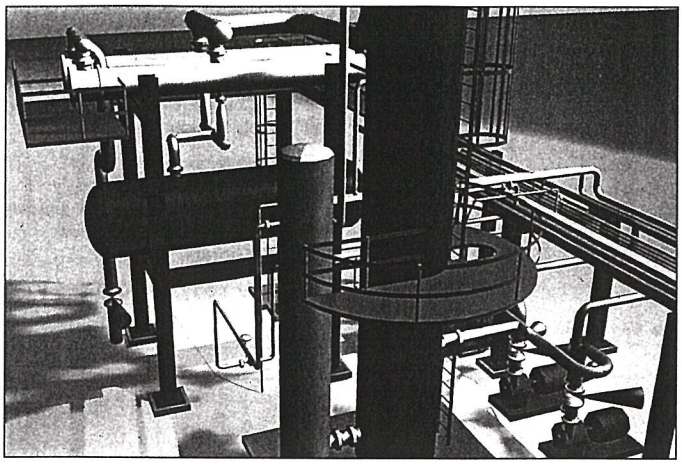
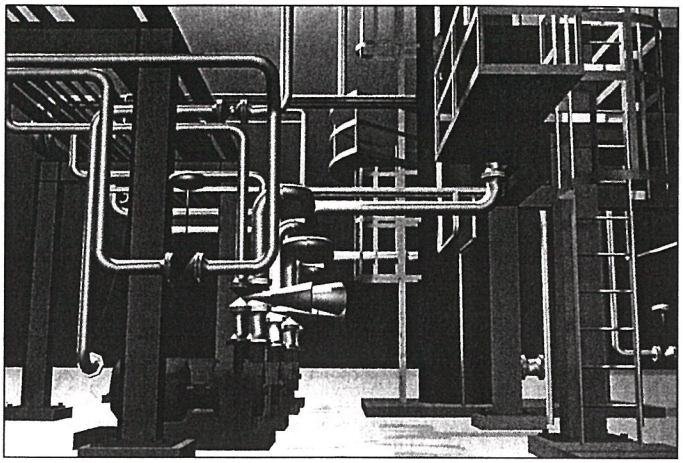
We track how a consulting engineering firm has streamlined its process plant design by using PC-based plant engineering software.



AutoPlant adds plant design capabilities to AutoCad...



...and reduces design lead times significantly.

Engineering the changes

Restech is a consulting engineering company, which specialises in process plant design for the petroleum industry. Its customers include Esso, BHP Petroleum and Altona Petrochemical Company (APC). It was one of the first Australian companies to use Cad for plant engineering. It has now installed AutoPlant plant engineering software, an AutoCad add-on that provides plant design capabilities, such as 3D models, automatic generation of isometrics and bill of materials, and interfacing checking.

The first major project completed with the new techniques was a plant for APC to treat spent caustics. The project involved a mixture of greenfield construction and interfacing with existing facilities. Before starting the project, Restech engineers, who had previously worked only in plain-vanilla AutoCad, had evaluated and demonstrated the leading plant design software packages.

The engineers chose AutoPlant because it was the only PC-based product on the market that could build and store a true 3D model. The advantage of doing the original design in 3D is that 2D arrangement drawings can be produced merely by defining views of the original design model. Isometric and bills of material can also be generated at this stage. Other packages produce 2.5D models which require much more time and effort to get from the model to the isometrics.

Another feature of AutoPlant is its textual database which stores specifications and other information on drawing entities. Coincidentally, prior to awarding the contract for the classic treatment plant, APC had made a similar evaluation and chosen AutoPlant for its internal engineering work. So, it made the use of the software a requirement for this contract.

A new philosophy

As well as learning new techniques, making the move from 2D to 3D required a significant change in project engineering philosophy. Working in 2D, the designer typically begins with the arrangement drawings which, because of the lack of the third dimension makes them less defined for complete interpretation. In many cases the true graphical projections and, importantly, the interfaces are not fully represented for ready identification by the designer, nor visually realistic to the non-practitioner. Hence planning with the aid of a series of 2D images inevitably results in poor design/project co-ordination and this leads to errors, costly delays and abortive work. More significantly, the problems do not come to light until construction is advanced on site. The later the detection of errors, the more expensive their repair.

On the other hand, the 3D model, which is the heart of the new process, fully defines the placement of every line in the project. So, at this early stage, the designer can detect problems such as interferences which would otherwise probably not become apparent until the checking phase.

Restech adopted a policy of training more advanced designers so as to go well beyond the problem-avoidance mode into true optimisation and consider aspects such as providing easy access for operations/maintenance and minimising construction costs which are difficult to achieve using the traditional approach. The model then becomes the defining document of the project and the production of arrangement drawings and isometrics becomes a relatively easy step.

In the real world, design changes continue to be issued well after the isometrics are produced. Project schedule requirements often mean the modifications have to be done on the isometric drawings, although the ideal approach would be to go back and alter the 3D model.

The overall time savings on the APC project were difficult to measure because a lot of applications' development and learning time was involved in the early stages of the project. On subsequent projects, time savings are evident.

Using manual draughting methods, designers usually need about 150 to 200 hours to produce a typical 30-ISO, A0-size orthographic drawing package from the P&ID. The isometric for each line takes about four hours to draw and two hours to check. So it takes about 380 hours to design each piping section.

On the other hand, using 3D design techniques, the drawing can be viewed from the front or any other angle to check clearances and fits. This simplifies the design process and reduces the time required to lay out a typical 30-ISO, A0-section to only 180 hours. Once the 3D layout is completed, it is much quicker to produce the isometric drawing than before. You just define the entities which make up

the line and the desired view, which takes three hours at the most, including checking. Thus, time required to complete each section is reduced to around 270 hours, a saving of about 30 per cent.

An important benefit of the new approach is that once the model has been created it is transportable between the clients and consultants so subsequent operations can be divided among them to reduce overall project lead-time. A good example is provided by a floating production, storage and off-loading facility which Restech recently worked on for BHPP. The project included nine process skids and a lot of inter-connecting piping. The client had a substantial in-house design team and wanted control over the basic engineering issues. So its in-house staff produced the original 3D model in AutoPlant and Restech produced the isometrics.

Meanwhile, BHPP's designers were producing 2D arrangement drawings and modifying the original design to incorporate certified vendor information. Actually, producing the original isometrics was relatively simple, but the subsequent design modifications took more effort. In the ideal world, these modifications would be entered to the model rather than the isometrics, but in this case time constraints made that impossible for many of the changes. The ability to produce the arrangement drawings and isometrics in parallel significantly reduced the overall project completion time.

The marketing edge

As the project examples demonstrate, the use of advanced Cad technology can also provide a significant marketing edge to a consulting engineering firm. Fast tracking of projects is facilitated by the readily varied 3D model and prompt documentation production. The infusion of the operability, maintenance and constructability aspects of the plant is more effective.

Apart from saving time, use of the new methodology produces a 3D model as part of the plant design process and this model can be used for training and presentations. For example, a rendering package can be used to create shaded images of 3D plant models and permit walk-throughs along a pre-defined path. Such models can be applied for diverse objectives, at varying stages of their development, ranging from management presentations, statutory approvals and commissioning control through operator training. Hazardous operations' analysis can also be improved greatly with the use of the 3D model.

Successful operation of Cad software depends on the acceptance and support of the system by management, users and others involved with engineering operations. It is important to have organised project teams, clear communications and strict adherence to control procedures within the team and its interfaces with other disciplines regarding design variations, checking and customised annotations.

At Restech, the successful operation of AutoPlant was helped by adequate hardware, up-to-date software, standardised components/symbol libraries, routine database maintenance, a structured training programme, and the development and improvement of expanding applications through the participation of specific engineering disciplines. AutoPlant specifications were also verified before modelling started.

To run a system such as Restech's is no longer prohibitively expensive. The cost of the hardware and software involved is now low enough to have very small significant impact on a consulting firm's operating cost. The capabilities of PC-based plant design packages are approaching, or even exceeding, systems available on shared-host and workstation computers costing 10 to 20 times as much. ◆