CONSULTING ENGINEERING FIRM DIVERSIFIES WITH 3-D PIPING DESIGN SOFTWARE

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In 1991, BVH Engineers, Inc., a Connecticut-based consulting firm specializing in structural, site, civil, mechanical and electrical engineering, was awarded an engineering design contract for a proposed 19.7 megawatt (MW) wood-fired power plant. A critical component of this project was the selection and use of custom-designed 3-D software to produce detailed piping drawings for construction and pipe stress analysis.

In August 1991, BVH Engineers responded to a request for proposal from CNF Constructors, Inc. for engineering consulting services on a wood-fired power plant in Chateaugay, New York. CNF Constructors, Inc. is a Connecticut-based engineering, procurement and construction firm specializing in mid to large-sized industrial and energy production projects.

In October, we were awarded the contract to design the project site work, building layout and structure, plumbing and HVAC. In addition, the job encompassed process piping layout and design, and pipe stress analysis. Although power piping is not BVH's foremost specialty, the mechanical staff was confident of its ability to obtain the necessary software and accomplish the job. After evaluating available software, we selected AutoPLANT computer aided plant design software from EDA, Walnut Creek, California. The success of this custom program has been tremendous. We began design production in February 1992. Test firing of the plant began in January 1993 with full rated capacity reached in February, only one year after commencement of design work.

The wood-fired KES Chateaugay Power Station is owned by KENETECH Energy Systems, Inc. (KES). KES develops, finances, and owns independent power projects on a national basis. Both CNF Construction and KES are subsidiaries of KENETECH Corporation of San Francisco. Located in the lumber country of upper New York state in the City of Chateaugay, the KES facility is designed to fire waste wood by-products of lumber mills. A wood-fired steam generator produces 170,000 pounds of steam per hour at 955 degrees Fahrenheit and a pressure of 1280 psig. The steam is then delivered to a 19.7 megawatt turbine driven generator which feeds the electrical power into the New York State Electric and Gas Company distribution grid. Four turbine extraction lines are

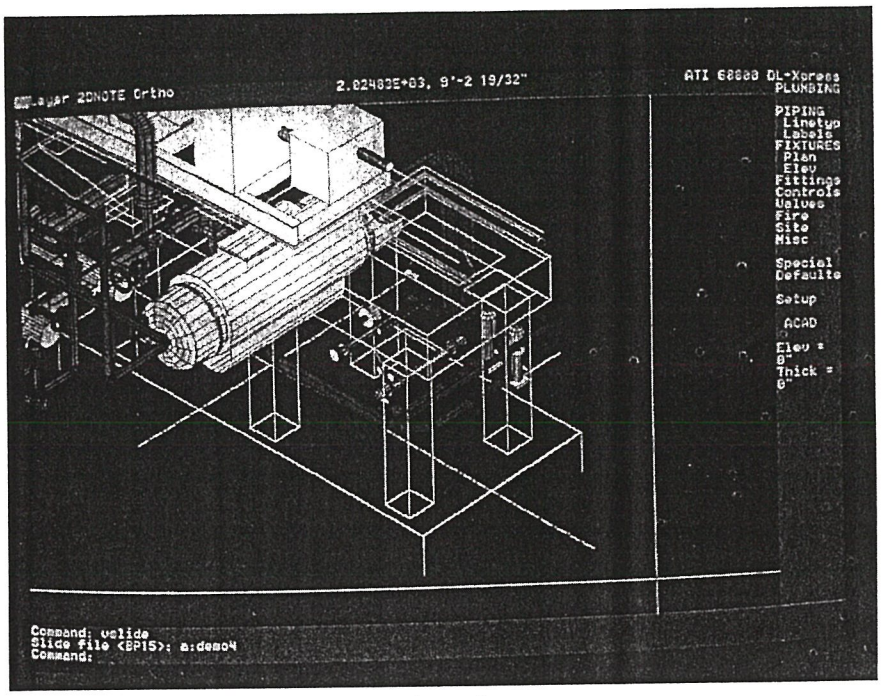

Figure 1

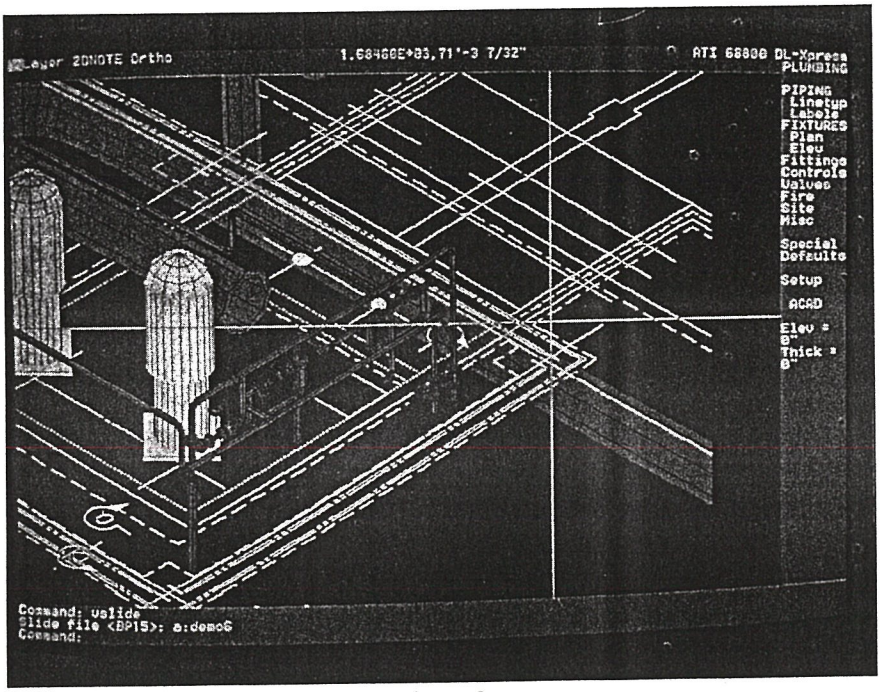

Figure 2

Caption for Figures 1 and 2: The power plant job encompassed process piping layout and design, and pipe stress analysis. BVH used AutoPLANT computer aided plant design software from EDA. Various screens of the project are depicted here.

used in a complex feedwater heating system. All air, oil, water, vents and other various piping systems were included in the scope of BVH's design work.

As a condition of receiving the design contract, BVH Engineers were required to acquire the necessary design software. Several packages were evaluated based on compatibility with existing hardware and software, cost, local support and ease of use. AutoPLANT met all our criteria and was ultimately selected. A key consideration was the EDA software is AutoCad based as AutoCad was already being used extensively by BVH and CNF Constructors. This minimized training time and expense since all of the hardware was in place and in use by BVH Engineers.

The AutoCad base was an important consideration. However, AutoPLANT's three-dimensional modeling and powerful database capabilities available at a reasonable price made our decision to purchase it as easy one. Our CAD operators and piping designers had little difficulty in adapting to the design program and its commands, and we were successful in generating more than a half-dozen customized pipe specification classes in the spreadsheet based specification files.

The "Designer" software enabled us to create three dimensional models not only of a piping run but also of the various vessels, pumps, and other equipment purchased for the plant. The 3-D model allowed the designers to

view each pipe run from various elevations or views to check for clearances and fits. AutoPLANT has features which, on command, convert the single line 3-D model to full three-dimensional representations showing the full outside diameter of all selected lines with insulation thicknesses and true valve and fitting dimensions shown. Obviously, elevation becomes an integral part of the model and forces the designer to be aware of a line's elevation at all times. This feature helps the designer locate valves and other equipment for proper operation and maintenance.

Once the three-dimensional model is designed, coordinated, and checked, the drawing can be converted to a "flat" two-dimensional representation in the plant view for the main orthographic layout drawing. Dimensions can be easily extracted automatically and placed on the drawing. Hidden line removal and all other notes are accomplished under standard AutoCad commands.

One of the most valuable features of AutoPLANT is the ability to automatically generate section and elevation views, convert them to two-dimensional representations, and input the views into the drawings with dimensions and views of the equipment. The drawings ultimately produced by BVH were used directly by CNF Constructors to fabricate the piping. Most of the large bore piping was shop fabricated, which helped improve quality control and reduce labor costs. AutoPLANT also has the ability to quickly produce bills of material complete from fittings and cut lengths of pipe down to quantities, sizes and specifications of flange bolts, gaskets, and piping system components, all derived from the specifications database and 3-D model.

The 3-D model allowed the designers to view each pipe run from various elevations or views to check for clearances and fits. On the right is John Pouliot, Senior Mechanical Engineer with BVH Engineers, Inc; pointing at the computer screen is Ernie Dominigue; BVH Designer; and seated is Pawle Kalinski, BVH CAD Operator.

The critical piping systems, such as high pressure steam, feedwater and extraction steam lines required pipe stress analysis and engineered support systems. The AutoPLANT AutoPIPE program was used for this purpose. The integration resident AutoPLANT allows downloading of geometry and specification data of a piping systems model from the Designer program directly into a stress analysis file in AutoPIPE. AutoPIPE then requires a preliminary support system to be modeled, including rigid supports, spring hangers, anchors, guides and other support components. Any geometric modifications to the model are made in AutoPIPE until the design parameters are achieved. The program allows for user defined load combinations to be modeled, such as a combined gravity plus thermal load which simulates the actual design operating conditions. The results of these user defined combination loads are typically used to evaluate force and moment loads on equipment. Further, in the case of the Chateaugay product, seismic loads were also modeled since the facility was located in the BOCA seismic zone 2.

Design work on the Chateaugay project was performed on a very aggressive schedule. It is highly unlikely that this schedule would have been met without the ability to visualize the design in three dimensions from the beginning of the modeling phase. AutoPLANT's three-dimensional modeling, powerful database capabilities, and AutoCad base proved to be a vital tool in this project. This system will also serve us well in future projects.

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