360 Degree Photography To Decrease Exposure, Increase Safety And Minimize Waste

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360 DEGREE PHOTOGRAPHY TO DECREASE EXPOSURE, INCREASE SAFETY AND MINIMIZE WASTE

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SUMMARY
High-resolution digital cameras, in conjunction with software techniques, make possible 360° photos that allow a person to look all around, up and dawn, and zoom in or out. The software provides the opportunity to attach other information to a 360° photo such as sound tiles, flat photos (providing additional detail about what is behind a panel or around a corner) and text (information which can be used to show radiological conditions or identify other hazards not readily visible). The software also allows other 360° photos to be attached creating a virtual tour where the user can move from area to area, and stop, study and zoom in on areas of interest.

A virtual tour of a building or room can be used for facility documentation, informing management and others, work planning and orientation, and training, thus minimizing the need to re-enter hazardous radioactive areas. Reducing entries decreases exposure, increases safety and minimizes waste.

1. BACKGROUND
Hundreds of DOE facilities are being vacated and declared excess as a result of changing national needs. The need is now shifting to deactivating and surveilling the vacated facilities until they can be demolished. As a result of this movement, personnel familiar with the facilities are leaving, and surveillance and maintenance crews unfamiliar with the facility and the associated hazards, are taking responsibility. Knowledge of the ‘as-left’ hazards is low and documentation is often minimal.

Several photographic tools are available to assist in documenting activities and conditions. Each tool has its advantages and disadvantages. The traditional flat photograph provides detailed information, but is narrow in its view and does not provide a perspective of the room or area. Unless there is a description of the photo, it is sometimes difficult for a person unfamiliar with the area to know where the photograph was taken. In addition, the scope of the photo is limited and the observer often desires to see what lies outside the boundaries of the photo. Unless scanned or digital photos are taken, the flat photos are placed in a file cabinet and often end up in storage which, for all intents, is inaccessible.

Blueprints provide valuable information and have been filed so they can be accessed relatively easily. However, in the old DOE facilities, the prints may not have been maintained and may not be accurate. Also, it is difficult for many people to mentally convert the flat images into three-dimensional images, and it may be difficult to mentally assimilate multiple prints into an overall mental image of a room layout.

Video has been used to provide a panoramic view, giving a perspective of the area and to help show how various portions of a room or area fit together. However, video was intended to record action through time. While video helps provide an overall feeling for the room, the viewer often wants to see outside of what was taped or to dwell on certain areas of interest longer.

When a person enters an unfamiliar room or area, they mentally evaluate their surroundings to determine the size of the room, what is there, and how it all fits together. A new photographic tool, a 360° photograph, allows a person to look all around and up and dawn. This tool does not take the place of the other tools, but helps fill in the shortcomings of the other tools. Most importantly, the 360° photograph allows one to gain perspective of a room or area by looking all around. The technology allows the various documentation tools to be linked.
II. APPROACH
The 360° photographs are taken with an 'off the shelf' digital or film camera like the Nikon' Coolpix2 camera (see Figure 1) with a 185° lens. The camera is mounted on a mttator that locks it into position when rotating it 180°. The mttator mounts on a standard photography tripod. Since detail is important in the photos, a higher end multi-pixel camera or a high-resolution scan is used. Two back-to-back photos are taken with a 185° fisheye lens, which are later merged on the computer to create the 360° photographs. Once a mom is entered with the camera on the tripod, it takes only a few seconds to set the tripod and take the photos. One of the limitations to preparing 360° photos is the lighting in the area being photographed. Since the buildings and areas of interest are not normally occupied, lighting conditions may not be maintained. With little to no lighting, illuminating an area over 185° without "hot" spots is a challenge. A helpful technique to overcome the lighting challenge is to enhance the photos using standard photo enhancing software such as Photoshop'. Photo enhancing allows the photographer to balance the lighting and "bring out" details of interest. Color can also be adjusted if necessary.

Once the Images have been enhanced, the two back-to-back photos can be merged into a 360° photograph using the vendor software and then further refined, if needed. When the 360° photograph is ready to be saved, an 'Image key' purchased from the vendor is required. The image key allows the photo to be saved using multiple formats convenient for displaying on the internet, sending in e-mail messages, or putting on a compact disk (CD) or a file server.

Click on the icon to the right to open a 360° photograph. To look around the 360° photograph, position the cursor to the left, right, above or below center (cursor changes to a hand pointing in the direction the view will move) and press the left mouse button. Notice that the farther you move the cursor from center, the faster the view moves. When you place the cursor just above center, it changes to a magnifying glass with a plus symbol. Press the left mouse button to zoom in. Place the cursor just below center and a magnifying glass appears with a minus symbol. Press the left mouse button to zoom out.

The 360° photographs can be linked to each other creating a virtual tour of areas within a room or of several rooms. Flat photos showing detail, including photos taken with a gamma camera, audio files, text information, and internet addresses can also be linked to the 360° photograph. Alternately, the information can be presented in HTML format with essentially unlimited linking capability.

III. SIGNIFICANCE
Uses of the 360° photography include:
1) documenting facility configuration and conditions, 2) informing those with a need to know, 3) planning work and conducting pre-jobs, and 4) training. Conducting these activities using the 360° photos leads to decreased exposure, increased safety and waste minimization.

A. Documentation
It is easy to document the configuration and condition of a room or area using the 360° photographs since additional information such as detailed photos including gamma camera photos, audio, text and internet addresses can be linked. Linking can be accomplished directly or using HTML. Items are linked by creating a 'hot spot' (target). The hot spots can be made different colors for different types of information. For example, radiological conditions and material inventory information can be shown using a magenta colored target. Attached details photos can be identified by blue targets and so on. Hazards, especially hidden or unobvious hazards, known to the operating personnel can be identified on the 360° photo using a pop-up note. In this way, the 360° photo is used to document the facility condition and to improve safety. References or

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1 Nikon is a registered trademark of Nikon Inc.
2 Coolpix is a registered trademark of Nikon Corporation
3 Photoshop is a registered trademark of Adobe Systems Incorporated.
links to documents can be included so information concerning area can be found quickly.

This facility documentation can be put on file servers or on compact disks for easy and quick reference. A great deal of data can be linked and maintained without filing file cabinets. The ease of access enhances the potential the information will be used and real hazards will be recognized. This enhances efficiency and safety since the proper levels of caution and protection can be employed based on the knowledge of those who worked in and operated the facility.

B. Information

As we move into an era of greater regulation, there is a need for management, contractor managers and DOE, to be better informed of conditions. Mora and more, regulatory agencies have a need to assess facility conditions. At many DOE facilities, entry into areas is difficult, requiring protective gear and a cadre of support people. Therefore, the 360° photos with linked information provides a good overall perspective during presentations as well as for information on demand by placing the photos on CD or on a file server.

As an example of how this has been used, two Defense Nuclear Facilities Safety Board (DNFSB) people wanted to discuss and tour the cells at 231-Z. The cells are a contamination area and the day they were there was overcast which increased the level of radon and the potential to be contaminated. After the status of the cells was discussed in the conference room, a virtual tour of the cells was offered. After taking the virtual tour, they stated that they had seen what they needed to see and were satisfied. In addition to seeing what they needed, ALARA was improved by not entering a radioactively contaminated area; the dress and entry waste was avoided, minimizing waste; and the operator and radiological technician, who would have been needed to support the entry, were not pulled off their jobs which enhanced productivity.

The same scenario has occurred with management and DOE personnel, reducing the entries into hazardous areas while providing needed information.

C. Planning

The 360° photography has been used to enhance planning and pre-job orientation. The Critical Assembly Room (CAR) at 209-E is a radiologically airborne area. Entries are only made once a quarter to perform necessary surveillances. During one of the routine surveillances, 360° and flat detail photos were taken of the moms. Since it was anticipated that the inlet filters would have to be changed soon, detail photos of the filters were taken. The photos were then used to plan the job and later to orient the workers. The 360° photo was used to give an overall perspective of the work area and discussions were held of how work would proceed in the cramped area. Finally a detailed photo of the filter assembly was used to identify how the filter was attached and what tools would be needed to remove it. When the team entered to perform the work, they were so well oriented by the photos about what to expect, that the work was completed quickly.

A few days before the filter change out occurred at 209-E, DOE representatives were evaluating for voluntary protection program. The planner explained how he was going to use the 360° and linked photos to orient the workers and to conduct the pre-job. The use of the tool was identified as a noteworthy practice on the DOE internet site, http://www.eh.doe.gov/vpp/, as follows:

A Noteworthy Practice at River Corridor Project

(360-degree Photograph Technology)

The DOE-VPP (voluntary protection program) onsite review team found a noteworthy practice at the River Corridor Project during week of October 15-19, 2001. High-resolution digital cameras in conjunction with newly developed software techniques now make 360° photo coverage possible. These new systems provide the ability that allows a person to view all around, up and down (i.e., all wall, floor and ceiling surfaces). The technology strongly supports as low as reasonably achievable (ALARA) principles. The 360-degree photographs are used for tours and work planning at Hanford. This tour process is used to review work in high radiation areas and allows AURA evaluations to be performed before the execution of the work. A virtual tour of any building or room can be used for training; people can see what is there, focus on points of interest and discuss what they would do or how they would respond to present conditions. Planners, operators and maintenance people can make use of the tour to plan work and decide ahead of time, while looking at the areas of interest, what and how they will perform the tasks they need to perform.
D. Training
Efforts are made by instructors to make training as realistic as possible. The most realistic training occurs in the field and next in mockups to simulate field conditions. However, when neither in-field nor mock-up training is available, 360° photos can help students obtain a perspective of field conditions. Using linked files, they can gather information and then respond as if they were in the situation.

The 360° photos can be used to enhance sensitivity to certain aspects of work, such as safety. In the past, to enhance sensitivity, photos have been composed for people to identify bad practices and situations that should be avoided. Usually, the photos show a very limited area and it is easy to spot problems. With the 360° photos, the observer could look around and would have to be more observant, as in the field, to spot problems.

IV. RESULTS
There are several tools for visually capturing and conveying information, each with its advantages and disadvantages. While the 360° photos do not take the place of these other tools, it works with these tools to provide perspective and to organize the information they provide through links. In addition to providing documentation and information, the 360° photos can enhance productivity, Increase ALARA and safety, and help minimize waste. It is a tool that can be obtained at little cost and, in the hands of an individual trained in digital imagery, digital virtual tours and documentation can be developed relatively cheaply.

Figure
Figure 1. Nikon Coolpix 990 Digital camera with a resolution of 3.3 megapixels.

Footnotes
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3. Adobe Photoshop is a registered trademark of Adobe Systems Incorporated.