A	13/05/2016	E. BARRET	E. MARCARIAN	E. MARCARIAN
Rev.	Date	Auteur / Author	Verifié par / Checked by	Approuvé par / Approved by

Trident Park Energy from Waste Facility

Client	Client's Representative
Viridor Trident Park Limited	FICHTNER Consulting Engineers Limited

EPC Contractor

CNIM
18, rue Grange Dame Rose
78457 Velizy Villacoublay Cedex
FRANCE

Lagan CONSTRUCTION
Rosemount House
21-23 Sydenham Road
BELFAST BT3 9HA

Subcontractor identification	Subcontractor logo

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Temperature site measurements
Vs
CFD simulation results

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1. INTRODUCTION

CFD software used for modeling is StarCCM+ version 10.06 provided by CD ADAPCO company.

Following the CARDIFF furnace CFD modelling 47021103_95I003, this document presents Temperature site measurement Vs CFD simulation result.

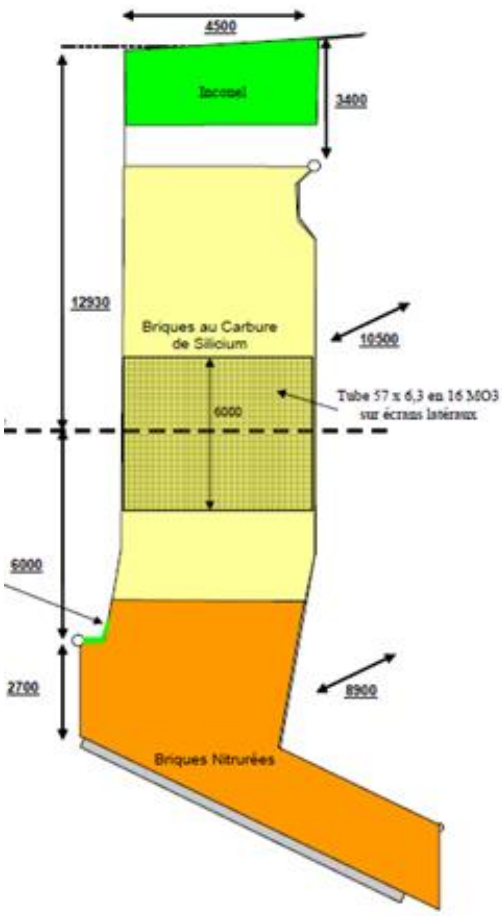
2. CHARACTERISTICS OF CARDIFF BOILER

Cases studied are MCR (100%) and low load (60%) to 8000 operating hours whose characteristics are the following:

- **Point DSG :**
  LHV (**100%**) = 10 030 KJ/Kg
  Waste mass flow (100%) = 22 960 Kg/h
  ➔ Qw = heat provided by the wastes = 63.96 MW
- **Point 5 :**
  LHV (**60%**) = 7 000 KJ/Kg
  Waste mass flow (60%) = 19 750 Kg/h
  ➔ Qw = heat provided by the wastes = 38.40 MW

The primary air preheating will be made by a preheating on the steam from the turbine, up to 150°C and by drum steam beyond. Secondary air is also injected at 150°C.

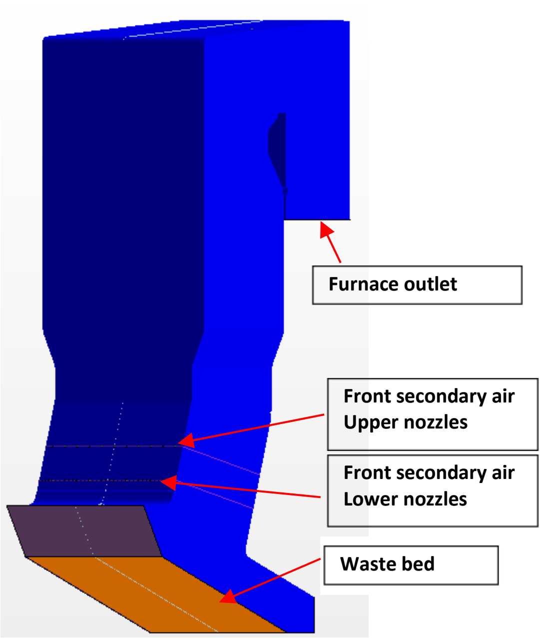
The furnace overall dimensions in the CFD model used are in compliance with the picture below :

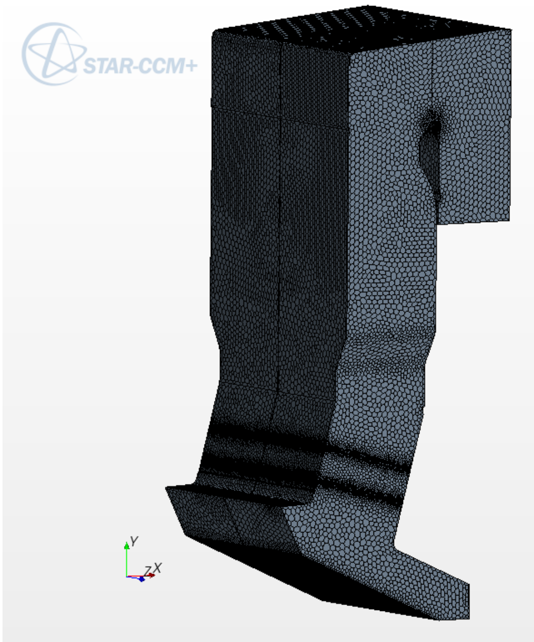


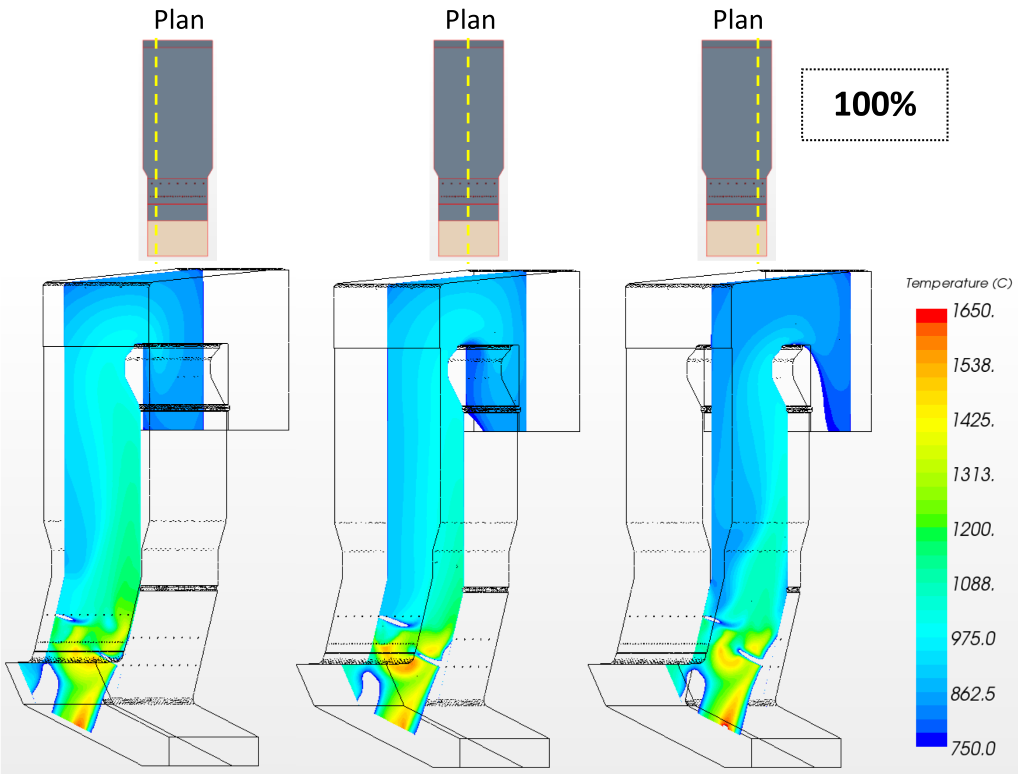
3. MODEL DESCRIPTION

The CARDIFF model used to check the T2S is the same as CARDIFF furnace CFD modelling presented in 47021103_95I003.

- Geometry for modelling,
- Mesh characteristics (polyhedral, cell size constraint, etc)
- Physical models (turbulence k-ε, radiation, etc),
- Boundaries conditions (masse flow inlet for secondary air nozzles and waste bed, etc)
- Input data (Gaseous stream properties (grate load), secondary are values, etc)
- Load case results (100%, 60%)



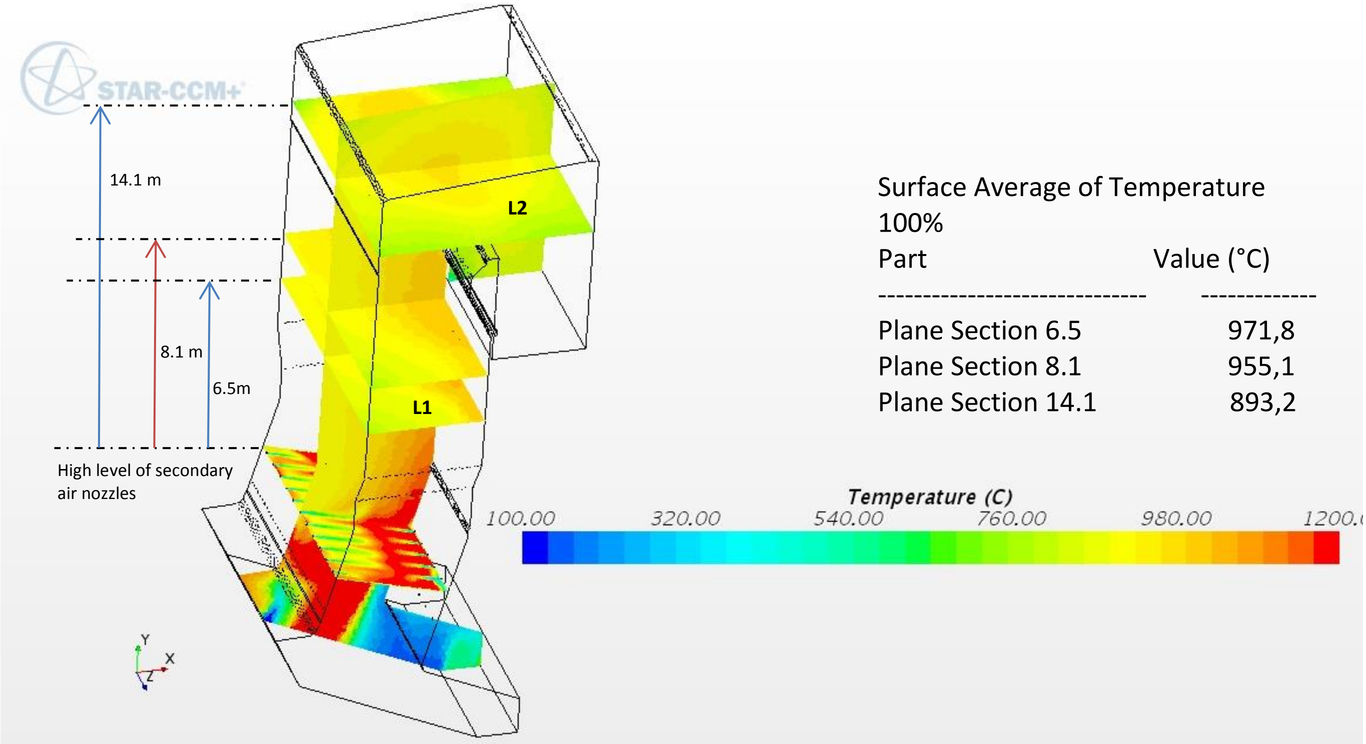




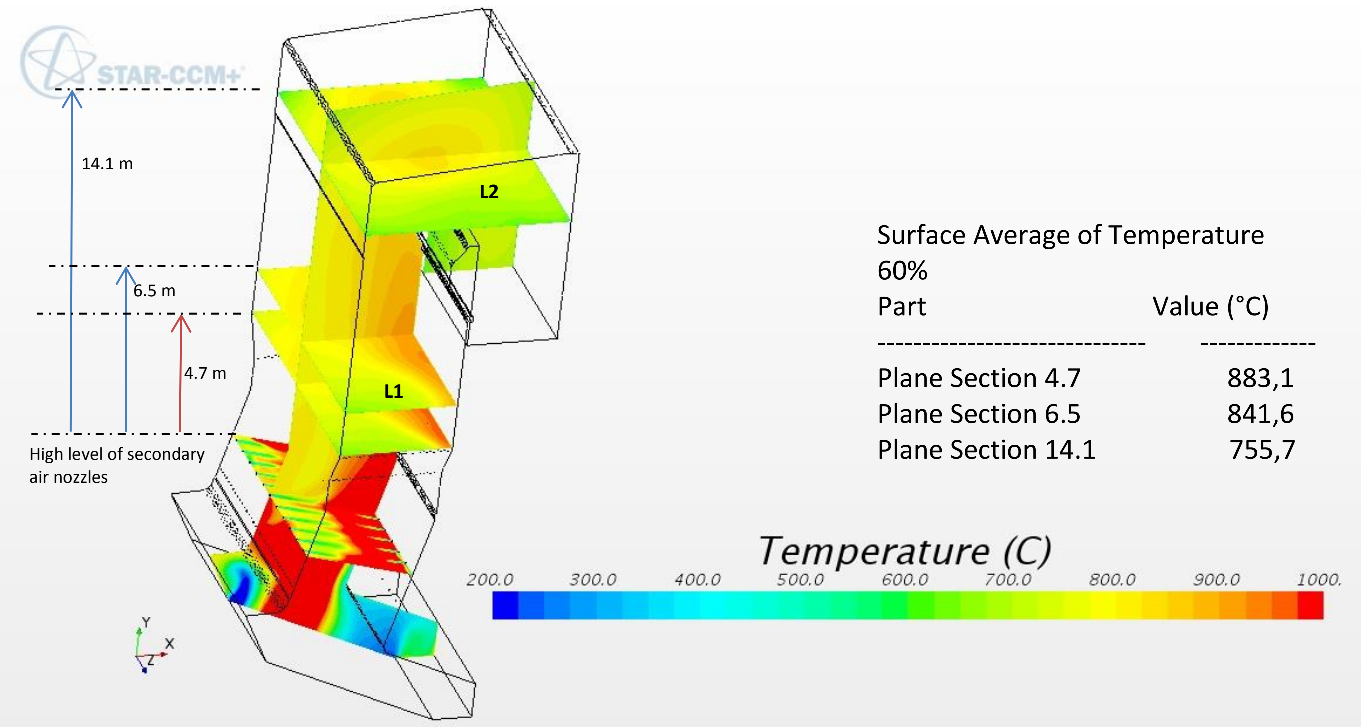
4. TEMPERATURE SITE MEASUREMENT VS CFD SIMULATION RESULTS

4.1. CFD simulation results

4.1.1. Load case 100%



4.1.2. Load case 60%



4.2. Temperature site measurements

4.2.1.Load case 100%

According to the report AVI 60476341 003 CARDIFF Efw performance test Annex 4

L1					
LHV (KJ/kg) : 8 560 Waste mass flow (Kg/h) : 27 760 heat provided by the wastes (kW) : 66.00					
Height (m)	6.5		H2S = 8.1	14.1	
side	Left	Right		Left	Right
Temperature (°C)	1032	960	T2S = 981	958	890
L2					
LHV (KJ/kg) : 9 090 Waste mass flow (Kg/h) : 25 488 heat provided by the wastes (kW) : 64.36					
Height (m)	6.5		H2S = 8.1	14.1	
side	Left	Right		Left	Right
Temperature (°C)	1041	1010	T2S = 1002	915	917

4.2.1.Load case 60%

According to the report AVI 60476341 003 CARDIFF Efw performance test Annex 4

L1					
LHV (KJ/kg) : 10 320 Waste mass flow (Kg/h) : 14 760 heat provided by the wastes (kW) : 42.31					
Height (m)	H2S = 4.7	6.5		14.1	
side		Left	Left	Left	Right
Temperature (°C)	T2S =1042	953	801	862	836
L2					
LHV (KJ/kg) : 8 590 Waste mass flow (Kg/h) : 15 948 heat provided by the wastes (kW) : 38.50					
Height (m)	H2S = 4.7	6.5		14.1	
side		Left	Left	Left	Right
Temperature (°C)	T2S = 960	849	854	837	801

4.3. Comparisons

100%		CFD	Site measures (average)	Err (%)
T2S	°C	955	991	3.6
Lvl 1 (6.5m)	°C	972	1010	3.8
Lvl 2 (14.1m)	°C	893	920	2.9
60%				
T2S	°C	883	1001	11.7
Lvl 1 (6.5m)	°C	842	864	2.5
Lvl 2 (14.1m)	°C	756	834	9.3

To conclude, CFD and site measurements are in compliance.

CFD temperatures are generally slightly below the temperature site measurements. This can be explained by the use of perfect average value to compare to mapping method used during test on site.

The part load case considered for CFD calculation is the most stringent with the lowest LHV. In these conditions, compare to the test values, temperature profile will be lower in CFD calculation.