



# Reducing thermally expanded systems to fabrication dimensions

*Texas Gulf Coast Engineers*

The dimensional uncertainty associated with the design and installation of large, irregular components located in elevated structures has always been a challenge to engineers and construction professionals. In addition to the logistical problems of measuring these components, some units, such as an FCCU, operate at extremely high temperatures (1,200

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F). At these temperatures, components are too hot to approach for measurement purposes. The scenario is further complicated by the dimensional changes that occur due to the thermal expansion of the component. This expansion must be accounted for and adjustments made so the fabrication measurements can be determined.

Traditional measurement methods, includ-

ing laser scans, cannot provide the precision required to accurately model piping and equipment operating at temperature in the field with the dimensional certainty required to fabricate and install without adjustment. This is validated by the fact that in almost every case where traditional methods are utilized for these applications they are used in conjunction with leave-long field-fits. A leave-long field-fit is an additional length of material added to the estimated length of an element because of the inability to measure well. Once adjacent elements are installed, allowing more accurate field data to be obtained, the field contractor will "trim" the element for final installation.

### TGCE hot model to cold model work process

New technology developed by Texas Gulf Coast Engineers (TGCE) provides the accuracy required to model these thermally expanded elements accurately. TGCE is the developer and exclusive user of the Advanced Integrated Measuring System (AIMS). AIMS combines laser total stations and photogrammetry into one integrated system. It captures dimensional data by extracting 3-D informa-

tion from 2-D digital images and from total station point shots.

TGCE's approach to thermally expanded components is unique and comprehensive. During dimensional capture, temperature measurements are also obtained. Infrared guns are used in the field by TGCE personnel to capture temperatures at key locations for future hot model adjustment to fabrication dimensions. Control room temperature data is also used to supplement and confirm the field temperature data. All temperature measurements are taken at the time the dimensional capture occurs to ensure the temperature measurements correlate with the dimensional data.

The precise thermally expanded model and temperature data are loaded into Caesar II pipe stress software for analysis. The traditional method of using Caesar II is to start with a cold model and allow the software to calculate the stresses in the component (piping or equipment) due to dimensional changes associated with a given elevation in temperature. TGCE uses a reverse engineering process to determine the cold dimensions of a hot model by reducing the hot model's temperature to ambient temperature. Because the hot model

has been precisely captured, the Caesar II cold model will match the true geometry of the component at ambient temperature, providing the fabrication dimensions required for any component. This functionality eliminates the need for leave-longs in hot services because of an inability to predict cold dimensions.

TGCE's work process provides all the dimensional data required for revamp projects and turnarounds without rework or leave-longs. Reactor/regenerator heads, internals and all associated piping are dimensionally prepared for fit-up at grade before installation in the structure. Components are installed with the specified weld gap with no adjustments required.

By avoiding the cutting and grinding required by traditional methods, both pre-turnaround and turnaround schedules are typically reduced by significant amounts. Major turnaround "loss product cost" typically exceed \$1 million per day. Additional savings in labor and equipment cost are also experienced when rework and leave-longs are eliminated.

**For more information, visit [www.tgcengineers.com](http://www.tgcengineers.com) or email Jerry Crawford at [service@tgcengineers.com](mailto:service@tgcengineers.com) or call (713) 477-8682.**

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- Construction Field Support

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