

Electronic Exhibit Formatting for the BHP Billiton - San Juan Mine Permit Renewal, San Juan County, New Mexico¹

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Abstract. The creation and submission of BHP-Billiton's (BHPB) – San Juan Mine Permit No. 04-01, an electronic permit renewal document, required specialized formatting for the electronic permit exhibits prior to submission. Submitting functional electronic exhibits to the State of New Mexico's Mining and Minerals Division (MMD) enabled the agency's personnel increased access to permit information and a more efficient permit review and approval process. BHPB devised an electronic exhibit format and data management system, which would provide MMD with the ability to review the different types of permit exhibits in their native software environment. These exhibit types included: engineering exhibits, consisting of computer aided design (CAD) exhibits; land and facility management exhibits, consisting of geographical information system (GIS) exhibits; and legacy exhibits, consisting of historical exhibits or exhibits which have no electronic antecedents. With the exhibit format established, BHPB addressed a data management and storage system, which would facilitate efficient updating and revising of the exhibits, which would also minimize the storage requirements of the permit exhibit.

Additional Key Words: Electronic permit submission, computer aided drafting (CAD), geographical information systems (GIS), legacy maps, data management, and object linking.

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Introduction

In the late 1990's, the State of New Mexico's Mining and Minerals Division (MMD), Energy, Minerals, and Natural Resources Department began to implement an electronic permitting initiative for its surface coal mine regulatory program. The purpose of this initiative was to move from a paper, or hard copy, permit submittal to an electronic permit submittal. MMD's goals for implementing this initiative were, 1) to increase access to permit information, 2) to exercise greater control over work projects, and 3) to streamline the permit review and approval process.

To comply with the MMD initiative, BHP-Billiton's San Juan Coal Company (SJCC) began to electronically submit versions of their mid-term and annual reports. These electronic submittals were comprised of both the permit text and image files of the permit exhibit. Submitting the permit text electronically accomplished the agency's goals of increasing access and streamlining the review process; however improvements and changes in the exhibit formatting and methods of submission were needed to achieve these goals.

Prior to the San Juan Mine (SJM) Permit 04-01 renewal, the electronic exhibits were created and submitted by exporting either a .tif images or a .pdf documents from the mapping software. While these methods enabled the agency to view the exhibits, they were static displays of information and functional only as visual references. Agency personnel were unable to perform additional calculations or independent analysis on these images. To extract information from the images, agency personnel needed to print the exhibit and perform calculations by hand or bring the file into their own mapping software and "heads-up" digitize the features of interest. Since the exhibits were originally electronic files within the mapping software, printing and re-digitizing the exhibits is time consuming and inefficient.

The renewal of SJM Permit 04-01, provided SJCC an opportunity to submit a completely electronic permit, comprised of the permit text documentation and functional exhibits all within their native software environments, i.e. Word, Excel, AutoCAD, and ArcGIS¹. The electronic permit components enabled MMD personnel to efficiently complete their own review and analysis of the permit submission.

¹ The use of software trade names is for descriptive purposes only, and does not represent an endorsement by Buchanan Consultants, Ltd. or San Juan Coal Company.

The permit text required little or no format modifications; however after preliminary reviews, several problems and concerns were identified with the formatting and the data management structure of the exhibits. These formatting problems included; 1) the different software and exhibit types required individualized formatting, 2) permit exhibits could not be easily updated or revised, and 3) multiple instances of the same data were located throughout the permit directory which could lead to confusion over which data is current and dramatically increased the storage space required to house the permit. To address these problems, SJCC coordinated their mapping efforts with MMD to ensure that the exhibit formatting and data structure utilized for the permit renewal would be acceptable to the agency.

Exhibit Formatting

Three exhibit types were identified within the SJCC San Juan Mine permit renewal. These three exhibit types are comprised of;

- Engineering exhibits
- Land and facility management exhibits
- Legacy Maps

Engineering exhibits were identified as exhibits created and maintained within AutoCAD computer aided design software (CAD), and used for engineering design and construction. Typically these exhibits consisted of road and pond design, mining sequences, and land/ lease ownerships. Land and facility management exhibits were identified as exhibits created and maintained within ArcGIS geographical information system (GIS) software, and used for managing and tracking the use of the various land and facility features throughout the mine permit and adjacent areas. Legacy maps were identified as exhibits, which had no electronic precedents. These maps often consisted of historical and baseline data scanned from hand drawn paper or mylar exhibits. Each of these three exhibits types had their own special considerations pertaining to exhibit formatting and data management.

Engineering Exhibits

The engineering exhibits, or AutoCAD drawings, were the simplest files to format and manage. The AutoCAD software is designed to store and retain all information data required to

complete the drawing within the drawing file itself. Additionally, the software can look for user specified files outside of the drawing file. Examples of these user specified files include: custom fonts, linetypes, or links to other drawing files (external references). If the user has not specified any such options or references, the drawing file can be transferred to any computer with little difficulty.

Custom fonts and linetypes are files the user has created or modified specific to their AutoCAD environment. The files contain definitions and display information for these custom features. Without supplying these files, AutoCAD may not draw the features as the user intended. Upon opening a drawing file, which contains these custom files, AutoCAD will try to automatically locate them. If unsuccessful, it will prompt the user to manually locate them or select substitutes.

In creating the exhibits for the permit submittal, SJCC attempted to utilize only the default fonts and linetypes supplied within the native AutoCAD software environment. However, some third party AutoCAD drawings may have contained references to these custom files. If such references did occur, the custom files were included with the permit submission and were placed within the data layer folder.

External references are drawing files stored outside of the file, which AutoCAD may reference and display within the current drawing. These files may contain features such as property boundaries, contour lines, utility information, or other basemap information that occurs within multiple files. An added benefit of using the external reference allows the user to use a single file across multiple drawings; consequently reducing the overall file size. Referencing this information from one file also makes updates and revisions easier to accomplish. All changes or revisions to the external reference will automatically be represented in the main drawing file. To permanently change these features, all the user needs to do is either modify the original external reference drawing or save over the old external reference with the new drawing giving it the same file name.

In instances where a certified engineer's sealed exhibits were required, SJCC submitted two copies of the exhibit; an AutoCAD drawing and a .pdf document. Agency personnel were able to perform analysis and calculations using the supplied AutoCAD drawing; allowing the drawing to be preserved with the engineers seal in a .pdf document. As mentioned earlier saving an

exhibit in a .pdf document is a static method of display which does not allow the viewer to perform computations or alter the exhibit in any way.

Land and Facility Management Exhibits

The land and facility management exhibits were created using ArcGIS software. This software allows the display of information from multiple sources within a single exhibit. These exhibits are referred to within ArcGIS as map documents. The types of data sources, or data layers, ArcGIS can display include tabular data, various image files, CAD based drawings, or GIS specific files (shapefiles, grids, and coverages).

Unlike AutoCAD, ArcGIS does not save any of the displayed data layers within its map document. Rather, the map document only contains the data layer's file path and display information, color scheme, layer transparency, and labeling style. As long as the file paths of the data layers do not change, the map document can be transferred between different drives and computers without affecting the intended display. However, once a map document is transferred between drives, the stored file paths within the map document are no longer valid. If this is the case, all data layers must be relocated and remapped to represent the current file paths. SJCC created and saved the map documents and data layers using the relative pathname command and a data management system designed to alleviate the problem of having to remap all of the data layers within a map document. This would thereby permit the map document to be shared between multiple computers.

The relative pathname command in ArcGIS stores the data layer pathname without the drive name (i.e. C:\, D:\, or E:\). Utilizing this command, the map documents and data layers can be transferred to additional computers or drives without remapping the data layers. The only requirement is that the map document and data layers remain within the same directory structure as originally specified. The data layers can be located either ahead of or behind the map document in the same directory structure; however the data layers cannot be outside the map document directory structure (Figure 1).

The use of the data management system also enables SJCC to minimize the occurrences of repetitious data layers. Similar to the AutoCAD external reference file, a single file containing data can be referenced to multiple map documents. The use of a single data layer can increase the efficiency of updates and revisions. As data is added or modified, the old data layers are

replaced with the new data layers during the copying command process. With the single data layer referenced multiple times, the likelihood that a data layer update would be missed is reduced, allowing all map documents to remain consistent.

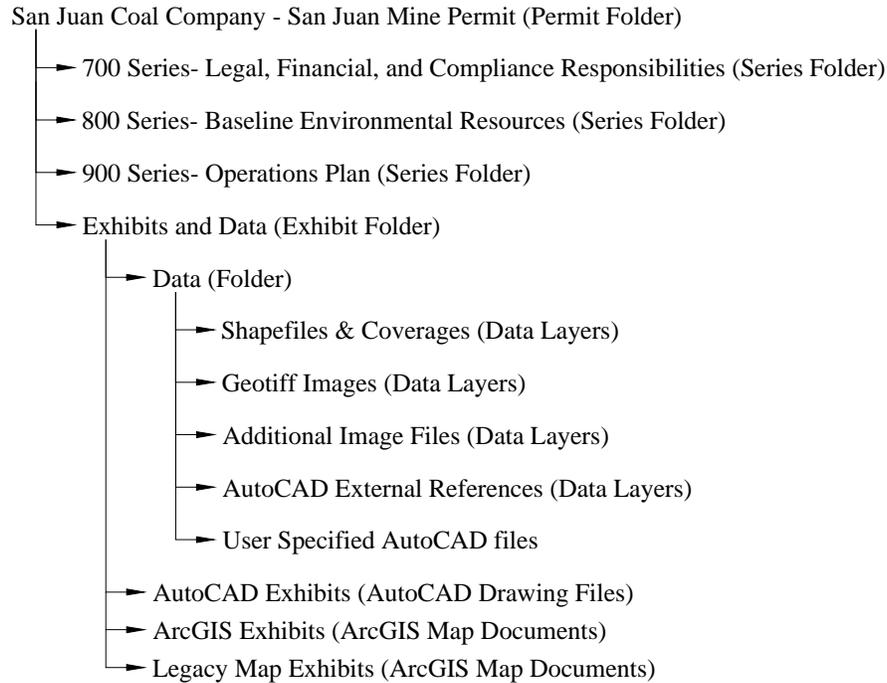


Figure 1. SJCC Permit Directory Structure

The use of single data layer references and the relative pathname command produced an overall permit structure that was different from previous submissions. In past submissions, the exhibits had been included within each permit section. The relative pathname command could have been used if SJCC chose to store the exhibits by permit section, however doing so would have required saving 40 instances of the basemap aerial image. Doing so would also have exponentially increased the storage needs of the permit document. Instead, SJCC decided to place all exhibits within a dedicated centralized “Exhibits and Data” folder in the permit directory (Figure 1). This folder would organize the exhibits in one location and also contain a folder to organize and store all of the data layers.

Legacy Exhibits

Legacy maps are the third type of exhibits found within the San Juan Mine 04-01 permit renewal submission. These exhibits have no electronic antecedents. Typically, these exhibits occurred mainly within the baseline information section of the permit document and consisted of mylar maps or hand drawn exhibits. Legacy maps were scanned using a large format scanner and the images were saved as a .tif image file. The .tif image was next incorporated into an ArcGIS map document; where it was georeferenced to the mine coordinate system. Georeferencing was conducted using coordinate tic points present in both the legacy map and mine coordinate system or other common identifiable points, such as road intersections, building corners, etc. Georeferencing using tic points is the preferred method, since this method produced more accurate results.

Once the control points were selected, the image was “best fit” to match the control points. ArcGIS automatically shifted the image to the new coordinates, adjusted the scale of the image and applied a rotation factor to obtain the “best fit” of the image to the control points. With the image shifted, scaled, and rotated, it was possible to resave the image as a geotiff image. A geotiff is a tiff image file referenced to a specific spatial extent, as determined by the accompanying image world file.

The benefit of transferring the legacy exhibits to a geotiff is it allows the image to be viewed with other spatially corrected data. This allowed agency personnel to view the image file with the current permit boundary and aerial imagery within the ArcGIS software. Agency personnel could also extract additional information by adding additional data layers or digitizing the features from the geotiff images.

The drawback of using the legacy maps in the permit were the quality of the final exhibit depended solely on the quality of the original document. If the original exhibit had faded or was too dark to distinguish exhibit features, the deficiencies were translated to the electronic exhibit. Also, for the text to be legible at the exhibit scale, the images were required to be scanned at high resolutions; significantly increasing the file size and required storage space.

Exhibit Linking

The final step in formatting the exhibits for the permit submission was to link the exhibits to their respective text references within the list of exhibits found in the beginning of each section.

By linking the exhibit text reference to the exhibit, this would assist the agency personnel in locating the proper exhibit and eliminate confusion between exhibits.

The software language difference between AutoCAD and ArcGIS created difficulties in establishing exhibit to text links. Due to the self contained nature of AutoCAD exhibits, they could be linked to the text using the standard hyperlink command found within Microsoft Word. The ArcGIS exhibits, containing only the data layer file paths, could not be linked using this command. ArcGIS operates as a software package or suite; programs essential to ArcGIS are started automatically and run in the background of the computer while ArcGIS is open. This suite of software, initiated by ArcGIS, required the exhibits to be linked to the text using the object link command rather than the hyperlink command.

Summary

As this was the first electronic permit to supply fully functional AutoCAD and ArcGIS exhibits, a steep learning curve needed to be overcome before the permit renewal could be submitted. The creation and updating of the exhibits was straight forward; as governed by the regulation requirements and the permit text. The goal and challenge of the permit exhibit submission was to devise and organize an exhibit format, which would provide MMD with a set of functional exhibits meeting their regulatory needs.

SJCC achieved this goal by; 1) providing MMD with all exhibits in their native software environments so agency personnel could effectively review them, and 2) creating a file management structure in which to organize the exhibits so they could be transferred among different computers. Exhibits were created in software packages readily available to MMD personnel. Engineering exhibits were presented as AutoCAD, while land and facility management exhibits were presented as ArcGIS exhibits, and finally legacy maps, were presented as geotiff images.

The file management structure organized the exhibits and data layers in a centralized folder within the permit document folder. By centralizing the exhibit and data layer storage, the data layers would occur only once, yet could be referenced in multiple exhibits. With the single instances of data layers, revisions and updates could be made with greater efficiency throughout

the permit term. The centralized storage also permits the use of relative pathnames, so the ArcGIS exhibits do not need to be rebuilt every time the exhibit is opened.

Once the exhibits were created, they were linked to the proper text reference in the list of exhibits found at the beginning of each section. The differences in the AutoCAD and ArcGIS software required the two exhibit types be linked using different techniques. AutoCAD maps were linked using the hyperlink command while ArcGIS maps were linked using the object link command. Locating and opening specific exhibits will be assisted by having the exhibits linked to their text references within the text document.

The combination of these different formatting techniques enabled SJCC to submit a fully electronic permit renewal submission, which will help MMD reach their goals of increasing access to the permit document and efficiency during the review and approval stages of permit submission.