“PROCESS TECHNOLOGIES FOR MAXIMUM CO-GENERATION”

Presented by :

ISGEC JOHN THOMPSON, INDIA

At: ISSCT Factory Workshop, Gold Coast, Australia

8-12 May , 2011



website :www.isgecgroup.com

Sanjay Awasthi
Senior Vice President
Email : sanjayawasthi@ijt.co.in

- We all are aware that, in today's context, there is no substitute for renewable energy generation. The available non-renewable energy resources are inadequate to meet the growing power demand.

- For maximizing cogeneration, role of energy conservation is very important for saving of energy in terms of steam, bagasse and power.

- Maximum Co-generation is possible through adoption of energy and steam saving technologies in the sugar plant.

We are designing, supplying & erecting 24000 TCD process house at White Nile Sugar Company, Sudan. This plant is designed with most modern technologies and automation at 30 % on cane steam consumption for maximizing co-generation and producing white sugar of 60-65 ICUMSA with out refinery process to making it more cost effective.

Overview of Plant

Project	White Nile Sugar Company, Sudan
Capacity	24000 TCD
Process	Defecation process followed by filtrate clarification system and micro filtration of filtrate to bring it in direct clear juice, Syrup clarification followed by multi-bed filter and syrup sulphitation, low grade sugar melt clarification system
Final Product	White sugar of 60-65 ICUMSA
Steam Consumption	30.0 % on cane

ISGEC GROUP
Celebrating 75 YEARS
www.isgec.com

ISGEC John Thompson

ISGEC GROUP

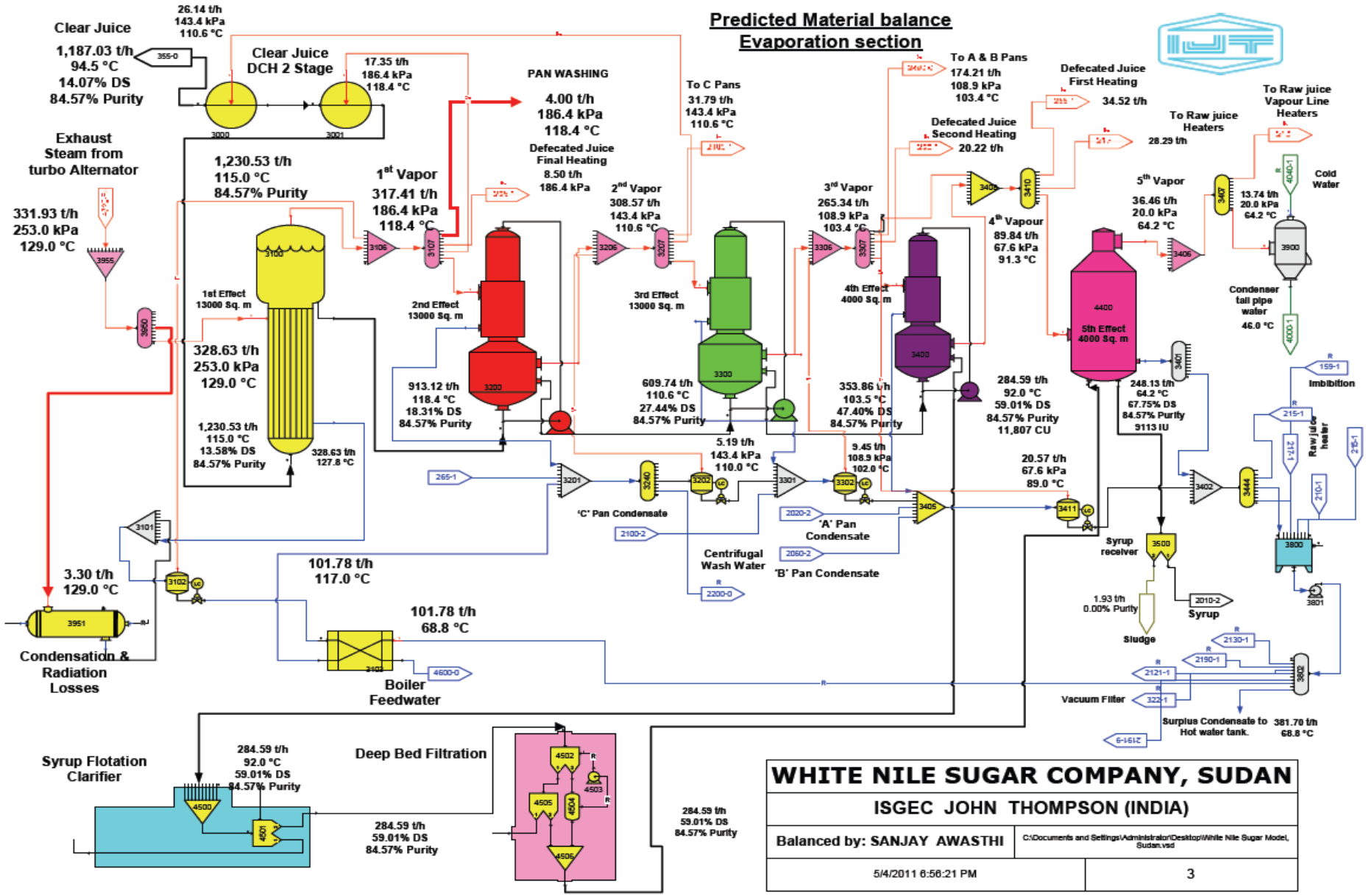
Steam Energy Saving Devices

The following Steam Energy saving Devices are adopted to reduce steam consumption:

- **Condensate flash recovery system**
- **Melting and molasses conditioning using noxious gases**
- **Avoiding syrup heating in syrup clarification**
- **Direct contact juice heaters**
- **Continuous vacuum pans**
- **Falling film evaporator**
- **Quintuple evaporator configuration**
- **Extensive bleeding scheme**

Celebrating 75 YEARS

www.isgec.com



WHITE NILE SUGAR COMPANY, SUDAN	
ISGEC JOHN THOMPSON (INDIA)	
Balanced by: SANJAY AWASTHI	C:\Documents and Settings\Administrator\Desktop\White Nile Sugar Model, Sudan.vsd
5/4/2011 6:56:21 PM	3

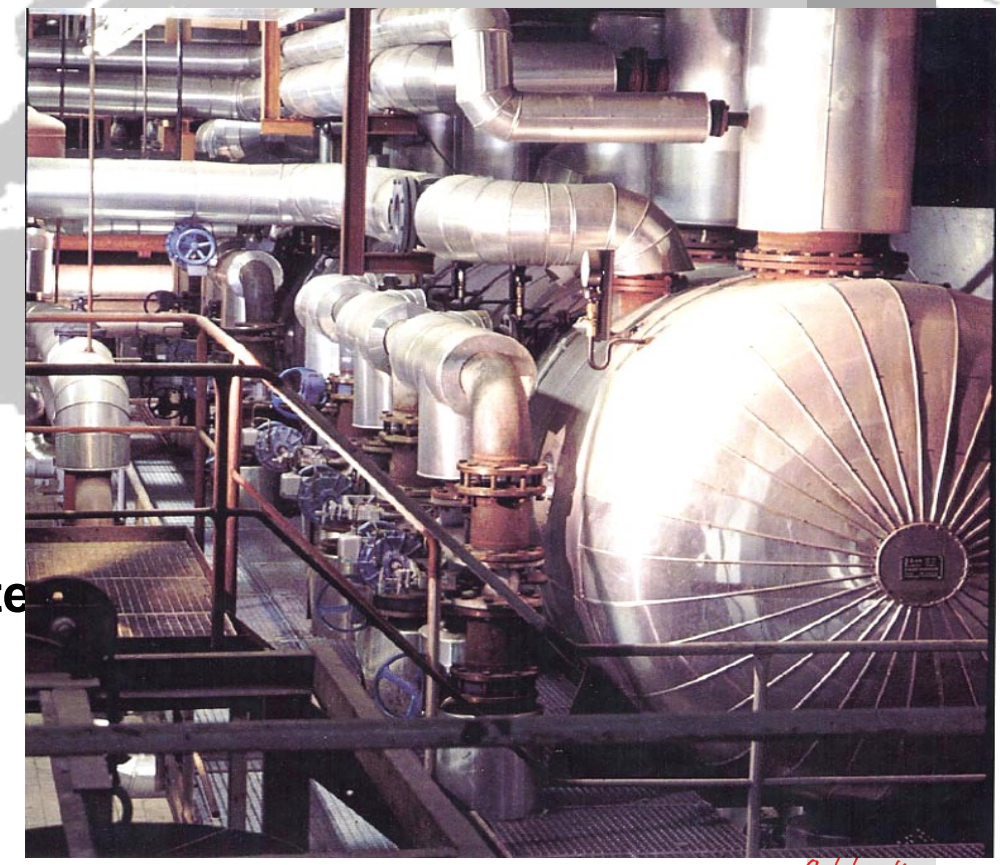
Power Energy Saving Devices

The following Power Energy saving Devices are adopted to reduce power consumption:

- **Use of Variable Frequency drives on**
  - ✓ Air compressors
  - ✓ All pumps for Juice, Molasses, Massecuite where flow regulation is required
  - ✓ Injection pumps and spray pumps
- **Use of Planetary Gears on**
  - ✓ Crystallizers
  - ✓ Pug mill & Magma mixers
  - ✓ Sugar Melter
- **Power saving in Cooling and Condensing system**
  - ✓ Multi-jet condensers
  - ✓ Automation in cooling and condensing system to reduce water requirement

Condensate flash vessel

- ✓ Recovers the heat from various condensate streams of Evaporator sets, Pans and heaters
- ✓ Reduces steam consumption by 2-2.5 % on cane
- ✓ Eliminates several condensate pumps i.e. power saving



ISGEC John Thompson

ISGEC GROUP

Molasses Conditioner

- ✓ Utilization of Noxious Gases
- ✓ Reduces steam consumption
- ✓ Inbuilt static mixer; no mechanical agitation
- ✓ Installation on pan floor
- ✓ No cleaning required
- ✓ No water required for conditioning



Celebrating 75 YEARS

www.isgec.com

ISGEC John Thompson

ISGEC GROUP

Molasses Conditioner



Celebrating 75 YEARS

www.isgec.com

Sugar Melter

- ✓ Utilization of Noxious gases
- ✓ Sugar Melter is a low retention device which operates at 70-85 deg C temperature.
- ✓ Horizontal shaft is driven by efficient & compact planetary drive



ISGEC John Thompson

ISGEC GROUP

Direct contact heater for juice heating

- ✓ Low capital cost
- ✓ Operates at very low approach temp.-1.5-2.0 deg C
- ✓ Eliminate juice heater cleaning
- ✓ Low maintenance cost
- ✓ Ease of control



Celebrating 75 YEARS

www.isgec.com

ISGEC GROUP

Continuous Vacuum Pan for Massecuite Boiling

- ✓ Uniform Crystal growth in CVP
- ✓ Provides flexibility of operation with minimum operators
- ✓ Low Massecuite boiling head helps to run by V3 vapour
- ✓ Under-base heating helps to promote circulation and prevent crystallisation on the shell

ISGEC John Thompson

ISGEC GROUP

Continuous vacuum pan



Celebrating 75 YEARS

www.isgec.com

Falling film evaporator

- ✓ Falling film evaporator are used at 2nd, 3rd and 4th effect.
- ✓ Low juice residence time in falling film helps in less sucrose destruction and color formation.
- ✓ Falling film evaporator works on very less delta T

ISGEC John Thompson

Falling film evaporator



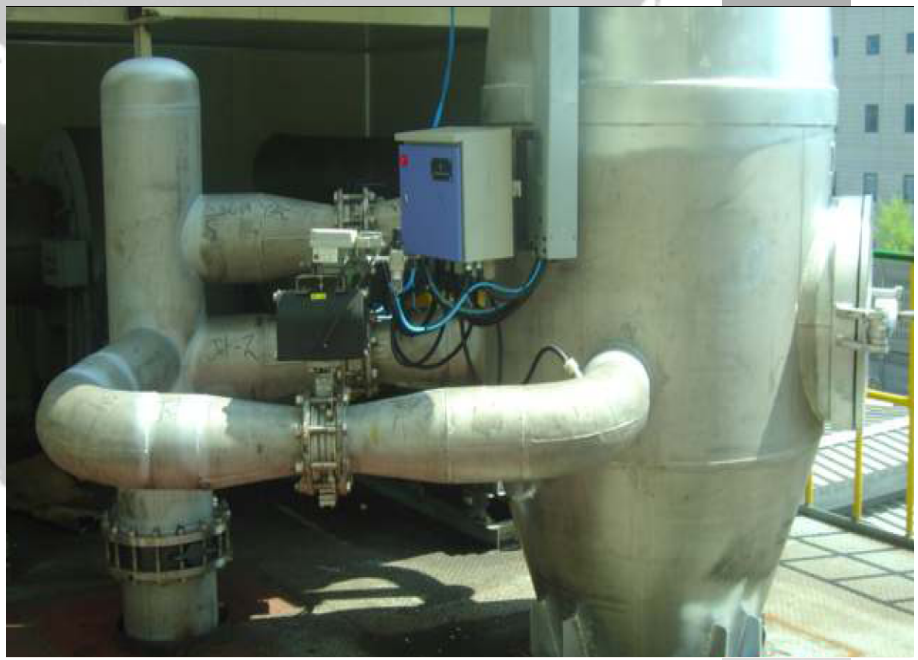
ISGEC GROUP

Celebrating 75 YEARS

www.isgec.com

Multi-jet Condenser

- ✓ Spray Nozzles Condense vapour
- ✓ Jet nozzles increase momentum of water flow in the tailpipe venturi to evacuate air bubbles trapped in the system
- ✓ Water required is only 40 kg/kg vapours
- ✓ Automation further reduces need of water



Celebrating
75 YEARS
www.isgec.com

ISGEC GROUP

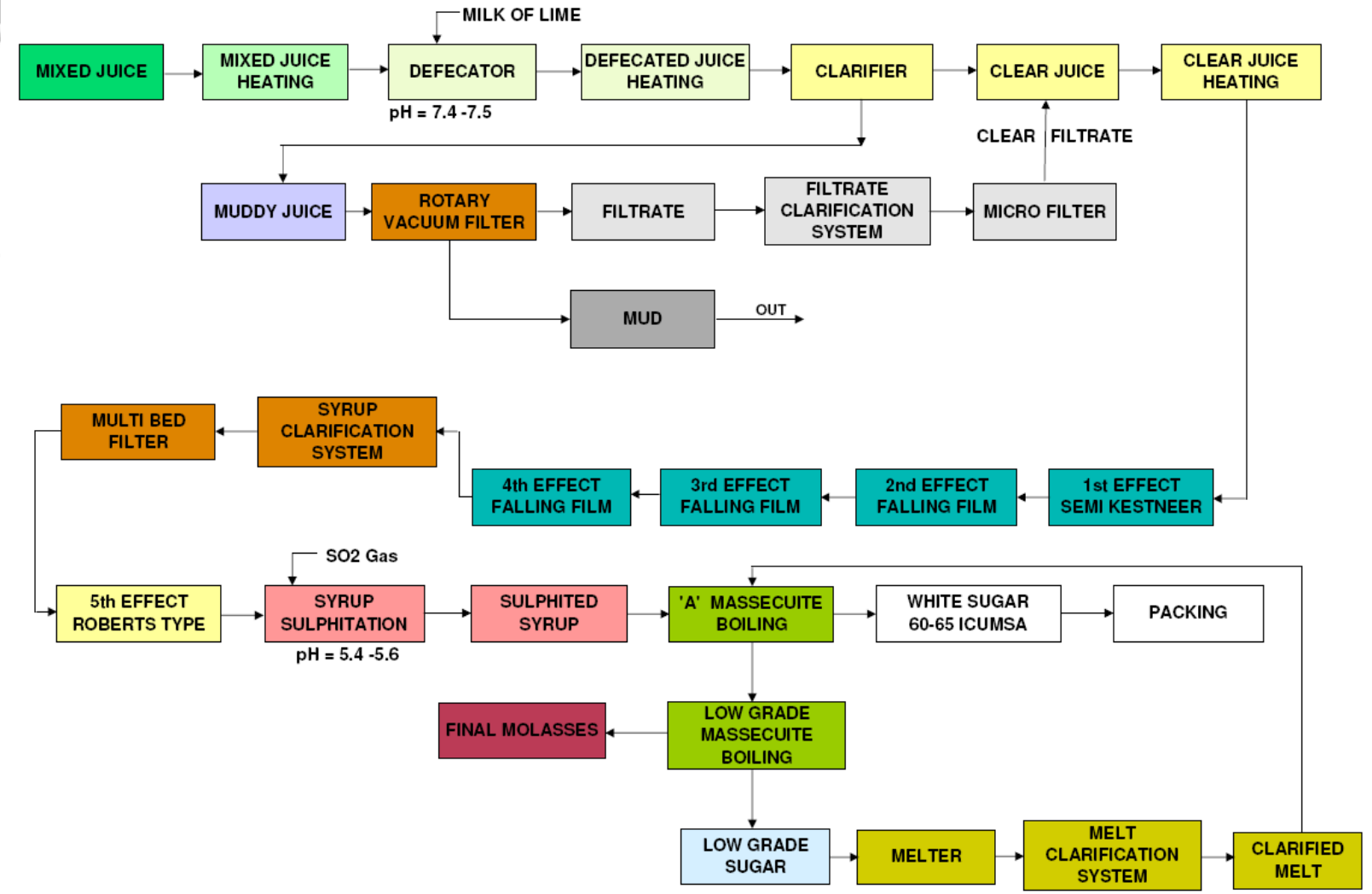
Selection of Process

- ✓ For juice clarification, defecation process is adopted to reduce Sulphur content in sugar and scaling in evaporator.
- ✓ For achieving sugar quality as per international standards, syrup clarification followed by multi-bed filter and syrup sulphitation, filtrate clarification followed by micro filtration of filtrate to bring it in clear juice & low grade sugar melt clarification system is adopted for decolorization of juice .
- ✓ Specially designed boiling scheme helps to reduce final molasses purity and improve sugar quality.

ISGEC John Thompson

ISGEC GROUP

Process Flow Diagram of White Nile Sugar



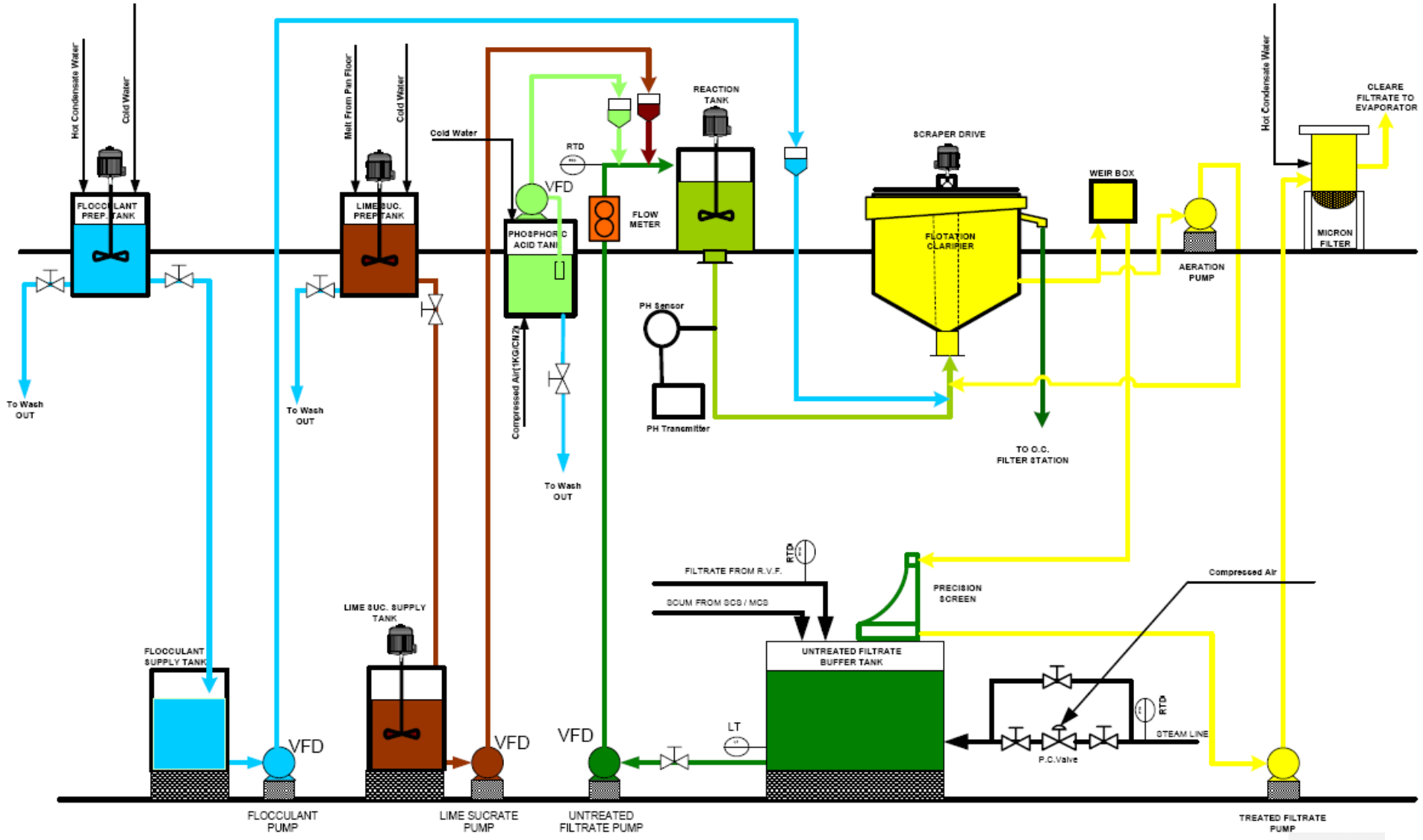
Celebrating 75 YEARS

www.isgec.com

ISGEC John Thompson

ISGEC GROUP

Filtrate clarification system



Salient Features of FCS

- Micro filtration of filtrate
- Clarified filtrate is directly sent to evaporator
- No recirculation of Bagacillo & mud particles to mixed juice
- Helps in reducing Suspended Particulate Matter (SPM) in final sugar.

ISGEC John Thompson

ISGEC GROUP

Micro-Filter for Filtrate



Celebrating 75 YEARS

www.isgec.com

ISGEC John Thompson

ISGEC GROUP

Filtrate Flotation Clarifier



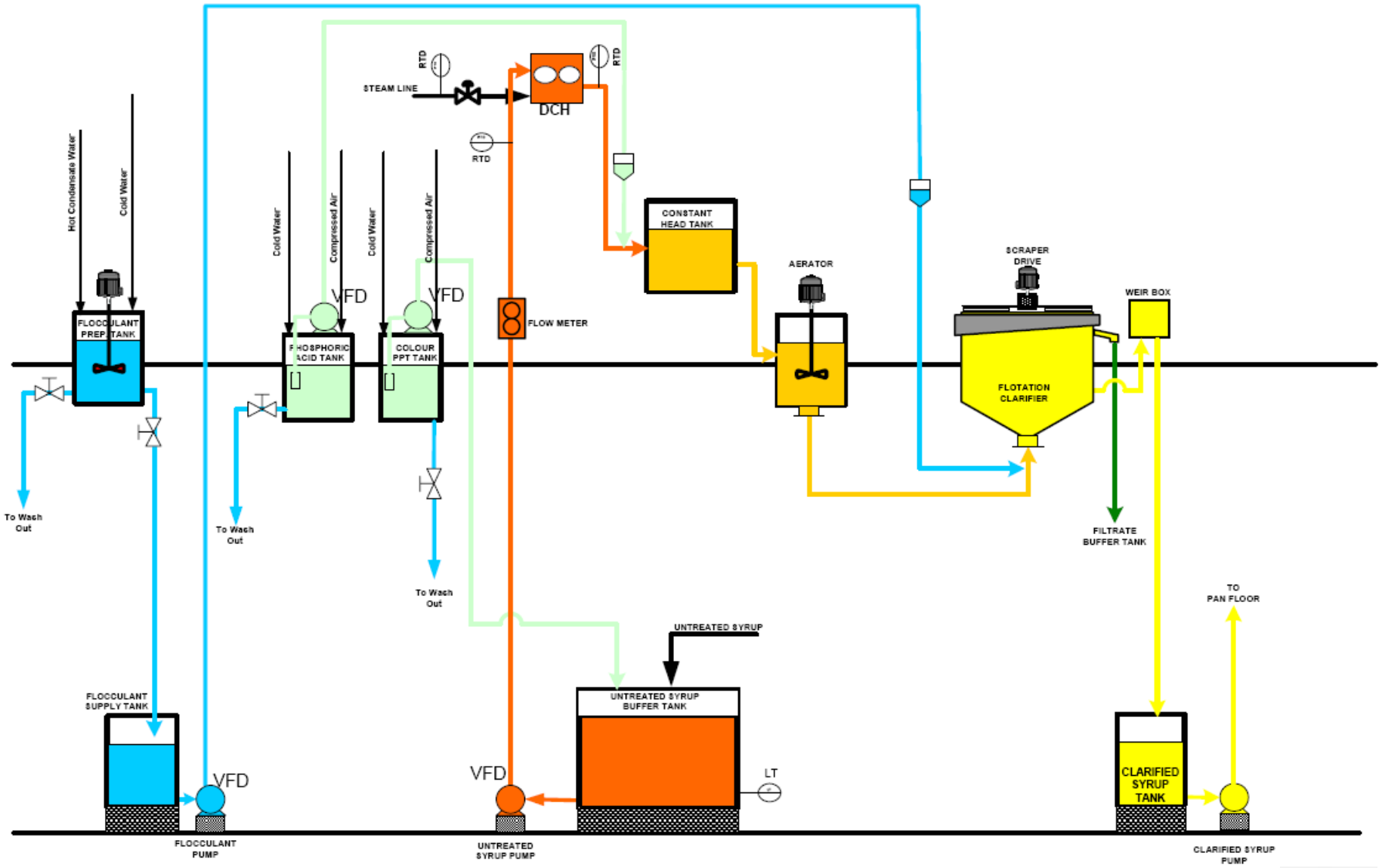
Celebrating 75 YEARS

www.isgec.com

ISGEC John Thompson

ISGEC GROUP

Syrup Clarification System



ISGEC GROUP

Salient Features of SCS

- Syrup heating (55- 75^{0}C) is avoided by taking syrup from 4th effect to syrup clarification system and clarified syrup is return back to 5th effect.
- It helps in steam saving and reduce scaling in 5th effect.
- Removal of suspended impurities and turbidity from syrup resulting clearer and brilliant sugar crystal

ISGEC John Thompson

ISGEC GROUP

Syrup Floatation Clarifier



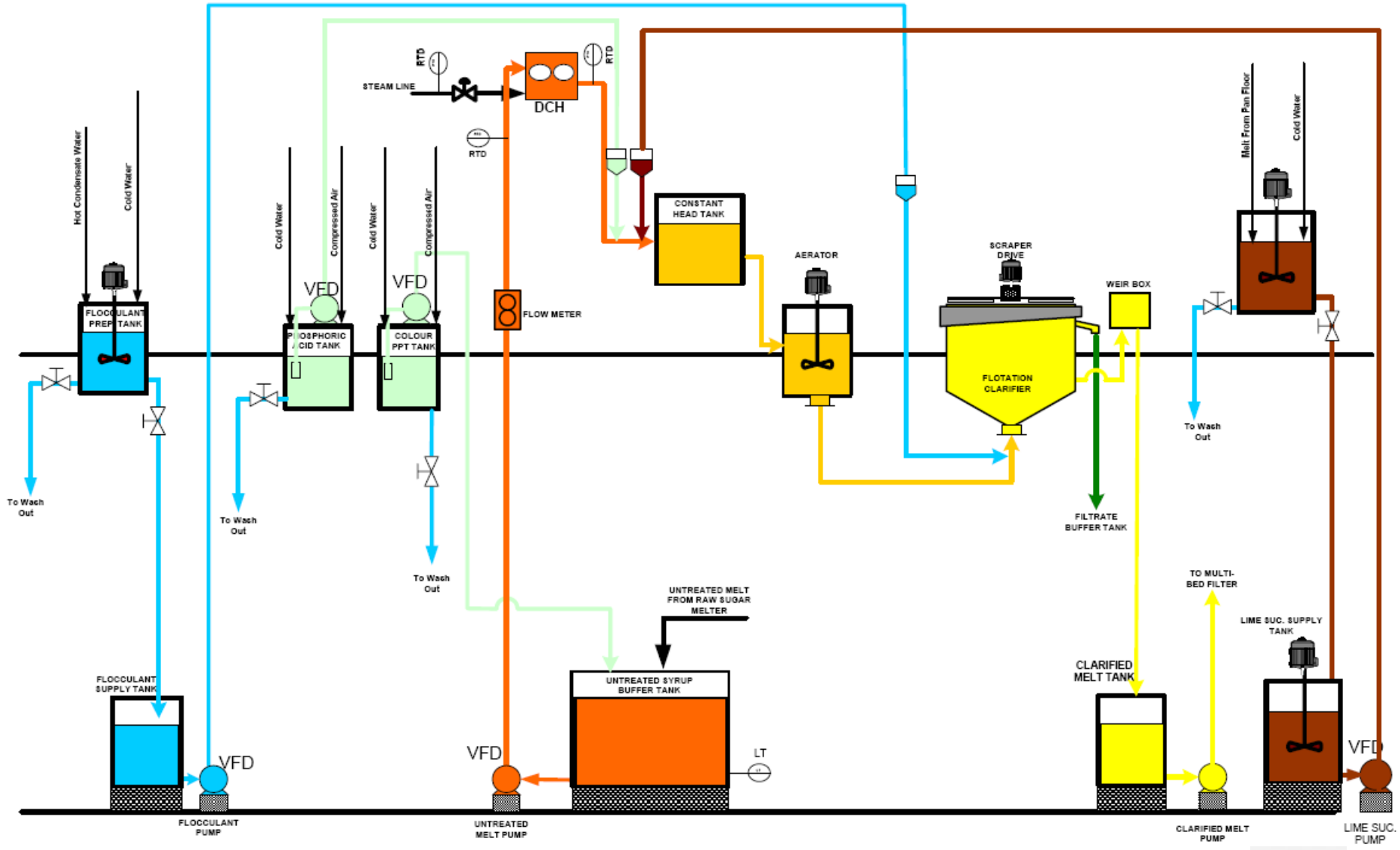
Celebrating 75 YEARS

www.isgec.com

ISGEC John Thompson

ISGEC GROUP

Melt Clarification System



Salient Features of MCS

- Removal of turbidity and particulate matter results lower ash content in white sugar
- Better keeping quality of sugar
- Lowering of non-sugar, leading to lower final molasses purity
- Scum of melt clarification system contains calcium phosphate and it returns back to process which helps in clarification and further colour removal

ISGEC John Thompson

Colour Balance of Process House
(White Nile Sugar Company, Sudan)

Mixed juice colour	12000 IU
Colour reduction during defecation	10%
Filtrate juice colour	17000 IU
Filtrate colour after filtrate clarification system	14450 IU
Clear juice colour	10800 IU
Un-treated syrup	13500 IU
Colour reduction during Syrup clarification system	25%
Syrup colour after Syrup clarification system	10125 IU
Colour reduction during syrup sulphitation	10%
Syrup colour after Syrup sulphitation	9113 IU
Melt Composition	
A1 Sugar	15%
A1 Sugar Colour	1100 IU
B Sugar	60%
B Sugar Colour	2100 IU
C A/W Sugar	25%
C A/W Sugar	4000 IU
Melt Colour	2425 IU
Melt Colour reduction after melt clarification	25%
Melt colour after melt clarification	1818 IU

ISGEC GROUP

Celebrating 75 YEARS

www.isgec.com

Colour Balance of Process House

Contd..

A massecuite	
Syrup	65%
Syrup colour	9113 IU
Melt	35%
Melt colour	1818 IU
A massecuite colour	6560 IU
A Sugar	40%
A Heavy run off	60%
A Sugar colour	60-65 IU
A Heavy run off colour	11460 IU
B massecuite colour	12606 IU
B Sugar	35%
B Heavy run off	65%
B Sugar colour	2100 IU
B Heavy run off colour	18263 IU
C massecuite colour	20090 IU
C Sugar	30%
Final run off	70%
C Sugar	4000 IU
Final run off colour	28753 IU

ISGEC GROUP
Celebrating 75 YEARS
www.isgec.com

Energy Mass Balance

Design Basis

Crushing capacity	24000 TCD
Crushing rate	1100 T/h
Pol % Cane	13.51
Fibre % Cane	15.50
Mixed Juice % Cane	101.56
Defecated juice % cane	103.16
Clear juice % cane	111.86
Untreated syrup % cane	22.55
Brix of clear juice	13.58
Brix of Syrup	67.75

Celebrating
YEARS
www.isgec.com

Bleeding Scheme

Evaporator configuration:

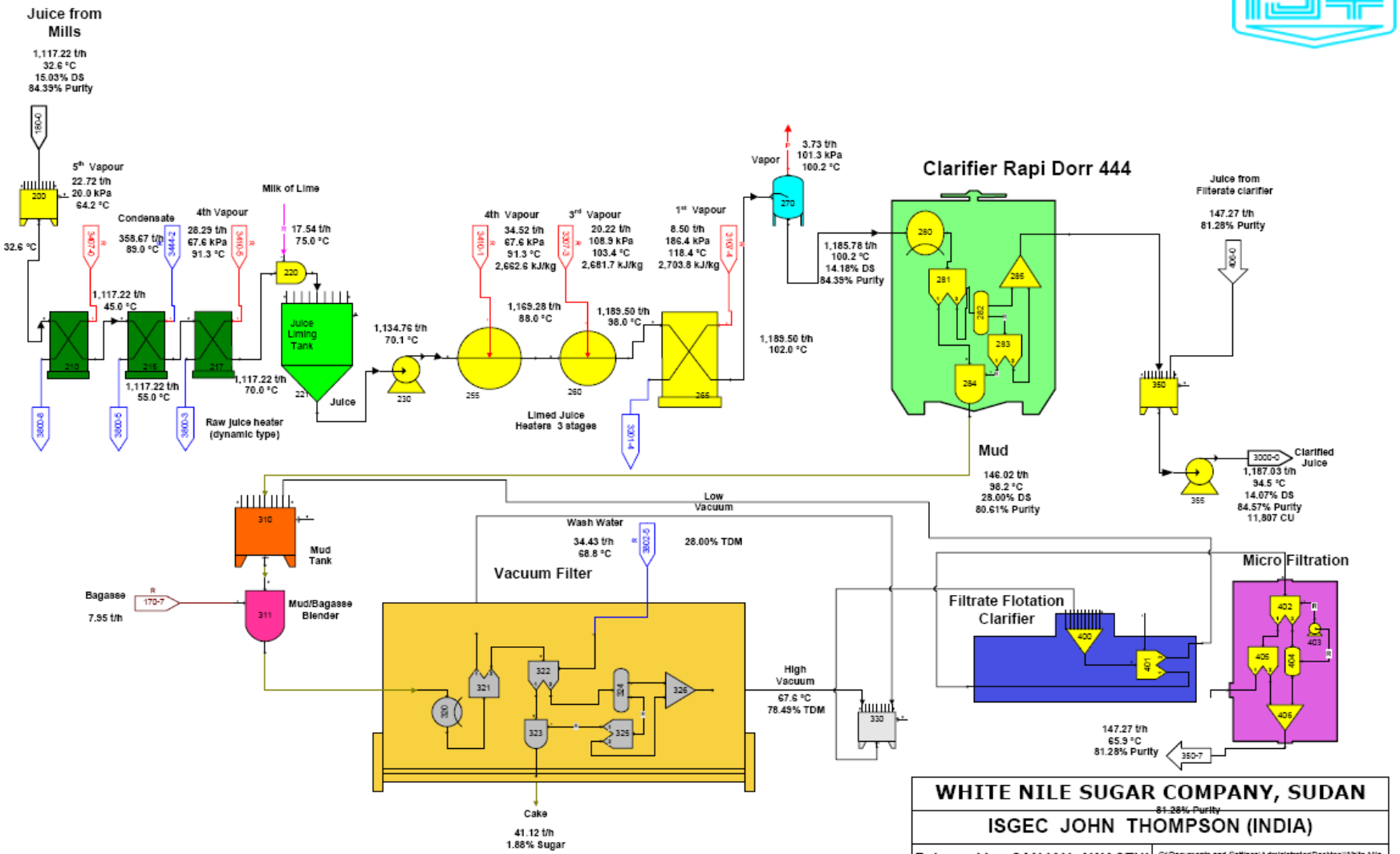
- Quintuple effect evaporation with flash recovery system
- Designed for 30.00% steam consumption.

1st effect vapour	CJ- II heating + SJ- III heating + Pan washing
2nd effect Vapour	CJ- I heating + C Pan boiling
3rd effect vapour	SJ-II heating + A, A1 & B Pan boiling
4th effect vapour	RJ-III heating + SJ- I heating
5th effect vapour	RJ-I heating
Hot Condensate	RJ-II heating

Celebrating
YEARS
www.isgec.com

Predicted Material balance

Clarification Section



Steam Condition

Heating media	Pressure Kg/cm2(a)	Temperature (Deg. C)	Latent heat (Kcal/kg)
L.P. steam	2.53	129.00	520.43
1st body vapours	1.86	118.40	527.23
2nd body vapours	1.43	110.60	532.51
3rd body vapours	1.09	103.40	537.03
4th body vapours	0.68	91.30	544.52
5th body vapours	0.20	64.20	560.86

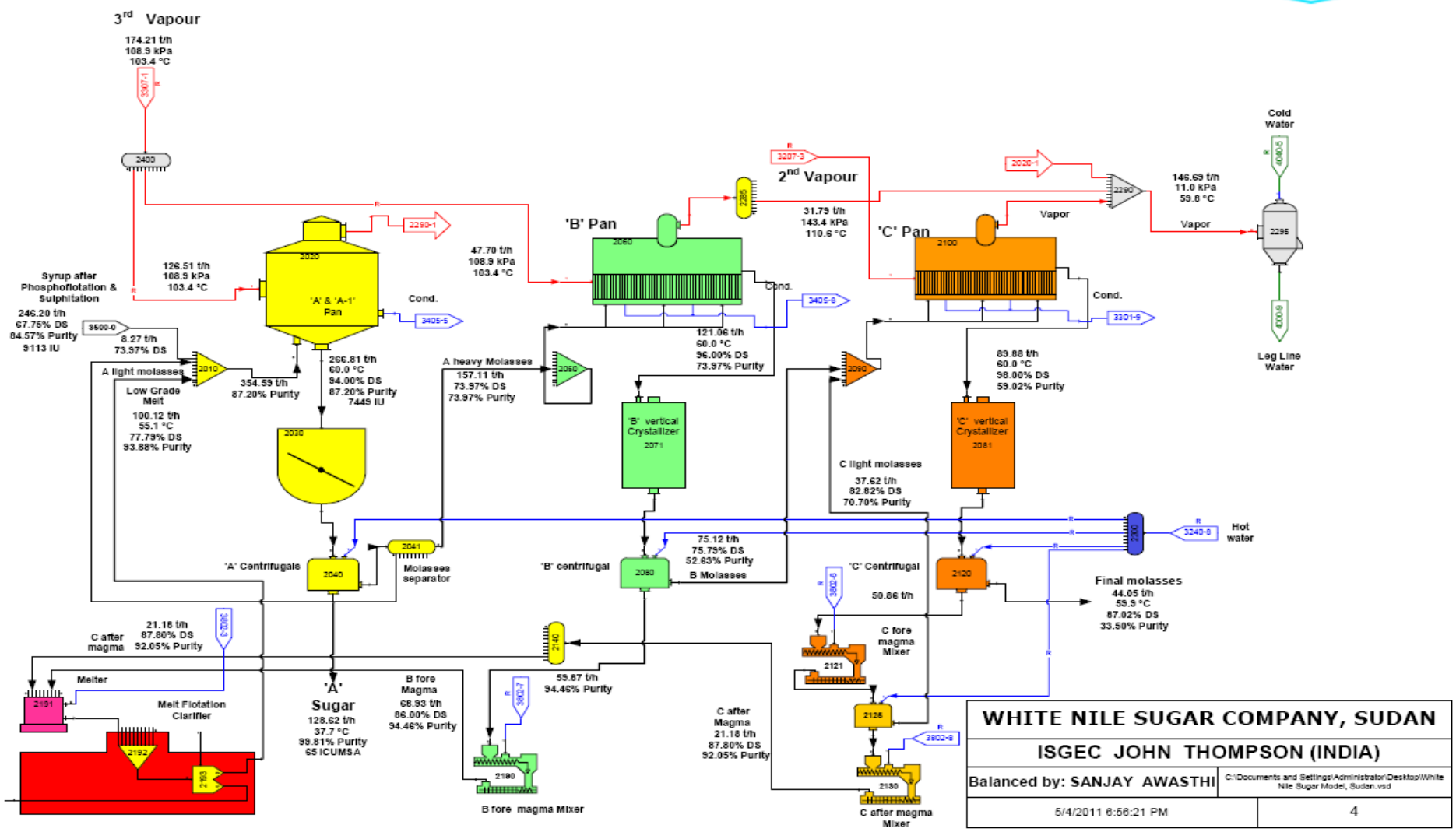
Bleeding Patterns

		Heating Media	Heater Type	Steam T/hr
Raw juice 1st Heating	From 32.6 -45 deg C	5th Body vapour	VLJH	22.72
Raw Juice 2nd heating	From 45 - 55 deg C	Hot Condensate	Tubular heater	----
Raw Juice 3rd Heating	From 55 - 70 deg C	4th body vapour	Tubular heater	28.29
D. Juice 1st Heating	From 70.1- 88 deg C	4th body vapour	DCJH	34.52
D. Juice 2nd heating	From 88 – 98 deg C	3rd body vapour	DCJH	20.22
D. Juice 3rd heating	From 98 – 102 deg C	1st body vapour	Tubular	8.50

Bleeding Patterns

		Heating Media	Heater type	Steam T/hr
C. Juice 1st heating	From 94.50-108 deg C	2nd Body vapour	DCJH	26.14
C. Juice 2nd heating	From 108-115.0 deg C	1st Body vapour	DCJH	17.35
A & A1 Pan boiling		3rd Body vapour		126.51
B Pan boiling		3rd Body vapour		47.70
C Pan boiling		2nd Body vapour		31.79
Pan washing		1st Body vapour		4.00

Predicted Material balance
Crystallization section



WHITE NILE SUGAR COMPANY, SUDAN	
ISGEC JOHN THOMPSON (INDIA)	
Balanced by: SANJAY AWASTHI	C:\Documents and Settings\Administrator\Desktop\White Nile Sugar Model, Sudan.vsd
5/4/2011 6:56:21 PM	4

ISGEC GROUP

Total Steam Requirement For Process House

	T/Hr	% Cane
Exhaust Steam Requirement	328.63	29.87
Condensation & radiation losses	3.30	0.30
Total Exhaust Steam Requirement	331.93	30.17

ISGEC GROUP

Conclusion

Modern Sugar Plants offers following conclusions

- **Good quality sugar can be made with out refinery process.**
- **Less steam consumption in process means less boiler capacity**
- **In order to have at least 300 days of operation, the saved bagasse can be used to prolong the co-generation beyond season**
- **In co-generation, less extraction and more steam to condenser leads to more power production. It makes a sugar plant a self sustain business model.**

ISGEC John Thompson

ISGEC GROUP

THANK YOU

Celebrating 75 YEARS

www.isgec.com