APPENDIX U-7

EXECUTIVE SUMMARY OF INVESTIGATION OF KOEHLER-BRIGHT STAR MODEL 5100 AND 5200 SERIES CAP LAMPS AND CAP LAMP COMPONENTS

U.S. Department of Labor

Mine Safety and Health Administration
Approval and Certification Center
765 Technology Drive
Triadelphia, West Virginia 26059

November 17, 2011

MEMORANDUM FOR NORMAN G. PAGE
Accident Investigation Team Leader

FROM: JOHN P. FAINI
Chief, Approval and Certification Center

SUBJECT: Executive Summary of Investigation of Koehler-Bright Star Model 5100 and 5200 Series Cap Lamps and Cap Lamp Components Recovered from Performance Coal Company's Upper Big Branch – South Mine

The Approval and Certification Center (A&CC), as requested by Upper Big Branch Mine Accident Investigation Team Leader, Norman Page, conducted a laboratory investigation associated with respect to Koehler-Bright Star cap lamps and cap lamp components recovered from a fatal mine explosion at the Upper Big Branch Mine-South on April 5, 2010.

The cap lamps and cap lamp components received were:

1. Exhibit No. A-9 – Mark V, 5200 Series cap lamp with plastic battery cover with PTO.
2. Exhibit No. A-10 – Mark V, 5200 Series cap lamp with plastic battery cover.
3. Exhibit No. A-11 – Mark V, 5200 Series cap lamp with plastic battery cover.
4. Exhibit No. A-12 – Mark V, 5200 Series cap lamp with metal battery cover with PTO.
5. Exhibit No. A-13 – Mark V, 5200 Series cap lamp with plastic battery cover.
6. Exhibit No. A-14 – Mark V, 5200 Series cap lamp with plastic battery cover with PTO.
7. Exhibit No. A-15 – Mark V, 5200 Series cap lamp with plastic battery cover.
8. Exhibit No. B-1-B – Mark V, 5200 Series cap lamp with plastic battery cover with PTO in pouch.
9. Exhibit No. B5-A – Mark V, 5200 Series cap lamp with plastic battery cover with PTO.
10. Exhibit No. B7-A – Mark V, 5200 Series cap lamp with plastic battery cover.
11. Exhibit No. B-11-C – Mark V, 5200 Series cap lamp with plastic battery cover.
12. Exhibit No. B15-A – Mark II, 5100 Series cap lamp with plastic battery cover.

13. Exhibit No. B18-A – 5000 Series battery with plastic battery cover with PTO and cord.
14. Exhibit No. B19-A – Mark V, 5200 Series cap lamp with plastic battery cover.
15. Exhibit No. B-20-B – Mark V, 5200 Series cap lamp with plastic battery cover.
16. Exhibit No. B-22-A – 5000 Series battery with plastic battery cover and cord.
17. Exhibit No. B26-C – Mark V, 5200 Series cap lamp with plastic battery cover with PTO.
18. Exhibit No. 5-5-10-1 – Mark V, 5200 Series cap lamp with plastic battery cover.
19. Exhibit No. PE-0071 – Mark V, 5200 Series cap lamp with plastic battery cover (recovered from Survey Spad (S.S.) 19871 Crosscut 102).
20. Exhibit No. PE-0078 – 5000 Series battery (recovered 233' outby S.S. 22649).
21. Exhibit No. PE-0080 – Metal battery cover with PTO and cord (recovered outby S.S. 22649).
22. Exhibit No. PE-0081 – Mark V headpiece (recovered outby S.S. 22649).
23. Exhibit No. PE-0091 – Mark V, 5200 Series cap lamp with plastic battery cover with PTO (recovered Int. S.S. 22639).
24. Exhibit No. PE-0231 – Plastic battery cover and battery insulator and cord and Mark V headpiece (recovered from shield 112).
25. Exhibit No. PE-0231-A – Dirt and debris from Exhibit No. PE-0231.
26. Exhibit No. PE-0232 – 5000 Series battery (recovered from shield 109).
27. Exhibit No. PE-0236 – 5000 Series battery (recovered between pontoons of shields 108 and 109).
28. Exhibit No. PE-0240 – 5000 Series battery (recovered from edge of shields 94 and 95).
29. Exhibit No. PE-0241 – Plastic battery cover with PTO and cord and Mark V headpiece (recovered from shield 92).
30. Exhibit No. PE-0289 – 5000 Series battery and cord (battery recovered from mantrip outby S.S. 24401 inby end of operator's compartment and cord laying on outby end of operator's compartment).
31. Exhibit No. PE-0327 – 5000 Series battery (recovered Adj. to Stage Loader).
32. Exhibit No. PE-0350 – 5000 Series battery (recovered inby S.S. 24754).
33. Exhibit No. PE-0481-C – Components of a 5000 Series battery (recovered from shield 109).
34. Exhibit No. PE-0485 – Components of a 5000 Series battery (recovered from shield 107).

A broad assortment of cap lamp exhibits was recovered ranging from fully intact exhibits to individual cap lamp components. It is unclear if any of the individual components were at one time part of a fully intact cap lamp. Additionally, the exhibits ranged from a small amount of dirt and debris to being entirely covered and/or filled with dirt and debris. Several of the exhibits were considered hazardous material and required decontamination prior to any investigation activities.

Multiple exhibits showed evidence of damage from the explosion such as heat damage, charring, soot, missing pieces or severe physical damage. Some exhibits were not maintained in approved condition pre-explosion. Nearly all of the batteries had minimal to no detectable electrolyte fluid. Two of the exhibits battery covers were attached to the battery with electrical tape. Several of the exhibits had tape covering cuts in the cord casing. Several of the exhibits had cuts in the battery cover wiring exposing the conductors. Some of the exhibits had an excessive amount of corrosion on the battery cover wiring and battery terminals. Several of the exhibits had loose or missing hardware.

From the evaluations and tests conducted there was no evidence found that any of the exhibits had enough electrical energy to ignite a methane and air mixture or enough thermal energy to ignite coal dust.

The summary of the inspections, tests, and evaluations is below:

There were various inspections, tests, and actions conducted on the exhibits such as filling each battery with electrolyte and charging, flash current testing, measuring the inductance of each cord, spark testing, measuring the surface temperature of each bulb and one exhibit cord, verifying that bulb ejection mechanism of each headpiece operated properly, performing a detailed inspection, and comparing each exhibit to the approval documentation on file.

A total of 19 out of the 27 recovered batteries were able to be charged. Six batteries were damaged to the extent that they were not able to be filled with electrolyte. Two of the 21 batteries that were filled with electrolyte leaked and could not be charged.

There were 19 batteries that were flash current tested. One battery was flash current tested as a single cell due to the other cell being damaged. Results from the testing showed that Exhibit No. B15-A had the lowest internal resistance and Exhibit No. PE-0091 had the highest open circuit voltage.

The inductance was measured on 15 of 24 cap lamp cords. Six of the cords were damaged and were not able to be measured. Three of the cords were not able to be accurately measured. Results from the measurements showed that Exhibit No. A-12 had the highest inductance.

There were two spark ignition tests conducted. One test consisted of the battery of Exhibit No. B15-A and the cord of Exhibit No. A-12 and the second test consisted of the battery of Exhibit No. PE-0091 and the cord of Exhibit No. A-12. Results from the testing showed that neither combination had enough electrical energy to ignite a methane and air mixture.

Surface Temperature tests were conducted on 10 of 12 headpiece bulbs. Two of the bulbs were damaged and were not able to be tested. Results from the testing showed

that the highest measured temperature was not enough thermal energy to ignite coal dust.

The Bulb Ejection Mechanism for 20 of 21 headpieces was tested. One of the headpieces was damaged to the extent that it was not able to be tested. Results from the testing showed that all bulb ejection mechanisms operated properly.

Detailed inspections and comparison to approval documentation for multiple exhibits showed evidence of damage from the explosion such as heat damage, charring, soot, missing pieces or severe physical damage. Some of the exhibits were found to have properties making it possible they were not maintained in permissible condition pre-explosion and perhaps considerable enough to affect the operation. Nearly all of the batteries had minimal to no detectable electrolyte fluid. Two of the exhibit's battery covers were attached to the battery with electrical tape. Several of the exhibits had tape covering cuts in the cord casing. Several of the exhibits had slices in the battery cover wiring exposing the conductors. Some of the exhibits had an excessive amount of corrosion on the battery cover wiring and battery terminals. Several of the exhibits had loose or missing hardware.

From the evaluations and tests conducted, there was no evidence found that any of the exhibits had enough electrical energy to ignite a methane and air mixture or enough thermal energy to ignite coal dust.