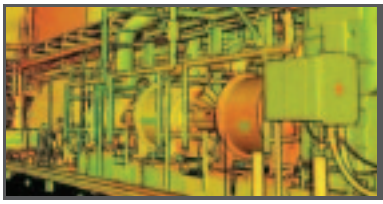
Paper Mill Retrofit

Alternative, economical workflow lets WGI take advantage of Cyrax® for 2D design project

Scope As-built info to support routing of 4,000 ft. of new, large bore piping and design of related structures in congested 185,000 cu. ft. space

Contractor Washington Group International, Birmingham, AL

Date 2000 (design phase); 2001 (construction phase)



"We've since used this workflow — or variants of it — on over a half dozen projects and gotten great results. Essentially zero rework. It's proven to be a really economical and versatile way to take advantage of the completeness and accuracy of Cyrax scanning for a wide range of 2D or 3D retrofit projects."

3D Laser Scanning Group Leader, WGI, Birmingham, AL

Project Facts

Field: 3 days; 2-person crew; 62 scans

Office: 129 hrs (includes time for red-lining & revising proposed 2D design drawings)

Deliverable: Dimensional input to mark-up 2D MicroStation drawings

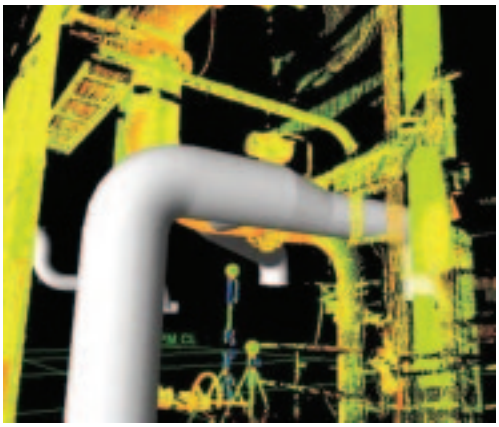
Customer Benefits

- 100% interference-free retrofit design
- Helped overall project be completed on time and within budget
- Economical as-built costs compared with other methods
- Better design from a maintenance and operations standpoint
- Ability to do data collection of complex areas on a tight schedule

Background: Washington Group International had a contract to design and construct a paper mill retrofit. The full retrofit involved new piping plus associated equipment and structures. Washington Group International had already used Cyrax 3D Laser Scanning for as-builting on other major retrofit projects with excellent success; however, those projects had also all used high-end, plant design CAD with automatic interference detection. Although the project at hand was a 2D design project with a limited budget, the WGI project team still saw the value in the raw accuracy and completeness of Cyrax 3D laser scanning, if they could figure out an alternative work process that wouldn't require their design team to have to switch to high-end 3D CAD. WGI developed an alternative 3D laser scanning workflow plan and was awarded a portion of the retrofit as-built work to support the routing design of large bore piping in the most congested area. The scan team was given three days to do the fieldwork with 6mm or better accuracy.

Project Workflow: In the field, WGI used a 2-person crew for three days to capture detailed as-built geometry of an area targeted to accommodate about 4,000' of new, large bore piping (mostly 10", 24", and 30") and associated equipment and structures. They supplemented the scanning with scan targets that enabled a very high-accuracy registration of scans to each other and to the plant survey grid. The targets were also surveyed with a total station for grid tie-in and QA. Once the scans were registered together, WGI deployed an economical work process for using the registered scans for 2D design verification. Here's the overall sequence:

1. Align the proposed 2D design with the same coordinate system as the registered point clouds
2. Using Cyra software tools, recreate the proposed design *directly within the Cyrax point clouds*. This can also be done by importing a 3D CAD design, for example from MicroStation, directly into Cyclone™.
3. Since the point clouds are 3D, use Cyra software to do a "virtual walk-down" of the proposed piping within the point clouds, i.e. follow the proposed piping along its routing through the point clouds. (Depending on the project, subdivision of the point clouds can be helpful in allowing fast 3D visualization and walk-through's.)
4. During the virtual walk-down, identify each potential area of interference of the proposed design with the point cloud. Cyclone can also do this interference detection against point clouds automatically.
5. When an interference area is found, model the point cloud *only* in the area of local interference and use Cyra software tools to establish the exact geometry change in design needed to avoid the interference
6. Incorporate the design change by marking up and then revising 2D drawings and repeat the process for the areas of potential interference to ensure the design is interference-free
7. Use the same methodology to address other design considerations such as maintenance and operations access needs



When this methodology was deployed, a total of 12 significant interferences involving large bore pipe were found and corrected in the final design. Some of the interferences would not have been caught by other methods because (a) the areas were too inaccessible to have been measured accurately by other means or (b) the interferences were too subtle to catch (e.g. flange interference). The workflow and laser scans also caught a critical error in the vendor's drawings for a central piece of equipment.

(See other side) ▶

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Paper Mill Retrofit (page 2)

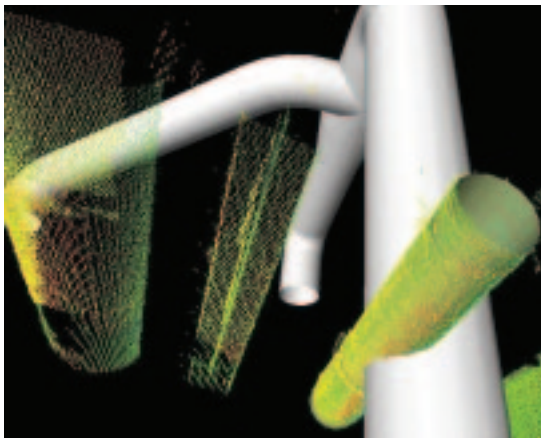
"The construction crew hollered at me and said 'This 30-inch line won't fit'…and because we'd used Cyrax for the as-built I said it would. It fit like a glove. I wish we could have used Cyrax on more portions of the project; it would have avoided some other problems we ran into."

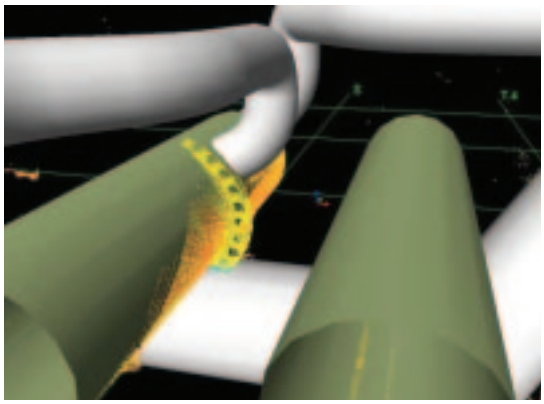
Greg James, Piping/Mechanical Design Leader,
WGI, Birmingham, AL

The laser scanning team ended up fielding more than 80 requests for dimensions from structural, piping, mechanical, and electrical designers on the project. Without Cyrax, personnel would have had to return to the site to try to collect the requested dimensions. With the Cyrax data in hand, site revisits were significantly reduced. Taking full advantage of the high accuracy of the laser scans, several "very tight fits" were also allowed to remain in the design. In the end, the overall cost of deploying Cyrax for the project was about one-half the cost of methods requiring full 3D modeling of point clouds and the same or less as creating as-builts manually. The Cyrax results were, however, far more complete and accurate than a manual/CAD as-built.

Advantages to working and designing within cloud points: In addition to the **flexibility** this alternative work process gave the design team for taking advantage of Cyrax on a 2D project, the work process offered several other advantages:

- Working directly within the point clouds allowed the design team to take full advantage of one of the most powerful features of laser scanning: the **completeness** of the raw scans. Scans literally captured "everything" in a scene: ducting, pipe hangers, lighting, electrical, etc. By working within the point clouds, the designer no longer had to worry about "what points within the scan cloud to model" when creating an as-built drawing. As a result, more interferences and potential maintenance access problems were caught in design.
- Finding potential interferences or maintenance access problems by working directly within the point clouds significantly reduced the amount of "point cloud modeling" that was needed. This easily **reduced overall scanning project costs by 50%**, making it more cost effective than even simple, manual as-builting.
- Point clouds captured all of the flaws of reality, some of which mattered in construction. Real life objects have lateral sweep, are deflected, and are out-of-plumb. When point clouds are "best fit" to geometric primitives or to catalog models, the resulting simplified representations may not exactly reflect what's really there. However, when the design work was done inside the point clouds, the **designer could account for these imperfections of the real world** and further avoid interferences and maintenance and operations problems down the road. If modeling of point clouds were needed for doing pipe stress analysis or for establishing tie-point locations, this could have been done as well.
- Working in the point clouds made it easy to take advantage of the **power of 3D visualization** without having to create a 3D as-built model or use 3D for design. In essence, 3D was "free" with laser scanning and Cyra software made it very easy to walk through and fly through plants and facilities.





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