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Air Quality Control Systems

AQCS:MRC: R652:C
Dt: 09.06.14

Mr.Prakash Dora
OPGCL.

Dear Sir,

Sub : Submission of revised (rev.02) Ash collection data in ESP hopper– reg.
Project: OPGCL BANAHARPALLY STPS STAGE –II, Unit-3 & 4 (2X660 MW).

Ref : Customer no: R652 & R653.
Our clarification letter AQCS:MRC: R652:C dt.20.03.2014
DCPL transmittal ref no: **OPGC/BTG/0194/03-04-2014.**

The has reference to comments on Ash collection data in ESP hoppers vide your above letter. Our point wise reply to DCPL comments are indicated below.

Sl.no.	Document title	Rev. No.	purpose
1.	Ash collection data in ESP hoppers	02	information

Our point wise reply to DCPL comments are indicated below:

SL NO	DCPL COMMENTS	BHEL REPLY
1	**In page no: 9 of 14:** It will be 9 fields working:	Noted Same is corrected in the revised ash collection data
2	**In page no: 9 of 14:** Please check the total ash collected value.	We have corrected the total ash collected value in page no. 9 of 14 of rev.02 document.
3	**In page no:11 of 14:** Please check the total ash collected value.	We have verified the total ash collected value as indicated in the rev-01 document value and it is in order.

We would request to kindly approve the revised document in information category for our record purpose.

With Regards

M.Ravichandran,
Manager / AQCS,
BHEL- Ranipet.

CUSTOMER: Odisha Power Generation Company Limited (OPGCL)

ASH COLLECTION DATA IN VARIOUS FIELDS OF ESP HOPPER

PROJECT: IB Valley, Banharpalli (2X660 MW)

PREPARED BY	:	B.BEHERA
REVIEWED BY	:	M.RAVICHANDRAN
APPROVED BY		GUNASEKAR. G
DATE OF ISSUE & Rev 00	:	21.08.13 Rev.No.00
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Rev.NO.	Rev.Date	Reason for revision
01	20.03.2014	Valley angle corrected in page no.2 “Ash collection data” at BMCR-WC condition added from page no. 3 to 7.
02	09.06.2014	Total ash collected value corrected in page 9 of 14 Number of fields working also corrected in page 9 of 14

Digitally signed by SANDIP SARKAR
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REQUIREMENTS OF ASH HANDLING SYSTEM FOR ESP
(ASH COLLECTION RATES FOR ASH HANDLING SYSTEM DESIGN ONLY)

The Electrostatic Precipitators are installed after the Air-pre heater collects the maximum amount of fly ash from the dust laden flue gas in a boiler circuit and is stored temporally in the ash hoppers. These fly ash have to be removed from the hoppers by installing fly ash removal system.

In order to ensure that most efficient and economical design for the fly ash removal system, it is of utmost importance that certain major points are to be brought to the notice of those responsible for the specifications and the design of fly ash handling equipment.

There are 4 electrostatic precipitators of size FAA - 10 X 45M - 2 X 116150 - 2 per boiler. Each ESP is provided with 4 hoppers arrangement across the flow directions. Each ESP is provided with 40 numbers of hoppers. These ash hoppers are located directly beneath the fields and receive the fly ash dislodged from the collecting electrode and emitting system. The hoppers are of pyramidal shape with an outlet opening size of 400x400 mm and are designed to have a valley angle of 62.6 Deg. This valley angle is provided to ensure free flow of fly ash. For free flow of ash it is recommended to set the hopper heater temperature at 120 Deg C during normal operation of ESP.

Hopper heaters are provided to avoid condensation of water vapor on the inside surface of the hopper. The ash handling system supplier shall ensure a gas-tight joint at hopper outlet to avoid admission of moisture into the hopper wall and interfere with the free flow of ash inside the ash hoppers.

One of the important factors to be considered while specifying the ash disposal system is the pattern of ash collection in ash hoppers along the flue gas path. The rapping of the collecting electrodes and emitting electrodes are intermittent and are programmed by microprocessor based rapper controller. This intermittent operation of rapping mechanism is essential from the point of view of operation of the precipitators. Sufficient collection of fly ash on the collecting plates must be permitted so that at the time of rapping, the collected dust shears off the collecting electrodes and falls into the hoppers in the form of large agglomerates thereby minimizing the rapping losses.

Ash Collection Rate at BMCR-WC Condition:

The ESP is designed with all fields in service at BMCR WC firing . Regarding the patterns of ash collection at different field availability conditions are tabulated below.

Case-I: The ash collection rate is furnished for 9 working fields considering the **first field OUT of service condition**. (Details furnished in Table-1)

Case-II: The ash collection rate is furnished for 8 working fields considering the **first field and second fields OUT of service condition**. This is because at some time any one field in addition to the Case-I might occur. (Details furnished in Table-2)

Case-III: The ash collection rate is furnished for 9 working fields considering the **last field OUT of service condition**. This is another variant of Case-I.(Details furnished in Table-3)

Case-IV: The ash collection rate is furnished for all 10 working fields considering all fields are in service for information purpose. (Details furnished in Table-4)

(TABLE – 1)

CASE – I

Pattern Of Ash Collection Rate In Different Hoppers Considering **9 Fields Working And First Field out of service** Condition (At BMCR WC condition)

Field Sl. no	Working Field No	Stage Efficiency %	Rapping Frequency Raps/hr	Period of Collection (minutes)	Ash Collection per rap (Kg/Rap)	Ash collection Per hopper (Kg/hr)	No. of hoppers per field in a row	Ash collection per ESP (kg/hr)
1	**OUT OF SERVICE**							
2	2	68	15	4	566.6	8499	4	33997
3	3	17.2	10	6	215	2150	4	8599
4	4	7.8	6	10	162.5	975	4	3900
5	5	3.635	4	15	113.6	454.4	4	1817
6	6	1.71	3	20	71.3	213.9	4	855
7	7	0.838	2	30	52.4	104.8	4	419
8	8	0.4	1	60	50	50	4	200
9	9	0.198	1	60	24.8	24.8	4	99
10	10	0.103	0.5	120	25.5	12.75	4	51
							Total (kg)	49937
							Total ash entering in one ESP per hour, in kg	49995
							Total ash collected in one ESP per hour, kg	49937

(TABLE – 2)

CASE – II

Pattern Of Ash Collection Rate In Different Hoppers When The **First Field And Second Field Out Of Service** Condition (At **BMCR WC**- condition)

Field Sl. no	Working Field No	Stage Efficiency %	Rapping Frequency Raps/hr	Period of Collection (minutes)	Ash Collection per Rap (Kg/Rap)	Ash collection Per hopper (Kg/hr)	No. of hoppers per field in a row	Ash collection per ESP (kg/hr)
1	**OUT OF SERVICE**							
2	**OUT OF SERVICE**							
3	2	68	15	4	566.6	8499	4	33997
4	3	17.2	10	6	215	2150	4	8599
5	4	7.8	6	10	162.5	975	4	3900
6	5	3.635	4	15	113.6	454.4	4	1817
7	6	1.71	3	20	71.3	213.9	4	855
8	7	0.838	2	30	52.4	104.8	4	419
9	8	0.4	1	60	50	50	4	200
10	9	0.198	1	60	24.8	24.8	4	99
							Total (kgs)	49886
							Total ash entering in one ESP per hour, in kg	49995
							Total ash collected in one ESP per hour, kg	49886

(TABLE – 3)

CASE – III

Pattern Of Ash Collection Rate In Different Hoppers Considering **Last Field OUT OF SERVICE** Condition (At BMCR WC condition)

Field Sl. no	Working Field No	Stage Efficiency %	Rapping Frequency Raps/hr	Period of Collection (minutes)	Ash Collection per Rap (Kg/Rap)	Ash collection Per hopper (Kg/hr)	No. of hoppers per field in a row	Ash collection per ESP (kg/hr)
1	1	68	15	4	566.6	8499	4	33997
2	2	17.2	10	6	215	2150	4	8599
3	3	7.8	6	10	162.5	975	4	3900
4	4	3.635	4	15	113.6	454.4	4	1817
5	5	1.71	3	20	71.3	213.9	4	855
6	6	0.838	2	30	52.4	104.8	4	419
7	7	0.4	1	60	50	50	4	200
8	8	0.198	1	60	24.8	24.8	4	99
9	9	0.103	0.5	120	25.5	12.75	4	51
10	**OUT OF SERVICE**							
							Total (kg)	49937
							Total ash entering in one ESP per hour, in kg	49995
							Total ash collected in one ESP, kg/hr	49937

Electrostatic Precipitator Hopper Ash Collection data

(TABLE – 4)

CASE – IV

Pattern Of Ash Collection Rate In Different Hoppers Considering **all fields in service** (At BMCR WC Condition) for information purpose.

Field Sl. no	Working Field No	Stage Efficiency %	Rapping Frequency Raps/hr	Period of Collection (minutes)	Ash Collection per Rap (Kg/Rap)	Ash collection Per hopper (Kg/hr)	No. of hoppers per field in a row	Ash collection per ESP (kg/hr)
1	1	68	15	4	566.6	8499	4	33997
2	2	17.2	10	6	215	2150	4	8599
3	3	7.8	6	10	162.5	975	4	3900
4	4	3.635	4	15	113.6	454.4	4	1817
5	5	1.71	3	20	71.3	213.9	4	855
6	6	0.838	2	30	52.4	104.8	4	419
7	7	0.4	1	60	50	50	4	200
8	8	0.198	1	60	24.8	24.8	4	99
9	9	0.103	0.5	120	25.5	12.75	4	51
10	10	0.054	0.5	120	13.5	6.75	4	27
							Total (kg)	49964
							Total ash entering in one ESP per hour, in kg	49995
							Total ash collected in one ESP, kg/hr	49964

Ash Collection Rate at Design Condition :

The ESP is designed with one field out of service at TMCR WC -25% Excess air. Regarding the patterns of ash collection at different field availability conditions are tabulated below.

Case-I: The ash collection rate is furnished for 9 working fields considering the **first field is in OFF condition**. This is because the ESP is designed with one field out of service. (Details furnished in Table-1)

Case-II: The ash collection rate is furnished for 8 working fields considering the **first field is OFF and second field is OUT of service condition**. This is because at some time any one field in addition to the Case-I might occur. (Details furnished in Table-2)

Case-III: The ash collection rate is furnished for 9 working fields considering the **last field is in OFF condition**. This is another variant of Case-I.(Details furnished in Table-3)

Case-IV: The ash collection rate is furnished for all 10 working fields considering all fields are in service for information purpose. (Details furnished in Table-4)

(TABLE – 1)

02

CASE – I

Pattern Of Ash Collection Rate In Different Hoppers Considering **9 Fields Working And First Field In Off** Condition (At TMCR WC-25% Excess air condition)

Field Sl. no	Working Field No	Stage Efficiency %	Rapping Frequency Raps/hr	Period of Collection (minutes)	Ash Collection per rap (Kg/Rap)	Ash collection Per hopper (Kg/hr)	No. of hoppers per field in a row	Ash collection per ESP (kg/hr)
1	**OFF**							
2	2	71	15	4	564.9	8473.5	4	33890.0
3	3	17.5	10	6	208.8	2088	4	8353.0
4	4	6.5	6	10	129.3	775.8	4	3103.0
5	5	2.75	4	15	82.1	328.4	4	1313.0
6	6	1.23	3	20	48.9	146.7	4	587.0
7	7	0.54	2	30	32.3	64.6	4	258.0
8	8	0.242	1	60	29	29	4	116.0
9	9	0.114	1	60	13.5	13.5	4	54.0
10	10	0.057	0.5	120	13.5	6.75	4	27.0
						Total (kg)		47702
						Total ash entering in one ESP per hour, in kg		47733.3
						Total ash collected in one ESP per hour, kg		47702

02

(TABLE – 2)

CASE – II

Pattern Of Ash Collection Rate In Different Hoppers When The **First Field Is Off And Second Field Out Of Service** Condition (At **TMCR WC-** 25% Excess air condition)

Field Sl. no	Working Field No	Stage Efficiency %	Rapping Frequency Raps/hr	Period of Collection (minutes)	Ash Collection per Rap (Kg/Rap)	Ash collection Per hopper (Kg/hr)	No. of hoppers per field in a row	Ash collection per ESP (kg/hr)
1	**OUT OF SERVICE**							
2	**OUT OF SERVICE**							
3	2	71	15	4	564.9	8473.5	4	33890.0
4	3	17.5	10	6	208.8	2088	4	8353.0
5	4	6.5	6	10	129.3	775.8	4	3103.0
6	5	2.75	4	15	82.1	328.4	4	1313.0
7	6	1.23	3	20	48.9	146.7	4	587.0
8	7	0.54	2	30	32.3	64.6	4	258.0
9	8	0.242	1	60	29	29	4	116.0
10	9	0.114	1	60	13.5	13.5	4	54.0
							Total (kgs)	47675
							Total ash entering in one ESP per hour, in kg	47733.3
							Total ash collected in one ESP per hour, kg	47675

(TABLE – 3)

CASE – III

Pattern Of Ash Collection Rate In Different Hoppers Considering **Last Field Off** Condition (At TMCR WC -25% Excess Air condition)

Field Sl. no	Working Field No	Stage Efficiency %	Rapping Frequency Raps/hr	Period of Collection (minutes)	Ash Collection per Rap (Kg/Rap)	Ash collection Per hopper (Kg/hr)	No. of hoppers per field in a row	Ash collection per ESP (kg/hr)
1	1	71	15	4	564.9	8473.5	4	33890.0
2	2	17.5	10	6	208.8	2088	4	8353.0
3	3	6.5	6	10	129.3	775.8	4	3103.0
4	4	2.75	4	15	82.1	328.4	4	1313.0
5	5	1.23	3	20	48.9	146.7	4	587.0
6	6	0.54	2	30	32.3	64.6	4	258.0
7	7	0.242	1	60	29	29	4	116.0
8	8	0.114	1	60	13.5	13.5	4	54.0
9	9	0.057	0.5	120	13.5	6.75	4	27.0
10	**OUT OF SERVICE**							
							Total (kg)	47702
							Total ash entering in one ESP per hour, in kg	47733.3
							Total ash collected in one ESP, kg/hr	47702

Electrostatic Precipitator Hopper Ash Collection data

(TABLE – 4)

CASE – IV

Pattern Of Ash Collection Rate In Different Hoppers Considering **all fields in service** (At TMCR WC-25% Excess Air Condition) for information purpose.

Field Sl. no	Working Field No	Stage Efficiency %	Rapping Frequency Raps/hr	Period of Collection (minutes)	Ash Collection per Rap (Kg/Rap)	Ash collection Per hopper (Kg/hr)	No. of hoppers per field in a row	Ash collection per ESP (kg/hr)
1	1	71	15	4	564.9	8473.5	4	33891.0
2	2	17.5	10	6	208.8	2088	4	8353.0
3	3	6.5	6	10	129.3	775.8	4	3103.0
4	4	2.75	4	15	82.1	328.4	4	1313.0
5	5	1.23	3	20	48.9	146.7	4	587.0
6	6	0.54	2	30	32.3	64.6	4	258.0
7	7	0.242	1	60	29	29	4	116.0
8	8	0.114	1	60	13.5	13.5	4	54.0
9	9	0.057	0.5	120	13.5	6.75	4	27.0
10	10	0.027	0.5	120	6.5	3.25	4	13
							Total (kg)	47715
							Total ash entering in one ESP per hour, in kg	47733.3
							Total ash collected in one ESP, kg/hr	47715

Ash collection Pattern:

It may be noted that in the first working field 564.9 kg of ash is dislodged by rapping, in one minute. The second rapping takes place only after (period of collection – 1) 3 minutes and again raps off 564.9 kg of ash. In case the first working field is rendered ineffective due to certain problems, the second working field which was earlier collecting ash at the rate of 208.8 kg/rap will now be collecting 564.9 kg/rap just like the first field. The same logic is applicable for the subsequent fields in series as indicated in the Table.

The ash handling system shall have to cope with sudden surges in the pattern of ash collection in the hoppers. There shall not be any reduction in ash evacuation capacity of hoppers subsequent to first field hoppers for the reason explained above.

In case, the capacity of ash handling is inadequate, it will lead to frequent choking and undue build–up of ash in the hoppers, ultimately resulting in tripping of the fields of electrostatic precipitator.

Therefore it is imperative that these factors are taken into consideration while specifying the ash handling system for the electrostatic precipitator.

Table 1-4 shows that the ash evacuation capacity of the first 3 fields shall be same.

However, in practice, there will be natural collection of ash when the fields are switched off depending upon the particle size. If the first field is off, it is expected that, the natural collection would be around 20% and if the first two fields are off, it would be around 25%. Though the fields are off, there will be rapping in operation. Therefore, the ash handling system should work even when the fields are switched off.

NOTE

1. The above data to be used for designing the ash handling system purpose.

2 The ESP ash collection rates furnished above are for ONE ESP ONLY and the same values shall be considered for other ESPs also.

3 The predicted values of ash collection data at different hoppers is based on design point condition. However, while designing ash-handling system, **suitable margins** for the ash handling system operation and maintenance has to be considered over and above the data indicated above.

4 It may be noted that for maintaining flowability of ash, stainless steel lining is provided at the bottom portion of the hopper. Kindly note that for hoppers of stainless steel lining 360x360 mm size inside the hopper will be cut at works before dispatch. Hopper wall 8 mm thick shall be cut open at site suitably by Ash handling vendor/executing agencies during installation of fluidizer pad.

5 Stainless steel lining 360x360 mm size inside the hopper will be cut at works. Space provision of 400 X 400 mm is envisaged in each hopper on two opposite sides for installation of fluidizer pad.

6 It is recommended to evacuate the ash hoppers periodically and it may please be noted that the accumulation of ash beyond the permitted level of ESP hoppers may, not only affect the ESP performance due to damage / misalignment of ESP internals but also may lead to structural failure because of overloading of ash.