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CLIENTE Customer	ANSALDO ENERGIA	DOC N° Doc N°	D-804-0
IMPIANTO Plant	POWER PLANT	FOGLIO Sheet	1 Di of 7
LOCALITA' Location	ROSIGNANO	COMMESSA Job	370-00804 B1001A05

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## 1. Introduction

Here below are reported measurements, analysis and calculations to evaluate drift losses of the Evaporative cooling tower of the Combined Cycle Power Plant in Rosignano Solvay.

### 1.1. Drift

During evaporative cooling tower operations circulating water flowrate is distribute as droplets or film to maximize the surface area exposed to the air.

In these processes, small droplets are entrained in the air moving through the tower. Droplets that are not removed from the air stream (by the drift eliminators) are exhausted from the cooling tower into the environment. These droplets are known as DRIFT.

### 1.2. Measurement Procedure

The measurement procedure scope is to evaluate the percentage of droplets exhausted from cooling tower on the total circulating water flowrate.

The exhausted droplets possess the same minerals as the circulating water so the procedure is conducted with these steps:


- collect a circulating water sample;
- collect exhausted water droplets over drift eliminator through an isokinetic sampling probe;
- find a chemical element such a mineral or salt which is present in significant concentration into circulating water;
- measure the salt weight which is collected into isokinetic sample;
- compare tracer salt quantities into circulating water and isokinetic sample.

Percentage is calculated according CTI ATC 140:

$$D\% = (A_{sp} * W_t) / (A_n * Q_w * T_s * [M]_{hw} * r_w)$$

where

$A_{sp}$  = cooling tower cell surface;  
 $W_t$  = tracer's weight collected in the isokinetic sample;  
 $A_n$  = isokinetic probe suction surface;  
 $Q_w$  = circulating water flow;  
 $T_s$  = sampling period;  
 $[M]_{hw}$  = tracer's concentration in the circulating water;

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rw = circulating water specific volume;

## 2. Plant

### 2.1. Plant Description

Evaporative cooling tower is a 6 cells back-back concrete structure.

All cells have same characteristics, circulating water is pre-treated with a filtration and chemical plant.

Plant summary features:

Cooling tower:	WET
Structure:	PreCast concrete
Cells number:	6 back-back all open around
Cell Dims:	15.6 x 15.6 mt
Fan:	9144-6-40F
Installed Power:	170 Kw each cell
Water flowrate:	17840 m3/h
Hot water Temperature:	32,55 °C
Cold water Temperature:	21,65 °C
Wet bulb Temperature:	10,65 °C
Drift Eliminators:	H130
Drift% expected:	0.002% of circulating water flow


### 2.2. Inspection

Before starting sampling an inspection of the plant was conducted to check operating conditions.

A cell was selected as representative of whole plant.

Cell is in a good conditions, water distribution system is ok, mechanical equipment is ok, drift eliminator panels are good.

Circulating cooling water is sea water; according to that recommended tracer should be chlorides.

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## 3. Measurement

### 3.1. Those Presents

Drift test was done on 19/01/07 at presence of:

Ansaldo Energia:

M. Faravelli

A. Cademartori

F. Galante

SPX Cooling Technologies Italia

D. Massara

A. Garagiola

### 3.2. Ambient Conditions

No clouds, ambient temperature 16.47 °C, barometric pressure 1027.4 mBar.

Wind speed < 4.5 m/s.

All parties agreed that ambient conditions are acceptable for drift test.

### 3.3. Instrumentations


Isokinetic probe is equipped with a double filtration. The first filtration stage is a centrifugal filter (cyclon) and the second is a 4 micron particles separator filter.

Vacuum at isokinetic probe is regulated through a valve. Regulation is done according temperature, pressure and air speed inside a measurement pipe.

During isokinetic sampling circulating water flowrate and hot water temperature is acquired.

Used instrumentations is in the following table:

Nr.	Description	Service
1	Anemometer	Air speed at sampling point
2	PT100	Air temperature at sampling point
3	Manometer	Barometric pressure at sampling point
4	Anemometer	Air speed inside measurement pipe

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Nr.	Description	Service
5	PT100	Air temperature inside measurement pipe
6	Pitot tube	Pressure and air speed inside measurement pipe
7	PT100	Hot water temperature

Circulating water flowrate was calculated with pump's curves checking the pressure at pump's discharge and crossing data with an ultrasonic flowmeter device.

### 3.4. Isokinetic Sampling

Isokinetic sampling was conducted in the following way:

- probe was located into the cooling tower cell over drift eliminators plan at about 1 mt.
- probe is connected to vacuum pump by a measurement pipe on the fan deck.
- valves on vacuum line is adjusted to have isokinetic sampling, comparing temperature, speed and pressure inside cell and inside measurement pipe.
- 30 min isokinetic sampling period was respected
- during isokinetic sampling period a bottle of circulating water was collected.
- After isokinetic sampling period probe was washed with demineralized water that is than collected for chemical analysis.

### 3.5. Probe Washing

Probe washing was done with following procedure:

- after each sampling operation, probe was opened and 4 micron particles filter removed. Filter was sealed inside bottle #1 with about 50 ml of distilled water.
- Centrifugal filter and probe was washed with distilled water. All water was collected inside bottle #2. Than distilled water was added to bottle #2 to reach about 200 ml of total amount of water and bottle sealed.
- Probe was than prepared for a new sample.


Above operations was repeated for each sample.

For each sampling about 250 ml of circulating water was collected inside bottle #3.

### 3.6. Drift% Calculation

All collected samples are sent to an authorized chemical laboratory for the analysis (see attached laboratory certifications).

A calculation of tracer weight was done considering the amount added by used distilled water.

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Calculation of Drift % was done according CTI-ATC140 formula:

$$D\% = (Asp * Wt) / (An * Qw * Ts * [M]hw * rw)$$

Results are collected into following summary table:

### Chemical analysis and drift% calculation

Job:	<b>I.240.00008</b>
Customer:	<b>Ansaldo</b>
Plant:	<b>CC Power Plant</b>
Location:	<b>Rosignano Solvay</b>

AN probe area (m2)	0.001134
QW circulating water flowrate Cell (m3/h)	3193.5
ASP cell area (m2)	243.36
ts sampling period (min)	30
water density @ 34.4°C (kg/m3)	994

Sampling Date	Probe washing Sample Nr.	Filter Sample Nr.	Point	WT (mg) Chlorides	Hot Water [M]HW		
					Sample Nr.	Data prel.	chlorides mg/l
19/01/07	1329	1325	p1	0.3020	1337	during p1 sample	27950.000
19/01/07	1330	1326	p2	0.5633	1338	during p2 sample	26570.000
19/01/07	1331	1327	p3	0.5465	1339	during p3 sample	28732.000
19/01/07	1333	1328	p4	0.3095	1341	during p4 sample	23930.000

Drift %
Tracer
Chlorides
0.0001
0.0003
0.0003
0.0002
D% <b>0.0002</b>

### 3.7. Conclusions

According to CTI ATC140 calculations procedure and chemical analysis results coming from an authorized laboratory, final value of drift % is

$$D\% = 0.0002\%$$

of total circulating waterflow.

This value is lower than expected and guaranteed value of di 0.002%.

$$D\% < 0.002\%$$