Project Title: Advice for designing of controlled blasting parameters for safety of nearby houses/structures at stone quarry located at Mauza Katnikol, Block No. 15, Sheikhpura, Bihar.

Project No.: CNP/4883/2019-20

Executive Summary:

This report relates to the scientific study carried out by the Rock Excavation Engineering Division of CSIR-Central Institute of Mining and Fuel Research (CSIR-CIMFR), Dhanbad at Block No. 15 stone quarry, Mauza Katnikol, Sheikhpura, Bihar. The main objective of the study was to assess the safe and efficient controlled blast design patterns for conducting safe blasting operations without affecting and endangering the nearby residential houses, important surface structures and habitats. In order to assess the safe controlled blast design patterns, the Rock Excavation Engineering Section of CSIR-CIMFR carried out field investigations during the period of 2nd and 3rd August 2019. During this period, the experimental blasts were conducted at various locations of the mine with blast design and charge loading parameters. Blast induced ground vibrations and air overpressure/noise generated during the experimental blasts were monitored at various concerned locations i.e. near surface structures/houses. The blasting events were also recorded using digital video camera to observe any occurrences of flyrock during the trial blasts.

The results of the study, analyses of data made in the report are summarized below.

1. In total, nine experimental blasts were conducted with varying design parameters and explosive charging patterns. The diameter of holes used in all the blasts was 100 mm. The depth of blast holes was 6.0 m. The total number of holes in a blasting round varied from 14 to 30. Burden and spacing values in all the blasts was 2.0 m and 2.5 m respectively. The top stemming columns varied between 3.0 m and 3.5 m depending on the depth of the holes and blast face conditions.

2. All the experimental blasts were conducted using large diameter cartridge explosives of 83 mm diameter, 2.78 kg weight. The explosive charge per hole varied widely from 19.00 to 22.00 kg depending upon the hole depth and effective burden in front of the hole.

3. Blast induced ground vibration and air overpressure were monitored by placement of seismographs near different surface structures in periphery of the stone quarry. The seismographs were placed in the nearby of village Katnikol, near main road of

Jamuara village, near blasting shelter in the quarry premises, near quarry office and near crusher house.

4. The maximum magnitude of ground vibration data recorded during the experimental blasts was 18.76 mm/s with peak dominant frequency of 9.25 Hz. The blast was conducted at eastern lease side on 03.08.2019 with 18 numbers of holes and the total explosive charge was 350.00 kg. The maximum explosive weight per delay was 19.50 kg. Seismograph was placed near the blasting shelter at a distance of 90 m from the blast face.

5. The maximum value of ground vibration data recorded in Katnikol village is 2.69 mm/s at peak dominant frequency of 8.38 Hz. The data was recorded for the blast conducted at blast face located in the south-west side of the lease on 02.08.2019. The monitoring location was at a distance of 192 m from this blast.

6. The only vibration data recorded near Jamuara village was 1.94 mm/s at peak dominant frequency of 17.8 Hz. The vibration was recorded for the blast conducted at blast face located in the eastern side of the lease on 02.08.2019. The monitoring location was at a distance of 166 m from this blast.

7. The maximum magnitude of blast vibration recorded near industrial building of the quarry owner viz. quarry office was 1.49 mm/s at peak dominant frequency of 17.8 Hz. The vibration was recorded on 02.08.2019 for blast conducted at eastern side of the lease. The quarry office was located at a distance of 190 m from the blast face.

8. The maximum magnitude of vibration recorded near industrial structure viz. crusher house was 7.48 mm/s at peak dominant frequency of 7.625 Hz. The vibration was recorded for the blast conducted at south west side of the lease on 03.08.2019. The crusher house was located at a distance of 135 m from the blast face.

9. The ground Vibration recorded in all the blasts near the residential/domestic and industrial structures were within safe limit as per DGMS circular 7 of 1997.

10. The dominant frequency of ground vibration was in the range of 6.25 Hz and 59.5 Hz. However, in many cases, the dominance of frequency falls within 8 Hz. So blast induced ground vibration should be restricted within 5 mm/s for safety of nearby structure not belonging to owner and 10 mm/s for the industrial buildings as per DGMS circular 7, 1997.

11. The air overpressure levels recorded from the different trial blasts varied between 104.9 dB(L) and 131.7 dB (L). The maximum level of air overpressure recorded from experimental blasts was 131.7 dB(L). The blast was conducted on 03.08.2019 with eighteen numbers of holes. The total explosive charge in the blast was 350 kg and maximum charge weight per delay was 19.50 kg. The air overpressure was monitored at a distance of 90 m near the blasting shelter.

12. Based on the USBM Standard for surface mining the air overpressure level of 134 dB(L) has been considered as safe limit for large scale surface mine blasting. Therefore, it is clear that the levels of air overpressure recorded during experimental blasts were well within the safe limit**.**

13. No flyrock was observed in any of the experimental blasts. The throws of the blasted materials were also controlled and restricted within the blasting areas only. The control of flyrock was achieved through proper blast design patterns along with their proper implementation and supervision of the total blasting operations.