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High Vol Petro Analysis Coal Analysis As Received Dry Basis % Moisture 7. 52 xxxxxx % Ash 5. 10 5. 51 0. 79 % Sul 0. 86 %Volatile 37. 35 34. 54 Fixed Carbon 57. 14 52. 84 13, 522 BTU/lb 14, 622 MAF BTU 15, 475 FSI 7 Oxidation 96 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_ CERTIFICATE OF ANALYSIS PETROGRAPHIC ANALYSIS Date sampled: 09-Mar 11 MACERAL COMPOSITION VOLUME% REACTIVES V-Types 7 8 9 10 7. 3 36. 4 20. 5 2. 0 66. 2 0. 0 3. 4 VITRINITE EXINITE RESINITE Semifusinite INERTS 3. 8 Total Reactives 73. 4 Semifusinite Micrinite Fusinite Mineral Matter Total Inerts 9. 7 3. 2 6. 7 7. 0 26. 6 0. 88 MEAN MAXIMUM VITRINITE REFLECTANCE % Composition Balance Index Calculated Stability Rank (Strength) Index 1. 00 3. 32 42 Ash % (dry) Sulfur % (dry) Volatile Matter % (dry) Volatile Matter, daf 5. 51 0. 85 37. 35 39. 53 Mid Vol Petro Analysis DATE SAMPLED: DATE RECEIVED: PROXIMATE ANALYSIS: Moisture % Volatile Matter % Ash % Fixed Carbon % BTU/lb Calories/Gram Sulfur % FREE SWELLING INDEX: OXIDATION: %T SULFUR FORMS: Pyritic % Sulfate % Organic % TOTAL % FUSION TEMP. (F): Initial Softening (H-W) Hemispherical (H-1/2W) March 9, 2011 March 9, 2011 AS REC’D 7. 28 25. 45 8. 78 58. 49 13, 053 7252 0. 79 8. 0 96. 3 DRY BASIS PETROGRAPHIC DATA (MACERAL ANALYSIS) VITRINITE TYPE V-8 V-9 V-10 V-11 V-12 V-13 V-14 V-15 V-16 V-17 Vitrinite Exinite Resinite Samifusinite TOTAL REACTIVES Samifusinite Micrinite Fusinite Mineral Matter TOTAL INERTS Composition Balance Index Rank Index Mean-Max Reflectance Calculated Stability Factor SOLE HEATED OVEN: (52/2) % Moisture % - 6 Mesh BDT ET Contraction 52/2 DRY BASIS: 27. 45 9. 47 63. 08 14, 078 7821 0. 86 MAF MINERAL ANALYSIS: Silicon Dioxide SiO2 Aluminum Oxide Al2O3 Iron Oxide Fe2O3 Calcium Oxide CaO Magnesium Oxide MgO Sodium Oxide Na2O Potassium Oxide K2O Titanium Dioxide TiO2 Phos. Pentoxide P2O5 Sulfur Trioxide SO3 DRY BASIS 55. 75 26. 81 7. 39 1. 70 1. 03 0. 56 2. 59 1. 33 0. 37 1. 27 15, 551 REDUCING OXIDIZING ULTIMATE ANALYSIS: Carbon % Hydrogen % Nitrogen % Oxygen % Ash % Sulfur % TOTAL % GIESELER FLUIDITY: Max. Fluidity (ddpm) Max Fluid Temp Initial Softening Temp. Solidification Temp Temperature Range ARNU DILATATION % Maximum Contraction % Maximum Dilatation Initial Softening Temp Initial Dilatation Temp Final Dilatatiion Temp CALCULATED CSR: Respectfully Submitted \*Corrected to 2. 5 G Air Dried Coal and 4. 00 MM Tube Radius 2 018 440 403 487 84 27 40\* 392 429 474 % REACTIVES 4. 80 19. 00 10. 90 2. 00 1. 40 0. 70 5. 40 8. 80 10. 90 4. 10 68. 00 2. 10 1. 10 2. 00 73. 20 % INERTS 5. 80 10. 60 4. 90 5. 50 26. 80 1. 37 5. 24 1. 25 62 Low Vol Petro Analysis DATE SAMPLED: DATE RECEIVED: March 9, 2011 March 9, 2011 AS REC’D 10. 02 16. 03 6. 29 67. 66 0. 78 DRY BASIS: 17. 82 6. 99 75. 19 0. 83 8. 0 99. 8 DRY BASIS MINERAL ANALYSIS: Silicon Dioxide SiO2 Aluminum Oxide Al2O3 Iron Oxide Fe2O3 Calcium Oxide CaO Magnesium Oxide MgO Sodium Oxide Na2O Potassium Oxide K2O Titanium Dioxide TiO2 Phos. Pentoxide P2O5 Sulfur Trioxide SO3 Undetermined DRY BASIS 54. 43 26. 18 8. 77 1. 43 1. 18 0. 53 2. 80 1. 21 0. 67 0. 93 PROXIMATE ANALYSIS: Moisture % Volatile Matter % Ash % Fixed Carbon % BTU/lb Sulfur % FREE SWELLING INDEX: OXIDATION: %T SULFUR FORMS: Pyritic % Sulfate % Organic % TOTAL % FUSION TEMP. (F): Initial Softening (H-W) Hemispherical (H-1/2W) ULTIMATE ANALYSIS: Carbon % Hydrogen % Nitrogen % Oxygen % Ash % Sulfur % TOTAL % GIESELER FLUIDITY: Max. Fluidity (ddpm) Max Fluid Temp Initial Softening Temp. Solidification Temp Temperature Range ARNU DILATATION % Maximum Contraction % Maximum Dilatation Initial Softening Temp Initial Dilatation Temp Final Dilatatiion Temp CALCULATED CSR: Respectfully Submitted REDUCING OXIDIZING PETROGRAPHIC DATA (MACERAL ANALYSIS) VITRINITE TYPE V-14 V-15 V-16 V-17 Vitrinite Exinite Resinite Samifusinite TOTAL REACTIVES Samifusinite Micrinite Fusinite Mineral Matter TOTAL INERTS Composition Balance Index Rank Index Mean-Max Reflectance Calculated Stability Factor SOLE HEATED OVEN: (52/2 % Moisture % - 6 Mesh BDT ET Contraction 52/2 % REACTIVES 3. 60 34. 30 19. 70 15. 30 72. 90 0. 00 0. 00 1. 40 74. 30 % INERTS 5. 50 7. 90 8. 30 4. 00 25. 70 3. 63 7. 10 1. 61 52 3. 93 79. 3 52. 4 +11. 7 +13. 2 189 476 439 509 70 20 97\* 415 451 487 49. 0 \*Corrected to 2. 5 G Air Dried Coal and 4. 00 MM Tube Radius Mine & Sample Information Coal Source Seams Date Identification Averages Sample Date: March 9, 2011 Moisture Moisture Equilibrium Moisture 5. 57 1. 25 17. 48 7 75. 53 0. 66 18. 81 14, 660 85. 02 4. 37 1. 24 7 0. 66 1. 73 0. 03 Std Dev 0. 32 0. 07 1. 36 1. 14 2. 5 1. 69 204. 35 1. 72 0. 21 0. 13 1. 14 0. 65 0. 01 Proximate Analysis (dry basis) Volatile Matter Ash Fixed Carbon Sulfur Volatile Matter dry, Calorific Value BTU/lb (dry basis) Ultimate Analysis (dry basis) Carbon Hydrogen Nitrogen Ash Sulfur Oxygen Chlorine Phosphrous Forms of Sulfur Sulfate Pyritic Organic Physical Characteristics FSI Hardgrove Grindability Grindability Moisture Oxidation Index (% T Ash Chemistry (% of ash) SiO2 Al2O3 TiO2 Fe2O3 CaO MgO K2O 0. 01 0. 12 0. 53 7. 8 101 0. 69 97 50. 24 28. 82 1. 43 10. 09 2. 56 1. 42 1. 75 0. 01 0. 01 0. 35 141 0. 05 1. 41 0. 7 0. 83 0. 01 1. 2 0. 31 0. 06 0. 6 Na2O SO3 P2O5 SrO BaO Mn3O4 Undetermined Ash Analysis Total Alkali in Ash (% Base/Acid Ratio Silica Percentage Slag Viscosity at 260 Alkall Index Rheology Gieseler Plastometer Softening Temperature Max Fludity Temperature Solidification Temperature Plastic Range Maximum Fluidity Arnu Dilatometer Maximum Contraction Maximum Expansion Softening Temperature Temperature of Max Temperature of Max 0. 55 2. 53 0. 05 0. 15 0. 26 0. 05 0. 14 2. 29 0. 2 78. 14 481 1. 44 0. 06 0. 43 0. 06 0. 02 0. 04 0. 01 0. 1 0. 54 0. 02 2 126. 54 0. 13 438 478 507 69 93 20 61 436 463 496 2. 685 2. 700 2. 700 2. 700 2. 12 2. 12 4. 24 12. 73 0. 71 3. 54 1. 41 3. 54 1. 41 21. 21 Ash Fusion Temperature Initial Deformation Softening ST (red.) Hemispherical HT Fluid FT (red) Petrography Petrographic Indicies Mean Maximum Refl 1. 69 Standard Deviation 0. 0512 Distribution of Vitrinite Types (100% basis) V-10 V-11 V-12 V-13 V-14 V-15 7. 5 V-16 47. 5 V-17 45 V-18 V-19 Maceral Analysis 0. 03 4. 95 20. 51 25. 46 Vitrinite Liptinite 69. 3 0. 2 Semi-inert Macerals Semi-fusinite 19. 5 Inert Macerals Oxyvitrinite 0. 3 Fusinite 7. 9 Inertodetrinite 2. 3 Micrinite 0. 5 Macrinite Reality Checks Ash Volitile Matter Fixed Carbon Volatile Matter (dry Carbon (dry ash free Hydrogen (dry ash free Nitrogen (dry ash free Oxygen (dry ash free Rank DAF Carbon to Rank DAF Hydrogen to Ra Gieseler Plastic Ran Gieseler Maximum F Arnu Dilation 7 17. 48 75. 52 18. 8 91. 42 4. 7 1. 33 1. 86 1. 69 54. 09 2. 78 69 93 60. 5 8. 06 3. 82 0. 14 3. 25 0. 71 0. 14 1. 14 1. 36 2. 5 1. 69 0. 73 0. 16 0. 16 0. 72 0. 03 1. 34 0. 14 4. 24 12. 73 3. 54