Appendix M. Concept design basis report

Memorandum

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Subject	Concept Design Basis Report	Project Name	Prospect Hill Energy from Waste Plant
Attention	Prospect Hill International	Project No.	IS305100
From	Karl Ivanusic & Dave Harridge	Status	Final
Date	15 April 2020		
Copies to	Jacobs Project Team		

1. Introduction

Prospect Hill International (PHI) are developing a municipal solid waste (MSW) fired Energy from Waste plant at a greenfield site in Lara, located approximately 58 km south west of Melbourne.

Jacobs have been engaged to assist PHI with the development of a suitable Concept Design for the plant that will allow PHI to progress with the EPA Works Approval process.

The purpose of this Design Basis document is to record the source and basis for the Concept Design including key assumptions made for the Energy from Waste (EfW) plant.

2. Site

The site in question for the proposed Energy from Waste plant is 164-200 McManus Road, Lara, Victoria. PHI have purchased the land and are the title holders.

The site is approximately 395 x 400 m in size and is a greenfield undeveloped parcel of land located in an Industrial 2 Zone.

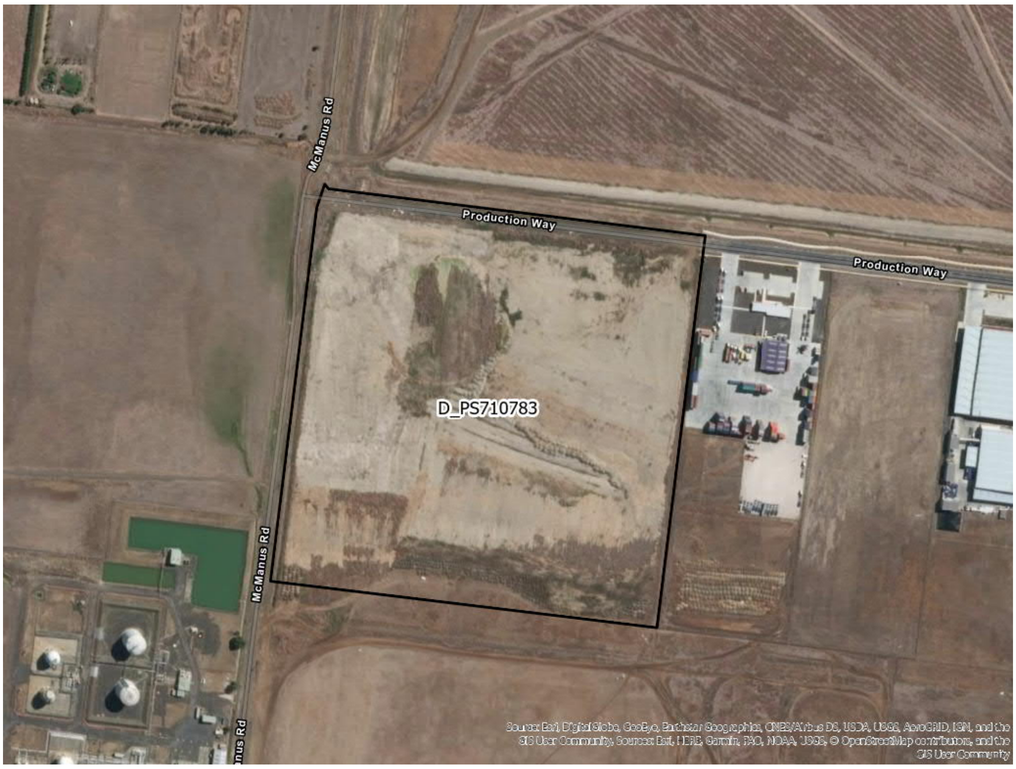
The location of the site is shown below in Figure 1 and a spatial image of the actual site footprint is shown in Figure 2.

Based on the publicly available desktop information (no site visit occurred during the Concept Design), the site appears to be relatively flat with evidence of some earthmoving due to what appears to be knolls throughout the site. The site appears to drain towards the north west based on typical elevations from Google Earth but it is recommended to be confirmed by site survey.

Currently the VicPlan database indicates that there is a planned subdivision for the overall property as shown in Figure 2, one for the road reserve (R1\PS742703) and one for the main property (4\PS742703). It is unclear when this subdivision plan was made and whether it will come into effect. However, Jacobs has accounted for this potential subdivision by offsetting the property boundary to the intersection with the new road reserve.

Figure 1: Site location

Figure 2: Spatial Image of the site



3. Assumptions

- The footprints adopted in this Concept Design for the main power station components were predominately based on the layout drawing provided by the Technology Partner (via PHI), Everbright International. These were deemed a reasonable footprint for this size of plant;
- The calorific value, moisture content and ash for the waste and the chemical composition are indicative only and are based on Jacobs experience on various other energy from waste projects in Australia. It is PHI's responsibility to undertake the waste modelling and ultimately to determine a suitable design waste fuel specification including calorific value and other key design parameters. This may change some of the performance parameters for the plant. This assessment has also not investigated the sources of waste nor which councils it will be coming from;
- A stormwater detention pond has been incorporated in the layout. The size shown is indicative, based on a 1 in 10 year storm event and designed to allow for approximately one (1) hours' worth of inflow to buffer the pre-development stormwater discharge for the site. This can also provide some storage capacity for harvesting rainwater for process use. The eventual size will need to be confirmed during a feasibility study or detailed design with input from the City of Geelong Council;
- A wastewater holding pond has been incorporated in the layout. The main wastewater source for the EfW plant will be the cooling tower blowdown. The size of the pond is indicative, based on a volume of approximately 7 times the size of the estimated daily cooling tower blowdown at typical ambient conditions (and 4 times at the maximum conditions). The size will need to be confirmed during a feasibility study or detailed design in order to satisfy the maximum 35°C sewer discharge temperature specified by Barwon Water;
- The layout drawing was produced on the basis that two boiler trains capable of a throughput of 200,000 tonnes per annum (each) would be situated on the site. Some space on the layout drawing was also reserved so that a potential third unit could be installed in the future.
- For the purposes of the thermodynamic modelling and preliminary consultations with various third parties/stakeholders, the performance of the plant and the plant outputs/requirements were based on two 200,000 tonnes per annum boiler lines;
- A single row of mechanical draft cooling towers was proposed and aligned to benefit from prevailing southerly to westerly winds without spray carryover to vulnerable equipment, and to minimise air flow limitation affects from surrounding buildings and equipment. The arrangement is expected to provide good heat transfer performance. The Cooling Tower dimensions were also increased to accommodate the additional heat load seen during 100% turbine bypass operation which is a typical functionality requirement for EfW plant.
- As there is a high likelihood of a staged development, the use of two steam turbines, each capable of swallowing 100% of the steam from one boiler line has been adopted;
- It will be necessary that the Technology Partner will be able to comply with and supply equipment that is in line with the Industrial Emissions Directive (IED) 2010/75/EU which the Victorian EPA have adopted for local regulation. Demonstrating compliance with the recently released 2019 European Commission Waste Incineration Best Available Techniques (BAT) Reference Document (2019 WI BREF) will be critical in terms of a successful outcome with the EPA;
- The use of a flue gas treatment system incorporating an Air Pollution Control Residue (APCr) recycling system will be adopted for the project, such as a Circulating Fluidised Bed (CFB) or similar. This is in-line with BAT recommendation 28 in the 2019 BREF document to minimise lime reagent use and to provide greater absorption capacity for short term acid gas spikes; and

- It was agreed with PHI that the treatment of the APCrs would not be done on site and instead collected in silos and transferred by gravity fed rotary valves to enclosed trucks to be treated offsite at the Prescribed Industrial Waste (PIW) landfill in Lyndhurst, Victoria;

4. Third party/stakeholder consultations

During the Concept Design process, key third party stakeholders were contacted in order to inform the concept design process and identify any preliminary technical issues and risks that may hinder further development of the EfW plant. Table 1 below provides a summary of the various stakeholders that were contacted.

Table 1: Third party stakeholders

Third party stakeholders	Main aim(s) / Reason for consultation
Barwon Water	To determine the location of the nearest potable water and sewer main as well as better understand the allowable quantities of water that can be used and discharged at the site. Potable and allowable trade waste water standards were also of interest.
City of Geelong Council	To determine the location of the nearest council owned stormwater Legal Point of Discharge (LPOD) point as well as better understand the allowable discharge rate from the site;
Powercor / AusNet Services	To seek preliminary confirmation that the electrical point of connection, as determined by Jacobs, is suitable and that there are no perceived technical issues at this stage of the development. Similarly, if there were issues with the proposed connection point, Powercor and AusNet Services should provide feedback for other suitable locations which will help inform the future feasibility of the project.
AusNet Services	To determine the location of the nearest natural gas main as well as better understand the allowable quantity of gas that can be used at the site and the pressure. Natural gas will be used as an auxiliary fuel for the boilers.

Based on feedback received from the various stakeholders, it was identified that there were a lot of existing utilities assets nearby the property. Third party stakeholder feedback provided has indicated that potable water, sewer mains and a gas distribution main are all running along Production Way and that an existing stormwater culvert is running along the corner of McManus Road and Production Way.

Continued consultations are required with Barwon Water due to a lack of available supply from their current potable water main which will require a future upgrade. Similarly, continued consultations with Powercor / AusNet Services are required to finalise the electrical connection point for the project.

5. Design Basis

The key external plant interfaces required for the Prospect Hill EfW plant are listed below:

- Waste supply/delivery;
- Disposal of APCr and bottom ash;
- 66kV electrical connection;
- Natural gas (for auxiliary firing / start-up);
- Potable water;
- Trade waste / waste water;

- Stormwater; and
- Telecommunications;

In order to successfully operate the EfW plant, the required quantities of these and other services need to be determined. As part of this Concept Design process, Jacobs have determined estimates for some of these key services. Further preliminary design and commercial engagement with the providers of these services will need to be progressed with the relevant authorities in order to provide additional surety over technical feasibility of supply and commercial charges and contractual arrangements.

The following sections provide a summary of the key design inputs used throughout the Concept Design process.

5.1 Site conditions

The EfW plant and equipment should be designed and capable of reliable and continuous operation at various design conditions including:

1) At the maximum ambient dry bulb air (shade) temperature and a relative humidity (RH) at the higher end of the range that can occur during those summer conditions (typically summer climatic conditions are hot and dry at this site);
2) At the minimum ambient temperature and at maximum relative humidity up to and including 100 per cent; and
3) The plant design performance shall be optimised for the mean maximum ambient dry bulb air (shade) temperature of 15°C, with a corresponding relative humidity of 65 per cent;

Table 2 outlines the preliminary design conditions that were considered during this Concept Design. These values may not necessarily correspond to the actual values used during a future detailed feasibility study however, provide a basis for comparison between some different operating conditions.

A summary of the major climate statistics recorded for the Lara region over a period of several years have been retrieved from the Australian Government Bureau of Meteorology and can be seen in Appendix C. The climatic data is based on the Avalon Airport site 087113 (Latitude 38.03° South, 144.48° East and 11.0 m elevation).

Table 2: Site climatic design conditions

Parameter	Unit	Typical Site Ambient	Maximum	Minimum
Air temperature	°C	15	45	-5
Relative humidity	%	65	14[1]	100
Prevailing wind direction		9am – Westerly – See Appendix C for wind speed / directional plots 3pm – Southerly – See Appendix C for wind speed / directional plots		

[1] A detailed assessment on the weather conditions during summer will need to be undertaken during the feasibility study to determine the likely range of relative humidity, and consequently wet bulb temperature, that the EfW plant is likely to see. As a value higher than 14% could be likely and this will affect the performance of the plant, particularly the cooling towers, condenser and steam turbine as well as water usage.

Parameter	Unit	Typical Site Ambient	Maximum	Minimum
Site elevation	m		20	

5.2 Design parameters

Note that some of the below design parameters are still subject to confirmation with third party stakeholders or with the technology provider, or in subsequent stages of preliminary design, but are provided here now as a starting point as the basis for the Concept Design and Works Approval purposes.

Table 3: Key design input parameters

Design parameter / input	Value	Comments
General		
Plant design life	25 years / 200,000 hours	
Office facilities	Yes	
Warehouse and maintenance facilities	Yes	
Guard house	Yes	Manned at entrance to site
Number of boiler lines	2	Concept design allowed for two lines with space reserved for a potential expansion to a third line in the future
Number of steam turbines	2	
Landscaping buffers	9 m from the front property boundary and 5 m from any side street	
Building setbacks	>24 m from front property boundary. This was also applied to the western boundary, but not to the eastern and southern boundaries.	This includes the 9 m front landscaping buffer
Fence alignment	The site fencing should typically follow the property boundary. However, along the northern boundary there are existing utility services so the fence will need to be located in a manner not to obstruct maintenance or access to these services.	Offset between the fence and underground services to be confirmed during detail design. Anticipated to only require ~1-1.5 m separation to the nearest service.
Fuel		
Annual plant fuel consumption	400,000 tonnes/annum	Based on 2 x 200,000 tonnes/annum boiler lines
Estimated calorific heating value	9.5 MJ/kg (LHV)	Indicative value only
Estimated moisture content	34.5%	Indicative value only
Estimated ash content	16.52%	Indicative value only
Estimated sulphur content	0.1%	Ultimate analysis, Indicative value only
Estimated chlorine content	0.43%	Ultimate analysis, Indicative value only

Design parameter / input	Value	Comments
Start-up and combustion stabilisation fuel (auxiliary fuel)	Natural Gas	
Annual auxiliary fuel consumption	Up to 38,000 GJ/annum	Based on 1% of annual waste heat input. The Technology Supplier provided input indicating the annual auxiliary fuel consumption would be approximately 19,200 MMBTU or 20,350 GJ/annum which is ~0.6% of annual waste heat. It's deemed better to be conservative at the moment so 38,000 GL/annum will be assumed.
Logistics		
Connecting road load limits	VicRoads' mapping system for heavy vehicle routes shows that all roads likely to be used in the vicinity of the plant site and from the Princes Fwy and Geelong Ring Rd are already classified to accommodate B-doubles trucks with a length of 26 m.	
Incoming waste vehicle types and payloads	Waste delivery vehicles to be used are likely to include: • Collection compactors- particularly from nearer locations, places and regions which do not generate sufficient waste volumes for larger vehicles and locations which do not have waste transfer facilities capable of loading larger bulk transfer vehicles or containers. These typically have up to 10 t waste carrying capacity and are generally nearly full for most trips. • 19 m semitrailer bulk waste vehicle – from waste transfer facilities with bulk transfer vehicle loading capacity, such as Citywide's Dynon Rd facility. These typically have a carrying capacity 25-30 t. Most are routinely full nearly all loads. Various other high productivity freight vehicles are expected to be used, which can only operate under permit on roads classified to accommodate them. These include: • 26 m b-doubles – carrying capacity up to 38 t • 30 m a-doubles – carrying capacity up to 45-50 t • Various high productivity freight vehicle (HPFV) combinations to 36.5 m.	
Transportation routes	Jacobs undertook a preliminary assessment on potential transportation routes. It is likely that waste delivery vehicles will need to approach the plant from Melbourne and Geelong on the Princes Fwy / Geelong Ring Rd, and potentially on other roads from the north and west, such as the Midland Hwy, Ballan Rd and Bacchus March Rd. There are two main access options to the plant site from Melbourne, both via the Princes Fwy heading south west from Melbourne: 1) Princes Fwy → Geelong Ring Rd exit → right on Bacchus Marsh Rd → right onto Heales Rd at the roundabout → left onto Broderick Rd → left onto Production Way → left into the EfW site 2) Princes Fwy → Geelong CBD exit → right onto Broderick Rd → left onto Production Way →left into the EfW site The first option appears to be superior however both will require further assessment in terms of the ability for the proposed vehicle classes to negotiate all required turns. It is likely most waste deliveries from the south and south west of the site would use Latrobe Terrace/Princes Hwy or the Geelong Ring Rd with a left turn on Bacchus Marsh Rd and then the same route as indicated in option one. Bacchus Marsh Rd provides a shorter distance to the plant than Broderick Rd, but is dependent upon vehicles being able to adequately	

Design parameter / input	Value	Comments
	negotiate all turns, particularly the right turn at the roundabout at Bacchus Marsh Rd and Heales Rd. The origin of waste from Melbourne is unknown at this stage, as it depends on which local government areas the plant's operators are able to secure waste sourcing contracts, and the arrangements these LGAs have in place or develop.	
Weighbridges	2 off within the EfW site	One for entering vehicles, one for exiting vehicles
Site access	Main waste truck access provided via Production Way (north-east corner) Main office / visitor car access provided via McManus Road (south-west corner)	
EfW Plant Operation		
Plant availability factor	90%	
Maximum operating hours per annum	7,884 hours	Based on plant availability factor
Plant load factor	95%	This is to account for some time during the year where the plant will not operate at 100 % MCR and allows some extra capacity to catch up on waste treatment before and after overhauls or forced periods of reduced waste throughput
Equivalent plant full time operating hours	7,490 hours	Design number of hours used for determining waste throughput
Power Plant		
Design waste throughput per boiler (2 total)	26.7 tonnes/hour	Based on equivalent full time operating hours
Combustion technology	Reciprocating grate	
Boiler main steam conditions	440°C, 64 bar (abs), 83.3 t/h	Assumed at ambient conditions. TBC during detailed design
Air preheaters	Primary and secondary air preheaters. Target temperature minimum of 120°C	Heat supplied from bled steam line from IP Turbine, temperature will depend on design waste moisture range.
Flue gas exit temperature after economiser	~170°C	As confirmed by Technology Supplier
Furnace exit temperature	>850°C	After the last injection of combustion air. Needs to be maintained for at least two seconds in accordance with the European Union Directive 2010/75/EU
Target O_2 in flue gas	7%	At economiser outlet, as confirmed by Technology Supplier
Fly ash to bottom ash ratio	20 % / 80%	As recommended by Technology Supplier
Flue gas treatment	NOx control (SNCR), Fabric Filter, Semi-Dry FGD system with lime and activated carbon injection.	Semi-Dry system with APCr recirculation such as Circulating Fluidised Bed system

Design parameter / input	Value	Comments
Recycling of reagents in FGD system	Yes	
Stoichiometric lime dosing ratio	1.9	
SO_2 removal efficiency	95%	Technology Supplier indicated up to 96% is possible
HCl removal efficiency	99.5%	Assumed
Stack exit temperature	~140°C	
Stack exit velocity	18.3 m/s per flue	Starting point for air dispersion modelling which will confirm stack height. Assume stack will have one inner steel chute of ~2m diameter per line, both encased by a larger concrete windshield.
Stack height	70 m	Estimated starting point for air dispersion modelling, the stack height will be confirmed during the modelling process and may change.
Turbine	Single casing condensing turbine (1 per boiler, 2 total).	
IP turbine bleed pressure	4 bar (abs)	Assumed, to be optimised during detailed design
LP turbine bleed pressure	1 bar (abs)	Assumed, to be optimised during detailed design
Generator speed	1500 rpm	4 pole
Gearbox required	Yes	
Feed water system	One LP heater, deaerator and gland steam condenser	No HP heaters
Deaerator/feedwater temperature	130°C	Assumed, to be optimised during detailed design
Condenser	Wet	
Condenser pressure	8 kPa (abs)	Assumed, to be optimised during detailed design
Cooling tower type	Mechanical induced draft	
Cooling tower cycles of concentration	5	Assumed, to be optimised during detailed design
Allowable cooling water temperature rise	15°C	
Cooling tower approach temperature	8°C	
Estimated number of cooling towers	4 (two per unit)	
Natural Gas Connection		
Estimated maximum natural gas demand during start-up of boilers	355 GJ/hr (~2.1 kg/s)	For two boilers. Equivalent to 70% MCR fuel input per hour from the waste fuel. Based on Technology Supplier feedback this may be slightly less.

Design parameter / input	Value	Comments
Required natural gas pressure	40-70 kPa	Assuming using atmospheric burners
Natural gas connection point	180 mm Polyethylene AusNet Distribution Main. Application to be lodged with a retailer for a “shipper” I&C connection.	AusNet Services were contacted and confirmed they have a high pressure gas pipeline (~400 kPa) in McManus Road and that 70 kPa could be provided after the meter.
Distance to connection point	<25 m	From property boundary
Power and Grid Connection		
Proposed grid connection point	66 kV Bus at Geelong Terminal Station, via one of the remaining spare bays	The Bus is owned by AusNet Services, although Powercor own and operate the sub-transmission network in Western Victoria and have planning access to spare bays. This is the current expectation, although consultation with AusNet is still on-going.
Transmission voltage	66 kV	
Transmission frequency	50 Hz	
Power factor (at step up transformer HV terminal)	0.9	
Generator voltage	11 kV	Assumed, to be optimised during detailed design
Indoor switchroom rating	20 kV	To be selected based on typical industry standard ratings which may be slightly higher than the generator voltage
Number of transformers	2	One transformer per unit
Typical transformer size	30 MVA	Based on 110% MCR and a 10% margin applied
Total power station electrical capacity rating	Up to 60 MVA	Typical daily output is estimated to be closer to 50 MVA
Distance to connection point	7 to 8 kilometres of new 66 kV line	From property boundary. The radial distance is approximately 5.4 km, however the route will need to follow established road and other transmission paths. The new line could be a mixture of underground and overhead depending on the eventual route.
Single Line Diagram	Provided in Appendix D	Indicative only, subject to proposed connection point.
Water Connections		
Potable water source	Barwon Water potable water main	Barwon Water have indicated that further negotiation and consultation is required prior to proceeding to detailed design due to other high consumption developments proposed for the area.
Connection size	DN225	Based on information provided by Barwon Water, there is an existing DN150 potable water main running through the road reserve along Production Way. Barwon Water have stated that this would not be sufficient to supply the amount of water and as a minimum would require an upgrade to a DN 225 line from their DN 300 main in Heales Road.

Design parameter / input	Value	Comments
Distance to connection point	~1100 m	From property boundary. An upgrade of the water main is required along McManus Road to Heales Road.
Fire water supply	To be supplied from on-site fire water tanks	Tanks to be topped up from the Barwon Water potable water main
Fire water storage requirements for hydrant system	Minimum 4 hours for fire hydrants.	Additional storage may be required for sprinkler systems (if applicable)
Water pre-treatment type	Gravity type sand filters	
Demineralised water plant type	Reverse Osmosis Electro de-Ionisation	
Storm water connection point	City of Geelong Council stormwater drainage system. The point of connection is most likely going to be an existing 900 mm culvert near the corner of Production Way and McManus Road.	The discharge will be via the Stormwater detention pond.
Distance to stormwater connection point	< 40m	From property boundary
Waste water and sewage connection point	Barwon Water sewer main	Based on information provided by Barwon Water, there is an existing DN150 sewer main running through the road reserve along Production Way. Barwon Water indicated that based on current discharge volumes in the area and the predicted discharge from the Energy from Waste plant, there is no requirement to upgrade the existing sewer line. This will need to be re-assessed during the detailed feasibility stage.
Distance to waste water and sewage connection point	<25 m	From property boundary. To be confirmed pending adequacy of existing sewer.
Water Balance	Provided in Appendix E	Indicative only, subject to detailed design.

5.3 Key plant outputs

A selection of key plant outputs is shown below in Table 4. These are typically based on ambient conditions unless noted otherwise.

Table 4: Key plant outputs

Design parameter / input	Value	Comments
Plant output		
Estimated gross plant power output	40,702 kW	Based on ambient site conditions for two units
Auxiliary load	4,724 kW	Based on ambient site conditions. Estimated to be approximately 11% of gross output.

Design parameter / input	Value	Comments
		Technology Supplier indicated their experience is closer to 15-17%.
Estimated net plant power output	35,978 kW	Based on ambient site conditions
Plant net efficiency (LHV)	25.53%	
Plant net heat rate (LHV)	14,101 kJ/kWh	
Typical potable water usage	Approximately 2.5 ML/day	For ambient conditions, to be optimised during detailed design
Waste water discharge volume	Approximately 0.4 ML/day	For ambient conditions, to be optimised during detailed design.
Total boiler bottom ash produced (dry basis)	7.2 tonnes per hour (3.6 tonnes per hour per boiler)	Based on a 16.52% waste fuel ash content and an 80:20% bottom ash to fly ash split
Total boiler fly ash produced (dry basis)	1.8 tonnes per hour (0.90 tonnes per hour per boiler)	Based on a 16.52% waste fuel ash content and an 80:20% bottom ash to fly ash split
Total air pollution control residue discharged	2.7 tonnes per hour (1.345 tonnes per hour per boiler)	
Semi-dry flue gas treatment reagent usage (dry basis)	0.2505 tonnes per hour per boiler	Based on burnt lime / quicklime
Typical activated carbon injection rate	10.72 kg/hr per boiler	

Appendix A – Layout drawing

NOTES:

1. ALL DIMENSIONS ARE IN METERS & ARE APPROXIMATE ONLY.
2. BARWON WATER POTABLE WATER AND SEWER PIPELINES ARE SHOWN AS INDICATIVE ONLY.
3. GENERAL ROAD LAYOUT DESIGN ALLOWS FOR 36.2 M TYPE 1 ROAD TRAIN (A-DOUBLE / B-TRIPLE) VEHICLES TRAVELLING BETWEEN 5-10 KM/H.
4. LANE WAY USED FOR VEHICLES TO ACCESS BOTTOM ASH LONG TERM STORAGE WAREHOUSE.
5. TRAILER DETACHMENT AND PARKING AREA.
6. AUSNET SERVICES GAS PIPELINE IS SHOWN AS INDICATIVE ONLY. LOCATION TO BE CONFIRMED DURING THE NEXT PHASE OF DESIGN.
7. CITY OF GEELONG COUNCIL 900MM STORMWATER CULVERT SHOWN AS INDICATIVE ONLY. LOCATION AND SIZE TO BE CONFIRMED DURING THE NEXT PHASE OF DESIGN.

LEGEND:

- BOUNDARY LINE
- FENCE LINE
- EASEMENT - POTABLE WATER AND SEWER
- EASEMENT - GAS
- EASEMENT - STORMWATER

SCALE 1:1000 (A1)

20 10 0 20 40 60 80 100m

CONCEPT

REV	DATE	APP'D	REVISION	DRAWING NUMBER	REFERENCE DRAWING TITLE
A	xx.04.20		PRELIMINARY		

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CLIENT: PROSPECT HILL INTERNATIONAL

PROJECT: PROSPECT HILL ENERGY FROM WASTE PLANT, LARA

DRAWN	DRAWING CHECK	REVIEWED	APPROVED
R. INCAMPO			
DESIGNED	DESIGN REVIEW	DATE	DATE
K. IVANUSIC			

TITLE: PROSPECT HILL ENERGY FROM WASTE PLANT
CONCEPT STUDY
LAYOUT

SCALE	DRAWING No	REV
1:1000	IS305100-0000-MC-DRG-0001	A

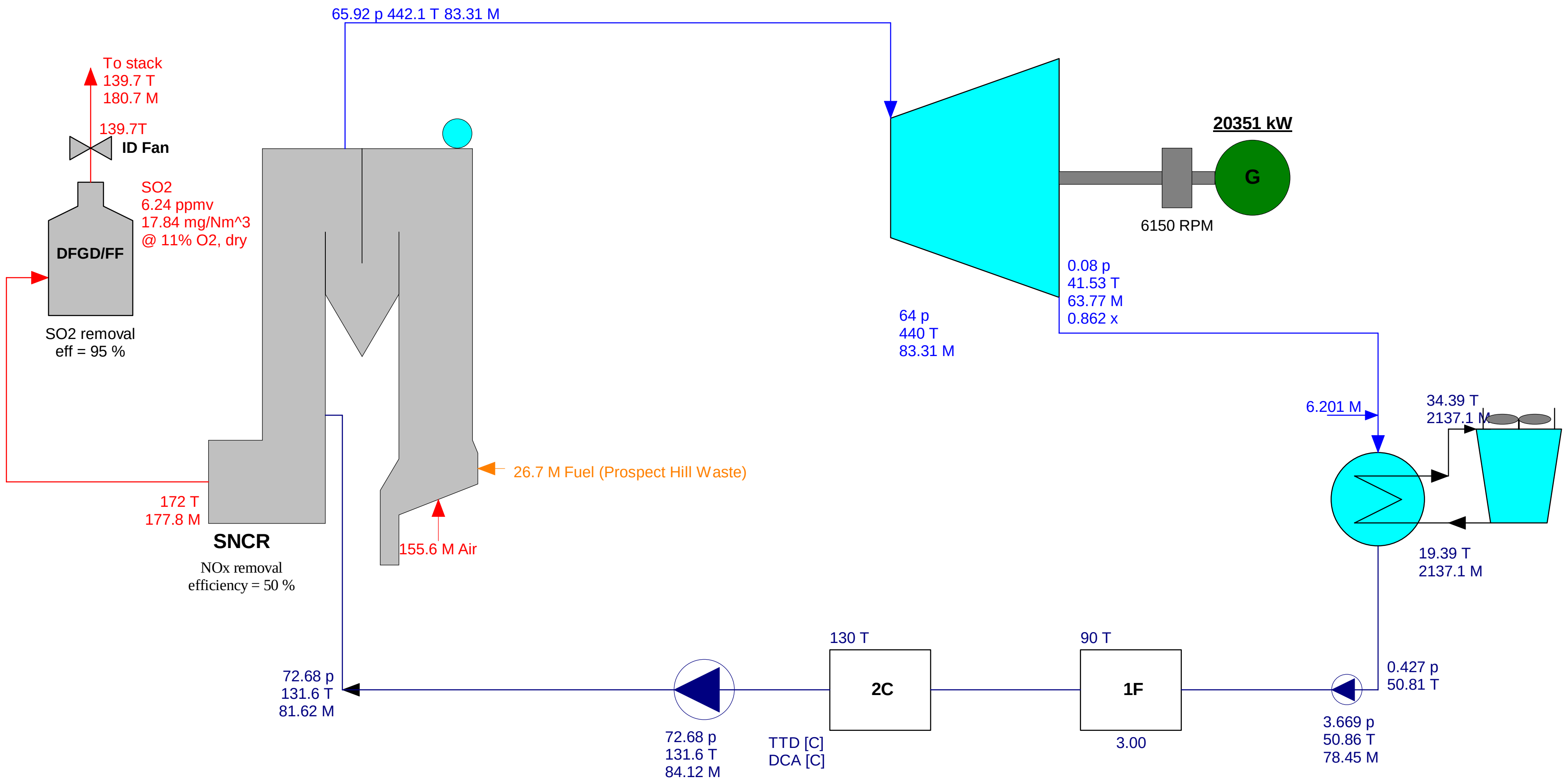
A1

DATE: 9/04/2020 1:32:35 PM NAME: INCAMPO, ROBERTO
LOCATION: J:\IE\Projects\03_Southern\IS305100\01 Design\Drawings\IS305100-0000-MC-DRG-0001.dwg

Appendix B – Heat balance diagrams

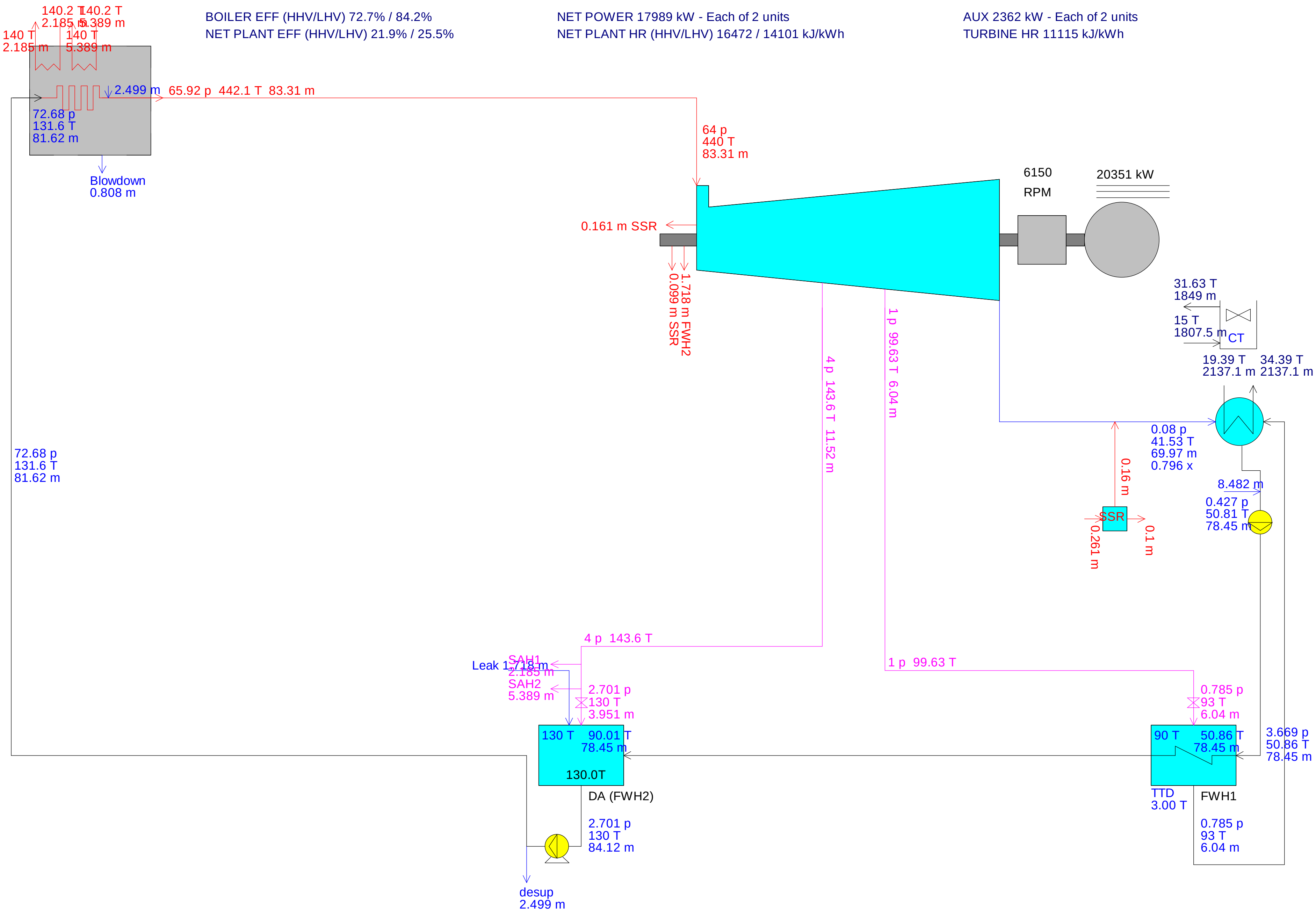
Plant gross power	40702	kW
Plant net power	35978	kW
Number of units	2	
Plant net HR (HHV)	16472	kJ/kWh
Plant net HR (LHV)	14101	kJ/kWh
Plant net eff (HHV)	21.86	%
Plant net eff (LHV)	25.53	%
Aux. & losses	4724	kW
Fuel heat input (HHV)	592.5	GJ/h
Fuel heat input (LHV)	507.2	GJ/h
Fuel flow	1281	t/day

Ambient
1.011 p
15 T
65% RH
11.38 T wet bulb



Mass-Burn Grate Boiler (Trash Burner)

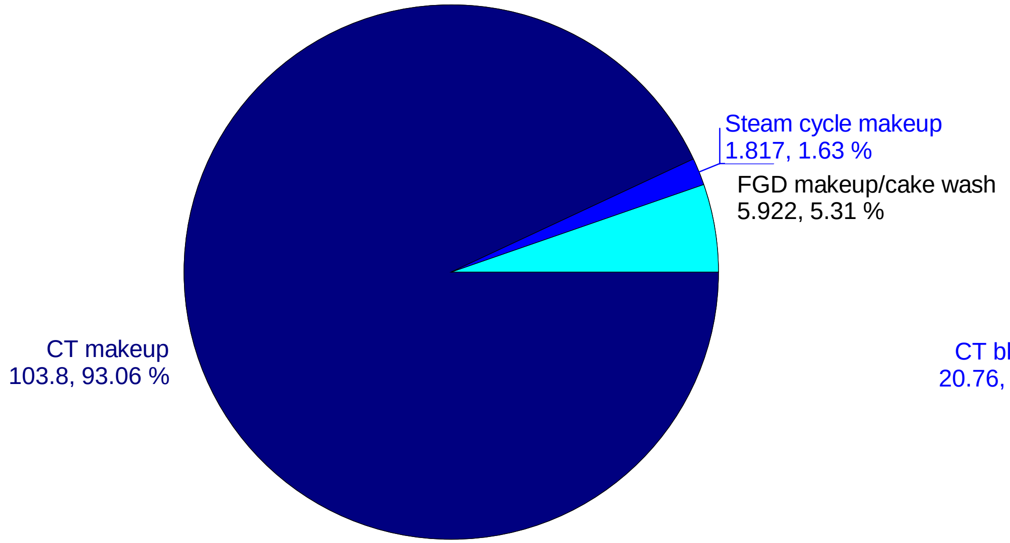
- Each of 2 units
p [bar] T [C] M [t/h] x [-]



STEAM PRO 28.2 Ivanusic, Karl 464 04-06-2020 17:24:45 Steam Properties: IFC-67
FILE: \\jacobs.com\ANZ\IE\Projects\03_Southern\IS305100\01 Design\Concept Design\Concept Thermoflow Model\4 Prospect Hill EfW Plant 2 boiler + 2 turbi
p[bar], T[C], h[kJ/kg], m[t/h], x[-]

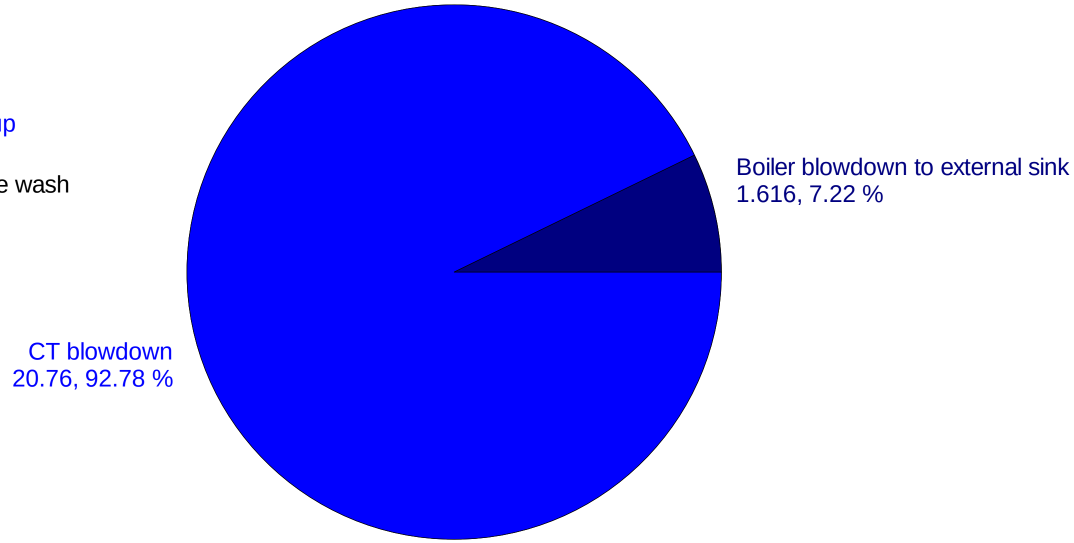
Plant Water Consumption [t/h]

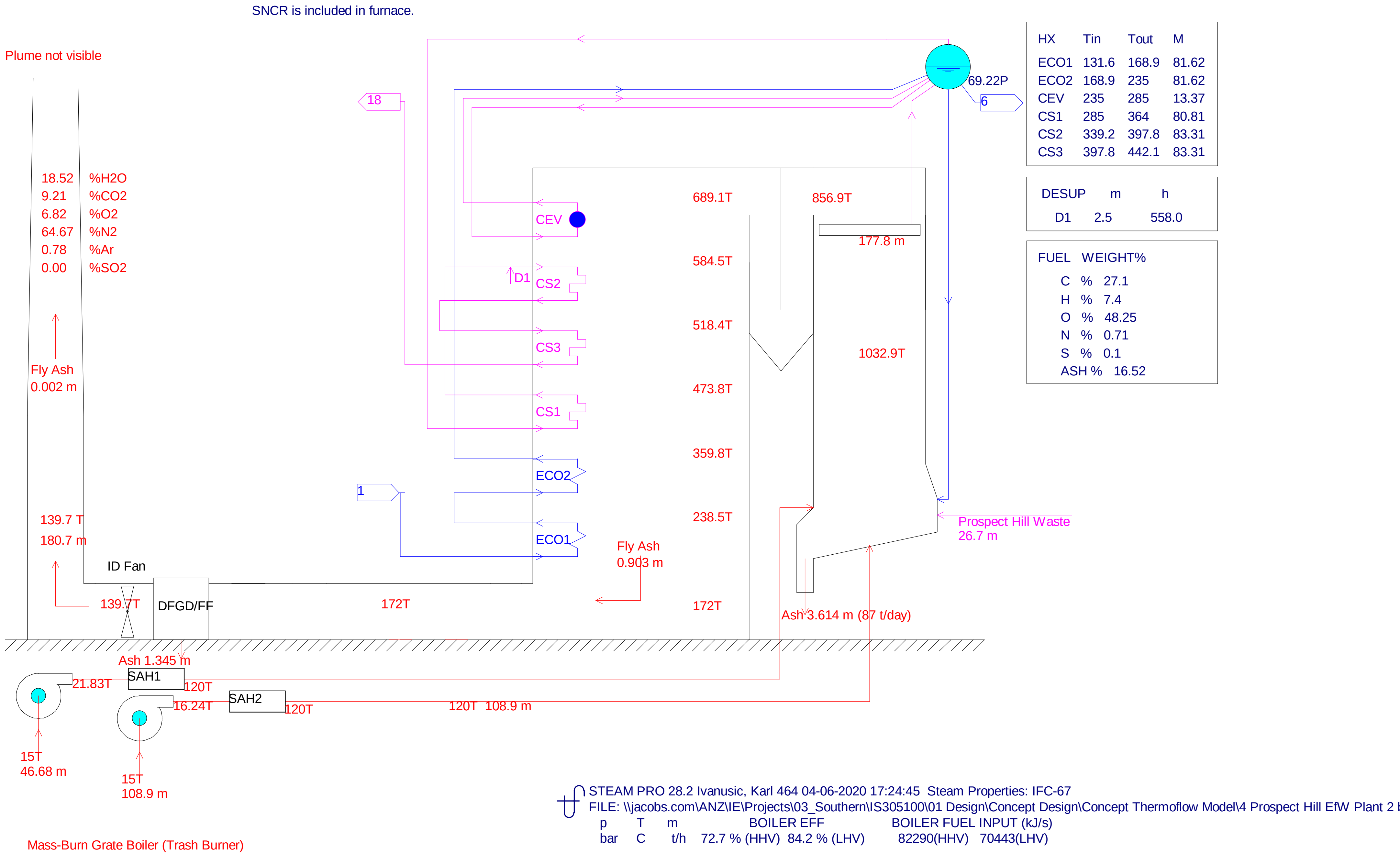
Plant water consumption = 111.5 t/h



Plant Water Discharge [t/h]

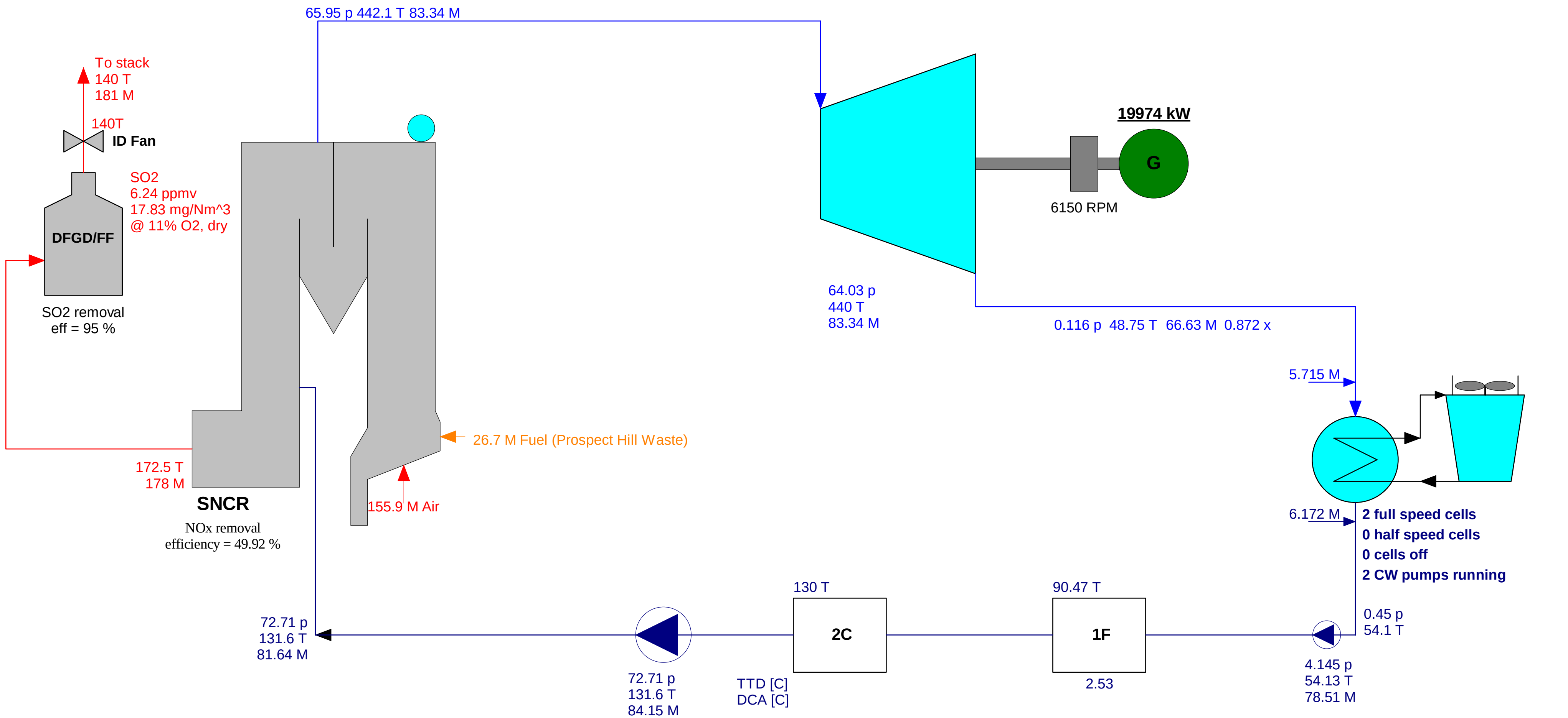
Plant water discharge = 22.37 t/h




SNCR is included in furnace.
Plume not visible
18.52 %H2O
9.21 %CO2
6.82 %O2
64.67 %N2
0.78 %Ar
0.00 %SO2
Fly Ash
0.002 m
139.7 T
180.7 m
ID Fan
139.7T
DFGD/FF
172T
Fly Ash
0.903 m
172T
Ash 3.614 m (87 t/day)
Ash 1.345 m
SAH1
21.83T
120T
SAH2
16.24T
120T
120T 108.9 m
15T
46.68 m
15T
108.9 m
18
1
69.22P
6
CEV
D1
CS2
CS3
CS1
ECO2
ECO1
689.1T
856.9T
177.8 m
584.5T
518.4T
1032.9T
473.8T
359.8T
238.5T
Prospect Hill Waste
26.7 m
HX Tin Tout M
ECO1 131.6 168.9 81.62
ECO2 168.9 235 81.62
CEV 235 285 13.37
CS1 285 364 80.81
CS2 339.2 397.8 83.31
CS3 397.8 442.1 83.31
DESUP m h
D1 2.5 558.0
FUEL WEIGHT%
C % 27.1
H % 7.4
O % 48.25
N % 0.71
S % 0.1
ASH % 16.52
STEAM PRO 28.2 Ivanusic, Karl 464 04-06-2020 17:24:45 Steam Properties: IFC-67
FILE: \\jacobs.com\ANZ\IE\Projects\03_Southern\IS305100\01 Design\Concept Design\Concept Thermoflow Model\4 Prospect Hill EfW Plant 2 I
p T m BOILER EFF BOILER FUEL INPUT (kJ/s)
bar C t/h 72.7 % (HHV) 84.2 % (LHV) 82290(HHV) 70443(LHV)
Mass-Burn Grate Boiler (Trash Burner)

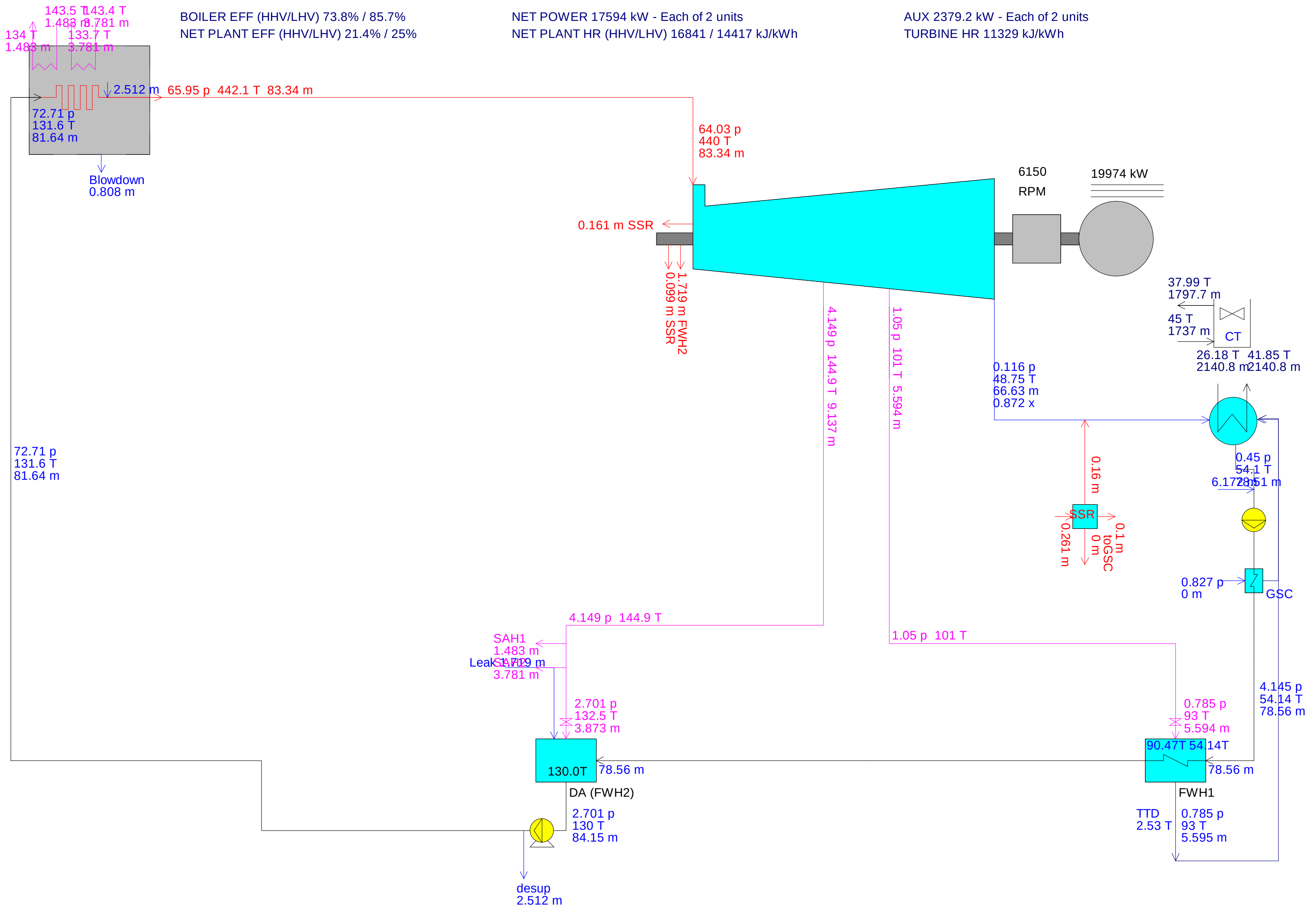
Plant gross power	39947	kW
Plant net power	35189	kW
Number of units	2	
Plant net HR (HHV)	16841	kJ/kWh
Plant net HR (LHV)	14417	kJ/kWh
Plant net eff (HHV)	21.38	%
Plant net eff (LHV)	24.97	%
Aux. & losses	4758	kW
Fuel heat input (HHV)	592.6	GJ/h
Fuel heat input (LHV)	507.3	GJ/h
Fuel flow	1282	t/day

Ambient
1.011 p
45 T
14% RH
22.87 T wet bulb



Mass-Burn Grate Boiler (Trash Burner)

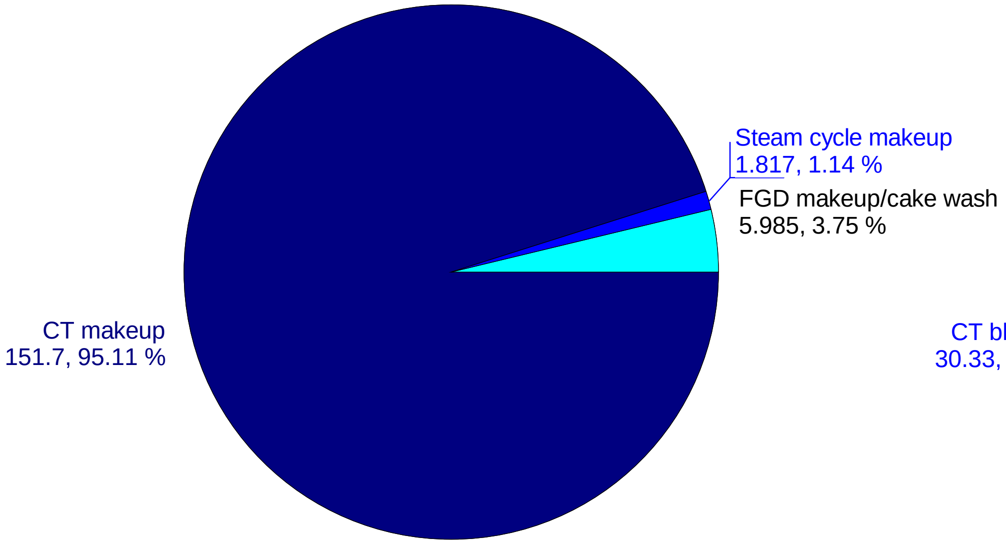
- Each of 2 units
p [bar] T [C] M [t/h] x [-]



STEAM MASTER 28.2 Ivanusic, Karl 464 04-06-2020 17:36:04 Steam Properties: IFC-67
FILE: \\jacobs.com\ANZ\IE\Projects\03_Southern\IS305100\01 Design\Concept Design\Concept Thermoflow Model\5 Prospect Hill EfW Plant 2 boiler + 2 turbine - Max temp\5 Prospect Hill Ef
1 CONDENSER 2 COOLING TOWERS
p[bar], T[C], m[t/h], h[kJ/kg], x[-]

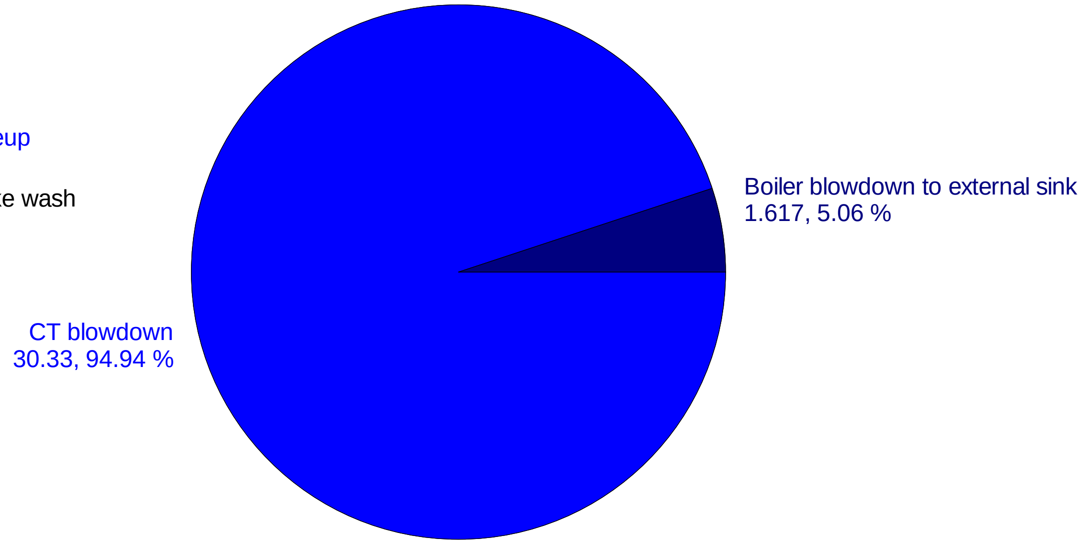
Plant Water Consumption [t/h]

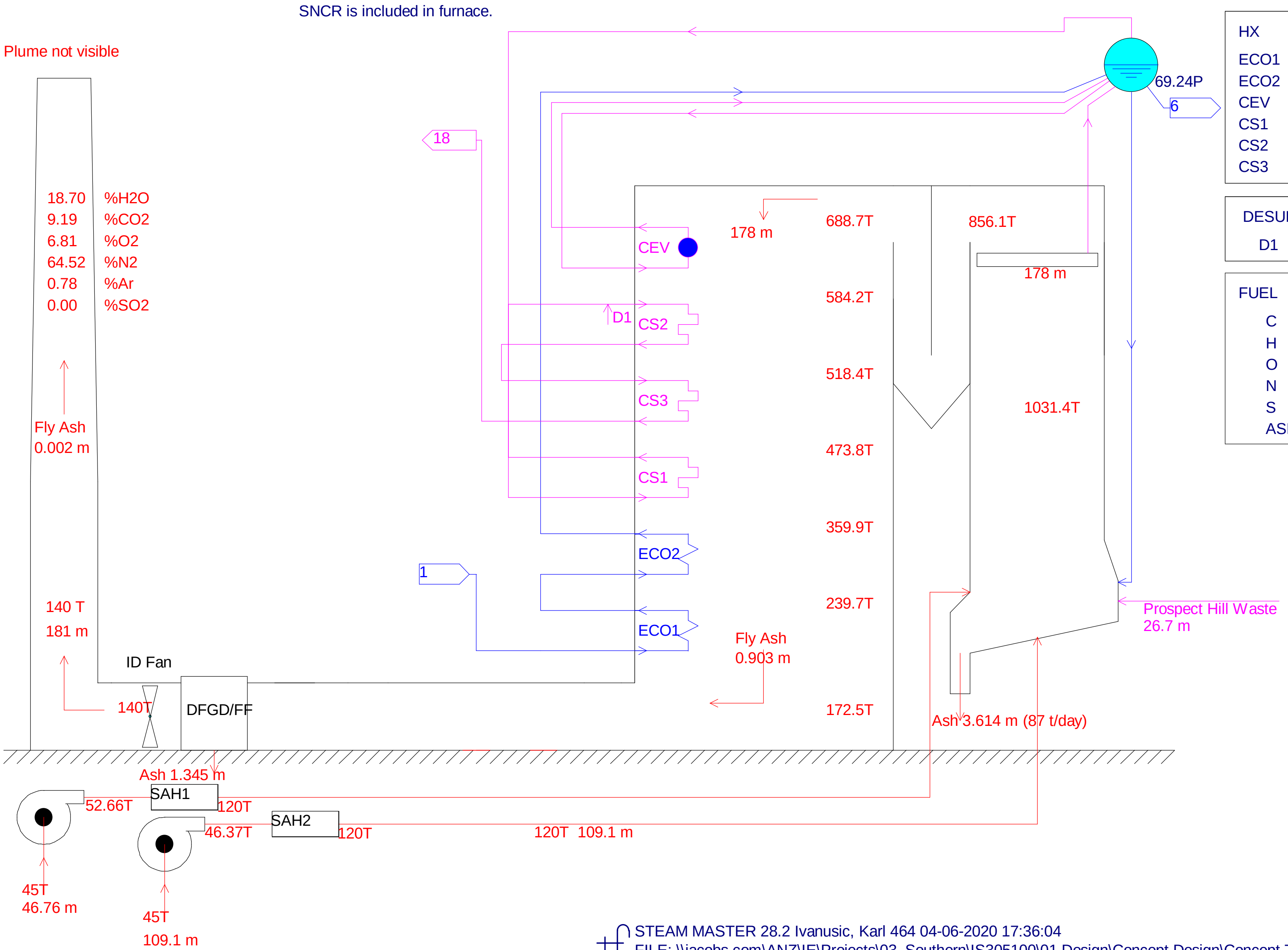
Plant water consumption = 159.5 t/h



Plant Water Discharge [t/h]

Plant water discharge = 31.95 t/h





HX	Tin	Tout	M
ECO1	131.6	169.4	81.64
ECO2	169.4	235.5	81.64
CEV	235.5	285.1	13.4
CS1	285.1	364.2	80.83
CS2	339.2	398.2	83.34
CS3	398.2	442.1	83.34

DESUP	m	h
D1	2.5	558

FUEL	WEIGHT%	
C	%	27.1
H	%	7.4
O	%	48.25
N	%	0.71
S	%	0.1
ASH %		16.52

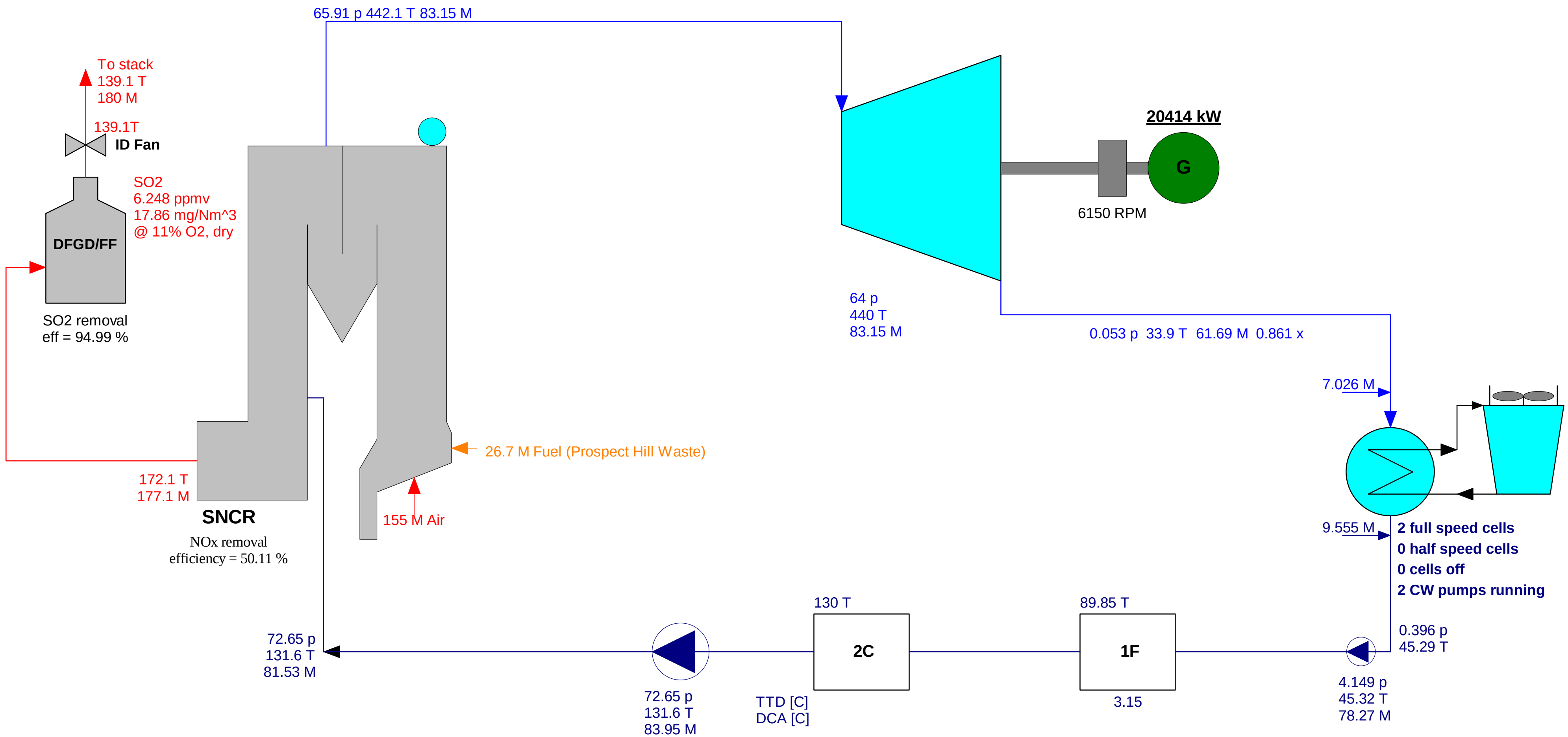
STEAM MASTER 28.2 Ivanusic, Karl 464 04-06-2020 17:36:04
FILE: \\jacobs.com\ANZ\IE\Projects\03_Southern\IS305100\01 Design\Concept Design\Concept Thermoflow Model\5 Prospect Hill EfW Plant 2 boiler + 2 t

p	T	m	h	Boiler Eff (HHV/LHV)	Fuel Energy kJ/s
bar	C	t/h	kJ/kg	73.8% / 85.7%	82310(HHV) / 70461(LHV)

Mass-Burn Grate Boiler (Trash Burner)

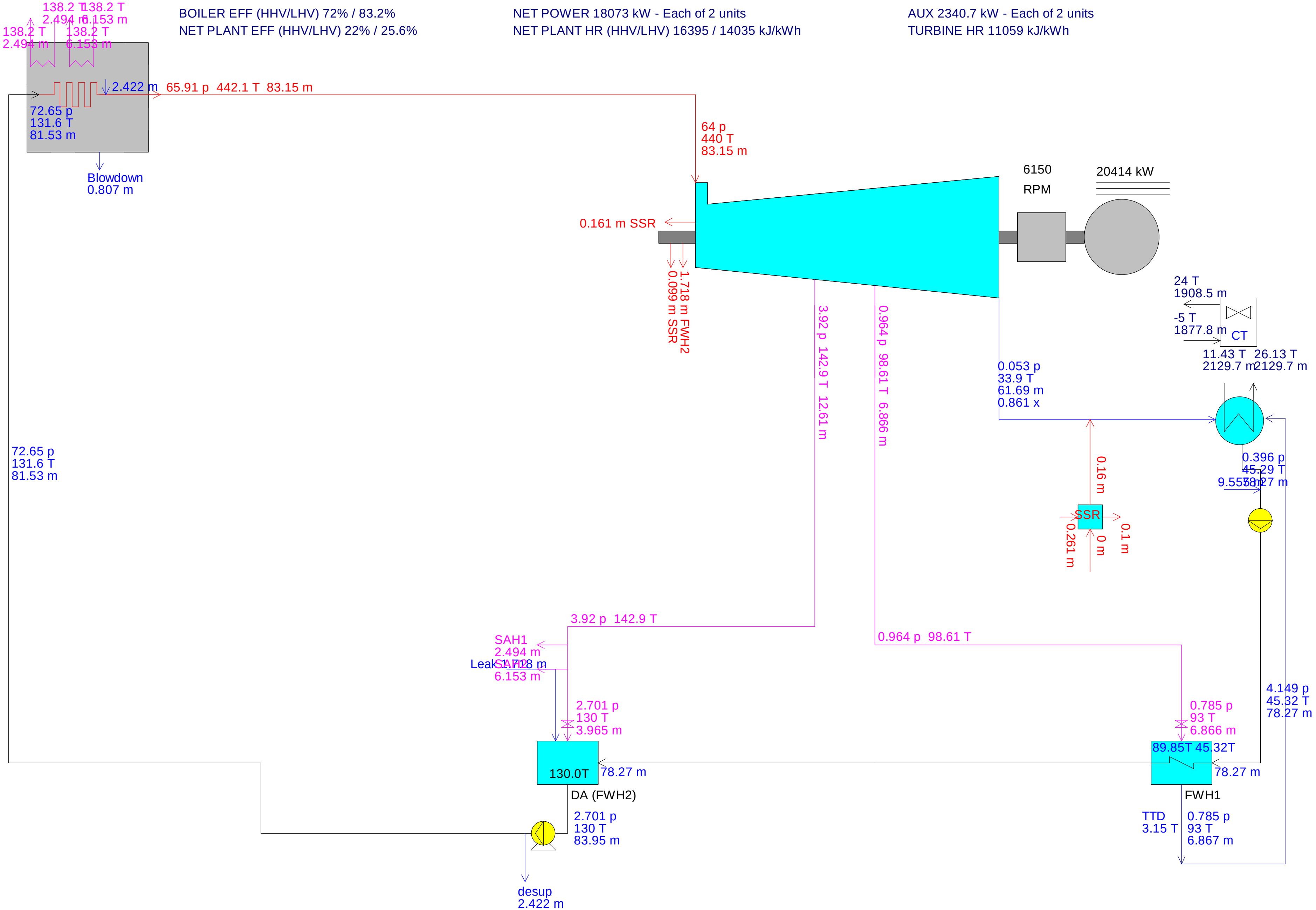
Plant gross power	40828	kW
Plant net power	36146	kW
Number of units	2	
Plant net HR (HHV)	16395	kJ/kWh
Plant net HR (LHV)	14035	kJ/kWh
Plant net eff (HHV)	21.96	%
Plant net eff (LHV)	25.65	%
Aux. & losses	4681	kW
Fuel heat input (HHV)	592.6	GJ/h
Fuel heat input (LHV)	507.3	GJ/h
Fuel flow	1282	t/day

Ambient
1.011 p
-5 T
100% RH
-5 T wet bulb



Mass-Burn Grate Boiler (Trash Burner)

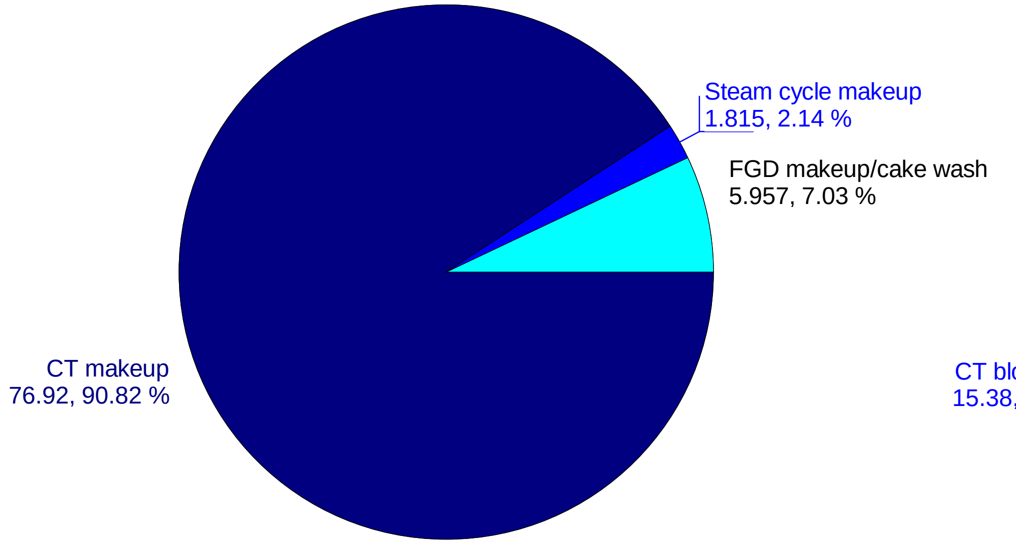
- Each of 2 units
p [bar] T [C] M [t/h] x [-]



STEAM MASTER 28.2 Ivanusic, Karl 464 04-06-2020 17:39:36 Steam Properties: IFC-67
FILE: \\jacobs.com\ANZ\IE\Projects\03_Southern\IS305100\01 Design\Concept Design\Concept Thermoflow Model\6 Prospect Hill EfW Plant 2 + 2 turbine - Min temp\6 Prospect Hill EfW Plar
1 CONDENSER 2 COOLING TOWERS
p[bar], T[C], m[t/h], h[kJ/kg], x[-]

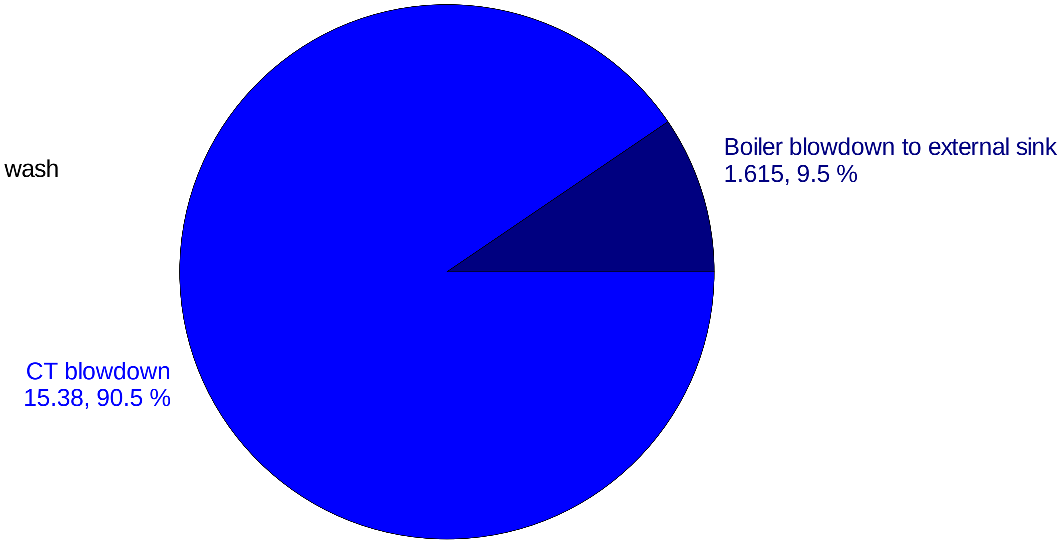
Plant Water Consumption [t/h]

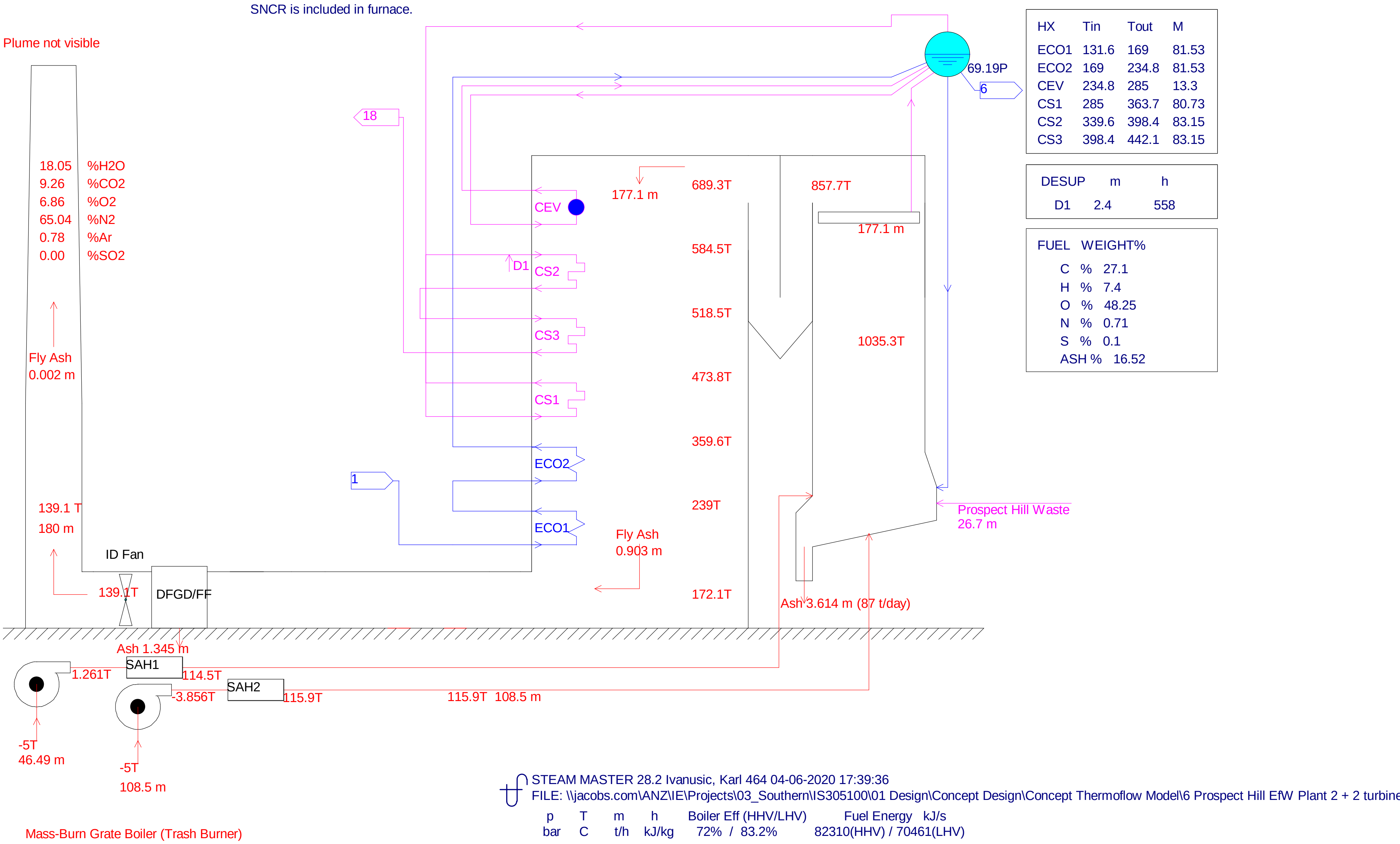
Plant water consumption = 84.69 t/h



Plant Water Discharge [t/h]

Plant water discharge = 17 t/h




SNCR is included in furnace.
Plume not visible
18.05 %H2O
9.26 %CO2
6.86 %O2
65.04 %N2
0.78 %Ar
0.00 %SO2
Fly Ash
0.002 m
139.1 T
180 m
ID Fan
139.1T
DFGD/FF
Ash 1.345 m
SAH1
1.261T
114.5T
SAH2
-3.856T
115.9T
115.9T 108.5 m
-5T
46.49 m
-5T
108.5 m
18
1
CEV
D1
CS2
CS3
CS1
ECO2
ECO1
177.1 m
689.3T
584.5T
518.5T
473.8T
359.6T
239T
172.1T
Fly Ash
0.903 m
857.7T
177.1 m
1035.3T
69.19P
6
Prospect Hill Waste
26.7 m
Ash 3.614 m (87 t/day)
HX Tin Tout M
ECO1 131.6 169 81.53
ECO2 169 234.8 81.53
CEV 234.8 285 13.3
CS1 285 363.7 80.73
CS2 339.6 398.4 83.15
CS3 398.4 442.1 83.15
DESUP m h
D1 2.4 558
FUEL WEIGHT%
C % 27.1
H % 7.4
O % 48.25
N % 0.71
S % 0.1
ASH % 16.52
STEAM MASTER 28.2 Ivanusic, Karl 464 04-06-2020 17:39:36
FILE: \\jacobs.com\ANZ\IE\Projects\03_Southern\IS305100\01 Design\Concept Design\Concept Thermoflow Model\6 Prospect Hill EfW Plant 2 + 2 turbine
p T m h Boiler Eff (HHV/LHV) Fuel Energy kJ/s
bar C t/h kJ/kg 72% / 83.2% 82310(HHV) / 70461(LHV)
Mass-Burn Grate Boiler (Trash Burner)

Appendix C – Climatic site conditions

Table 5.5 : Summary of Climate statistics for Lara (Avalon Airport)[2]

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature (Based on a year period of 1995 – 2020)													
Maximum (°C)	46.3	47.9	42.0	36.1	28.0	23.6	22.5	25.9	31.3	37.8	41.8	45.8	47.9
Mean maximum (°C)	26.6	26.3	24.4	20.6	17.3	14.7	14.2	15.4	17.8	20.3	22.5	24.6	20.4
Mean minimum (°C)	14.2	14.5	12.7	9.7	7.7	5.8	5.2	5.5	6.7	8.0	10.5	11.9	9.4
Minimum (°C)	4.5	6.8	2.9	0.6	-0.7	-2.9	-4.0	-4.4	-1.7	0.1	2.6	4.8	-4.4
Rainfall (Based on a year period of 1995 – 2020)													
Mean rainfall (mm)	32.3	32.3	26.6	37.3	37.6	39.4	37.6	42.5	44.0	46.7	48.4	29.2	454.8
Decile 5 (median) rainfall (mm)	25.0	22.0	24.2	30.0	31.0	37.0	31.4	39.5	41.5	40.0	42.2	26.4	441.0
Mean number of days of rain ≥ 1 mm	2.9	2.5	3.0	4.4	5.8	6.2	6.7	6.9	6.7	6.2	5.2	3.5	60.0
9 A.M. Conditions (Based on a year period of 1995 – 2010)													
Mean 9am T (°C)	18.9	18.5	16.3	14.4	11.6	9.1	8.3	9.8	12.4	14.4	15.9	17.4	13.9
Mean 9am RH (%)	68	71	74	76	84	86	85	80	72	66	69	66	75
Mean 9am wind speed (km/h)	18.2	17.0	16.6	16.7	15.8	15.2	16.5	18.6	21.9	21.7	20.4	19.8	18.2
3 P.M. Conditions (Based on a year period of 1995 – 2010)													
Mean 3pm T (°C)	24.0	24.2	22.4	18.8	15.8	13.6	12.9	14.1	15.9	17.9	20.3	21.8	18.5
Mean 3pm RH (%)	50	49	49	56	64	68	66	62	58	53	54	53	57
Mean 3pm wind speed (km/h)	26.3	25.4	24.1	22.3	20.1	20.5	21.9	24.4	26.2	26.5	26.9	27.0	24.3

[2] http://www.bom.gov.au/climate/averages/tables/cw_087113_All.shtml#temperature

9am Wind rose data[3]

[3] http://www.bom.gov.au/clim_data/cdio/tables/pdf/windrose/IDCJCM0021.087113.9am.pdf

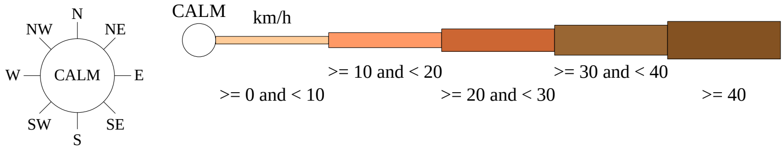
Rose of Wind direction versus Wind speed in km/h (01 Nov 1965 to 10 Aug 2019)

Custom times selected, refer to attached note for details

AVALON AIRPORT

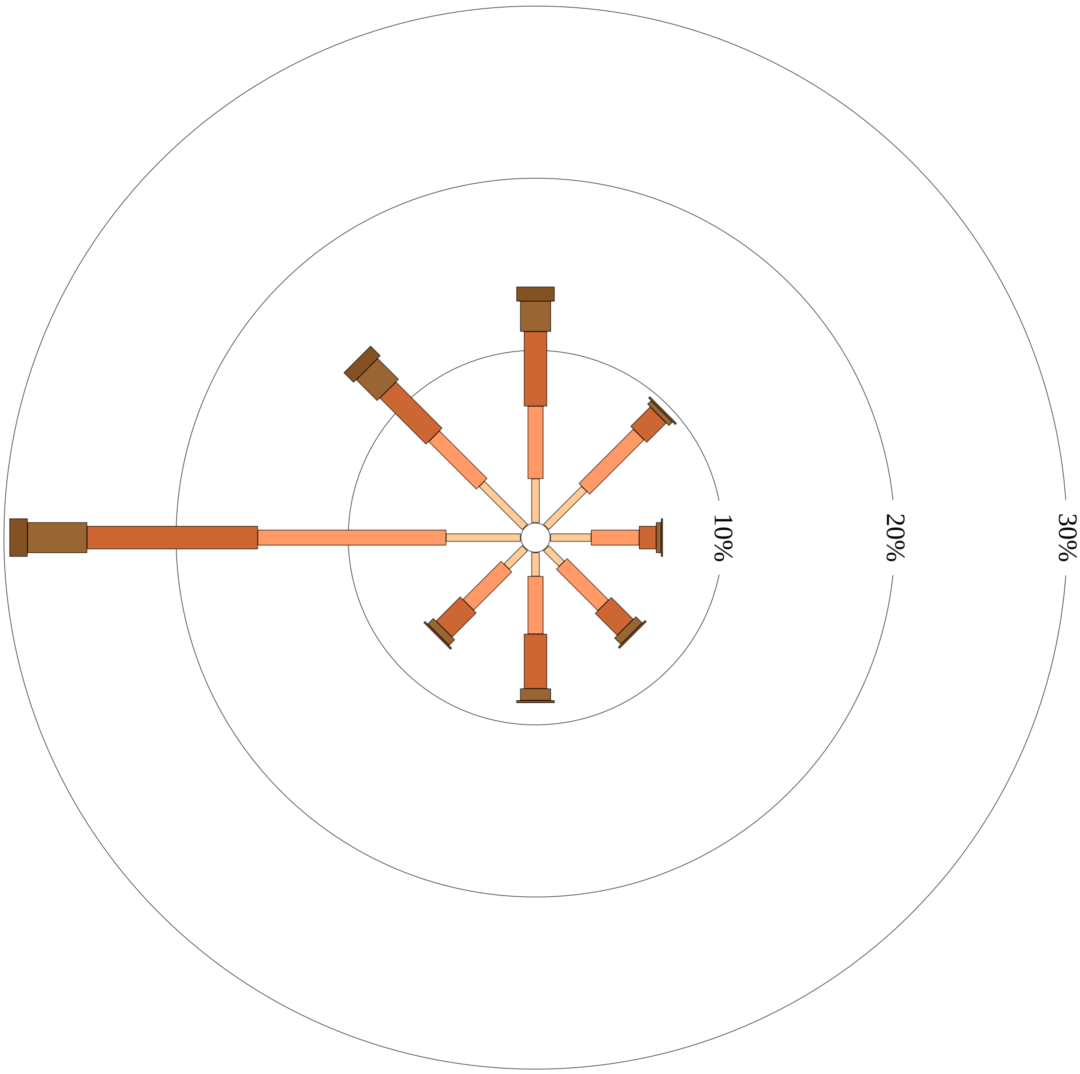
Site No: 087113 • Opened Jan 1965 • Still Open • Latitude: -38.0287° • Longitude: 144.4783° • Elevation 10.m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



9 am
10182 Total Observations

Calm 4%



3pm Wind rose data[4]

[4] http://www.bom.gov.au/clim_data/cdio/tables/pdf/windrose/IDCJCM0021.087113.3pm.pdf

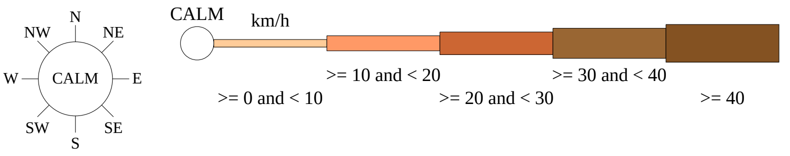
Rose of Wind direction versus Wind speed in km/h (01 Nov 1965 to 10 Aug 2019)

Custom times selected, refer to attached note for details

AVALON AIRPORT

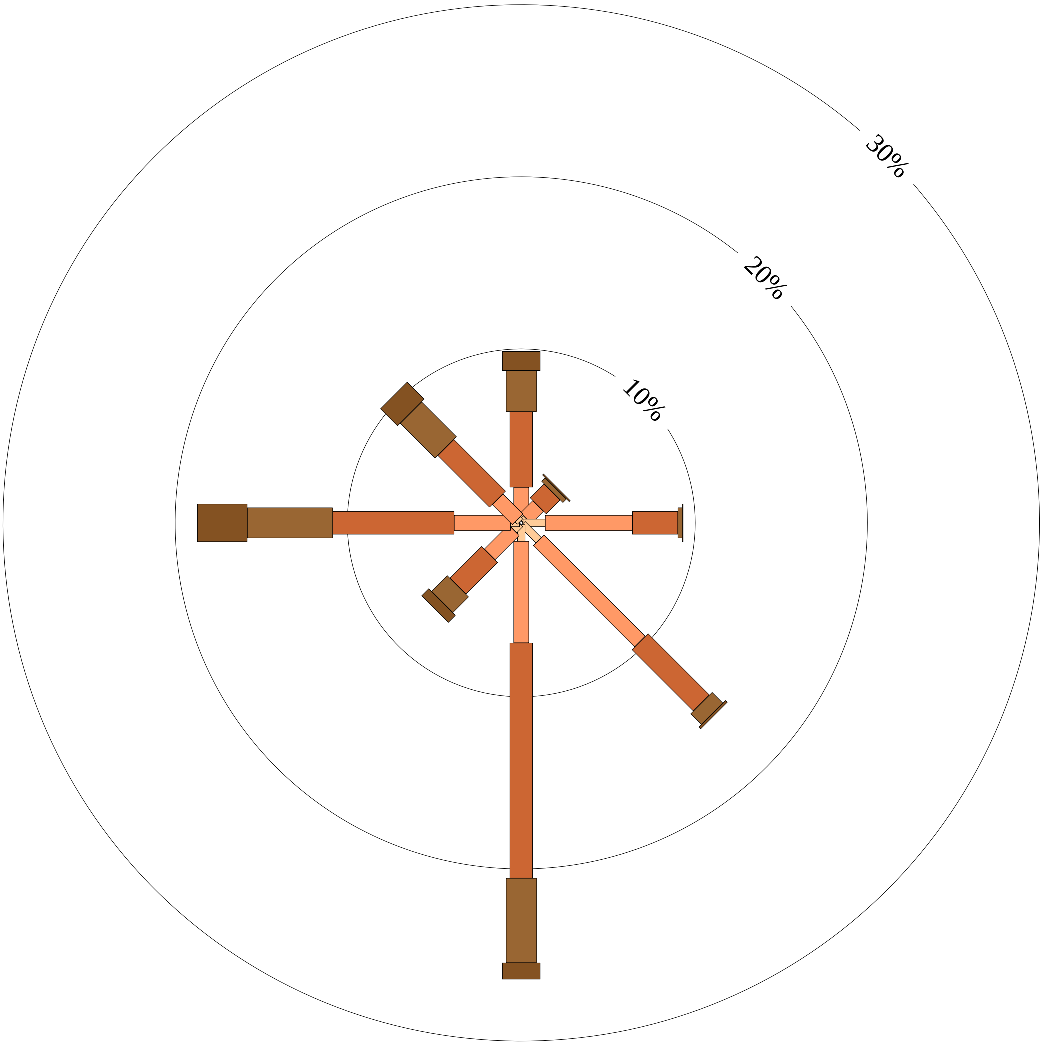
Site No: 087113 • Opened Jan 1965 • Still Open • Latitude: -38.0287° • Longitude: 144.4783° • Elevation 10.m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.

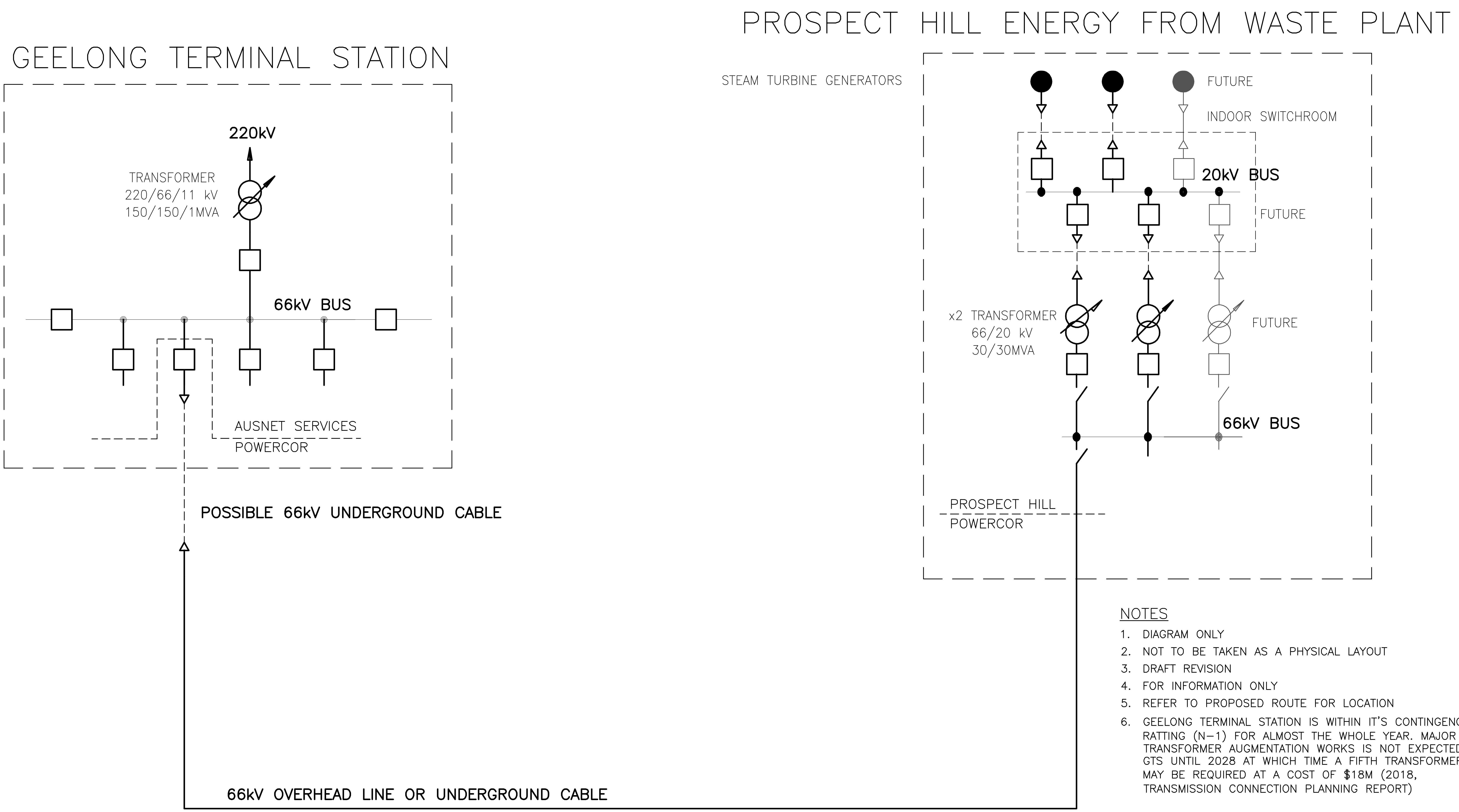


3 pm
10409 Total Observations

Calm *



Appendix D – Single Line Diagram



NOTES

1. DIAGRAM ONLY
2. NOT TO BE TAKEN AS A PHYSICAL LAYOUT
3. DRAFT REVISION
4. FOR INFORMATION ONLY
5. REFER TO PROPOSED ROUTE FOR LOCATION
6. GEELONG TERMINAL STATION IS WITHIN IT'S CONTINGENCY RATTING (N-1) FOR ALMOST THE WHOLE YEAR. MAJOR TRANSFORMER AUGMENTATION WORKS IS NOT EXPECTED AT GTS UNTIL 2028 AT WHICH TIME A FIFTH TRANSFORMER MAY BE REQUIRED AT A COST OF $18M (2018, TRANSMISSION CONNECTION PLANNING REPORT)

CONCEPT ONLY

DRAWING No.	REFERENCE DRAWING TITLE	REVISION DESCRIPTION	REV.	BY	CHK'D	APPR'D	PRJ. ENG	DATE
REFDWGNO1	REFTITLE1	DESC1	REV1	TKC	KI	APP1	PRJENG1	03/03/20

CLIENT PROSPECT_HILL

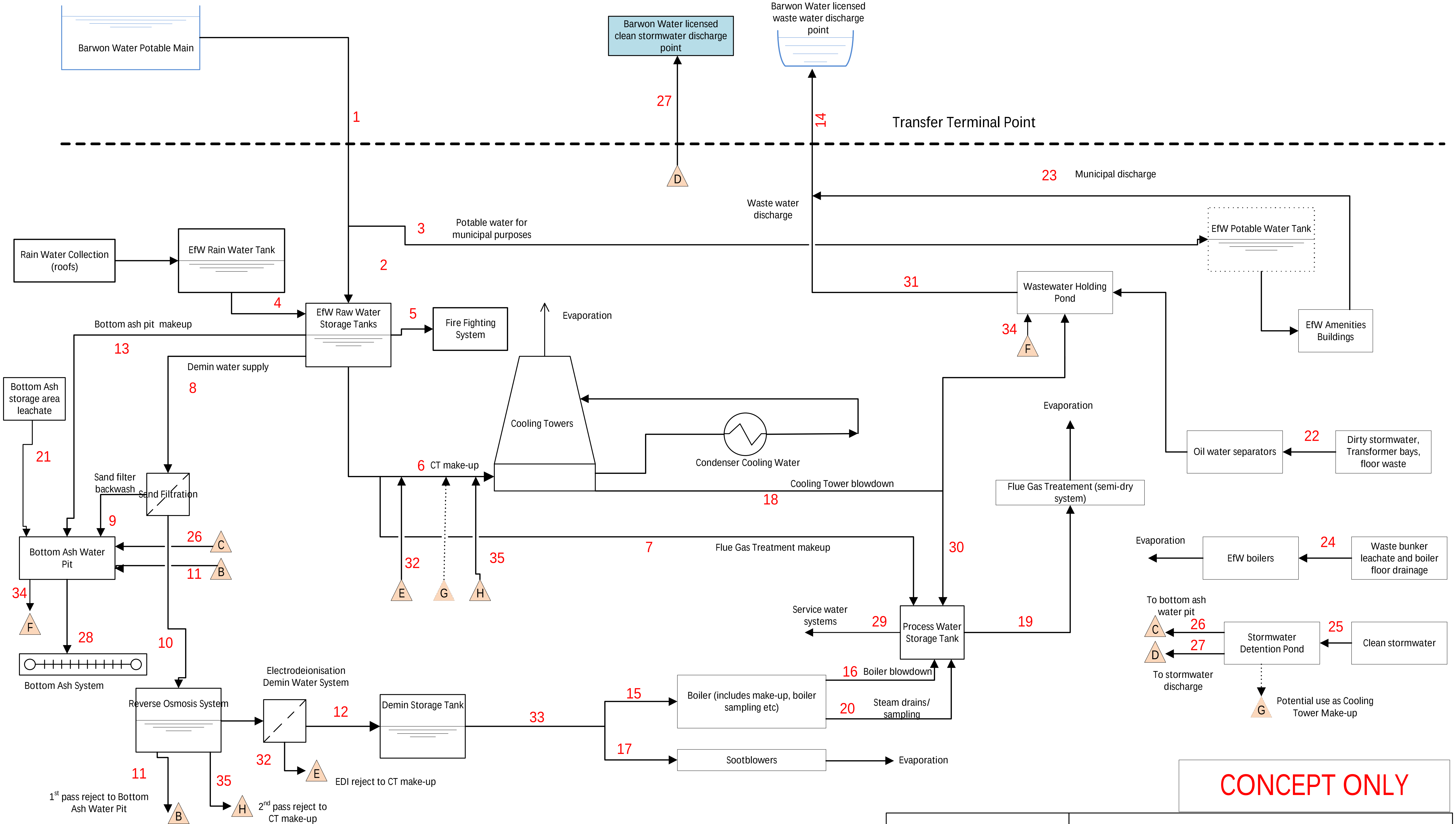
	BY	DATE
APPROVED	APPRVD	APPDATE
CLIENT APPROVED	CLTAPP	CLTDATE
ISSUED FOR CONSTRUCTION	ISSCON	ISSDATE
SCALE	SCALE	

JACOBS

CLIENT No. CLTDWGNO REV. CLTREV
DRG. No. JACOBSDRGNO REV. JACOBSREV

PROSPECT_HILL
ELECTRICAL_SINGLE_LINE_DIAGRAM
TITLE3

Appendix E – Water Balance



Notes:

1) This water balance shows preliminary information only and is subject to change during the detailed feasibility and engineering phase.

2) The flows shown below are based on ambient site conditions (15°C and 65% RH) and corresponding plant performance based on these conditions.

Stream No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Flow (m^3/day)	2,516	2,500	16	51	-	2,481	-	70	4	66	13	51	-	389	48	39	3
Stream No.	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Flow (m^3/day)	499	143	5	12	20	13	24	83	- 2	84	27	44	142	377	3	50	-

Prospect Hill	Prospect Hill Energy from Waste Plant					
	Preliminary Water Balance Diagram					
Concept Only	SIZE	FSCM NO		DWG NO		REV A
Prepared by Karl Ivanusic - Jacobs	SCALE	NTS	15/4/2020	SHEET	1 OF 1	