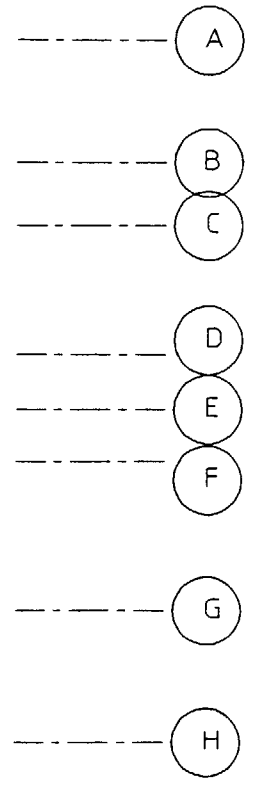
H
G
F
E



ENGINEERIN
BLOCK

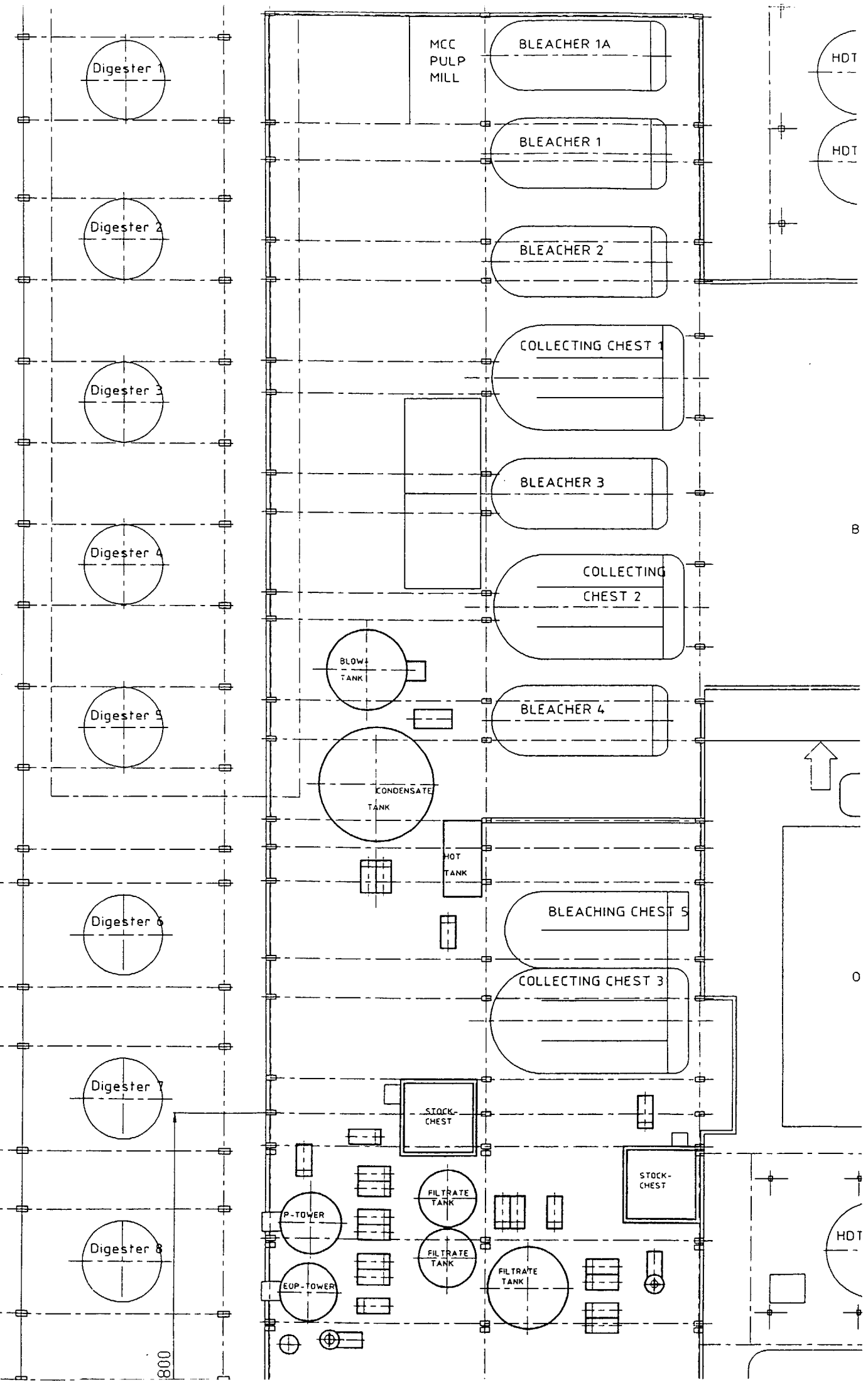
C Section 5

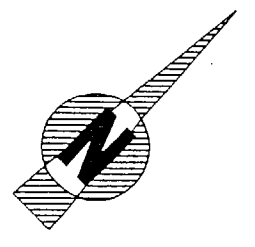
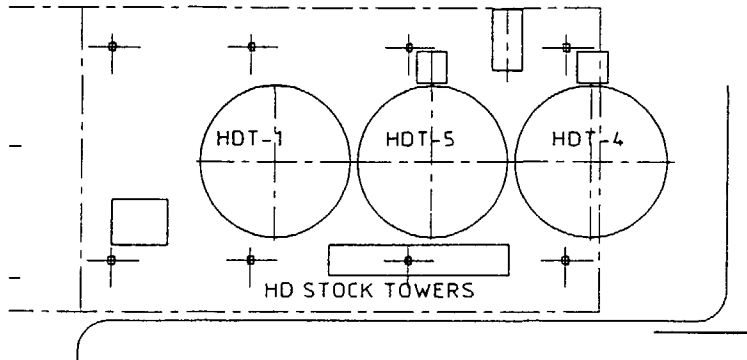
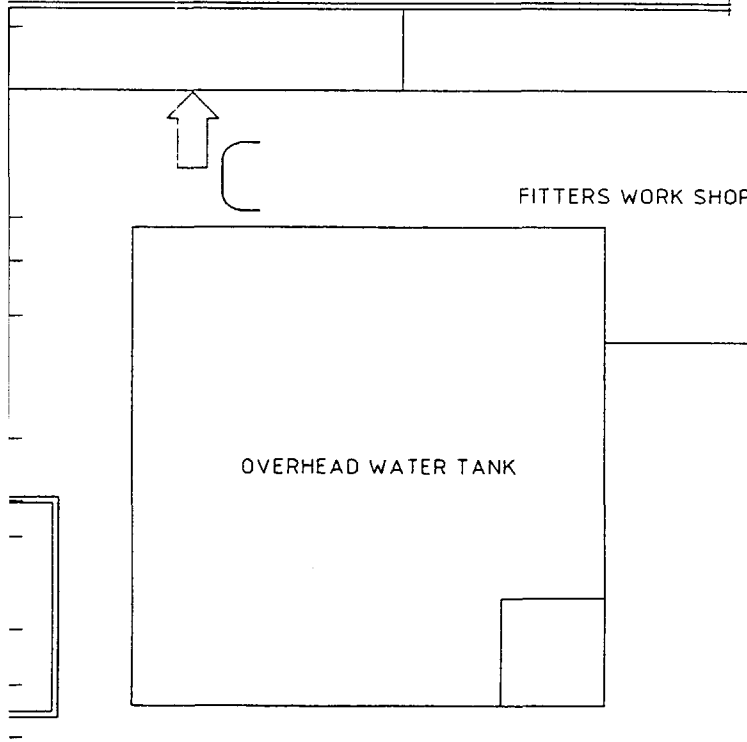
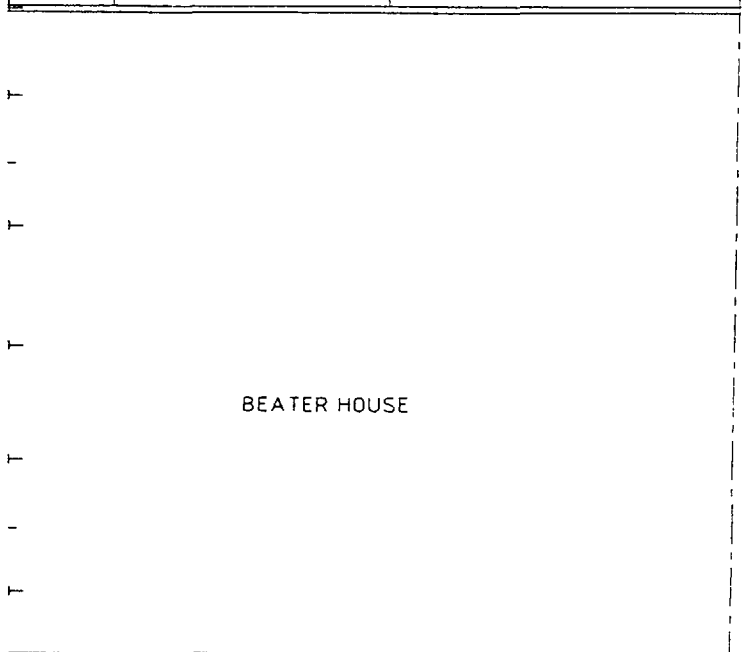
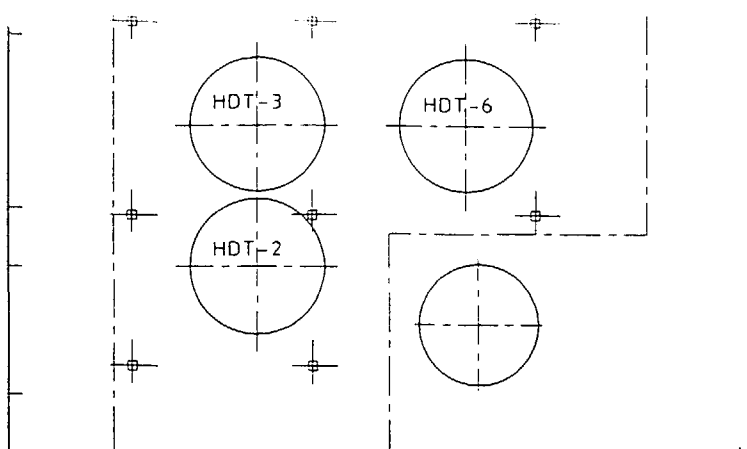
ENGINEERING
BLOCK



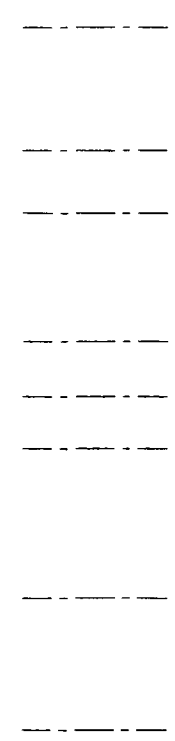
78800

800



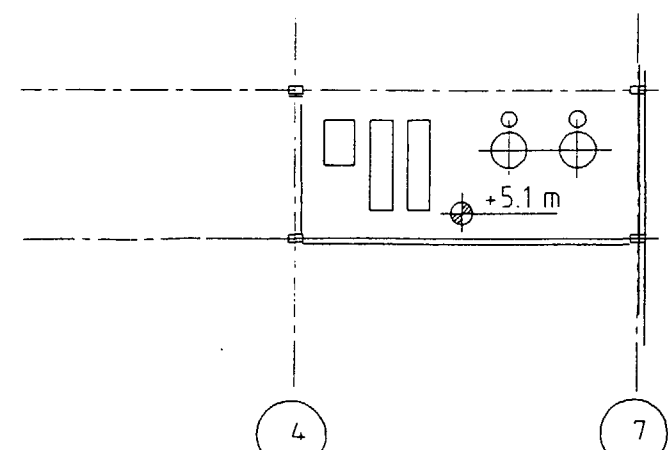


92400



- (A)
- (B)
- (C)
- (D)
- (E)
- (F)
- (G)
- (H)

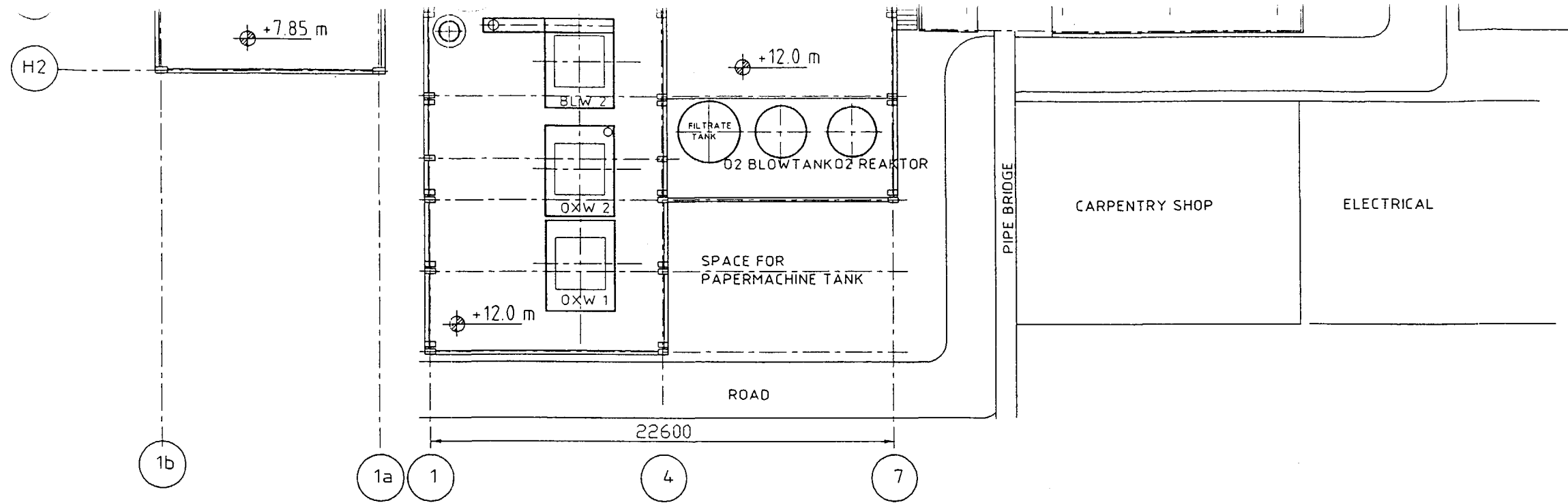
SCREENING AREA
ELEVATION 5.1 m



Section 6

H
G
F
E

Die unbefugte bzw. bestimmungswidrige
Verwendung dieser Unterlage ist nicht
gestattet und wird gerichtlich verfolgt.



ELEVATION FLOOR +5.1m +7.85m

C
Section 7

ACAD - PART:TRIFIB3

16

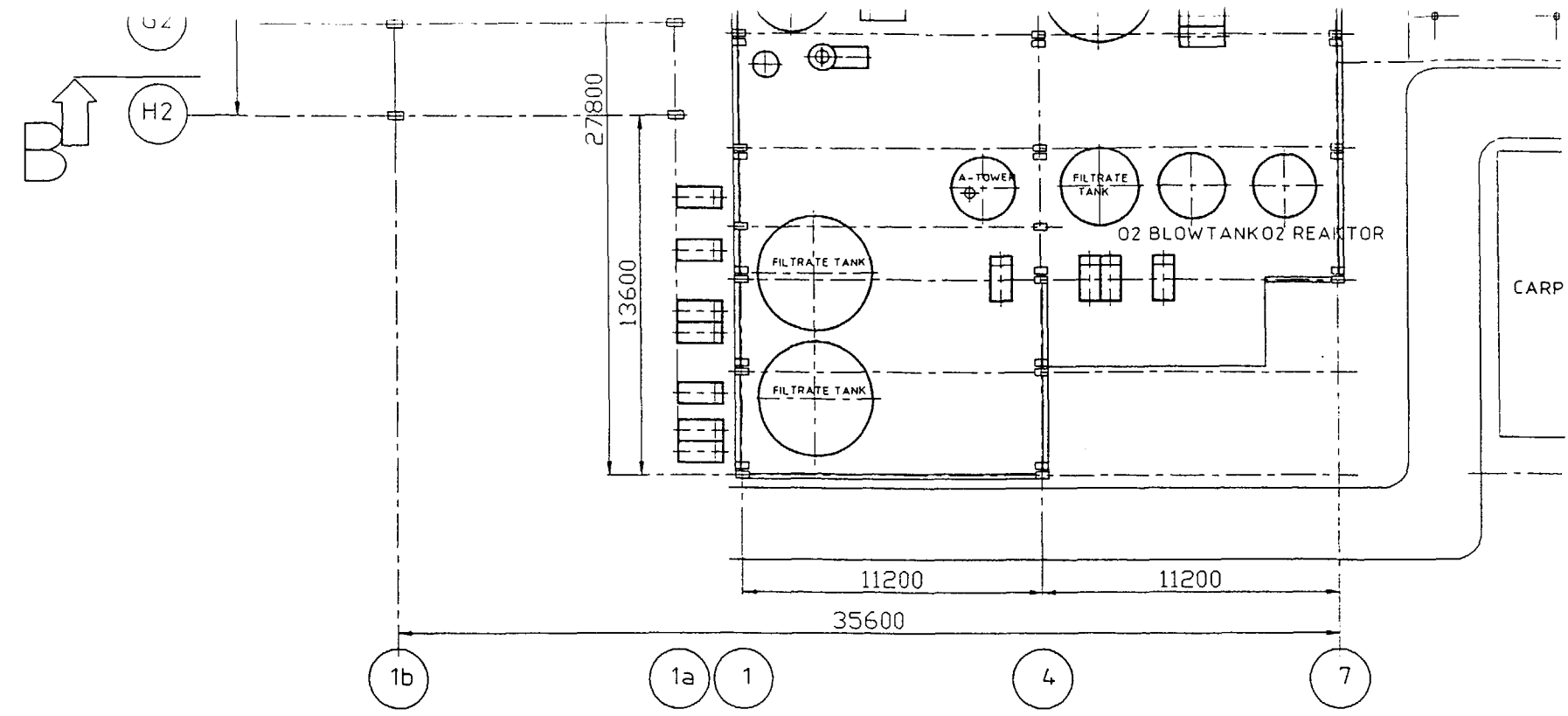
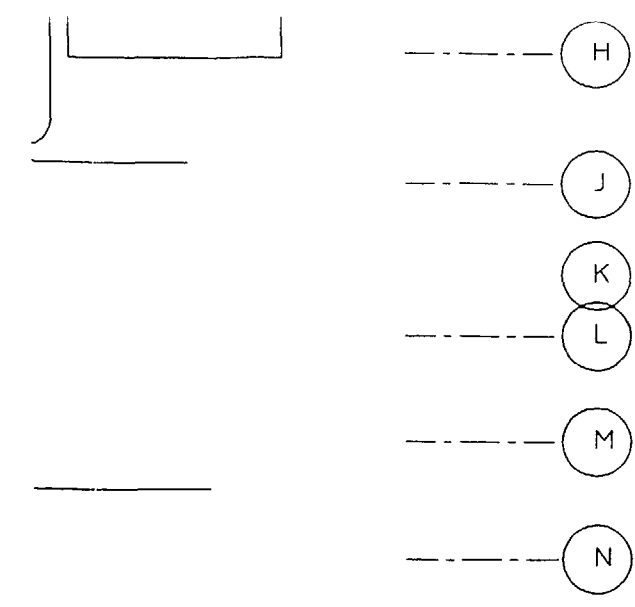
15

14

13

12

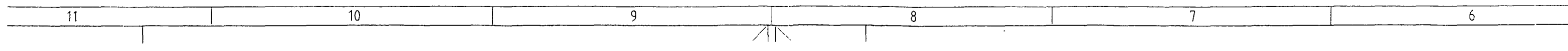
11

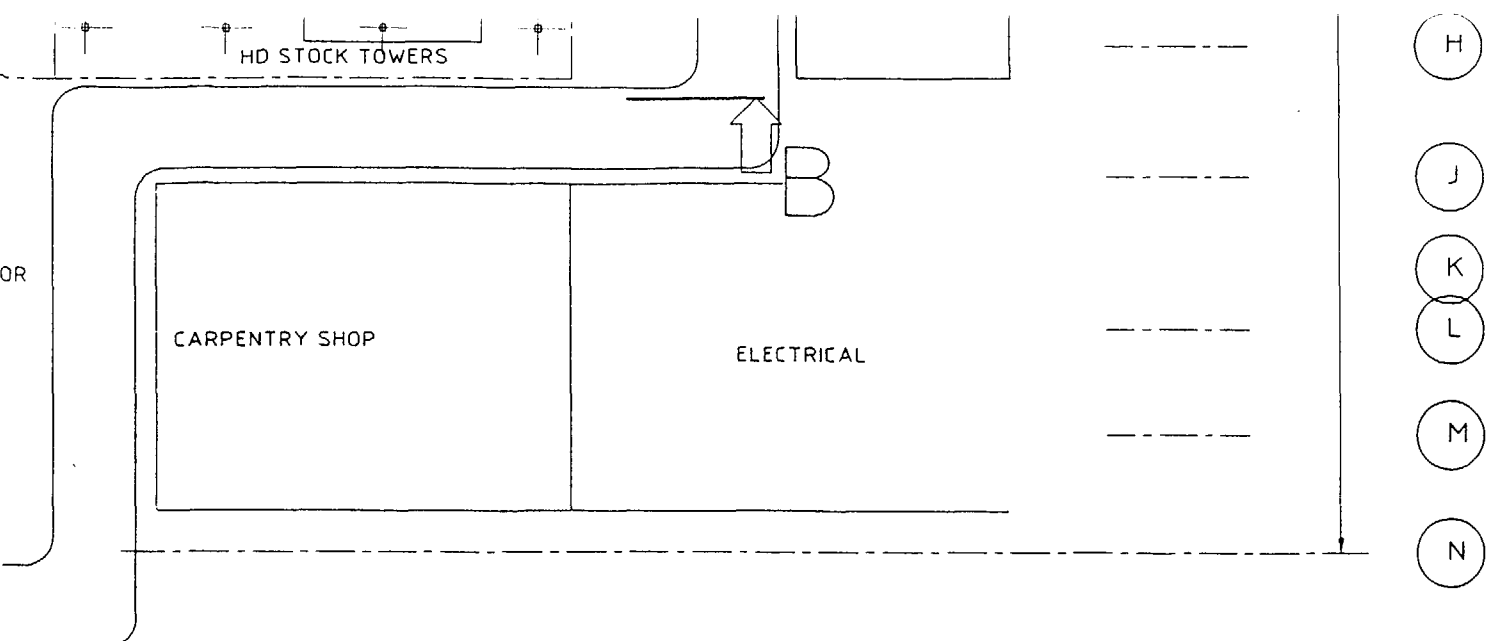


7.85m + 12.0m + 12.17m

ELEVATION GROUND

C Section ⑧





Section 9

OUND FLOOR

STAGE 2 NEW OXYGEN DELIGNIFICATION & BLEACHING

- LAYER 9 EXISTING BUILDING BEAM 1-4
- LAYER 8 EXISTING BREAKER
- LAYER 7 PHASE 2
- LAYER 5 DELETE EXIST CHLOR. & BROWN ST WASHER
- LAYER 3 DELETE EXIST EQUIPM.
- LAYER 2 NEW EQUIPMENT

2		EQUIPMENT UPDATED		20.8.97	kn	kr
1		REVISION		15.1.97	kn	kr
Änderung Revision	Anz. d. Änd. No. of Mod.	Änderungsinhalt Modification		Datum Date	Bearbeiter Made by	Geprüft Checked by
	Datum Date	Name Name		Hersteller/Manufacturer		
Gezeichnet Drawn	29-10-1996	KN		Herstellerzeichnungs-Nr./Manufacturer Dwg. No.		
Geprüft Checked	29-10-1996	KR	Maßstab/Scale 1:250	 IMPCO-VOEST-ALPINE Pulping Technologies GmbH		
Projekt/Customer		Benennung/Title			Masse/Mass	
TRIBENI		RETROFITTING PHASE 2 PULP MILL LAYOUT			Werkstoff/Material	
Kunden/Customer-Doc-No.:		IVA-Doc-No.:		Blatt Sheet	von of	Format Size
		ITC.ZF/ZAL 2003 E				A0
						Änderung Revision
						2

