THE BAKSHI JUDICIAL INQUIRY REPORT INTO THE KORBA CHIMNEY DISASTER OF 23 SEPTEMBER 2009

TRANSLATED INTO ENGLISH FROM THE ORIGINAL HINDI VERSION OF 9 AUGUST 2012

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:: CHAPTER ONE::

-:CONSTITUTION OF THE COMMISSION:-

The Commission of Inquiry was constituted by the Government of Chhattisgarh and was notified on 13.10.2009. The aforementioned notification was published in the Extra-Ordinary Gazette of Chhattisgarh of 13th October, 2009. The Notification is reproduced here below:-

::CHHATTISGARH GOVERNMENT GENERAL ADMINISTRATION DEPT.::

(Raipur – Dated : 13.10.2009)

No. F-3-15/2009/1-7

As the under-construction Power Plant's chimney of the Bharat Aluminum Company had collapsed, due to which several persons had died, the State Government is of the opinion that, on account of the public interest involved in this incident, it is necessary to constitute a Commission of Inquiry to inquire into the following:-

1) When and how the mishap occurred?
2) Circumstances and reasons leading to the mishap?
3) Who is responsible for the collapse of the Chimney?
4) In order to ensure quality in construction, whether necessary measures were adopted?

   If not, then what were the shortcomings?

   And who is responsible for them?
5) Whether, during construction, necessary safety and rescue arrangements as per rules and regulations were made?

   If not, then who was responsible for this?
6) Suggestions for prevention of such a mishap in the future. In exercise of powers conferred under Section 3 of the Commission of Inquiring Act 1952 (60 of 1952), the State Government in the public interest is hereby constituting a One-man Commission of Inquiry under Shri Sandip Bakshi, District and Sessions Judge, Raipur. The Commission shall complete the Inquiry within three months from the date of notification and submit the report to the Government.

The Commission can seek technical assistance from any organization / person during the Inquiry.

In the name and order of the Governor.

(A. K. Toppo)
Additional Secretary
Chhattisgarh Government
General Administration Dept.

Chhattisgarh Government, General Administration Department, Secretariat, Dau Kalyan Singh Bhavan, Raipur, Order dated 13th October 2009, No.F-3-15/2009/ . General Administration Department's Notification No.F-3-15/2009/1-7 dated 13.10.2009 regarding the constitution of the Committee of Inquiry for Judicial Inquiry into the collapse of the under construction Chimney of the Bharat Aluminium

Company, Korba, Upper Collector, Korba Shri P.L. Nihalani has been appointed as the Secretary to the Commission.

(A. K. Toppo)
Additional Secretary
Chhattisgarh Government
General Administration Dept.

In Order to complete the work of the Commission of Inquiry in the office of the Additional District Magistrate, Korba, the following personnel are approved to work.

1. Smt. Manju Sharma, Assistant Grade-2 and Steno – ADM.
2. Shri B. P. Marble, Steno-typist
3. Shri Sukh Singh Markam

Remuneration Rules / Provision / Advance in light of separate inspection will be informed to the Commission.

Under Secretary
Government of Chhattisgarh
General Administration Dept

Chhattisgarh High Court, Bilaspur, advertisement No.7910 Bilaspur dated 15.11.2009 by Shri R. K. Baret, Stenographer, District Establishment, Raipur, is permitted to serve with the Commission of Inquiry.

(Rajesh Srivastav),
Additional Registrar (D.E.)

Government of Chhattisgarh, General Administration Department, Steno-typist, Shri B. P. Marble did not provide any service to the Commission of Inquiry and Hon’ble

Chhattisgarh High Court approved stenographer Shri R. K. Baret above who wrote and prepared the Report and his contribution and service is appreciated.

:: CHAPTER— TWO::

-: Inquiry Procedure and Scope :-

Inspection of the site of collapse of power plant of the Bharat Aluminium Company (BALCO) Korba, was conducted on 03.11.2009. At the time of Inspection, in addition to the Secretary to the Commission, Shri P.L. Nihalani, the then Additional District Collector, Shri Ashok Agrawal, the then Superintendent of Police Shri Ratanlal Dangi, and other Civil and Police officials were present. After completion of the inspection of the Site, a 2 minute silence was observed as a mark of respect to all the deceased workers. The debris of the collapsed chimney had been removed. A huge pit was visible at the site. None of the materials used for the construction of the Chimney – cement, sand, steel rods - was seen at the site. Hence the examination of the quality of material used in the construction was not possible. Samples of the concrete used in the construction of the chimney were sought from the concerned companies but it was informed that the said concrete samples were already handed over to the Korba Police for their investigation. Police authorities informed that during the examination/analysis of the samples, they were deteriorated/crushed/destroyed. Hence, there were no materials available for repeat examination. Consequently, in such a situation, the commission had to depend on the Inquiry Reports of the State Government and other concerned

companies – Bharat Aluminium Company (BALCO), Shandong Electric Power Contractor (SEPCO), Gannon Dunkerley and Company Limited (GDCL) - and considering all other circumstances and concerned oral and written evidences, prepared its Report.

The Inquiry procedure adopted by the Commission of Inquiry was published as a Notice in the Chhattisgarh Gazette of 11th December 2009 and it was announced that any person who wanted to convey any routine or special information by way of evidence regarding the mishap, either written or oral, may do so in the Office of the Commission during the official working hours, on a sworn affidavit in Hindi and, if in any other language, then accompanied by a Hindi Translation, within 15 days from the date of publication of the Notice; and if any one wishes to give oral evidence before the Commission, may give an application stating subject matter and complete address.

SUPPLEMENT/ADDENDUM

Judicial Inquiry "Sandip Bakshi Inquiry Commission"

Procedure to be adopted by the Inquiry Commission.

1. The language of the Inquiry shall be Hindi
2. The main office of the commission shall be in Korba and will be attached to the office of Additional District Magistrate, Korba.
3. The Commission's office will function from 10.30 am to 1.30 pm and 2.00 pm to 5.00 pm on all days except Sundays and holidays declared by the State Government.

4. The normal sittings of the Commission shall be in the office of the Additional District Magistrate, Korba. However, if deemed necessary, the sittings may be also held at any other places in the State. The date, time and place of sittings of the Commission will be notified in advance.
5. As the Inquiry is concerned with public interest and fixing the responsibility and exposing the failures, and as ordinary citizens, who are the foundation of our democratic policy, are the ultimate deciders and stakeholders and have deep interest in the proceedings of the Commission, it has been decided that every action of the Commission will be kept open for the scrutiny of the ordinary citizen until and unless the commission for some special reason feels the need to conduct the said Inquiry sittings in camera.

6. When the commission requires a sworn affidavit, the same will be sworn before (JMFC) Judicial Magistrate First Class or any other officer authorized in that regard. The Affidavit can be submitted to the office of Secretary, Commission of Inquiry (Collectorate premises) Korba, by registered post or in person to the Secretary to the Commission or any other official authorized by the Commission and take the acknowledgment.

7. In case the Affidavit is in any other language, the same must be accompanied by a Hindi translation duly endorsed by Judicial Magistrate First Class.

8. Every Affidavit must contain the name of the person making it and must be made in the form of numbered Paragraphs, each Para

containing a specific fact. The Affidavit must indicate the Deponent's occupation, age and actual place of residence.

9. In case the Affidavit discloses any facts or acts or information, then the source of such information is also to be disclosed. The Deponent must enclose / attach the list of all documents on which he is relying in his Affidavit. Also a list of witnesses along with their details and addresses be enclosed on whom the Deponent intends to rely on to substantiate the contents and averments in his Affidavit. The Deponent must provide a brief description regarding each witness he will be relying upon for substantiating his averments, and also state why the deponent may be unable to get such a witness to swear an affidavit and require to have his oral examination.

10. The parties filing the affidavits will be required to submit five additional copies of the affidavits to be given to the parties to the Inquiry.

11. In case the deponent's statement or part thereof is based on any document, either the original document or a certified copy of the same be attached. In case the original document is not with the Deponent, then the name of such person who has the custody of such original document must be disclosed. In case the document is with some department or authority, the name of such department or authority be disclosed.

12. In case of a need to provide clarification or clarity regarding the statements made in any affidavit, a separate affidavit is to be submitted, clarifying the doubts or discrepancies in each such

statement made. Each statement or accusation made in the Affidavit must be specifically denied or admitted by clearly stating the Para numbers. Also the Para numbers must be clearly mentioned, regarding which the counter affidavit or affidavit-in-reply is being made.

13. In terms of Notice issued under Rule 5, after conducting the necessary inquiry, if the Commission deems it necessary in the interest of justice, it may summon the deponent for personal appearance before it for oral examination and cross-examination. In such case, the affidavit already filed by the Deponent will be considered as the main subject of examination. In case the commission decides to take oral evidence under Rule 5(5) (A), it will first intimate in writing to the State Government and other deponents regarding the subject matter of such examination of the deponent. However, the Commission cannot compel any deponent to submit himself/herself for oral examination before the Commission.

14. In case of imitation for oral examination all parties and person will be permitted to cross-examine in terms of section 8(c).

15. The Commission, can issue *suo moto* summons, refuse to summon any deponent for oral examination or cross examination and may instead permit for examination through a questionnaire.

16. Every person who requests the Commission to summon the witnesses, will, against the names of such witnesses on the list, state and indicate the purpose or reason for which the said witness is to be summoned and also state why the commission cannot get a sworn affidavit from such a witness. The Commission reserves the right to refuse

summoning any such witness it considers unimportant or unnecessary or irrelevant or if it considers that summoning of such a witness is done to cause undue delay or harassment.

17. Certified copies of all documents received at the entry will be available officially without official proof. Similarly, all such documents including orders from government departments different sections and cooperative agencies, will be available without official proof unless such documents are specifically barred from disclosure in public interest.

18. The commission will not be constrained by the technical requirements prescribed under the Evidence Act. However, the principles of natural justice and fair play will be honoured by the Inquiry Commission.

19. All Rules and Regulations as required to carry out the Inquiry will be considered and given due importance in the course of time.

20. In terms of Rule 4(2) and (6) of the Commission of Inquiry Act of 1972, the Secretary to the Inquiry Commission is authorized to sign all communications and orders issued by the Inquiry Commission.

21. The Commission is of the opinion that taking all the allegations and accusations together may not be in the interest of justice. The Commission will, depending on convenience, consider the allegations and accusations made by way of affidavits in response to the notice issued under Rule 5(2).

22. The Commission reserves the right to refuse, reject or annul any part of an application, petition or affidavit or any document which it considers to be unrelated, irrelevant, unreasonable, baseless, aggressive, divisive, specious or open to public criticism and ridicule.

23. The Commission reserves the right to amend, change, cancel or join any rules of procedure it deems fit in course of the inquiry.

[A list of 74 names and messages from three other persons omitted]

:: CHAPTER— THREE::

- When and How Mishap Occurred -

A 1200 MW (Megawatt) Power Station was under construction at the Bharat Aluminium Company Limited (BALCO) in the industrial town of Korba in Chhattisgarh. One Chimney had already been constructed and another one was to be constructed next to it.

On the morning of 23 December 2009, the chimney construction work was underway as usual and had reached a height of around 225 metres. Throughout the day it was extremely hot and there was strong sunlight, when suddenly at around 3.00 p.m. The sky got overcast with clouds and suddenly

there was heavy downpour, accompanied by thunder and lightning and suddenly with a loud crashing sound, the chimney crashed to the ground.

Eyewitnesses Kirtandas, Ramavtar and Musharaf Ali have stated that, within a short span of barely five-ten minutes, dark rain clouds had gathered overhead, accompanied by heavy gusts of wind, and there was strong lightning, and with a loud sound the under-construction chimney broke into pieces and crashed to the ground. Musharaf Ali has stated that the Chimney suddenly collapsed to the ground. The Chief Engineer of Gannon Dunkerley and Company Limited (GDCL), Ashok Kumar Sharma, who was present at the site, in his Report has stated that he witnessed the collapse of the Chimney. He has stated that at the time of the collapse, there was first lightning and then blasting and smoke on all four sides. He did not know from where the chimney broke. This witness has further stated that the chimney did not fall towards left or right but came vertically crashing down. The National Institute of Technology (NIT) Raipur, in its Inquiry Report, has recorded the statements of Santosh Sen and Divendra Sono who were engaged as workers at the site. They too have described the same incident. Santosh Sen has stated that the upper part of the Chimney was seen shaking and, at the same time, it started raining and the upper portion of the chimney was seen falling into the chimney and with a loud sound then fell to the ground.

Based on the account of the eye witnesses and the Reports of the National Institute of Technology (NIT), Raipur, prepared after inquiry and inspection made on the site of mishap, it becomes clear that the biggest industrial disaster in the industrial development of Chhattisgarh occurred on

23.09.2009 at around 3.00 to 3.30 pm when the under-construction 225 metres high Chimney of the Bharat Aluminium Company vertically collapsed to the ground with a loud sound due to sudden high speed winds and rain.

:: CHAPTER—FOUR, FIVE & SIX::

1. Circumstances and reasons lfor the mishap?

2. Who is responsible for the collapse of the chimney?

3. Were necessary quality control measures adopted during construction in order to ensure safety? What were the shortcomings? Who is responsible for them?

The three important terms of reference from the six terms of reference in the public interest, listed by the State Government for the Inquiry Commission to inquire into in the context of the collapse of the under-construction Chimney of Bharat Aluminium Company (BALCO) are as below:-

(1) The circumstances and reasons due to which the mishap occurred?
(2) Who is responsible for the collapse of the Chimney?
(3) Whether necessary quality control measure were adopted during the construction? If not, then what were the short comings? Who is responsible for them?

The above three aspects are closely related to each other and all three have to be taken together to draw out a conclusion.

The Government of Chhattisgarh, the Chhattisgarh State Electricity Board and Bharat Aluminium Company (hereinafter referred to as BALCO) among them had signed an Agreement on 7.10.2006, according to which, under the terms and provisions of the Indian Electricity Act 2003, they would establish a 1200 MW coal-fixed power plant (herein after referred to as the Project). As for the terms of the said Agreement, the project was to be executed by BALCO and within 60 days of completion of the Project, BALCO was to hand it over to the Electricity Department of the Chhattisgarh Government.

The above stated Project construction was contracted by BALCO to Shandong Electric Power Construction Corp (hereinafter referred to as SEPCO). The construction of the 2 chimneys was further sub-let by SEPCO to Gannon Dunkerley and Company Limited (hereinafter referred to as GDCL). GDCL appointed Tandon Consultants Private Limited (hereinafter referred to as TCPL) as consultants for drawing and design of the 2nd Chimney. For the purpose of internal control, BALCO appointed Development Consultants Private Limited (hereinafter referred to as DCPL) and for the purpose of supervision and inspection, appointed third party Bureau Veritas India Limited (BVIL).

After the mishap, Superintendent of Police, Korba commissioned an Inquiry by National Institute of Technology (NIT) Raipur and, through BALCO, initiated contact with different national and international technical and engineering organizations for their technical opinion and advice, among which are the private Report of Dr. J. Prasad, Associate Professor, Indian Institute of Technology (IIT) Roorkee, and Indian

Institute of Technology, New Delhi and a private Report of Dr. Vladimir A. Rakow, Lightning Engineer of Florida, USA and Indian Institute of Technology (IIT), Mumbai and a private report of Dr. Ravindra Arora, retired professor of Indian Institute of Technology, Kanpur, which are available.

There may be many reasons for a mishap and hence it is necessary to collect and analyze data which must come from approved scientists and engineers, involving all aspects such as physical, mechanical, electrical and electronic (sound-magnetic), engineering, along with Force Majeure.

In the first instance, the civil engineering related aspects have been examined, inspected and checked and laboratory tested and analyzed by DCPL and BVIL to arrive at the conclusions.

In the second instance, no clear basis was found on which to judge the possible consequences of electrical and lightning engineering.

Nor has any electrical engineering data been made available, nor has any analysis been done at this level. According to Professor Arora, the electrical engineering provisions were inadequate in the collapsed chimney. The mishap may have occurred due to design flaws, wind speed, lightning, heavy rain, shock waves and electromotive forces, or due to the limits of engineering, or due to some extraordinary circumstances. However, the cause of mishaps must be established on the basis of documentary evidence and technical data and must not be based on mere guess work or speculation.

Apart from BALCO, data has become available on other power projects which have tall chimneys, the analysis and Report of which has

been provided at No.(6), among which are LANKO's 2x600=1200MW Power Project's 2.70 metre tall Chimney, Chhattisgarh Electricity Brand's present CSPDCL's 220 metre tall Chimney and BALCO's NE PD designed and constructed 264 metre high Chimney. In comparison, the collapsed Chimney rested on "Pile" foundations, while all the other tall Chimneys were built on "Raft" foundations. Making a similar comparison, the shell of the collapsed chimney at Korba was also the thinnest of all.

Various evidences, proofs, reports etc. have been placed and presented before the Commission by various parties and sources and the same is placed at Annexures upon which point-wise discussion follows:-

Annexures

(1) Divisional officer, Korba, Report dated 24.09.2009 based on inspection.

(2) National Institute of Technology (NIT) Raipur test Report dated 24.12.2009 Report dated 31/2/2009 made by NIT Civil Engineering Professor along with you experts after inspection and examination conducted on 11th October 2009.

(3) Private Report dated 23.10.2009 prepared by Dr. S. N. Sinha (Indian Institute of Technology (IIT) Delhi).

(4) A. Reply of GDCL dated 08/01/2010 in response to letter of Secretary to Inquiry Commission No.92/Steno/Adm/Korba dated 26.12.2009.

(4) B. Report of Dr. J. Prasad, Associate Professor [Indian Institute of Technology (IIT) Roorkee] dated 12.10.2009 based on site inspection held on 28.09.2009.

(4) C. Letter of Dr. J. Prasad, Associate Professor [Indian Institute of Technology (IIT) Roorkee] dated 28.01.2010 along with Test Report by N.C.C.B.M., Vallabgarh (Haryana) dated 4/7/January 2010.

(4) D, NCCBM's comment on materials test.

(5) Letter from IPLN (India Precision Lightning Network) dated 10.09.2009 to M. Tyagi of GDCL.

(6) Letter of Shri J. K. Mukerjee, Head of the Project, BALCO dated 28.01.2011 to Collector of Korba, regarding (NEPD) data of the existing 265 metre high Chimney.

(7)

- Letter of Shri B. P. Mishra, Chief operations officer, BALCO dated 28.01.2011 to Collector of Korba, regarding data of the already constructed 13 Chimneys of up to 100 metre height.

- Letter of Col. Rajendra Kaul of LANKO dated 29.01.2011 to Collector of Korba, regarding data of the already constructed 270 metre high Chimney.

- Letter of the Super intending Engineer of Electricity Board SE (CSEB) Korba dated 20.02.2011 to Collector of Korba, regarding data of the already constructed 220 metre tall Chimneys.

(8) Letter of Dr. Vladimir A. Rakow of Lightning Engineering, Florida (USA) dated 12.02.2011 to Mr. Raviraj Gopal, Vice President, BALCO and Affidavit dated 16.02.2011 and letter of Professor Robert Holzworth of WWLN (World Wide Lightning Location Network), Washington, dated 12 January, 2011.

(9) Report of Professor Pradipt Banerjee Civil Engineering, Indian Institute of Technology (IIT) Mumbai dated 23.02.2011 based on the site inspection dated 14 & 15 January 2011.

(10) Private Report by retired Professor Ravindra Arora, Electrical Engineering [Indian Institute of Technology (IIT) Kanpur] dated 20th November 2009 sent to GDLL, Delhi.

(11) Technical analysis and opinion regarding Mechanical Engineering.
Technical Opinion regarding shock waves.

(12) A. Affidavit dated 7th October 2011 by Shri Vinay Gupta, Chief Executive Officer of TCPL (Tandon Consultants Pvt. Ltd) in response to summons of the Inquiry Commission dated 24.09.2011.

(12) B. Affidavit dated 12th October 2011 by Shri Vinay Gupta, Chief Executive Officer of TCPL (Tandon Consultants Pvt. Ltd) in response to summons of the Inquiry Commission dated 24.09.2011.

(12) C. Reply dated 20th October 2011 by Shri Vinay Gupta, Chief Executive Officer (CEO) of TCPL (Tandon Consultants Pvt. Ltd) in response to summons of the Inquiry Commission's Questionnaire dated 12.10.2011.

(12) D. Reply dated 31st October 2011 by Shri Vinay Gupta, Chief Executive Officer (CEO) of TCPL (Tandon Consultants Pvt. Ltd) on 13 points.

(13) Lack of Provisions / Requirements not fulfilled in terms of I.S. Code (4998 Part-I, 1992) along with copies of Provisions A1.2.2 to A1.2.5)

(14) Reply / Answers by State Government to the letter dated 18.4.2012 to the 17 Questions asked based on the Report of Dr. Vladimir A. Rakow.

(15) A- Reply / Answers given by BALCO on 24.5.2012 to the letter dated 27.4.2012 to 83 Questions asked based on the Report of National Institute of Technology (NIT).

(15) B- Reply / Answers given by GDCL on 25.5.2012 to the letter dated 03.5.2012 to 20 questions asked based on the Report of National Institute of Technology (NIT).

(16) Reply given by Shri Viral Mehta, Vice President of BARC on June 2012 to the letter dated 10.05.2012 issued by Government official Shri Yeshwant Thakur.

(17) Application of Shri Abhishek Sinha legal counsel of BALCO dated 14.06.2012 along with Affidavit dated 14.06.2012 along with Affidavit dated 13.06.2012 of Mr. Jivan Kumar Mukerjee, Vice President (Projects). Enclosed as below:-

A- Annexure Annexure A- 83 Question – Answers (mentioned at point No.15 above) to National Institute of Technology (NIT) Raipur along with Technical comment of Dr. J. Prasad, former Associate Profession I.T.I., Roorkee and present Director "Integrated Strategic Business Execution" (Director, ISBE) dated 7th June, 2012.

B- **Annexure** Annexure B- 83 Question – Answers (mentioned at point No.15 above) to National Institute of Technology (NIT) Raipur along with Technical comment by Dr. Vladimir A. Rakow dated 24th May 2012.

(18) Application of Shri Deepak Basu, Site-in-charge, DCPL in the context of Inquiry Commission Communication SL/128/J.E.C./2012 dated 10.5.2012.

(19) Application of GDCL giving answers to 6 questions in the context of Inquiry Commission Communication 126/J.E.C dated 10.5.2012.

(20) Responses of B.V.I.L. dated 23.05.2012 giving reply in respect of questions by Inquiry Commission Communication dated 10.5.2012.

(21) Affidavit dated 30.5.2012 of Shri Gunjan Gupta of BALCO.

(22) Affidavit by Shri J. K. Mukerjee,, Vice President of BALCO to 5 points along with Annexures:-

(A) EPC, contract clause 15.1, 15.2, 15.4

(B) BVIL

(C) SEPCO

(23) Estimated expenditure on coal captive power plant (CCPP) by authorities of the Chhattisgarh Electricity Regulatory Commission.

(24) Points regarding Force Majeure and Natural calamity.

(25) Technical views of Technical Consultant / Adviser.

(26) Technical suggestions.

Annexure :- (1) Reports of the Divisional Officer (B/S/) Korba dated 24.9.2009 on Site Inspection

The Provision Report dated 24.09.2009 made by the Divisional Officer (B/S) Korba after conducting a site inspection on the day after the collapse of the Chimney, does not give a clear picture about the construction materialize.

Annexure :- (2) - National Institute of Technology (NIT) Raipur, Test Report dated 24.12.2009 and Technical Report dated 31.12.2009 and Technical Report dated 31.12.2009 made by NIT's Civil Engineering Professor along with four experts after inspection and examination conducted on 11th October, 2009.

The Team of the National Institute of Technology (NIT) Raipur submitted Test Reports on the construction material to the Town Police Inspector, Balconagar, Korba *vide* letter No.4018, 4028/Testing/Civil/2009 dated 24.12.2009 regarding the Test carried out on the water and cement concrete. It submitted the Code Test Result and along with its No.4039/Testing/Civil/2009/Raipur dated 31.12.2009 Rebar Test Report.

A Detailed Report by the Team of National Institute of Technology (NIT) dated 31.12.2009:-

The Team of the National Institute of Technology (NIT) Raipur, a reputed National Institution, provided details of the Site Inspection, sample collection, site photographs, construction material and site/building foundation digging and testing reports etc. which are recorded at NIT Raipur Project No.370/Civil/Consultancy/2009/Raipur dated 07.10.2009.

The Expert Civil Engineering Team constituted by the National Institute of Technology (NIT) conducted a Site Inspection on 10th and 11th October 2009. NIT Team excavated the "Pile" and "Pile Caps" and checked the "Levels". The Team inspected the rubble, steel girders, debris of the collapsed chimney and also inspected the already constructed chimney II which stands nearby. The Team also examined eye witnesses statements and a first hand look at quality control in the construction process. The Team also scanned the documentary evidence. Based on their inspection and examination the NIT Expert Team in its Report at page numbers 1 and 2, provided detailed information and evidence, to carry the inquiry furthe,r throughlaboratory tests and Reports focused on six important points – (A) Soil Investigation,

(B) Analysis of Design and Detaining, (C) Construction Procedure, (D) Construction Materials, (E) Quality control (F) Other aspects.

(A) **Soil Investigation :-** The Soil Investigation was done by M/s Mishra and Associates, Kolkata. This is a private firm and is not in any way associated with any National and Indian Institutions nor with the Geological Survey of India, Kolkata or with the GSI Engineering Division at Nagpur. According to the advice of M/s Mishra there are two alternatives for laying the foundation of a chimney – Raft Foundation and Pile Foundation by way of Annular Footing on Piles. The existing Chimney II has a "Raft Foundation" while the collapsed under-construction Chimney I had been built on "Pile Foundation". No engineering reason is provided for constructing the two chimneys with different types of foundation. Raft foundation is always strong. But pile foundation is made strong only by adhering strictly to the design requirements.

The NIT Expert Team in its Report on page 3 has clearly pointed out that Indian Standards (IS) 1892 – 1979 clause 2.3.2. have been violated in the construction of the chimney, where it was required that the pile foundation must have been 44.1 metres depth, or one and half times the chimney diameter of 25 metres. However, examination of the Pile Foundation by the Expert NIT Team found that 19 completed holes showed that the maximum depth of piles did not exceed 21.4 metres which was much less than 44.1 metres required under IS provisions. The Pore Records of the Piles indicated that the minimum depths of piles was 19.0 metres and maximum was 22.6 metres. Hence, the soil excavation was not done to the recommended depth and was therefore in clear violation and severely compromised the strength of the foundation.

(B) Analysis of Design Details : In the NIT Team Report at Pages 3 and 4 it has been stated in detail that the R.C.C. design for Chimney I by the private body M/s Tandon Consultants Private Limited (TPCL), New Delhi was actually made for its client, M/s Gannon Dunkerley and

Company Limited(GDCL) and its checking has done by M/s Development Consultancy Private Limited, Kolkata. The NIT Expert Team, in its analysis of Design Drawing described at pages 23 and 24, has mentioned 25 technical books, letters and documents and analysis done in their context has led the NIT Team to state at pages 3 and 4 of its Report that the Chimney Design was well within the safety limits as prescribed by I.S. code and manuals.

(C) Construction Procedure

(1) **Chimney Foundation**

The soil investigation carried out by the M/s Mishra and Associates, Kolkata stated the deep digging of the foundation pit could lead to slope failure and hence a delicate and detailed examination and inspection is necessary and appropriate steps need to be taken to ensure the stability of the foundation.

However, the BVIL's Safety Investigation Report (SIR) dated 10.11.2008 (period 03.11.2008 to 09.11.2008) expressed concern that the time between the digging and refilling of pile No.157 was 38 hours and that stabilization of the sides of the hole with bentonite was not carried out. due to which the side soil entered the pile hole and reduced its depth by about 800 mm. The chimney contractor Gannon Dunkerley and Company Limited (GDCL) was alerted, however GDCL did not pay any attention to it and did not take any corrective measures.

In the same manner, Bureau Veritas India Limited (BVIL) in its Safety Investigation Reports (SIRs) dated 29.9.2008, 20.10.08, 17.11.08 pointed out the short-comings and violation of I.S. code 2911 with regard to pile foundation construction and its constant negligence, and accordingly had disclosed to BALCO and GDCL the need to take corrective steps. But the

construction work was carried out in the same negligent manner thus adversely affecting it.

The SIR of BVIL dated 28.12.2008 in the Report has exhibited that the in many of the pile foundations in respect of Chimney I which collapsed, there were gaps of up to one metre between the pile rebars [reinforced steel bars] when these should have been completely welded joint to joint. This was one of the greatest flaws adversely affecting the strength and stability of the chimney. Hence, as per S.I.R. Report of 1.9.2008, attention was not paid to these short-comings before going ahead with the piling work.

Further, the NIT Expert Team in its inspection and investigation has noted that in the leveling, the connection between pile and pile cap was not correct and that there were gaps of up to 500 mm in the levels, which is mentioned and photographs are exhibited at No.7 of the NIT Report. The same is also clearly visible in the photographs Nos.8 to 11 and this is a blunder in the construction procedure as there is a gap of 300mm. between the piles and piles caps and the pile caps are not connected to each other as required. It is the existence of many such piles that became the main reason for the collapse of the Chimney down to the foundation. Using such dangerous methods in the laying of the foundations and construction of Chimney was a gross violation of the various guidelines of the I.S. Code.

(2) **Chimney Shell**

Various short comings and violations are described / mentioned in the Report of NIT at page numbers 6 to 9 and in the S.I.R. Reports of BVIL made over a period of ten days – 17.11.2008, 28.12.2008, 5.1.09, 19.1.09, 16.2.09, 9.3.09, 23.3.09, 6.4.09, 13.4.09 and 8.6.09., including the lack of welding of the rebars to the required length, poor quality of

cement, lack of appropriate results in the slam test of the concrete, deliberate absence of use of a vibrator in setting the concrete, the use of terms such as “cancer of the concrete”, to describe a %% gap leading to a 20% reduction in strength of the concrete. The sub-contractor GDCL in the construction of the Chimney did not bring about any improvement in construction and quality, nor did it demolish the sub-standard work and re-construct the same by following all the quality standards. Neither the Chimney Contractor SEPCO nor the original owner BALCO paid any attention what was going on.

The BVIL’s SIR of 19.1.09 clearly mentions that the chimney construction sub-contractor M/s GDCL's quality control schedule required weekly meetings which instead were conducted only on 10.11.08, 1.12.08, 5.02.08 and 5.01.09. The GDCL promised to improve quality control, but actually paid no attention to did it bring about any real improvement.

Similarly, in the construction of the chimney shell a vibrator was not used to improve Honey-Combing and no attention was paid to improving the different depths, while no Rendroc S-2 or Conbertra GP2 was used.

In construction, concrete curing requires a certain amount of time. But no attention was paid to the process of concrete curing. Furthermore, in the BVIL’s S.I.R. of 13.4.09 it is mentioned that, during the extreme hot seasonal temperature of 40C, no precautions were taken during construction activity. No attempt at all was made to cool the construction material in the extreme heat or to follow the requirements of I.S. Code 7861 Part-I, 1975.

In the same manner, from a quality control aspect, the chimney construction sub-contractor GDCL did not make any improvements despite the daily inspection reports of DCPL. The remarks for the period 4.6.09 to 9.7.09 made by GDCL have been mentioned in the NIT Report at pages 9, 10 and 11. M/s DCPL's remarks on quality control were neither acted upon by the contractor SEPCO, and nor by the owner BALCO. The NIT Report at page 11 has mentioned the DCPL remark of 9.7.2009, wherein NIT at Table-1 (EL+121.om) has mentioned the critical deviation of chimney alignment which is in clear violation of the Code (AC 13.07.08). It is pointed out that the deviation is 2 to 3 times the maximum permitted vertical deviation. This is a dangerous condition for the chimney's stability.

Thus in this manner gross negligence has been witnessed in the vertical alignment of the chimney, and poor construction practices, poor workmanship, poor construction management, lack of supervision, lack of commitment for quality construction and poor human resources management were prevailing at the construction site.

(B) **Construction Material**

According to the Report of the National Institute of Technology (NIT) Raipur, reported in detail at page numbers 11, 12 13 and 15 and BVIL's S.I.R. Reports of 03.11.2008 and 10.11.08, it is clear that the mix of "ordinary Portland Cement" was adversely impaired. On several occasions, BVIL advised and notified the Chimney contractor GDCL to use a different cement batching plant. Similarly, BVIL had given clear instructions regarding compressing of the cement, but neither GDCL nor BALCO paid any attention to this, on account of which the strength of the concrete was severely compromised.

Five days of Safety Inspection carried out by BVIL on 10.11.08, 27.1.09, 9.2.09, 6.4.09 and 20.4.09 in its S.I.R. BVIL indicated several points, due to which the construction materials could become ineffective, leading to weaknesses. Several reports and instructions were issued by BVIL but the sub-contractor GDCL, contractor SEPCO and chimney owner BALCO did not pay any heed to these, nor did they take any corrective measures as per the S.I.R. Reports of BVIL, thus leading to sub-standard construction work.

(1) Water :- According to the NIT Report Table 13, that the water quality was within prescribed limits of I.S. 456-2000.

(2) Reinforcing steel bars:- According to the NIT Report on page 14, table 14, the reinforcing steel bars (rebars) were within the prescribed limits of I.S. 1786-1985.

(3) **Concrete core samples:-** According to the NIT Report on page

(4) No.14 and at table 8 mention is made of the poor quality and weakness of concrete based on the tests conducted by NIT in the cement concrete core samples. The photographs No.19 to 21 indicate that the cement concrete is extremely weak and photographs No.15 to 18 indicate that the size of the aggregates was 80mm whereas it ought to be 20mm.

According to Table No.4 on page 14 of NIT Report, all cement concrete core samples were found to be less than the strength required by the I.S. Code. Thus, the ingredients and quality was not as per the requirements of concrete design. According to the NIT Report, it is mentioned on page 15 that the construction was characterized by weak, substandard ,construction materials, defective construction procedures, poor quality storage of materials, and lack of quality control. along with poor construction supervision and management.

(C) **Quality Control:** National Institute of Technology, Raipur.

(1) According to the NIT Report, page No.15, 16 and 17 and BVIL, in its S.I.R. Reports dated 10.11.2008. 27.1.09, 23.2.09, 16.3.09, 20.4.09, 11.05.09, 8.6.09, 22.6.09 and 29.6.09, twenty points were raised making special mention of complete lack of quality control in the contraction work, which was not as per the requirements of I.S. 4925-2004, I.S. 7861 Part-10262-1989. BVIL had given written instruction to stop the concreting work and to carry out the same with strict quality control. However, neither the sub-contractor for Chimney construction GDCL, nor the main contractor SEPCO, nor the owner of the chimney, BALCO, paid any attention to these instructions, due to which the concretization work and construction work was adversely affected, thereby severely compromising the strength of the Chimney I.

(2) The Third Party M/s DCPL, appointed specifically to inspect and report on quality control by GDCL, in its Inspection Reports on 8 occasions, dated 4.6.09, 5.6.09, 6.6.09, 9.6.09, 10.6.09, 20.6.09, 1.7.09 and 9.7.09, expressed serious concerns regarding the quality control and construction work and advise immediately remedial measures to be adopted. However, the sub-contractor for Chimney construction, GDCL, main contractor SEPCO and owner BALCO did not pay any attention and the same is borne out by the photographs at Nos. 22 to 28 in the NIT Report which show extremely poor quality construction work.

Hence, as per the various documents, reports and photographs submitted by the Experts Team of National Institute of Technology (NIT), Raipur, BVIL and DCPC, it is clear that in the quality control and construction major blunders were committed due to which the BALCO Chimney collapsed and crashed to the ground.

(D) OTHER ASPECTS (as per NIT Report pages 18/19)

(1) Statement of eye witnesses and workers

The NIT Expert Team has recorded the statements of eyewitnesses and workers, including one labour contractor and 2 DCPL employees and 10 employees of BVIL.

In this regard, the labour contractor and father of Shri Prithvinath Singh, Shri Virbhadur Singh has disclosed serious violations. He has indicated that the mishap in "Batching Plant" led to a delay of two months in the construction of the Chimney and that construction was obstructed for these two months and hence, during the following four to five months, construction work was carried out round the clock (for 24 hours). When the collapsed Chimney construction work reached a height of 65 metres, extreme difficulty was experienced in moving the "Slip Form" [a process by which concrete is poured continuously] to the next level, due to weak concrete. The Slip form operator refused to work and also complained of excessive ash in the concrete mix. The next 10 metres were built under the same conditions. Hence there was no technically qualified person provided for improvement or supervision either by BALCO, SEPCO or GDCL.

Employer of DCPL and father of the deceased Shri Parimal Choudhari, Shri Pradyat Choudhari has stated before Investigating Agency that there was a problem with the embediment of a valve in the flue duct which was not removed. Consequently the opening was filled up by way of "Patching". This was serious and dangerous.

About 10 employees of the BVIL have made statements along with their mobile numbers about having conveyed the various instructions as per S.I.R. Report.

(1) **By observation of collapsed Chimney**

The Report of the NIT Expert Team has provided on page No.20, eight photographs (No.28 to 35) showing the chimney at different heights, and pile foundations and pile caps immediately after the collapse of the chimney. The opinion of the Civil Engineering Expert Team of NIT is that the collapse of the chimney was due to the compressive failure of the concrete, and the break up and inward falling of the upper part of the chimney which caused the lower part of the chimney to sink telescopically down.

(2) **Possibility of failure due to lightning ruled out:-**

The NIT Expert Team in its Report at page No.21 has clearly stated tha,t attributing the collapse of the chimney to a lightning strike, is without any basis because, according to I.S. code 209, there must be a current of 25000 amperes to melt the steel rebars and the bodies of the dead must indicate serious burn marks. The burn marks found on some of the bodies retrieved from the debris of the collapsed chimney appear to be on account of use of electric arc cutters in the rescue operation and not from any lightning strike. Hence the possibility of a lightning strike has been totally rejected.

The NIT Expert Team has further stated in its Report that, even in case of lightning strike, the steel rebars, being in such large numbers, would directly conduct the electric charge of the lightning to the ground. I.S.2 09-196 requires provision to conduct lightning charge in any tall structure such as a chimney and the same was also provided in the collapsed chimney. This is clearly evident from the statement in evidence made by Alok Kumar and also from the photographs No.27 of

the existing Chimney II. Hence the possibility of failure or collapse of the Chimney-I due to lightning in completely ruled out.

Conclusions :-

The NIT Expert Team, BVIL and DCPL, based on different Test Reports and various documents, laboratory tests, various inspections and statements of the eyewitnesses, have expressed the opinion that:-

(1) The soil excavation for the purpose of foundation was not according to the I.S. Code.

(2) The Design and Detail of the Chimney construction was in accordance with the requirement of I.S. Code.

(3) The NIT Expert Team in its Report from pages 21 to 22 has provided 10 points based on a civil engineering perspective which were extremely serious blunders committed in the quality control and construction of the chimney. This led to compressive failure of the concrete leading to the collapse of Chimney-I. Among these 10 causes cited, it says that any single cause would have been sufficient to cause the collapse of the chimney.

(4) The collapse of Chimney-I was not due to lightning strike.

(5) The collapse of the Chimney was entirely due to the compressive failure of concrete and the break-up and inward falling of the upper part of the Chimney caused it to sink to the ground.

Annexure (3) Private Report of Dr. S. N. Sinha of Indian Institute of Technology (IIT) Delhi.

As per the Annexure above, the Report by Dr. S. N. Sinha Indian Institute of Technology (Delhi) was undertaken on the letter of GDCL dated 23.10.2009 and submitted to the same. However, he did not carry out any site inspection or investigation into the construction. In his Report on pages 1 and 2 at five different small paragraphs, he has stated several times that he was "informed by the client", without giving any view on civil engineering aspects on the lightning strike, even though a civil engineering expert and without collecting any data regarding lightning from the Meteorological Department, nor has he provided any supporting document or evidence to support his views. It is important to note here that his view are based on the request by his client GDCL and on their hearsay. This Report by Dr. Sinha is not endorsed by IIT, Delhi and does not have its sanction. The said Report is a private Report by Dr. Sinha and it has no connection what-so-ever with IIT Delhi. The Acting Director of IIT Delhi, Dr. Sinha, has used the name of IIT on his Letter Head and has given his report in favour of his personal client GDCL. In this episode, no test or specialist analysis has been done by any IIT Delhi Expert Team, either before or after the collapse of the chimney.

Annexure (4)-A – GDCL's letter of Reply dated 08.01.2010 in response to letter of the Secretary, Inquiry Commission No.92/Steno/ADM/Korba, dated 26.12.2009.

In response to the letter of the Secretary of Inquiry Commission dated 26.12.2009, GDCL *vide* its letter of reply dated 08.01.2010, answering the questionnaire at point 12, has stated that "there is no provision in the code regarding up to what level of concreting can be carried out in one single day". Apart from this there is no other technical issue involved.

Annexure (4)-B – Report of Dr. J. Prasad, Associate Professor of Indian Institute of Technology (IIT) Roorkee, dated 12.10.2009 after site inspection dated 28.10.2009.

BALCO contacted Dr. J. Prasad, Associate Professor, Indian Institute of Technology (IIT) Roorkee. As a result he visited the site and conducted an inspection on 28th September 2009. After discussions with technical personnel at BALCO, he submitted his opinion that, due to heavy winds and the heavy slip form, the chimney tilted to one side and as a result of excessive tilting it collapsed on its side. According to his Report, dated 12.10.2009, the chimney did not sink vertically but fell to the side.

As a civil engineering expert, he stated that concrete becomes strong with time and the slip form inside the concrete casting would have been easily supported by the cured concrete below.

In his Report, details regarding slip form are not provided, nor mentioned in the log book. He has also not stated at what speed the slip form should have been removed. Nor has be mentioned the extent and height to which the casting was carried out. He has not stated the actual height in metres of casting completed at the time of the mishap and collapse of the chimney. His Report does not contain and is not allied to any documentary evidence, nor has data regarding "Batching Plant" and other technical data been provided.

Terming his report " provisional, he mentions on page 02, four points to be considered for analysis with the Final Report which would be submitted within three to four months. However, there is no evidence to show that a final report was ever submitted.

Annexure (4)-C – Letter of Dr. Prasad, Associate Professor, (Indian Institute of Technology (IIT) Roorkee) dated 28.1.2010 along with the

Test Report dated 417 January, 2010 made By NCC BM, Vallabhgarh, Haryana.

Dr. J. Prasad, Associate Professor, IIT, Roorkee in his letter dated 28.01.2010 has attached a Test Report dated 4/7 January, 2010 issued by a Private Organization NCCBM. But no test of any kind was done at the Indian Institute of Technology (IIT) Roorkee, and no opinion or technical comment has been expressed.

Annexure : (4):- D – NCCBM's comment on the Material Test.

Dr. M. M. Ali, National Council for Cement and Building Materials in his letter to Police Superintendent Korba has submitted the laboratory test report of the construction material. The said Test Report contains a personal comment from Dr. J. Prasad of IIT, Roorkee.

(1) **Cement:-** The Design requires M-30 Grade concrete. However, the Test Report indicates that, out of 18 specimens, four were found to be not in compliance with the requirements of I.S. 1199-1959 while the rest were well within the limits prescribed.

(2) **Steel**:- As per the Design requirements, rebars of FE415, FE500 and Fe550 were essential, but a test of 08 specimen steel pieces (rebars) did not satisfy the requirements of I.S.1.786 – 1980 and I.S. 1788 – 1985. The yield strength being 0.2 percent of the Proof strength did not meet the requirement of the code/standards also, and in the bend, re-bend tests, the rebars did not fulfill the requirements of the standards / code. Hence, all the steel rebars did not conform in some way or other to the standards required.

The Thermal Mechanical Test of steel re-bars did not conform to the requirements / standards.

(3) Compressive strength of concrete :-

According to I.S. Code (Indian standard) 516, concrete standard grade is M30 and of the 05 specimen tests one fell below the standard while the other four conformed to the standard. Hence 20 percent of the concrete was below the standard.

Coarse Aggregates : I.S. 383 states that the grade of coarse aggregates is not determine.

Fine Aggregates : I.S. 383 states that the grade of fine aggregates in also not decided. Hence on account of this most of the construction material was not tested for proof of its quality or standards in the NCC BM laboratories.

Annexure : (5) Report of Indian Precision Lightning Network dated 10.09.2009 sent to GDCL's Tyagi.

The report shows data for all of Chhattisgarh and also for other states and there is no record of any kind of lightning in the entire Chhattisgarh region at the time the chimney collapsed.

The BALCO site of the collapsed chimney is approximately situated at 22.24N and 82.45 E for which there is no data for lightning. In BALCO's own same area there are about one dozen chimneys of small - large size and none of these witnessed any lightning strike or experienced a lightning based mishap.

Annexure :- (6) Letter dated 28.01.2011 of Shri J. K. Mukerhee, BALCO Head of the project to the Collector of Korba – Data of NEPD pre-constructed 265 metre high Chimney.

Letter dated 28/01/2011 of Shri B. P. Mishra, Chief Operations Officer of BALCO to the Collector of Korba – Data regarding 13 pre-constructed Chimneys of up to 100 metres height.

Letter dated 29/01/2011 of Col. Rajendra Kaul to the Collector Korba – Data regarding pre-constructed 275 metre high Chimney.

Letter dated 02/02/2011 of Superintending Engineer, Electricity Board SE(CSED) Korba to the Collector, Korba – Data regarding pre-constructed 220 metre high Chimney.

COMPARATIVE STATEMENT

Sr. No.	Particular	LANCO	CSEB CSPDCL	BALCO NEPD	BALCO / SEPCO SEPCO STAND COLLAT
1	**2**	**3**	**4**	**5**	**6**
1)	Power in MW	2x600=1200 MW	2x250=500 MW	4x135	2x300=600
2)	Metal fine steel in MM	2x6800 MW	2x4600	4x3500	2x5000
3)	Design	LANCO Gudgeon	BHEL N. DELHI	BALCO NEPDI	BALCO SEPCO

4)	Type foundation	RAFT RACC	RAFT RACC	RAFT CC	RAFT CC
5) (A) (B)	Diameter to MM @GL- Diameter Shell Thick	 29018MM 900MM	 22722MM 750MM	 29700MM 1000MM 800	 22000MM 600
6)	Diameter to MM @Height @Shell	<u>19600</u> @270 450MM	<u>15800MM</u> @220M 400MM	16240MM @ 264 500MM	<u>14950</u> @271M 300MM
7)	Memo No.	LPL/KSO/SPV /ADMIN/2011 05 DT. 29.1.11	SE(CIVIL)N 006/2011/E/ 230DT2-2-11	KA/SAFETY /89/2011 BALCO/ DT.28-1-11	KA/SAFETY /89/2011 BALCO/ DT.28-1-11

A comparative study makes it clear that in Korba itself there are several Power Project with chimney of similar height and extent, owned by LANKO,CSIB (CSPPL) and BALCO's other Chimneys having shell thickness of about 1½ times that of the collapsed BALCO Chimney. Hence it is due to an extremely thin shell of the Chimney-I of BALCO, that it collapsed.

Also in a similar manner, excluding the collapsed Chimney-I of BALCO all other Chimneys were constructed on a Raft and not Pile Foundation as indicated in photo No.(7). According to the NIT Expert Team Report, the blunder leading to the collapse of the Chimney-I, among many reason,s was primarily the flaw in Pile caps as evidenced by photographs (8) to (11).

Annexure:- (7) Letter dated 12.02.2011 of Dr. Vladimir A. Rakow of lightning Engineering of Florida, USA to Shri Raviraj Gopal, Vice President of BALCO and Affidavit dated 16.02.2011 and letter dated 12th January 2011 of Professor Robert Holzworth of World Wide lightning location network.

Shri Raviraj Gopal, vice President (Legal), BALCO had written a letter dated 16th December 2010 to Dr. Vladimir A. Rakow of Electrical and Computer Department of Florida University, and to Co-Director of he International Centre for Lightning Research and Testing (ICLRT) requesting an independent report, mentioning that the Reports prepared by National Institute of Technology (NIT) Raipur, GDCL, Indian Institute of Technology (IIT) Delhi and SEPCO were enclosed. Dr. Vladimir A Rakow in his 20 page Report dealt with 65 points, among which were Para No.3 to Para No.21, discussing the reports of the above-mentioned agencies.

(I) Dr. Rakow, in dealing with the Report of National Institute of Technology, (NIT), Raipur, at Points/Paras 14 to 16 has made critical remarks without support of technical records or analysis. Dr. Vladimir A. Rakow does not appear be knowledgeable about Civil Engineering, and has made no comments on the conclusions given at paragraphs No.1 to 12 of the Report by the Experts of the National Institute of Technology (NIT), Raipur. Dr. Rakow at his Para No.16 has termed the technical examination and analysis by the National Institute of Technology (NIT), Raipur as being "biased" which indicates Dr. Rakow being himself "prejudiced".

He has also given some points and advice regarding good practices. But the current mishap does not relate to college or university studies, but is

about massive loss of life and property. Hence, in such a situation it is necessary to conduct examination and analysis of the errors and omissions in the entire construction process and to arrive at the plausible causes of the mishap / disaster.

(II) Dr. Rakow, was misled by the term "National" in the case of the Vallabgarh Private "Testing Lab" and has wrongly described it as "National Lab", when it is not a National Institution.

Dr. Rakow has also mentioned that, according to the Meteorological Department of Korba or other nearby organization, there is no record or mention of any cloud burst, wind velocity and thunder storm in the area on 23.09.2009 on the day of mishap, and nowhere in entire Chhattisgarh state is there has any report of the existence of any kind of emergency situation.

(III) The entire Report of Dr. Rakow is about theoretical aspects of lightning and is based on and focused on 8 photographs about lightning and micro-burst in different parts of the world. Dr. Rakow, in his Report has included 92 pages of photocopies of books by him and other professors known to him, which has no direct or indirect relation to the mishap.

(IV) Based on the Report of Dr. Rakow, Professor Robert Holzworth of Washington has sent 13 pages regarding lightning for India for 23.9.2009 (day of mishap) and has in his letter mentioned that there was a storm from North to South at a distance of 05 to 10 kilometers from 10.00 to 10.30 consisting of approximately 4 strikes. However, this timing does not match with the time of occurrence of the mishap.

In is worth nothing that the photocopies regarding "Lightning" and "Strike", ordinarily show that the highest point is adversely affected. In

the same location, BALCO itself has over a dozen high chimneys. The height of the collapsed chimney was around 245 metres, but barely at 150 metres distance, stands BALCO's 265 metres tall, newly constructed chimney-II; and about 05 to 10 kilometres away from the collapsed chimney-I, there stand many high chimneys. In such a situation "Lightning Strike" happens at the highest structure and not on a smaller /lower structure. Dr. Rakow, in his reply dated 18.04.2012 to the questionnaire has stated that it cannot be concluded that lightning caused the mishap (collapse of chimney).

(V) At page 20, point/Para 63 the conclusion of Dr. Rakow is that lightning could not be the sole cause of a chimney collapse. Micro-burst and tornadoes together could be responsible for the mishap, he believes.

Further, this conclusion is based on the statements of the witnesses of BALCO itself. For an average person, even slightly heavy rains or high speed winds or thunder and shock waves, rattling of window panes and at whatever distance lightning strikes, the events would appear to be happening very nearby. Hence, in absence of any documentary evidence or data it is difficult to accept that there was a "Tornado" or "Micro-burst" In case of a "microburst" "typhoon" or even a weak "Tornado", there would have been many other mishaps within BALCO's premises. However, no such things happened.

In any case, the chimney was designed to withstand extreme stormy winds of up to 140 kilometres per hour. And in case of such high stormy winds there would have been many other mishaps in the area and the roofs of buildings would have been blown away. However, there is no report or evidence of any such occurrence or mishap in the BALCO Korba area. Hence the occurrence of typhoon, microburst or Tornado is rejected.

Suggestions for the future from an electrical engineers perspective, made by Dr. Rakow at Para Nos.(64) and (65), are very important and they need to be incorporated in electrical safety provisions in chimney construction.

Annexure (8) Report of Professor Pradipta Banerji of Indian Institute of Technology (IIT), Mumbai, dated 23/02/2011 based on the Site Inspection dated 14815 January 2011.

Professor Pradipta Banerji of Indian Institute of Technology (IIT), Mumbai, in response to the communication of Shri J. K. Mukherjee of December 2010, has sent a written report to him by DRD/CE/PB-15-10-11 dated 23rd February, 2011.

Professor Pradipta Banerji and his associates conducted a site inspection on 14 and 15 January, 2011 and held discussions with witnesses and technical personnel.

In his Report there is a description at page 2 of the collapse of the Chimney-I which was built on pile foundation and the safe Chimney-II built on Raft foundation. There is also a description of the mishap site focusing on 5 aspects of the scope of work of the Inquiry. This Report also alludes to the BALCO and GDCL commission inquiry report by a professor of IIT, Delhi made in his undivided capacity, and documents about Inspection carried out by a retired Professor of IIT, Kanpur. At page No.6 and 7 of his Report there is also mention made of the Report of the NIT Expert Team, Raipur procured by Superintendent of Police, the NCCBM test Report, as well as the documents on lightning procured by BALCO from Florida University, (USA). The Report of Pradipta Banerji has reviewed all the documents and design drawings.

He has presented his observations at page 1 of his Report through 3 Paras:-

(I) According to his Report, the design of the collapsed chimney is within the limits of I.S. Code 4998 (part-I) and the cause of the collapse of the Chimney cannot be attributed to the Chimney design.

Here it is worth pointing out that the distance between the two Chimneys is less than the prescribed minimum limits.

(II) (A) According to his Report, the NCCBM Test Report and Report of the NIT, Raipur, shows the collapse of the Chimney is not on account of material defect (substandard materials).

But in the NCCBM Report at several places there is clear mention that the Report of NIT Raipur, in clear terms, when discussing the piles and pile caps has used the terms “Blunder” and at Paras 13-14 has concluded that there has been negligence and lack of caution with there being several reasons for the collapse of the Chimney. The dangerously large sized 80mm coarse aggregates were specifically mentioned and photographs were presented as evidence showing the scale to substantiate its findings at photograph No.18. The Civil Engineering Professor Banerji of IIT Bombay has not provided any kind of analysis based on Civil Engineering and neither has he pointed out any short comings in the Reports made by other institutions. Instead, he has only referred to the technical Reports regarding the “Acceptable Limits”.

Referring to the BVIL’s Safety Inquiry Report (S.I.R.) on the “Acceptable Range”, he has stated that the collapse of the Chimney was not on account of the poor quality of construction.

However, according to the S.I.R. of BVIL mentioned on the page Nos.(5)_to (11) of the Report of National Institute of Technology (NIT), BVIL on several occasions had pointed out the extremely poor quality of workmanship and none of this finds mention in the Report of Professor Pradipta Banerji.

(B) Professor Banerji at page 7 of his Report in the last paragraph, has stated that the identical Chimney-II has been safe. But the two Chimneys, though identical above the ground level, are not at the foundation level. The safely standing Chimney-II is built on the strong Raft Foundation. The Report of the National Institute of Technology (NIT), Raipur, while mentioning several short-comings in the construction of Chimney-I clearly terms its being built on pile foundations, and with gaps in the pile caps being described as a "blunder".

(C) Professor Pradipta Banerji of IIT Bombay, on pages 8 to 14 of his report showing 6 coloured photos at Para 2-2 has, under a sub-heading "Possible Causes" simply rejected the points already made by the IPLN and WWLN. However, he has also mentioned that there is no documentary evidence on records from the Meteorological Department for the day of the mishap 23.9.2009. The Report has used the terms like cyclone, wind bolt, thunderstorm, lightning, microburst, shock wave, wind shear purely based on the descriptions given by the witnesses and employees of BALCO and without providing any documentary evidence to substantiate or support evidence or records. According to the design of the chimney, it was considered to be safe and able to withstand compression caused by wind speeds of up to 39 metres per second or 140 kilometres per hour and tension and shear, caused by such compression due to very high wind speeds. It is clearly visible and evident that the causes leading to the collapse of the Chimney arrived at by various

universities and national institutions are by way of assumptions without any hard technical evidence to support them.

(D) The conclusions arrived at by both Professor Banerji and Professor Sinha at IIT Delhi, and IIT Kanpur retired Professor Arora are without any basis. The retired Professor of the Electrical Department of IIT Kanpur has concluded that the temporary lightning arrestor was found to be insufficient or inappropriate.

Without citing or relying on any causes, reasons or analysis, the conclusion drawn by Professor Pradipta Banerji of NIIT, Raipur, in his detailed Report are totally out of context. However, the report of NIT Raipur is fully based on Design analysis, site inspection, examination, lab tests analysis, along with eyewitness evidences and given various reasons for the collapse of the chimney. The Expert Team of NIT has totally and categorically rejected lightning as the cause of the collapse.

(E) The Report of Professor Rakow of Florida University contains a theoretical presentation and attributes the collapse of the Chimney to possible lightning strike, but the same is without any supporting documentary evidence.

Professor Banerji has stated that there are no critical comments made about the building process in the NCCBM's materials testing Report. However, NCCBM is a private organization, while NIT Raipur is a national institution and a certification of Merit and Qualification given by NIT commands international recognition and acceptance. Professor Banerji of IIT Bombay, in his Report at Para 2 of page 2 has described the Report of Florida University about temporary lightning protection as per IS 4998 as being doubtful and ambiguous and has concluded that, apart from lightning and electro-hydraulic effect, raising of the extremely heavy

slip-form over green concrete (uncured / wet concrete) are the main causes of the collapse of the Chimney.

(F)According to the Report of Professor Banerji lightning could possibly be one of the many causes that resulted in the collapse of the Chimney. However he does not provide any technical evidence or data to support such conclusion.

Professor Banerji in his Report has pointed out the similarity between the Chimney collapse of 23.09.2009 and other such tall chimneys in India. However, he has not provided description of any specific site or project where the chimney has collapsed due to rainy conditions.

(G) Along with photographs 1, 2 and 3, he mentions that the reason for the collapse of the chimney is the existence of large openings in the lower part of the chimney wall/section for purpose of doors , but the doors were never pitted, thus allowing wind movement upwards in the chimney and causing wind shear; and, due to air pressure, tension and stress,,the Chimney collapsed. However, professor Banerji in his analysis does not give any kind of explanation for why, when in both the chimneys the conditions were similar, Chimney-II built on Raft foundation did not collapse. All conditions being similar, only the Chimney No. I built on pile foundation collapsed while the other Chimney No.II stood secure. The conclusion is that the cause of the collapse of the chimney cannot be just attributed to his analysis but to other causes. Using photographs at Nos.4, 5 and 6, he has stated that the break-up of the upper section of the Chimney and its falling inside the chimney caused the entire chimney to collapse vertically down. He has made a mention of the collapse of a chimney in England in 1965 which has no relation whatsoever to the present case.

(H) At page 10 of his Report, Professor Banerji in his Conclusion Section has stated two possible reasons for the collapse of the Chimney – one reason is lightning and other reason wind shear , with one or both acting together.

(I) Professor Banerji, in his Report, while giving reasons at page No.17 alludes to the suggestion made in the report of the Florida University regarding lightning precaution and safety.

(J) It is of special mention that Professor Banerji, who is a Civil Engineering expert, has suggested that good engineering practice required that the thickness of the Chimney should have been increased and the size of the hoop steel should have been increased so that the chimney structure would be stronger. He has also stated that such increase would entail higher investment in construction.

(K) According to the conclusion drawn by him the main reason for the collapse of the chimney are due to the thinness of the shell and of the Hoop Steel.

Annexure : (9) : Private Report of retired Professor Ravindra Arora of IIT Kanpur dated 20 November 2009 sent to GDCL, Delhi.

The Retired Professor Ravindra Arora of the Electrical Engineering Department of IIT Kanpur has sent his Report dated 20th November 2009 to GDCL, Okla Industrial Area, New Delhi

He has stated in his Report that he has not done any site Inspection. However, the Report of Prof. Arora is based on Report and documents made available to Professor Arora from various Experts and Specialist institutions by GDCL: (I) Report made by GDCL's own Joint Team of Mr. Mehra and Mr. A. K. Banerjee, which was GDCL's own Company Technical Committee to inquire into the mishap; (II) Eyewitness Statement of Mr. B.C. Chatterjee, General Manager (Mechanical) GDCL, (III) Private Reports (Reports in his individual capacity) of Professor Dr. S. N. Sinha of IIT, Delhi and (IV) IS-2309 (2000) and IS-4998 (Part –I) 1975.

(A) Professor Arora had retired from Electrical Engineering and he has not made any comment or analysis in the report regarding civil engineering.

(B) Based on the GDCL eye witness and IPLN Report, Professor Arora has presented his analysis on lightning. However, there is no independent eye witness. All the eyewitnesses are either from GDCL or BALCO and they are either their high officials or employees. The IPLN Report has presented lightning data for the entire Chhattisgarh area, from Ambikapur (Sarguza) to Bastar-Bhopalpatnam, and in such a vast area there are hundreds of chimneys, and BALCO itself has over a dozen chimneys. No other chimney collapsed or was adversely affected on 23.09.2009. At or near the location of the collapsed Chimney at Korba, 22N22" and 82E46" there is absolutely no lightning data. Also, there is no data available from the Meteorological Department for Korba and neither is there any data for nearby locations such as Champa, Katghora, Raigarh, Bilaspur, etc.

The GDCL's attempts to submit various theoretical technical reports as being independent amounts to an attempt to mislead.

(C) Professor Arora based on IS Code 4998 (Part-I) 1975 regarding lightning at Para No.35 on E-2.6.1 regarding temporary lightning protection provisions has provided a 3-page opinion in his Report, stating that, until the Horizontal steel and other reinforcements are welded to the vertical permanent electrical grounding, temporary lightning protection should be considered incomplete and unsafe. But, according to the Report of NIT, none of the steel rods were welded in the collapsed Chimney. Hence there was insufficient lightning safety in the collapsed Chimney and this is a serious short-coming of the construction.

(D) [omitted]

(E) Professor Arora, citing dozen of incidents in Kanpur and Lucknow has included a copy of his 4-page research paper on lightning, as presented at International Conference on lightning Protection (ICPC) held at Birmingham, U.K. in 1988 and included his experience of incidents at other places, which were essentially recommendation for the future but which had no relation to the chimney collapse at Korba.

Annexure :- (10) Technical Analysis / Comments and Opinion / views

From a Mechanical Engineering perspective sufficient analysis has not been done by NIT Raipur and Professor Pradipta Banerji of IIT Mumbai regarding additional and other examinations pertaining to the Mechanical Engineering aspects of the collapsed Chimney.

According to the Contract between SEPCO and BALCO dated 17th March 2008 at Para 7.1.2, the concreting of the shell of the 272 metre height Chimney No.I was to be completed by 1st February, 2009. However,

construction was not complete when the mishap occurred on 23rd September, 2009.

It is worth nothing, that even after 8 months delay from the deadline for construction, the constructing of the shell of the collapsed chimney had reached 240 to 245 metres. In the Report of the NIT Raipur, the eye-witness labour contractor Mr. Prithvinath Singh said that, due to a mishap in the Batching plant, for several months the construction work was halted. According to the same eye-witness labour contractor, Mr. Prithvinath Singh, serious difficulties were encountered in the movement of the slip-form when the construction of the collapsed Chimney was at the height of approximately 65 metres, due to bad concreting. This negligence had led to the slip form operator refusing to work and lodging a complaint about the use of too much ash in the concrete construction and because no technically knowledgeable person was provided by BALCO, SEPCO and GDCL to improve the situation.

The Report of the National Institute of Technology (NIT) Raipur includes descriptions by 13 eye witnesses among whom are 1 labour contractor Mr. Prithvinath Singh, 2 DCPL employees and 10 employees of BVIL.

The DCPL employee Mr. Pradyut Choudhary has told the Investigating Agency that the opening at the Flue Duct Level and the embediment of Valve caused a disturbance and without removing the valve, the opening was filled up by concreting or patching. This was serious and extremely dangerous.

In the Report of NIT Raipur, the 10 employees of BVIL have given their statements along with their mobile numbers. Their Safety Inspection

Reports (S.I.R.s) includes the various short-comings and omissions committed during the construction work.

On account of this it becomes crystal clear that, due to a delay in meeting the construction completion deadline, and due to mechanical and machinery failure, the quality of concreting and construction work of the collapsed Chimney was seriously compromised by carrying it out, ignoring quality control.

Even Professor Pradipta Banerji of IIT Bombay too in his Report has indicated and pointed this out, and in the letter of Shri Gunjan Gupta CEO of BALCO dated 6.10.2009 it is stated by him that there is no mention in the I.S. Codes of the level / extent of concreting to be carried out on each day. However, the concreting work of the chimney has to be such that it can bear the weight of the heavy slip-form and the green concrete that it will contain.

Once again, it is noteworthy that the log books for Batching Plant and the slip form are not available, which makes it difficult to know when (time and day) both the machines (batching and slip-form) were used at different heights and when their servicing and maintenance was done and/or how many days the machines were not operated, or to know what were the short-coming / errors / omissions that occurred and at what rate the work was carried out, including any overloading, and to know whether work was carried out as per the directions to maintain quality control in construction work, issued by DCPL and BVIL.

Annexure :- (11) Technical Comments regarding shock waves.

Shock waves emanating from different sound waves can and do adversely impact construction and under-construction structures. The different levels of sound are measures in "decibels" and, depending on the human audible range, sound levels either below or above those humanly audible, can have adverse impact on hearing. But exactly what levels of sound generated shock-waves impact constructed or under-construction structure is not specified or mentioned in the standards. In the same manner depending on the speed of sound ultra-sonic, super-sonic and extremely fast sonic Boom get created and the shock waves created can have severe adverse impact. It has been known and reported that, due to the Sonic Book created by the "Concorde" jet plane at the time of its take-off, the glass windows of the Airport terminal buildings are shattered.

Even ordinary sound waves are known to cause vibration. Due to the resonance effect of sound caused by rhythmic marching of troops, while crossing a bridge, the Army or N.C.C. marching contingents are not permitted to move in unison movement as it can lead to bridge collapse due to sound created vibrations. In part, the troops are split into small groups to cross the bridge in order to prevent the collapse or crash of a bridge due to vibrations arising out of resonance. Not just in case of the collapsed BALCO chimney, but throughout Chhattisgarh, there is no data or record available to show that shock waves caused by sound waves have been responsible for the collapse of chimneys.

Annexure:- (12)A – Affidavit of Mr. Vinay Gupta, Chief Executive Officer of Tandon Consultants Pvt. Ltd., TCPL, New Delhi, dated 7th October, 2011 made in response the summons of Inquiry Commission dated 24.09.2011 .

In response to the summons issued by the Inquiry Commission on 24.09.2011, in his capacity as the Chief Executive Officer of Tandon Consultants Private Limited (TCPL) Mr. Vinay Gupta filed his Affidavit dated 7th October, 2011 in which TCPL has clarified that the TCPL was only concerned with the Design of the Chimney and it was required to furnish entire design related data to GDCL. The Affidavit claims that the role of TCPL was strictly limited to providing the necessary number of design drawings to GDCL and DCPL as requested. Prior to the Design, the Soil Investigations were carried out by M/s Mishra and Associates, Kolkata being so commissioned under a contract made by BALCO through SEPCO through GDCL and finally given to TCPL for making the design of the Chimney.

(I) The Chimney Design ordered from M/s Tandon Consultants Private Limited (TCPL) by DCPL was accepted by GDPL, SEPCO and BALCO.

(II) TCPL, in Para No.8 in its Affidavit, has clarified that after the collapsed of the Chimney, BALCO, Korba had ordered an Inquiry by IIT, Delhi, Professor S. N. Sinha, and Dr. Sinha has given a clean chit to the Chimney Design as being safe and adequate. TCPL has also clarified that the distance between the two Chimneys in 147 metres and that the Chimney design and all other Parameters, except the foundation, were similar. Chimney No.II is based on a Raft Foundation and collapsed Chimney-I was erected on a Pile foundation. This means that the circumference, thickness and breadth of the foundation of the two Chimneys were different.

(III) At Para No (9) of its Affidavit, TCPL has stated that the Superintendent of Police, Korba and NIT, Raipur Team, was sent to conduct an investigation, in which the NIT Report dated 31.12.2009 has clearly stated, after the structural analysis of the collapsed Chimney, that the Design of the collapsed Chimney was within the limits of the Provisions of the I.S. Code.

Annexure':- (12) B Letter / Affidavit of Mr. Vinay Gupta, Chief Executive Officer of Tandon Consultants Private Limited, TCPL, New Delhi dated 12th October 2011 made in response to the summons of Inquiry Commission dated 24.09.2011.

Tandon Consultants Private Limited (TCPL) by letter dated 12th October, 2011 sent along with above stated/described Affidavit consisting of 11 Paras, mentions the contract dated 16.1.2008 with GDCL along with a copy of the same, in which the scope of TCPL and its remuneration are stated. There is no technical aspect to this.

Annexure:- (12)C – Reply by Mr. Vinay Gupta, CEO, Tandon Consultants Pvt. Ltd (TCPL) dated 20th October, 2011 in response to the questionnaire of the Inquiry Commission dated 12.10.2011.

TCPL *vide* its letter dated 20th October, 2011 has further submitted the contract by GDCL dated 16.1.2008 and another communicated dated 05.04.2008 regarding some points in the contract. However, in this there is no technical aspect mentioned.

Annexure :- (12) D – A 13 point Reply of CEO of Tandon Consultants Pvt. Ltd. dated 31st October 2011.

n response to the letter of this Inquiry Commission dated 12.10.2011, the TCPL in its reply dated 31st October, 2011 has presented points Nos.1 to 5 in response to the questionnaire. It has furnished the details along with the design consultants name and information about the GDCL-mentioned IS code.

(I) In its reply to the questionnaire, at Para No. 6, it has clearly stated that the location of the Chimney was decided by the layout designer and not by the structural designer. In this case M/s TCPL is only a structural designer and not a layout designer.

(II) The TCPL, in its points No.07, has made a clear mention that in case of identical chimneys, all dimensions such as height, breadth, circumference, diameter and thickness at all levels and shape must be the same.

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Here it is worth mentioning that the distance between the two Chimneys is less than that prescribed by the I.S. code ,and the foundation of one Chimney
is a Raft foundation and of the other is a Pile foundation. The two Chimneys are therefore not identical. In such a situation it was imperative that, before execution, a model study of both the Chimneys should have been done, but the same was not done.

(III) In Para No.(8) the TCPL has provided a list of different Chimneys which it has designed.

At Para No.(9), (10) and (11) the TCPL has stated that the contract between themselves and BALCO is for both chimneys and that TCPL was aware of the distance between both the Chimneys.

Hence, TCPL should have conveyed to GDCL and BALCO the minimum distance required between the two chimneys as required under the I.S. code. At Para Nos. (12) and (13) mention is made regarding the Soil Excavation carried out by M/s Mishra and Associates.

Here it is worth noting that, neither before nor after the design, was any inspection ever conducted by any National Institution or Engineering Division. However, on account of the differences in the type of foundation there should have been a "Model Study".

Annexure:- (13) Provision short-comings as per I.S. code (4998 Part I, 1992) and short-coming in terms of clause A.1.2.2 to A1.2.5, along with photos.

(A) [omitted]

It was essential to conduct a model study examination test at Pune or by another national level institution. However, without selecting such a model test, the design was approved and the decision to construct the chimney was taken by GDCL, SEPCO and BALCO, despite the fact that none of the companies had any chimney designing expertise of their own.

After the collapse of the Chimney, BALCO asked several national and international institutions, to give their reports. But if BALCO, SEPCO and GDCL had consulted and done the joint "Model Study" the tremendous loss of property and life due to the collapse of the Chimney could have been avoided.

Annexure : (14) Report of the Vladimir A Rakow (done in respect to contract at No.7) in reply / response to 17 question query of the Government dated 18.4.2012.

BALCO submitted an Affidavit dated 18th April, 2012 on the analysis by Dr. Vladimir A. Rakow, Professor, Electrical and Computer Engineering,

Florida University which was sworn before the Alachua County, State of Florida on 16th February 2012, in response to the questionnaire consisting of 17 questions by the Government.

His reply was received by the Inquiry Commission via an e-mail.
There are no technical annexures to queries from responses 01 to 09 regarding the collapsed Chimney of BALCO.

However, in the replies at No.10 and 11 regarding specific technical questions, it is stated that there was no evidence of the impact of lightning on the concrete structure, metal or iron and on the lift system operating on the structure.

The reply at No.11 is in reference to the BVIL investigation on which he has not expressed any opinion as to its correctness or in correctness.

According to his reply at No.12, the lightning can impact the structure in many ways.

According to him, the collapse of the BALCO Chimney because of the destabilization of the structure was not so much due to the fact of lightning strike and microburst, but due to failure of the slip form and the foundation.

He has further clarified that lightning could not be solely responsible for the collapse of the Chimney.

The Reply at No.14 clearly mentions that the temporary LPS (Lightning Protection System) was less than adequate. However the temporary LPS is within the limits prescribed by E-2-6.1 of I.S. – 4998C (part – I) 1975. It is extremely pertinent to note here that, design standards regarding stability and strength are generally prescribed, but they are not sufficiently mentioned herein.

There is no technical comment regarding the collapse of the Chimney in reply No.(16) and (17). The view mentioned is in keeping with his Report of February 2011 and no statistics are provided to support the claim that lightning strikes only those chimneys which are of 500 feet or more.

Annexure (15) A – Reply given by BALCO *vide* its Reply dated 24.5.2012 in response to the questionnaire consisting of 83 questions dated 27.4.2012 based on the Report of National Institute of Technology (NIT) Raipur dated 31.12.2009 (which is mentioned at No.2 above)

A Civil Engineering Professor of National Institute of Technology (NIT) Raipur along with four other Experts constituted the NIT Experts Team. They conducted an examination and inspection on 10/11 October, 2009 and the Test Report dated 24.12.2009 and technical Report dated 31.12.2009, which are mentioned at No.2 above. The spokesperson of BALCO *vide* a communication dated 24.04.2012, passed a list of 83 questions based on that report back to the expert team of NIT to which the National Institute of Technology (NIT) Raipur replied on 27.04.2012.

The Replies given by the Technical Team of National Institute of Technology (NIT) Raipur at Annexure 01 to 05 did not regard any specific aspects of the collapsed Chimney. The replies to these questions consisted of descriptions about the specialization of the Expert Team Members and theoretical discussions on the difference between Micro bursts and Hurricanes.

In replies No.6, 7, 8, 9 and 10 the NIT Team list their specialized abilities and specific experience and list the tests they conducted. In Para 7.3 of page 21 of its report dated 31.12.2009, the NIT reiterates that the collapse of the Chimney-I may not have been due to the strike of lightning.

At replies No.11, 12, 13, 14, 15 and 16 the National Institute of Technology (NIT) Raipur Team of Experts has stated that it conducted the tests after site

inspections on 10.10.2009 and 11.10.2009 and after procuring from T.I. Balconagar, Korba various documents and files and after discussion with various people and after collecting various notices. The team members had taken photographs of the collapsed Chimney structure and its surroundings.

Collection of samples was done as far as possible according to the I.S. code guidelines. Given that the rescue operation was underway, it was not entirely possible to follow all the necessary sampling techniques.

In the replies at No.17, 18, 19, 20 and 21, the NIT Team has clarified that while collecting the samples the NIT Team members were not present, but the physical on-site inspection was done by the NIT Team members. The photographs were also taken by an NIT Team member.

The site inspection and physical examination could not be carried out on 23.09.2009 because of the condition of the collapsed chimney. A discussion with the police department has revealed that extensive cutting and debris removing was been carried out with the help of different machines. The Core samples supplied by Korba Police for testing purposes had no signs of cracks.

Responses of the NIT Team at No.22, 23 and 24 indicate that it was able to get various documentary evidence and core samples of materials used in the chimney's fabric from the Police Department. It was also stated that no documents or reports were received by NIT from the Police regarding the injuries and deaths of the workers and employees.

At replies No. 25, 26, 27, 28, the expert team of NIT has specifically stated that there does not appear to be any evidence to show that the short-comings of construction and quality of work pointed out in the Safety Inquiry Report were addressed and rectified. There is mention of necessary improvements regarding issues raised in the S.I.R, but it can be assumed that no such improvement works were ever carried out. There is a clear reference in the NIT Report of

31.12.2009 that the NIT team received the S.I.R. from the Police Department. However it is not in receipt of information on what steps were taken by GDCL and SEPCO to correct the shortcomings mentioned in SIR.

At replies No. 30 and 31, the NIT team from Raipur has clearly stated that it had direct discussions with eye witnesses. Also a description of evidence and statements of eye witnesses of BVIL and DCPL has been indicated in its Report dated 31.12.2009 at Para Nos.7-1 and 7.2.

The NIT team discussed the issue of soil excavation methods with M/s S.K. Mishra and associates and refers to its report (which was same as the one received from the Korba Police).

At replies No.32, 33, 34, 35 and 36 ,there is a detailed description regarding the different outcomes of a temperature increase arising out of lightning, including thermal effect, melting and fire and burning caused due to electric arc.

The NIT have not conducted any tests on the melted rebars.

Replies No.37, 38, 39 , 40, 41, 42, 43, 44, 45, 46, 47, 48, 49 and 50 by NIT are theoretical answers to theoretical questions and special mention is mad,e along with a supporting photograph No.27, about the grounding, lightning arrestor of the other chimney (Chimney No.2) which stands next to Chimney No.1 (the chimney which collapsed). In these replies to the questions there are no observations relating to the grounding and lightning arrestor of the collapsed Chimney.

Replies of NIT team at No.51, 52, 53 and 54 refer to the collapse of the structure and foundation due to microburst. By replies at No.52 an 53 it has clarified that concrete failure and its sudden collapse results in a blast with loud sounds. A detail description of this is found in Article-4 at pages 5, 6, 7, 8, 9, 10 and 11 of the NIT Report.

Reports given at No.55, 56 and 57 consist of theories regarding the lightning strike and are not specifically related to the collapsed Chimney.

At replies No.58 and 59, the NIT Team has clarified that, according to the test reports of NCCBM, there are huge discrepancies in the concrete mixes and that the cement percentage varies from 15-84% to 27.29% and that such extreme variations is a significant factor in arriving at their conclusions.

At replies No.60, 61, 62 and 63, the Expert Team of NIT has reported on 31.12.2009 about the various short comings, already made at Para No.5 of its earlier Report, regarding weaknesses of the compressive strength of the concrete and it has concluded that, due to this there was a sudden concrete failure due to brittleness. Other points discussed here are not directly related to the collapsed Chimney.

At replies No.64 and 65, the NIT Team says that there are short-comings, errors and omissions made by BVIL in its own Safety Inspection Report because it does not indicate whether any corrective measures were taken or not. (From the BVIL Reports one should easily be able to conclude whether corrective measures were taken).

The report has confirmed that the sudden collapse is due to the many weaknesses and failure of cement concrete. The opinion of the team members is that improper cement content in the concrete mix, poor compaction and honey-combed concrete in the construction of the chimney shell, probably led to crumpling of the concrete and its sudden collapse.

By the Replies at No.66, 67, 68, 70, 71, 72 and 73, the NIT has clarified that the sudden collapse of the upper section of the Chimney led to the complete collapse. The collapse of the Chimney occurred from its weakest point. In its Reply, the NIT has further clarified that in its Report it does not claim that the collapse is only due to the foundation failure. Also, it has specifically mentioned that foundation failure could be ascertained by seeing whether the chimney collapsed telescopically or by tilting and falling on one side. In the case of foundation failure, the chimney would tilt and tend to fall sideways.

In Replies No.77, 78, 79, 80 and 81, the NIT Team has mentioned that as per Para 7.2.1. on page 20 of their Report dated 31.12.2009, the eye-witnesses stated that the upper portion of the Chimney collapsed first. The collapse of any chimney would happen at the weakest part of the chimney which is always the smallest diameter area, the link portion, or the lower portion of the Chimney where there are various openings.

At reply No.82, the NIT team has stated that their report is based on the notices, orders, evidence and materials provided.

At reply No.83, the NIT team has clarified that the burn marks seen during the post postmortem on the bodies of the workers could possibly be due to a lightning strike on the slip form in the upper portion of the Chimney. If this were the case then it would have to be due to a lack of lightning protection as prescribed.

Annexure:- (15) B-Reply of NIT dated 25.5.2012 in response to 20-point questionnaire of GDCL dated 03.05.2012 based on the Report

of National Institute of Technology (NIT) Raipur dated 31.12.2009 (which is mentioned at No.2 in this commission's report).

A Joint Site Inspection and collection of various evidence and core sampling was carried out by the 4-member Expert Team of the NIT Raipur of the collapsed BALCO Chimney on 10 and 11 October 2009 along with vital photographs taken and specimens collected for test at its own laboratories to prepare its joint report dated 31.12.2009, which is mentioned at Annexure No. 2 above.

Based on the NIT Report, the head of GDCL sent to the Commission Inquiry a questionnaire consisting of 20 queries on 24.4.2012 which in turn was forwarded 03.05.2012 to NIT. The Joint Reply of the 4 experts of NIT Raipur to the Questionnaire of 20-queries was returned to the Inquiry Commission on 25.05.2012.

In replies at No.1 and 2 to GDCL's queries about the experience of the NIT experts, the NIT stated that three of the four experts of the Technical Council have experience of working in the position of site engineers.

The replies at Nos.3, 4, 5, 6, 8 and 9 contain descriptions and analysis of the evidence submitted by BVIL and DCPL and also examination and analysis of the materials made available by the Chhattisgarh Police. The Safety Inspection Reports (S.I.R.) of BVIL refer to the use of poor quality materials.

Concrete cores provided by the police department were subjected to tests by NIT Raipur and photographs were taken of the core samples before and after the samples were crushed and their analysis and findings presented.

The reply at No.10 describes various types of fractures within safety structures and also speaks about the impact of load pressures on these structures in relation to guidelines from the B.I.S (Bureau of Indian Standards).

The reply at No.11, 12 and 13 states that the expert team are sufficiently knowledgeable about issues regarding lightning. But prior to this, they had not prepared a report regarding the collapse of any other chimney.

The expert team, on the question of equipment at the upper portion of the Chimney, has reiterated what has been said at Para No.7.2.1. of the NIT Report.

In the Reply at No.14, it was stated that as per the report of the National Council for Cement and Building Materials testing lab in Vallabgarh, the cement content of the concrete varies from 15.84% to 27.29% but there is no comment regarding the core sample, or on coarse aggregate/fine aggregate or on the strength of the rebar.

In the reply at No.15, 16, 17 and 18, it is stated that the findings included in the report are based on the written statements of the eyewitness evidence and on the evidence provided by the investigating agency. The information and reports provided by the Police have been analyzed in the light of the context of Paras No 3, 4, 5, 6 and 7 of the Report of NIT. The Post-Mortem Report was not made available.

In the Reply at No 19, the expert team has mentioned that the carrying out of the work on the Chimney to the height of 240 meters was mentioned in the :-

(1) Daily Work Progress chart

(2) Report of the Technical Committee submitted by K.R Mehra, IRSE(Retired) adviser to GDCL and A.K. Banerjee, Technical Advisor GDCL dated 27.10.2009.

Annexure:- (16) Reply of Mr Viral Mehta, Vice President of BALCO dated 04 June 2012 to the 9-Query Questionnaire dated 10.05.2012 of Mr Yeshwant Sinha, Government Officer

In the Reply given at No. 01 by the Vice President of BALCO regarding his duties and responsibilities, he has stated that the same were given in the Engineering Procurement Agreement between BALCO and SEPCO. According to Mr Viral Mehta, the Vice President was assigned the responsibility to coordinate the Time Schedules with SEPCO and to go to China for the Contract Review.

In Reply to No. 02 and 03 , it is stated that site visits had to be conducted from time-to-time to see the physical (actual construction) progress.

In the reply to important questions from 04 to 09, it is stated that Mr Viral Mehta had no details or records and has stated that information in reply to questions 05 to 09 can be collected or obtained from SEPCO.

It is important to note that the Vice President of a 1200 MW power plant which had an Engineering Procurement Construction Agreement with SEPCO and was also as the Chief Coordinator, had not visited or been present at the site of the collapsed chimney even once after the accident, despite the death of 40 workers. Nor had he collected any kind of records from SEPCO. In his reply Mr Viral Mehta has even admitted that the register regarding the Regulations of Employment and Conditions of Service for the construction work of the 1200MW Power Plant, as required under the Regulation Act 1996, was not in the possession of BALCO and had to be collected from SEPCO.

Annexure:- (17) Mr Abhishek Sinha, the Legal Counsel of BALCO in his communication dated 14.06.2012 has enclosed the Affidavit dated 13.06.2012 of Mr Jivan Kunwar Mukerjee, "Vice President" (Project).

The Affidavit dated 13.06.2012 sworn by Mr Jivan Kunwar Mukerjee, Vice President (Project) BALCO was received along with the communication dated 14.06.2012 from Mr Abhishek Sinha, the Counsel for BALCO.

The Affidavit by Mr J.K.Mukerjee is accompanied by Technical Comments at Annexures 'A' and 'B'.

A- **Enclosed Annexure 'A': Technical comments dated 07 June 2012 by Dr. J Prasad, former Associate Professor, IIT, Roorkee and the present Director of ISBE (Integrated Strategic Business Education) in response to the 83-query Questionnaire of National Institute of Technology (NIT) Raipur (mentioned at Annexure No.15 above).**

The 83-query Questionnaire by BALCO was again sent to two technical advisers selected by BALCO and presented for their analysis. The private technical report and site inspection of J. Prasad, Professor at the Indian Institute of Technology, Roorkee, (which have been presented in detail at Annexure – 4) has discussed the technical planning carried out by BALCO.

In comparison to the analysis and report of the highly qualified Ph.D - holding four members of the NIT team, consisting of a Professor and Associate Professors, the analysis of just a single former Associate Professor carries much less weight.

B. Enclosure (Annexure – B) :- Technical comment of Dr. Vladimir A. Rakow dated 24th May, 2012 given in response to 83-query questionnaire of the National Institute of Technology (NIT) Raipur (mentioned at Annexure-15 above).

The technical analysis comments by the 4 Civil Engineering Experts consisting of Professor, Associate Professors and Assistant Professor at the National Institute of Technology (NIT) Raipur, based on the site inspection and materials test, given in the report is described in detail at Annexure 02 above.

The questionnaire of 83 questions was forwarded by BALCO for an opinion to its technical adviser, Dr. Vladimir A. Rakow, who is an expert in Electrical Engineering but not in Civil Engineering. In his response Dr. Rakow has expressed his opinion only on the electrical engineering aspects of the questionnaire.

Dr. Rakow is entirely focused on the word 'Blast' in the Questionnaire of the National Institute of Technology (NIT) and time and again he returns to this word. Not being a civil engineering expert, Dr. Rakow is unlikely to be aware that, in the case of concrete failure, there would be a sudden blasting sound at the time of the collapse, which can be termed as a 'Burst' on a 'Blast'. For such a concrete 'Blast' there is no need for use of any electricity or explosives.

As an electrical and lightning expert, Dr. Rakow should not have expressed any views in the 83 query questionnaire on which he does not have expert knowledge. To give a biased or critical opinion on the report of the experts, while himself not being an expert on the subject, amounts to being prejudiced.

Annexure : - (18) Reply dated 22.05.2012 by Site Manager, Mr. Deepak Basu of DCPL in response to the letter of Enquiry Commission No.S2/128/JEC/2012 dated 10.5.2012

The Site Manager, Mr. Deepak, Basu DCPL of (Development Consultants Pvt. Ltd) has stated that "The report regarding construction quality has not looked at my DCPL submission. Hence it is not possible to reply to the questions regarding quality".

Annexure: – (19) Reply of GDCL to the Judicial Enquiry Commission letter No.128/JEC / dated 10/05/2012.

In response to the questions of the Judicial Enquiry Commission at 126/JEC/2012 dated 10.05.2012, GDCL has replied by letters dated 24.05.2012 / 30.5.2012.

The GDCL, in its response to the question 01 to 06, A and B along with question No. 01 to 03 A and B of 12-query Questionnaire of Inquiry Commission, has stated that GDCL had only a single slip-form which was in operation throughout construction and that at no time was there any delay or disruption in the construction work. Hence there was no adverse impact on the construction work.

However, in reply to demands (Annexure at 1 'B' and Reply at 3 'A' and 'B'), it failed to submit photocopies of the data-wise and shift-wise logbook which would show the operation of slip-form. It expressed its inability to furnish the logbooks on the pretext that they were either destroyed in the course of the mishap or taken away by the Police.

Here it is worth noting that the slip-form log book is usually kept with the operator supervisors. Hence the explanation that the log book has been destroyed in the mishap is unacceptable. Even the claim that police had taken the log book must be far from the truth. For whenever police

confiscate and seize any evidence, it would be recorded in writing by the concerned police officer. GDCL has also failed to produced any copy of such police recording or evidence in its response to the questionnaire.

It is also worth noting that, in stark contradiction to the reply given by GDCL to the Questionnaire, some employees informed the NIT, Raipur, Inquiry Team that, due to the breakdown of some GDCL machinery for about a month, the construction work was halted. It was also stated that there were problems with the slip form apparatus, which caused workers to refuse to carry out further work (page No.18, Paras No. 7-1-1- and 7.1.2. of the Inquiry Report of NIT Raipur). It is clearly mentioned that there was a delay of two months in chimney construction which resulted in work being carried out around the clock after that,for a period of four to five months, except on Sundays. Hence there is no truth in the reply of GDCL at replies No.1, 2 and 3.

At replies Nos. 4, 5 and 6, GDCL has stated that it was not aware of any mishap or breakdown at the batching plant which is mentioned at No.2 of the Report of NIT Raipur. The NIT reports that there was an accident at the GDCL batching plant and it was out of operation for 2 months. In order to make up for the short time, work was carried out continuously for 24 hours, except on Sundays.

There is evidence from copies of an uncertified 58 page log book in which, during February and March 2009, no work was done for about 2 days and similarly in the first week of April and May 2009, for about 15 days no work was done. This confirms the statement made by the witness in the Report of NIT Raipur, that the batching plant was not operational due to an accident or breakdown. However, GDCL in its reply at No.5 has stated that there was absolutely no problem with its batching plant and

there was no stoppage of work. Hence the replies given by GDCL to questions 06 ‘A’ and ‘B’ are not truthful.

Annexure:- (20) Reply of BVIL dated 23.05.2012 made in response to the questionnaire of the Enquiry Commission dated 10.05.2012.

In reply to the questions asked by the Inquiry Commission dated 10.05.2012, the Project Manager of Bureau Veritas India Limited (BVIL), Mr. Kamlesh Adhikari in this reply dated 23.05.2012 at nos. 01 to 02, ‘A’ and ‘B’ has clarified that the responsibility of BVIL was only to submit surveillance reports to BALCO and these did not regard quality improvement or stoppage of work due to poor quality. Bureau Veritas India Ltd (BVIL) was only concerned with making occasional reports to BALCO after inspection, pointing out the weaknesses and short-comings. The task of improvements in the construction work was that of the engineer and contractor SEPCO. The responsibilities of the BVIL were therefore limited.

The BVIL in its reply to 03 and 04 has stated that the necessary corrective action on its Inspection Reports was to be collectively carried out by BALCO, SEPCO and GDCL, being the specific responsibilities of the owner BALCO, contractor SEPCO and sub-contractor GDCL.

The document enclosed by BVIL in its reply at No.05 regarding Joint meetings between BALCO, SEPCO and GDCL, makes it clear that, during the most crucial phase of construction, only a single meeting was

held on 23.04.2009. During the crucial period of construction of the collapsed chimney, the three organizations responsible (BALCO, SEPCO and GDCL) the owner of the collapsed chimney, its contractor and sub-contractor, did not pay any attention to the Surveillance Reports of BVIL (Bureau Veritas India Ltd.)

Annexure :- (21) Affidavit of Mr. Gunjan Gupta of BALCO dated 30.05.2013.

In his Affidavit dated 30.05.2012, the CEO of BALCO at Paras Nos.01, 02, 03 and 04 has clarified that the responsibility for the 1200 Megahertz Power Project did not fall within his domain. He says his responsibility was limited only to BALCO operations.

At Paras No.05 and 06, he has stated that the Project Manager was Mr. Viral Mehta, Vice President, BALCO, and as per the Agreement dated 20.08.2007 the entire responsibility and accountability for construction was with SEPCO. He has further stated that the contents of his Affidavit may be read in relation to, and considered part of, his statement.

It is worth nothing here that SEPCO was the contractor for the 1200 MW Power Project and BALCO was the sole owner of the Project. On behalf of BALCO Mr. Viral Mehta, Vice President of BALCO was the Project Manager. Hence, BALCO, being the owner cannot excuse itself in any way from bearing responsibility.

Annexure :- (22) Affidavit of Mr. J. K. Mukarjee, Vice President of BALCO in Para 05.

Annexure :- (A) EPC contract, clause 15.1, 15.2, 15.4.

B) BVIL

(C) SEPCO

Mr. J. K. Mukarjee, Vice President (Project) BALCO, has submitted his Affidavit dated 31.05.2012. At Paras No.01 and 02, of his Affidavit he has clarified that his responsibility for the Project commenced from 12 January 2010 and that, in his earlier Affidavit of 27.01.2011, he has provided the Surveillance Inspection Reports (SIR) of BVIL which are mentioned in the Report of the National Institute of Technology (NIT) Raipur.

Through his present Affidavit, Mr. Mukarjee has furnished to the Inquiry Commission, documentary evidence of the responsibilities of BALCO, SEPCO and GDCL which are as follows:-

Mr Mukarjee in Para No.3 of his Affidavit has stated that after signing the EPC contract dated 20.08.2007, SEPCO was solely responsible for construction and in accordance with the said responsibility, SEPCO has submitted the monthly Reports (for the construction period from July 2008 to September 2009).

At Para No.4 of his Affidavit, he has clarified that there were no specialists or experts on power projects in BALCO. Hence, it appointed two expert agencies for the purpose – DCPL (Development Consultants Pvt. Ltd.) and BVIL (Bureau Veritas India Ltd.) The DCPL (Development Consultants Pvt. Ltd.) was tasked with the responsibility of checking and monitoring the work being carried out by SEPCO, as per the agreed engineering regulations and drawings.

M/s DCPL (Development Consultants Pvt. Ltd.) at Para No.18 of its statement dated 22.05.2012 has presented arguments that quality control was not part of its responsibilities.

According to the Agreement with BVIL (Bureau Veritas India Ltd.) dated 03.04.2008, it was required to submit surveillance inspection reports (SIRs) about quality of work carried out, upon which BALCO, SEPCO and GDCL were to hold weekly joint meetings.

It is clear from defense provided by BVIL (Bureau Veritas India Ltd.) on its behalf at Para No.21 of its reply to the questionnaire dated 23.05.2012, that its responsibility was limited to providing a Surveillance Inspection Reports (SIRs) stating the weaknesses and short comings in the construction work, upon which a Joint Meeting of BALCO, SEPCO and GDCL was to be convened to ensure that improvements in work were carried out accordingly. It was not the responsibility of BVIL to order stoppage of work in order to improve and overcome the weaknesses and shortcoming in the construction work.

From the above No.21, it is evident that, between January 2009 and July 2009, only one single joint meeting was held and not weekly joint meetings as stipulated. In the circumstances, no active attention was paid to weaknesses, shortcomings and poor quality.

At Para No.5 of this Affidavit it is stated that as per the EPC contract with SEPCO, dated 20.08.2007, it was SEPCO which was solely responsible to ensure quality control.

Annexure:-(23) Briefing from C.G. Electricity Regulatory Commission detailing the estimated cost of the Coal Captive Power Plant (CCPP) :-

It is learned from the officials of the Chhattisgarh Electricity Regulatory Commission (CGERC) that the estimated cost of the CC (coal captive) Power Plant at the time of the collapse of the BALCO Chimney was Rs 5 (five) crores per MW. Thus, the approximate estimated cost for 1200Mw works out to be around Rs. 6000 crores. However, the Agreement by BALCO for 1200 MW plant with SEPCO, a Chinese company, is for Rs. 2993 crores, which is the lowest quotation for the power plant. Hence the power plant has been made at the cheapest cost.

The Chinese company SEPCO had sub-contracted (with the consent of BALCO) the construction of both chimneys to GDCL which, through TCPL, made a design for the thinnest and cheapest chimney.

All three companies seemed to be exclusively focused on maximizing their profits. None of them have bothered to consider whether a low cost chimney can be constructed to be stable and strong. Hence all the companies involved in the construction of collapsed Chimney (BALCO, SEPCO and GDCL) are equally responsible and liable for the mishap of the Chimney under construction.

Annexure :- (24) Force Majeure and Natural Calamity

It is also essential to refer to emergency situations such as fire, earthquake, volcano, flood and storm, hurricane, typhoon, explosion, and

war-like situations in the context of which the collapse of structures occurs.

There is absolutely no record of any occurrence of such divine or natural emergency or calamity anywhere in Korba or the whole state.

Based on the all the technical documents the experts, eye witness accounts, site inspections carried out by the professors of various national and internationally reputed technical and technological institutions, laboratory tests and technical opinions of the experts and the analysis of the responses to the questionnaire, the multiple causes of the collapse of the Chimney can be stated as below:-

(A) **Civil Engineering**:-

According to the Report of NIT, specifically in its Paras Nos.1 and 12 on pages 211 and 212, there were multiple reasons for the collapse, such as poor quality of construction materials from the view point of civil engineering survey, research and development negligence in the construction work, blunders in achieving pile limits and pile connections to the appropriate levels, lack of rebar joints by way of welding, and lack of quality control. These have been collectively responsible for the collapse of the chimney. If these weaknesses and short-comings had not occurred the catastrophe could have been avoided.

Both chimneys were designed separately and differently but the distance between them was not stipulated. Both the chimneys cannot be said to be identical or in a cluster, as the foundations for both were different, and the lack of a joint model study led to different stresses and strains being placed on them. This was an extremely dangerous situation which could

have been avoided through achieving stability of the structures by undertaking a model study.

From a relative point of view the investment in the construction of the collapsed chimney borders on miserliness, with the thinnest and cheapest chimney being constructed, therefore lacking strength and stability. If the thickness of the shell of the Chimney was increased and more attention had been paid to the quality of construction materials used, the mishap could certainly have been avoided.

B) **Mechanical Engineering**:- From the mechanical engineering point of view, by not filling in an opening in the concrete wall caused by a chimney flue duct valve which was embedded, a serious and dangerous situation was created.

Due to defects in the slip-form, it was not possible to move it up to the height of 65 metres on account of which the ship-form operator refused to carry on working and lodged a complaint. But despite this, construction work was carried out to a height of another 10 metres. Similarly, as a result of breakdowns or an accident in the batching plant, construction work was held up and thereafter, in order to meet the time-deadline to complete the construction work, non-stop construction work was carried out, and as a result the freshly constructed section lacked the ability to bear the weight of the slip form and fresh cement concrete.

According to the eye witness accounts on the day of the mishap on 23.09.2009 it was noticed that, at the height of 240 metres to 245 metres, the weight of 45 to 59 tonnes of fresh concrete (green concrete) began to move, give way and collapse.

C) Electrical and Electronics (Lightning):- According to a professor of IIT, Kanpur, the necessary precautions against lighting strike were found lacking during the construction work. Along with this, according to NIT Raipur, the chimney faced weaknesses due to lack of necessary protection against lightning during the construction work, because the necessary cables and rebar (reinforcement bars) were not welded together to conduct the lighting charge.

However, NIT has totally rejected lightning as the cause of the collapse of the Chimney. Rakow of Florida University (USA) in his reply to the questionnaire has conceded that lightning alone was not the cause of the collapse of the Chimney.

D) Sound shock waves:- There is no documentary evidence or eye-witness statement regarding sound shock waves as the cause of the collapse of the Chimney. Hence sound shock waves as cause of the mishap is rejected.

E) Force Majeure and Natural Calamity:-

There is no documentary evidence, or report from the Meteorological Department, of any occurrence of volcanic, earthquake, hurricane, flood, storm, war-like situation, terrorist act, civil strife or destruction or any divine, natural or physical calamity.

After a thorough analysis, the technical opinion is that the primary reason for the collapse of the Chimney was due to the collective civil engineering and chemical engineering weaknesses, short comings or failures.

::CHAPTER – SEVEN::

Was there provision of measures necessary for the safety and rescue of the workers and other personnel during the construction, as required under the rules and laws applicable for such construction activity? If not, then who is responsible for this failure?

As regards the collapse of the Chimney 23.09.2009 from the technical point of view, the question as to whether the essential quality control yardsticks were adopted or not, was sought to be determined by the Inquiry Commission on the basis of the thorough analysis of all the related Inquiry Reports of all the concerned institutions / organizations. In the aftermath of the collapse of the incomplete Chimney, findings in regard to the quality of construction have already been arrived at on the basis of the quality analysis and reports of various organizations / institutions and also based on the depositions / statements made by various parties before the Inquiry Commission. Now it is essential to decide under whose authority the construction work of the BALCO

chimney was being carried out and what were the different provisions in this regard.

According to the facts brought before the Inquiry Commission, it has come to light that, in accordance with Indian Electricity Act, an MOU for 1200 MW Thermal Electric Power plant was signed between the Chhattisgarh Government, Chhattisgarh State Electricity Board and BALCO to provide electricity by construction of the power plant. The chimney was part of this power station. In the letter No.91/Steno/Admn/2009 dated 26.12.2009 sent by the Enquiry Commission, the Commission called for all the documents and records concerned with the construction work.

Based on the response given by BALCO in its letter dated 9th February 2012 to the above stated letter of the Commission the following comes to light:-

BALCO's 1200 MW Power Project was being constructed on 65.235 hectares of land and for this purpose BALCO had acquired the following approvals:-

a. Registration of the project by the Government of India, Ministry of Commerce and Industry, Secretariat of Industrial Assistance. On 13.6.2006.
b. Environment clearance by Government of India Ministry of Environment & Forests vide letter dated 14 August 2007
c. Permission to construct by the Chhattisgarhi Environment Conservation Board under the Water (Protection and Control of Pollution) Act 1974 and Air (Prevention and Control of Pollution) 1981 vide letter dated 25-9-2007
d. NOC (No Objection Certificate) from the Airports Authority of India for construction of Chimney vide letter dated 28-7-2008
e. Rail Transport clearance by the Government of India, Ministry of Railways for Transportation of coal vide letter 21-11-2006.

f. NOC from the Municipal Corporation Korba for construction of the 1200 MW power plant project consequent to which application for permission to build was submitted to Municipal Corporation of Korba and application of land use change (though the land was acquired by the state Government under the Land Acquisition Act for BALCO for industrial use)
g. Approval of drawings of 1the 200 MW power plant project including the two chimneys from the chief Inspector of Factories, Raipur.

In Para 11 of its letter, BALCO stated that the drawings of the Chimney were obtained by GDCL from Tandon Consultants and their analysis monitored by DCPL.

According to Rule 73(C) of Chhattisgarh Factory Rules, the construction or inspection of any building, wall, chimney, bridge, stairway, ramp, platform, stairway or any other structure, whether temporary or permanent, moveable or immovable, should be such that no bodily physical harm is caused. The Inspection Report of Chief Factory Inspection of BALCO dated 14.11.2008 was submitted to the Commission. The above mentioned Report includes the following conditions:-

1. This sanction / approval permission is not a permission / approval for the site or location of the factory.
2. This permission approval does not in any way endorse the title to land or property.
3. This permission / approval / sanction does not give any guarantee regarding the construction or material procurement.
4. In terms of Factory Regulations 1948 and M.P. and C.G. Factory Regulation 1962, the permissions granted do not grant any permissions to any necessary facilities shown in the plans and this order does not grant any permission to any such parts not permitted under the Regulations. It is thus essential to comply with all the Regulations.

5. It is necessary to seek the necessary permission / approval for factory effluents discharge and waste disposal from the concerned local public authorities and public engineers of Chhattisgarh Government, Raipur Pollution Control Board and concerned local authorities.
6. Provision of urinals and septic tank type systems for the toilets for men and women workers in the factory premises in terms of M.P. Factory Regulations 1962, Rule 50 to 54.
7. Before commencing the construction work the requisite Form-2 of stability certificate be produced.

According to Rule 3(A) of Chhattisgarh Factory Rules 1962, before commencing the construction work the occupier of the factory has to submit the stability certificate in Form 2 in terms of Rule 3 (3) of Chhattisgarh Factory Commission. But nowhere is it evident that ,before the commencement of the construction work on the Chimney, BALCO submitted the stability certificate. Hence, if it is believed that the 1200 mw Power Generation Project of BALCO is an extension of the BALCO plant, then it appears that the Chimney construction work carried out is in violation of the provision of Factory Act, 1948 and Chhattisgarh Factory Rules 1962.

In any case, the CEO of BALCO, Mr. Gunjan Gupta has stated on oath before the Commission that the responsibility of the 1200 MW Project did not fall within his jurisdiction. His responsibility was limited to BALCO operations only. However, so far as the BALCO Chimney was concerned, the registration of the Project Construction work was not done in terms of Factory Act and as far as he can recall the license under the Factories Act was received in June, 2011, and the application for registration was done about 3 - 4 months prior to it. From the above statement it appears that, prior to the generation of electricity from the 1200 MW Project, the

license for construction under the Factories Act was only procured by BALCO during the period when construction work was already underway.

Apart from the above stated fact, it has also come to the notice of this Commission that the exact location where the Chimney was being constructed came under the territorial jurisdiction of Korba Municipal Corporation. In these circumstances all the rules and regulations under the Chhattisgarh Municipal Council ,Act 1956 become applicable to the construction of the Chimney. As per section 5 (sub-section-7) of the Chhattisgarh Municipal Council Rules 1956, the term "building" is defined to include, a house, out-house, workshop, shed, hut or any other structure or enclosure, may it be of jute, thatch, brick, sand, mud, metal or any other material, irrespective of the fact that it is used for human habitation and includes sofas, balcony, staircase, threshold, walls, shelters and such other materials attached to a structure. However it does not include temporary shed or tent.

According to Section 293 of the Chhattisgarh Municipal Act/Rules 1956, no construction activity can be carried out without prior approval based on the said provisions. Section 294 of Chhattisgarh Municipal Rules 1956 required that any person who intends to construct any building has to furnish to the Municipal Commission the following documents:-

(a) Written application for the approval of the construction site, plans of the land along with the condition of the land, if government or municipal property, written proof of permission or approval for such land use, certified copies or if desired by the commissioner the original documents along with the appreciation and

(b) Application for permission for construction along with details regarding the foundations, height of the building, along with the land survey records and plans demarcating the surrounding and detailed account of the construction work, has to be submitted according to sub-section (1).

1. Any such building / structure which is entirely or partly joined, requires that every such plan / document be signed and certified by a recognized surveyor.

2. According to sub-section (1) every document to be presented must be prepared and described as required by the sub-rules.

3. According to clause (A) of sub-section (1) implementation / execution of the Orders is not permitted until the person appointed by the local Commissioner is accepted.

According to section 295 of the Chhattisgarh Municipal Corporation Act/Rules 1956, the Municipal Commissioner is authorized to refuse permission being sought for the construction of any building or structure. A provision is made under section 298 of the Chhattisgarh Municipal Corporation Act 1956 which requires that construction of any structure or building should be carried out under the supervision of a trained agency. Section 209 of the Chhattisgarh Municipal Corporation Act/Rules 1956 authorities empowers the Municipal Commission thus - “If it is found that there is a violation of any sub-clause or section made under these Rules while issuing the permission for construction of a building or if in the opinion of the State Government, it is essential in the larger public interest to revoke the permission granted by the Municipal Corporation or it is essential / necessary to re-examine or review, then the State

Government shall have the power to revoke such permission or order its review and in such a situation when any such order for revocation or review is made, all work of construction carried out prior to such order of revocation or review will be considered unlawful and done without any permission and action will be taken under the relevant sub-section of these Rules." Section 300 of the Chhattisgarh Municipal Corporate Act/Rules 1956 authorizes the Municipal Commissioner thus: "the order or permission issued by the Commissioner for construction or re-construction of any building shall remain valid for one year or for such period of time as provided under Section 293 from the date of the receipt of such permission. However, in case the construction or reconstruction of a building has not been completed within one year or within 2 years or any such length of time as permitted by the Commissioner, it will be considered that the permission has expired. However, such expiry of the construction permission does not debar from seeking fresh or extension of permission through fresh application as provided under the Rules."

In response to the Commission's letter No.91/Steno/Admin/2009 dated 26.12.2009, BALCO has furnished documents to the Commission, and a certificate of permission for the construction of the 1200 MW Power Plant was issued to BALCO by the Korba Municipal Corporation *vide* its letter No.Steno/2008/975 dated 17.06.2008. The conditions in this certificate of permission were as follows:-

1. The statutory responsibility for the establishment or erection of the Power Plant will lie with the owner of the land.
2. All Rules and Regulations applicable for the establishment / erection / construction of the Power Plant will have to be adhered to strictly.
3. Prior to the commencement of the work for construction of the power plant, BALCO must get approval for the layout plan from

the Town & Country Planning Department and submit the same to the Korba Municipal Corporation for its approval.

4. BALCO shall accept all conditions imposed by the Town & Country Planning Department.

BALCO has neither orally, nor in writing,informed the commission that it had implemented the conditions No.3 and 5 of the No Objection Certificate from Town & Country Planning Department for the construction of the plant, before the actual commencement of the construction work submitting it to the Municipal Corporation and obtaining its approval and after obtaining the approval for the layout plans carried out the construction work in compliance of the permission of Chhattisgarh Municipal Corporation Act/Rules 1956 and Chhattisgarh Land Development Rules 1984. Here it is appropriate to mention that, under the Rules 1984 and Chhattisgarh Municipal Corporation Act/Rules 1956, various provisions from the Safety point of view have been incorporated and there is clear provision regarding the quality of construction. In this regard the provisions under Rules 1984 are as given below. The various construction related activities are spelled out under sub-section-8 of section-2 of the Rules 1984.

(k) Any kind of construction, re-construction, of a building, charges / alterations in it and demolition of the building.

(l) Land development for Public Housing Scheme and collectivized Development.

(m) Land Development or re-development in which there are sub-divisions or different kinds of land use / land development within a colony.

The term Chimney has been defined in sub-rule 12 of Rule 2 of Rules of 1984 according to which "Chimney" is understood as an "upright shaft" in which there are one or more ducts for allowing the emissions of smoke and gases resulting from the burning of solid, liquid or gaseous fuels for heating any plant or equipment.

According to sub-rule 28 (k) of Rule 2 of Rules of 1984 a 'Tall structure' (tower) is explained as a building structure.

(1) which has 6 or more storeys

(2) whose height is over 18 metres (excluding 2.4 metre height for stilt parking)

As per the above definition, the construction of the Chimney by BALCO falls within the purview of Rules of 198, since the proposed height of the BALCO Chimney is 272 metres and it is considered to be a tall building. It is clear that, if permission for building construction is regulated under sub-rule – 51 of Rule-2, any breach of such authorization amounts to violation of the law / rules.

Sub-Rule – 67 of Rule 2 of the Rules of 1984 are concerned with 'Erection' or construction of a building or a structure as below:-

(K) 'Erection' of a building/structure or a site or location where earlier there may or may not have been a building.

(L) Reconstruction / erection of any such building which has been demolished or destroyed from the plinth level.

(M) Conversion of the occupancy from one type / kind to another.

Rule-3 of Rules of 1984 states that –

(1) These Rules will apply to all such land areas where colonies (slum) development or redevelopment takes place.

(2) These rules will apply to the design and constructing of any building.

(3) Wherever a whole or part demolition has taken place, these Rules will apply to all parts whether they are demolished or not.

(4) Wherever a whole or part is demolished then Rules will apply to all parts including those remain standing or are to be demolished.

(5) Wherever a building has been modified or altered, these Rules will apply to the entire structure irrespective of whether the building is old or new, and then Rules will apply regarding the rest of the building from the point of view of amenities and safety.

(6) Wherever there has been modification or alteration to the part of the building or structure, these Rules will apply to all such parts of the building affected or impacted by such modification or alteration.

From the above provisions of the land Development Rules it is clear that the construction of the BALCO Chimney came under the Land Development Rules.

According to Sub-Rule (four) of Rule 14 of the Rules 1984, any permission for construction of a high-rise structure in a Municipal area can only

be granted after a site Inspection by an approved committee. The constitution of such a committee is as under:-

(1)	Commissioner of Municipal Corporation	Chairman
(2)	Superintendent of Police or his nominee who is not lower in designation than a Deputy Superintendent of Police or City Police Commissioner.	Member
(3)	Executive Engineer of Public Works Department (Building and Roads) nominated by the Chief Engineer.	Member
(4)	Area / Regional Engineer of the Madhya Pradesh Electricity Board.	Member
(5)	A representation of the Fire Authority or District Assistant Fire Officer from any city corporation who is nominated by the Collector	Member
(6)	Joint Secretary / Under Secretary of Town & Country Planning Department nominated by the Chief Town Planer / Secretary of the Town & Country Planning Department.	

In compliance with Sub-Rule 3 of Rule – 17 of the Rules of 1984, in the case of construction of high-rise structures it is essential to furnish a plan of the development to the scale of 1:10000 along with the application for the permission and indicating the possible hazards surrounding the site on the plan at not less than 75mm.

According to Sub-Rule 10 of Rule 17 of the Rules of 1984 with regard to the structural stability in case of high-rise structure, it is essential to furnish a structural stability certificate duly attested by a structural engineer giving all the calculations along with all the instructions clearly.

However, from the documents produced before the Commission by BALCO it is clear that in the case of the Chimney in question the above stated requirement under land development rule 1984 was not fulfilled, and hence in these circumstances the commission reached the conclusion that despite the fact that the land development rule 1984 provides for specific provision under Rule 42 of Land Development Rule 1984 or such non residential structure, the same

has not been complied with or followed by BALCO in this case. This Rule is as follows:-

(K) The width of the main road linking to the building must not be less than 12 meters and the other end of this road whose width is not less than 12 metres must meet or link with another road.

(L) The Access road around all the four sides of the building shall be 6 metres wide and its layout must be as approved by the Government prepared in consultation with the city fire officer authority and shall be strong enough to withstand the weight / movement of 18 tonne Fire Tenders and an unobstructed open space where vehicles can enter and exit.

(M) The Entrance to the property / land should be wide enough for fire tenders to enter and in any case shall not be less than 4.5 metres wide. The gate to the entrance must be able to abut / touch the side walls so that the fire tenders can enter and exist without any hindrance / obstruction. In case the main gate is fixed on the Entrance wall, its minimum opening width must be 4.5 metres inside.

According to Rule 42(k) of the Rules of 1984 the additional requirements in building above the height of 12.5 metres are as below:

(one) the area of the land / property shall not be less than 1000 sq. mts and the minimum width of the frontage of the property must not be less than 18 metres wide and shall not be more than 30 percent of the area of the land

(two) the width of the main road on which the Building abuts should not be less than 12 metres.

However, the statements made by witnesses clearly indicate in the case of the construction of the BALCO Chimney that there was a serious violation of the provisions of the Land Development Rules 1984. In the Rule – 31 of Rules

1984 the duties and responsibility of owner of the building are specified and according to them:-

(1) The owner of the building is entirely responsible and not acquitted of any responsibility in terms of the Rules hereinabove stated, irrespective of the fact that the owner was in receipt of the said permission approved plan and specific approval and despite the inspections carried out by the various authorities.

(2) Every owner:

(K)who has been granted permission for the building and its surroundings shall allow entry at any reasonable time, of any Authority or an officer authorized in that regard of the concerned statutory authority.

(L) The owner of the site, or the authority of anyone concerned with the said property shall furnish all related documents.

(M) Whenever applicable, permissions for sewage lines, water mains, plumbing, tunnels connecting roads, electrical wirings, permissions for the main roads, high ways and all necessary permissions concerned with the proposal construction work, shall be obtained.

(N) Intimation to the concerned authority regarding intentions to start construction work at the site / location of the building (see appendix).

(O) Shall convey to the concerned housing authority written intimation to conduct inspection after reaching a certain level of construction (see Annexure P).

(P) Shall give written intimation to the concerned permission issuing authority on the completion of the construction work (see Annexure – Q).

(Q) Shall obtain the permission for occupancy in advance from the concerned authority (see Annexure – R)

(one) the occupancy for the building or for any part of construction or alteration or

(two) change in occupancy for a building or for any part of the building.

(R) After the receipt of the Application for occupancy from owner of the land in case the concerned authority does not issue the occupancy certificate within 30 days and if does not issue the necessary direction for change / modification within that period, it will be deemed that the occupancy certificate has been issued in terms of the section above.

(3) In case the owner of the land fails to comply with the duties and responsibilities, the Housing Development Authority of Chhattisgarh shall initiate appropriate action under the provision of Chhattisgarh Municipal Corporation Act 1956 (No.2 of 1956) and Madhya Pradesh Municipal Council Act/Rules 1961 (No.37 of 1961).

BALCO did not comply with the following rules:

Section 84 of Land Development Rules 1984 is concerned with structural stability and has also made provisions regarding the services, while Rule 85 of the Rules 1986 has provision regarding the quality of materials and quality of work.

From the above it is clear that the construction work of the Chimney was carried out contrary to, and in violation of, the provision of Municipal Corporation Rules 1956 and Land Development Rules 1984. Nor was formal permission for Chimney construction obtained as required under the provision of Municipal Corporation Act, 1956 and Land Development Rules, 1984. The formal approval of the plans of the Chimney were also not obtained.

The analysis of the construction material for its quality was not done as required under the provisions of law. Apart from this, BALCO failed to convince or establish before the commission that it had abided by and complied with the safety provisions of the Rules of 1996 (planning and services

conditions Rules) and Chhattisgarh Housing and other Construction Workers Rules 2008.

In the circumstances, the question that arises before this Commission is that when a construction of such scale and magnitude is being built,, in total violation of the safety provisions under the law, in such a situation who should be held responsible for the collapse of the chimney? In order to answer this question, apart from the various provisions cited above, it is also essential to cite the conditions mentioned in the Paragraph of the Agreement signed between Government of Chhattisgarh, BALCO and Chhattisgarh State Board of Electricity and the Agreement between BALCO, SEPCO and GDCL.

An Agreement was signed on 07.10.2006 between the Government of Chhattisgarh, Chhattisgarh State Board of Electricity and BALCO, according to which BALCO was to erect a coal fired thermal power station in terms of the provisions of the Indian Electricity Act, 2008. According to the Agreement the Project was to be established by BALCO and within 60 days of completion of the Project BALCO was to hand it over to the Electricity Department of the Chhattisgarh Government. The Inspection of the Project was to be carried out by the experienced authorities of the Energy Department of the State and STPB. According to Para 04 to the MOU all the statutory approvals were to be obtained by BALCO.

According to Para-7 of the Agreement, BALCO was to provide power to the consumers and the licensees as per Indian Electricity Act 2003 through its own power lines connected to the State Electricity Board, PGCIL and other grid lines. According to Para – 25 of the Agreement the liability towards property or persons arising out of any mishap or accident was entirely that of BALCO.

According to Para 22 of the Agreement, BALCO accepted shouldering the entire responsibility regarding the obtaining and following of all necessary statutory and legal formalities and procedures.

According to Para-7 of the Agreement, the Agreement was valid for a period of one year from the date of Agreement which was 07.10.2006, and thereafter the authority to extend the same was vested with the State Government.

According to Para-25 of the said Agreement on 10th October 2008, the Chhattisgarh Government (hereinafter referred to as the 'Government') Board and BALCO signed the Implementation Agreement. According to Para 4.1.11 of the Implementation Agreement, signed between BALCO, Government of India and Government of Chhattisgarh, all Acts Rules made at whatever point will be applicable to BALCO.

According to Para 4.1.12, BALCO was to adopt latest modern technology in the construction of the Power Plant which would make the plant environmentally compatible, safe, and would generate the optimum amount of power from the commercial point of view.

Before signing the Implementation Agreement on 20th August, 2007, BALCO entered into an agreement with SEPCO for construction of the Power Project, and accordingly SEPCO was assigned the responsibility as mentioned in Schedule 'one' and 'two' of the said Agreement. According to Para 7.3 of the Schedule "two" of the agreement the construction of this project involved construction of Twin Chimneys on the same premises, the height of which was to be 275 metres.

The Chimney was to be provided extra strength by use of concrete and the ducts were to be made of NS 1-2 material, which were to be GB 50051 – 2002 Quarter (half alloy) steel grade. The final 10 metres height of the Chimney was to be made of stainless steel. The ducts were to be insulated from the outside with mineral wool. The ducts were to stand on their own and platforms for maintenance of the concrete works and the ducts were to be provided.

According to ordinary conditions at Para 2 of the Agreement BALCO (termed as the owner in the Agreement) was to appoint a Representative with

responsibility in terms of the Agreement to assign duties, decisions, instructions, directives and orders on behalf of the owners BALCO. According to Para 2._.2 of the Agreement, any liability arising out of the negligence or mistake on the part of the representative, was the liability of the owner (BALCO). According to Para 3.2.2., SEPCO in compliance with its Agreement was to furnish within two months to the owner (BALCO) the list of contractors for the approval of the owner (BALCO). And according to Para 3.3.4 approval of the sub-contractor by the owner (BALCO) did not indemnify or exempt SEPCO from its contractual responsibilities or obligations.

Para 9 of the contract spells out the responsibilities of the owner (BALCO). According to Para 9.1.5, BALCO was required to appoint and provide a person for the purpose of supervision and management to assist SEPCO in order to ensure per-commissioning-stage reliability, performance guarantee tests over a warranty period. According to Para 12.1. of the contract SEPCO was required to submit all plans and documents pertaining to the project to BALCO for its approval and BALCO was required to approve the plans within 14 days. According to Para – 15.1 of the Agreement the entire responsibility for the safety at the work site was with SEPCO. Before the commencement of the work, SEPCO was required to prepare a comprehensive set of all rules and regulations pertaining to the safely and submit them to BALCO. SEPCO was to pre-determine and ensure that all the workers, representatives and sub-contractors, at whatever level of the work, complied with all the safety rules.

According to Para 15.2 of the Agreement, a safety Inspector was to be appointed who would be approximately qualified and competent for the work.

According to Para 15.3 of the Agreement SEPCO was required to maintain all records concerned with the safety health and welfare of the workers involved in the contractor's work. Para-18 of the Agreement has the necessary provisions for the Inspections and Supervisions. According to Para 18.1 the owner (BALCO) has the right to inspect any work before its completion or packing in case of any doubt or suspicion, and in case SEPCO did not provide sufficient

opportunity to BALCO to inspect work, the owner (BALCO) has the right to re-open the completed construction work, inspect it and examine it for its quality. According to Para 18.2 it was the responsibility of SEPCO and its sub-contractor to fulfill quality standards and quality control by complying with all the technical measurements and requirements, and it was the responsibility of SEPCO and its sub-contractor to furnish / submit all documents regarding quality control to the owner (BALCO).

Para 34 of the Contract is concerned with the responsibility / liability in case of mishap or accidents.

Under the terms of Agreement dated 20.8.2007 between SEPCO and BALCO, SEPCO entered into an Agreement with Gannon Dunkerley and Company Limited (GDCL) on 17th March 2008. This Agreement designated SEPCO as Employer and Gannon Dunkerley and Company Limited as a Contractor. According to this Contract the Contractor was to construct the Chimney. According to Para 19 of the Agreement / Contract the safety measures such as fencing, guarding and lightning, etc. were to be provided by the contractor and responsibility for site supervision and compliance of safety rules was the entire responsibility of the contractor.

According to Para 20.2 of the contract it was required to appoint a safety Inspector.

According to Para 24.1 of the contract, the contractor was required to submit to the employer's engineer all the requisite / necessary Inspection / Examination Reports regarding all the materials. And Para 24.2 of the agreement made provision for inspections of the construction work. Under Para 24.3 of the Agreement it was the responsibility of the contractor to furnish all Inspection Reports to the employer as per the necessary standards. According, to Para 24.4 it was the responsibility of the contractor to comply with all the requirements of all the technical standards and also to ensure their compliance by the sub-contractor.

In the circumstances it becomes clear to the commission that:-

Compliance with all the legal / statutory requirements for the construction of the Chimney was the responsibility of BALCO, and the responsibility to ensure / determine the safety measures was also that of BALCO, because BALCO was the owner of the Project.

However, through the contract dated 20.08.2007, BALCO shifted all its safety related responsibility / liabilities to SEPCO and in turn SEPCO through the contract dated 17.03.2008 had placed the safety related responsibility / liabilities on GDCL.

It is surprising that the Agreement between BALCO, the Government and Electricity Board for the project did not have any provisions to outsource the construction of the Project to any third parties. Nor is there any provision that, in case BALCO does out-source or sub-contract the project construction to a third party, the list of sub-contractors should be provided to the Chhattisgarh Government.

BALCO, SEPCO and GDCL carried out construction work contrary to the provision of Chhattisgarh Municipal Corporation Act 1956, Factory Act 1948, Chhattisgarh Factory Rules 1962 and Chhattisgarh Land Development Rules 1984. Consequently all the three are equally responsible and liable for the violation of the provisions of the above-mentioned Acts and Rules.

However such large-scale construction work, involving thousands of workers in which the mishap that happened and caused the death of 40 workers, was being carried out contrary to the provisions of Chhattisgarh Municipal Corporation Act 1956, Factories Act, 1948 along with the provisions of the Chhattisgarh Factories Rules 1984. No attempt whatsoever what made to stop the construction work being carried out in contravention of the Rules. Hence all responsible officers cannot be exempt from responsibility and accountability for the mishap.

Apart from the above stated facts, the provisions of the Government of India's Building and other Construction Workers (Planning and Service Conditions Rules) Act 1996 are also relevant in the context of rescue and relief of the workers and other persons affected due to the mishap. Chapter One of which and the same have been notified for the entire country from 01 March 1996, which states that these rules apply to every establishment in which 10 or more construction workers are employed or were employed during the preceding period of 12 months.

In section s62 and section 40 of the aforementioned Act, in exercise of inherent powers in consultation with the Expert Committee of the State Government, the Chhattisgarh Building and Other Construction Workers Act, 2008 was enacted. In Chapter two of this Act, the duties and responsibilities of the planners, architects, civil project engineers and designers are spelled out towards the construction workers. The responsibilities of the architects project civil engineers and designers towards the construction workers spelled out in section-6 are:-

(1) In case of any project, building construction or any other similar construction work, it is the responsibility of the Architects, Civil Engineers and designers to determine and ensure the safety and health of the workers working on such projects on building construction and must be included in the planning process for such project, construction and production.

(2) In course of the planning the Architect, Project Engineer and other specialists have to take sufficient precautions to see that the Design does not involve any danger or such processes or materials, the use of which

will endanger the health and safety of the workers involved in the construction work.

(3) It is the duty of those experts and specialists involved in the design of building, and construction projects to ensure that, in keeping with the safety and maintenance, all necessary safety and maintenance aspects are incorporated into the design of structures especially where they involve high risks or danger.

The State Government has notified *vide* No.F-10-1/2006/16 related 22.12.2008 that a Labour Commissioner or the Chief Inspector under the Building and Other Construction Workers Act, 1996, should be monitoring such a project for the purposes of safety of the workers and other persons during the construction work. Chapter 33 of the Chhattisgarh Building and Other Construction Workers Act, 2008, provides for a Chief Inspector and powers of the Inspectors. However, none of the above mentioned authorities conducted any site inspection of the Chimney construction site nor made any safety and Health related reports.

In the case of the BALCO project, the day to day responsibility for the health and safety of the on-duty persons and workers rested with the owner and the contractor. However, ordinarily, it is the responsibility of the contractor on the site of construction to ensure the carrying out of all the necessary safety precautions. With the help of the local medical officer, the necessary arrangements should have been made, such as provision of diagnostic kits, first aid, ordinary patient's room, ambulance service, etc. on the site of construction during the course of construction work.

During the Project construction, the construction of the Chimney was being done by the contractor GDCL. In his sworn affidavit, Mr. Alok Kumar Sharma has stated that he was employed as an engineer by GDCL and being the official responsible for the BALCO Chimney construction at the work site, had supervised the construction work up to the foundation level.

The construction of the Chimney's super-structure was done under the direction and supervision of other engineers of the company under directives of the engineers of the BALCO and SEPCO constituted team to ensure quality control. Nowhere has the site engineer clarified in his statement what arrangements or precautions or measures were taken by the contractor for the safety of the workers and other persons during the construction work.

However, in his cross-examination he has admitted that ,at the construction site there was no arrangement made for an ambulance by GDCL. There was a jeep kept as an ambulance and there was an ambulance made availableby BALCO. However, no register or document has been presented as evidence showing the presence of any ambulance at the construction site.

No one from BALCO, SEPCO and GDCL, has been able to place before the Commission any documentary evidence of safety equipment and measures that were made available to the workers involved in the construction work and whether ambulance service, diagnostic kits, first aid and ordinary sick room was available at the construction site. It can thus be concluded that, in the course of construction work, the provisions for safety and rescue as provided for under Factories Act or Building and Other Construction Workers (Planning and services conditions Rules) Act have not been followed or complied with.

The Chief Executive Officer (CEO) of BALCO Mr. Gunjan Gupta, has admitted to the commission that it was penalized with a fine for violation of the Safety requirements. He has said that he admitted to guilt due to

incorrect advice that was given to him. However, from his statement it becomes clear that there were serious short comings on safety during the construction work and that even the authorities of the Labour Department had alerted and pointed out these safety short-comings.

The then Assistant Labour Commissioner Satyaprakash Singh, in his sworn statement, has stated that, for the purposes of construction of the Chimney, under the terms of Labour Act, GDCL had applied for license to employ 300 workers. This was granted on 21.02.2009, but then GDCL increased the workforce to 600 on 24.05.2008, and on 27.08.2008 increased to 1000 and, on 16.12.2008 increased it to 1300. He did not go to the site during the construction of the Chimney. His Inspectors did visit. GDCL had not maintained the records, and hence it was fined Rs. 3700/-. By ignoring such a large construction project the highest authority of the Labour Department has exhibited utter negligence.

Satyaprakash Singh has stated that the responsibility for the safety arrangements during the construction at the construction site was that of the Industrial Health and Safety Officer and at the time, Mr. Rajju Bhoi was holding the position. Mr. Rajju Bhoi has accepted before the Commission that, at the time of the collapse, apart from Korba he was additionally holding the charge of Assistant Director of Industrial Health and Safety for Janzgir, Champa and Bilaspur. But during the construction of the Chimney he never never inspected the work on the chimney as it did not come under his jurisdiction. He has further added that since production had not commenced at the Project, he had no responsibility.

However, he has admitted that immediately after the mishap, in the dead of night, he clandestinely visited the construction site. Here it is worth mentioning that BALCO had already registered the Project under the

Factories Act and hence, it was expected, from the then Assistant Director of Industrial Health and Safety Mr. Rajju Bhoi, that even during the construction of the Project, right from the beginning he would perform his duties and responsibilities.

Rajju Kumar Bhoi in his sworn Statement has also furnished many documents and sought details under RTI (Right to Information Act) from the concerned Government Department about a mishap that occurred during the construction of a chimney at a construction of Power Project by Reliance Infrastructure Limited at Singrauli. Accordingly, he claimed that in case of the collapse of a chimney under construction, the provisions of Factories Act do not apply. He says it is the provisions of Construction and similar Other Workers Act and Rules which apply in this case. The Korba chimney disaster appears to be quite different from that of Singrauli Power Project because the Aluminium Plant of BALCO was already in production and it was for this reason that the Power Project was commissioned.

Even if it is assumed that there was no commencement of production in the Project and that the provisions of the Factories Act did not apply, then too it has been pointed out herein above that the drawings and design of the Chimney were approved by the Chief Industrial Inspector and that the Chief Industrial Safety Inspector is the Commissioner/Secretary of the Labour Department, a position which was held by Rajju Kumar Bhoi, Assistant Director, Industrial Health and Safety at Korba. Hence, it was required of Mr Bhoi to go to the construction site during the construction work and inspect it for the provision of necessary safety measures. But he has accepted that he never went to the construction site during the construction work, which clearly shows his negligence and hence he cannot be excused from his responsibility for shortcomings in the safety measures.

The various laws made for ensuring quality and safety of the chimney construction in the Project, were never complied with in their entirety. The necessary arrangements to ensure safety and rescue of workers and other persons during the construction work, as required under the various provisions of the law, were not made. And for all this BALCO, SEPCO and GDCL are responsible. Apart from this the negligence and insensitivity of the then officials of Municipal Corporation, Town and Country Planning Department and Labour Department is also evident.

::CHAPTER –EIGHT::

Suggestions to prevent the repeat of such a mishap in the future

(1) Before signing any Memorandum of understanding (MOU) with a local or foreign private organization, the Chhattisgarh Government must make special mention of some Rules and Laws and before permitting the construction of any major structure by any private party. must make it mandatory to seek approval for the design from a national institution, so that such tragedy or mishap does not happen again.

(2) Whenever, the State Government signs an MOU for a project with any party, the MOU must clearly include the provision that, in case

the other second party intends to outsource or sub-contract the construction of the Project or a part of it to some other third party, then detailed information regarding the subcontractor shall be provided to the Government, and the work order shall be incurred to the Third Party only after the Government has accorded its approval to the third party.

(3) Amendments should be carried out to the Chhattisgarh Municipal Corporation Act 1956 and Land Development Bye laws / Ruler 1984 regarding construction of factories and high-rise buildings, wherein to obtain necessary permission specific and detailed provisions be made and a comprehensive chapter be added on this strict penal provision be made for violation of any such rules / laws regarding construction.

(4) An Agency should be established in the State, made up of specialists and experts from different experts of construction of factories, and they must formulate specific and clear provisions regarding implementation of quality and safety in construction work and provisions to be made that any permission or approval for construction to be given under the Municipal Corporation Act or Town & Country Planning be given only after the approval accorded by the above mentioned Agency. And further there must be provision that, to ensure the quality of the construction work, at the interval of every 15 days, the above constituted Agency must conduct inspection of the construction work for its quality and also ensure that and check whether the construction work is carried out according to the approve d drawings and design.

(5) Any MOU between the Government and a company must be signed by the officials of the legal and labour ministries.

(6) The MOU must also include the provision that the company will comply with all the labour laws and will file weekly reports regarding the same to the Labour Department and District Collector / District Magistrate.

(7) The MOU must also include the provision that the company which intends to get the work done through a contractor or contractors, will provide all the details of such contractor / contractors to the Labour Department / Collector. It must also have the provision that 'Black Listed' companies cannot be awarded the contract. In a case where any worker, employee or official of a private company is facing any serious criminal proceedings, the same must be conveyed in writing along with the necessary enclosures / documents to the labour department / collector.

(8) The MOU must include the name, address and nature of work of every contract laborer and contract employee. A list must be maintained and furnished to the Labour Department and Collector every 15 days.

(9) There must be a law prohibiting use of the term 'Indian' or 'National' by any private or foreign private institution / organization, in order to avoid the deception that small private organizations are national organizations / Institutions. Due to the inclusion of the term 'National' in the names of private organization, such as Dr. Rakow was misled into believing that "Vallabgarh Lab" is a national institution since it is called National Vallabgarh Lab.

(10) Before the construction of a huge structure such as a tall chimney, it must be made mandatory for such approval to get a No Objection Certificate from for the various engineering, civil engineering, electrical and mechanical engineering departments comprising experts or specialized national level institutions.

(11) Before the reconstruction of the collapsed Chimney it is necessary to conduct a 'Model Study' and get necessary approvals thereafter.

(12) In terms of IS codes and as advised by retired professor Ravindra Arora of IIT Kanpur all provisions regarding electrical and lightning safety must be further strengthened.

(13) Professor Pradipta Banerji of the Civil Engineering Department of IIT, Bombay states that the thickness of the Chimney shell must be increased and steel and other materials requirements must be increased so that the new Chimney can be strong and stable.

(14) According to all the conclusions drawn by NIT Raipur there must be extreme precaution taken in constructions involving civil engineering. There has been a lack of precaution and utter negligence at all levels in the construction of the collapsed Chimney to the extent that it has been termed a "Blunder", and hence it is necessary that every precaution must be taken to ensure correct size and quality of construction materials such as cement, pebbles, sand, steel bars, etc.

(15) The 'speed' and the height to which the slip-form can be subjected must be determined in the case of construction of tall chimneys, so that the green / wet concrete can bear the brunt of the weight of such slip-forms. Hence it appears that there is also a necessity to make such provisions in the I.S. code regarding this.

Sd/-
9-8-12
(Sandeep Bakshi)
Judicial Enquiry Commission
and District and Session Judge,
Raipur, Chhattisgarh

Date: 09.08.2012

::CHAPTER –NINE::

::ACKNOWLEDGEMENTS::

After the creation of the Chhattisgarh State the tragic collapse of the under construction BALCO Chimney of the under construction power plant at Korba leading to death of 40 (forty) workers, shocked everyone. Considering the seriousness of the tragedy, the State Government had placed a very important responsibility on us as the ore-member Inquiry Commission. I have prepared the Inquiry Report with dedication, sincerity, impartiality and transparency.

It is not within the means and ability of a single person Inquiry Commission to alone conduct the Inquiry and prepare a Report on such a serious tragedy. All the parties openly, frankly, and without any discrimination have extended their full support, for which the Commission expresses it deep gratitude.

First of all this Commission wishes to thank all the Korba-based workers associations and union for their peaceful and unbiased co-operation during the course of the inquiry proceedings of the Commission. Mr. Rajendra Mishra in his capacity as the representative of the workers unions extended consistent co-operative and disciplined participation in all proceedings of the Commission and upheld the respect and dignity of the Commission. The Media too provide coverage to the proceedings of the Commission in a disciplined and patient manner.

During the inquiry into the seriously tragic accident, Mr. Abhishek Sinha, learned counsel on the behalf of BALCO, Mr. Ashok Tiwari the learned counsel on the behalf of GDCL and on behalf of the Government, the Assistant Attorney General, Mr. Yeshwant Singh Thakur sincerely co-operated with the commission in all of its proceedings. Mr. Manish Sharma, the learned counsel for SEPCO, has also extended his co-operated to the Commission by this participation in the proceedings from time to time. Apart from this other counsels who represented the companies remained present and this Commission conveys its gratitude.

The Commission wishes to thank the Secretary to the Commission, Mr. P. Nihalani for his able assistance to the Commission in its proceedings.

This Commission writes to thank in a special way Mr. R. K. Baret, the officiating stenographer assigned to the Commission by the Hon'ble Chhattisgarh High Court at Bilaspur. He has ably assisted the Commission in all its proceedings especially from the recording the evidence to preParation of the Engineer Report with dedication, sincerity and honesty. This Commission is also grateful to Mrs. Manju Sharma Assistant Grade who is attached to this Commission and also of Mr. Sukh Singh Markam, who even during the days of vacation break remained present to assist and enable the commission to carry out its proceedings and work.

The State Government in its Appointment Order of the Inquiry Commission, had provided that the Commission could call for expert assistance from any of the organization on technical matters and hence, the commission had requisitioned / sought the assistance of Mr. C.P. Sharma, retired Chief Engineer, who with full dedication, sincerity and impartiality hugely assisted the Commission, due to which they commission was able to succeed in preparing the Report on such a technical subject. This commission conveys special thanks to Mr. C.P. Sharma Chief Engineer.

Finally, this Commission expresses its deep condolence to the victims of this tragedy who are the soldier of progress and development, and also expresses a deep sense of grief to the families of the dead workers.

Sd/-
9-8-12
(Sandeep Bakshi)
Judicial Enquiry Commission
and District and Session Judge,
Raipur, C.G.

Date: 09.08.2012