Pushing The Envelope

The Engineering Challenges In Building The World's Largest Mobile Boiler Room

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Creative problem solving and innovation is the foundation of advancement in business, technology, and life. While creativity is the ability to produce new and unique ideas, innovation is a way of putting those ideas into action; it's turning an idea into a solution, a process, or a product.

The thought of building a 1,000-hp mobile boiler room was not a new idea, but for a long time that is all it was: an idea. It seemed as if a 1,000-hp boiler was just too big to fit inside a container with all of the auxiliary equipment required for a complete steam plant. However, the idea has been transformed and an innovation has been born: a 1,000-hp mobile boiler room is now reality.

To arrange an array of equipment in a manner that would accommodate the spatial constraints inherent with a fully contained mobile system was a painstaking effort in the design and engineering phase. Fabricating a mobile steam plant is a game of inches when installing all of the components involved. Physically inserting the fully pre-piped boiler/burner assembly into the container was an exercise in ingenuity and determination in order to avoid damaging any equipment or the container itself.

The project was a massive undertaking, requiring over twelve months to complete from inception of design to ribbon cutting, but Nationwide Boiler made it happen.

The entire system consists of the following components:

- 1,000-hp XID Superior firetube boiler with low NOx, high-efficiency Power Flame burner
- Vertical spray deaerator with triplex feedwater pumps
- Blowdown separator for vapor flash
- Boiler chemical delivery system
- Fully metered and regulated natural gas delivery system
- Fully metered and regulated No. 2 fuel oil delivery system with on-board pump
- Allen-Bradley, UL-listed, NEMA 3R, centralized motor control center with integrated burner management and firing rate control systems utilizing Siemens 353 loop controller for full plant control
- Custom 53' chassis with lift capability on fourth axle for increased maneuverability.

Both the boiler and deaerator were effectively R&D designs from the ground up. The standard drum diameter of a 1,000-hp Superior Mohawk boiler was quite larger than the height and width of the high-cube container. With that, Nationwide Boiler needed to figure out a way to make it fit without compromising the quality of steam produced. To maintain equivalent square footage for proper heat transfer, engineers were able to "stretch" the boiler and reduce the diameter to 2" less than the inside width of the container. Filling the container width also translated into greater vessel height than usual. This resulted in the belly being so close to the deck that the bottom blowdown nozzles were installed tangentially to keep the valving inside the plant and out of the elements during inclement weather.

Pushing the boiler design pressure limit, while considering constraints in weight distribution, was another issue to overcome. The 290 psig design pressure for this vessel was the maximum possible limit for the boiler drum thickness without tipping the scales of transit restrictions. Sticking with this atypically high design pressure allows a larger range of operating pressures for users while

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maintaining a legal weight for department of transit compliance.

Similar to the issue of physical size with the boiler, a typical deaerator sized for a 1,000-hp boiler is large all around, and modifications were needed. To make it fit inside the container, engineers reduced the height and optimized some of the larger piping nozzles into the vessel to stay within the dimensional limits. Higher flow rates require higher static head in feedwater systems utilizing centrifugal pumps.

Again, being limited to the confines of the container interior height resulted in the need for clever control schemes and a triplex feedwater pump arrangement to ensure proper operation and reliability.

Due to limited space inside the trailer, it was determined that it was not feasible to get a normal, full capacity water softener inside of the steam plant. Rather than compromising the system with an undersized water softener, a brand new, full-capacity, containerized water softening system was built to accompany the 1,000-hp mobile boiler room when needed. The mobile softener system was built in the same pre-piped and wired construction with single-point connections for all media, and it is easily piped over to the mobile boiler room.

The final product of this 1,000-hp mobile boiler room boasts industry leading control components manufactured from high-quality materials capable of withstanding the most rigorous service and climate for unparalleled reliability. The plant is built to service the customer's needs continuously from commission to shutdown; all systems have integrated redundancy and bypass options to ensure continuous operation. Additionally, all system components were designed with the operator in mind to facilitate regular preventative maintenance and operation.

Working in close concert with the boiler manufacturer, Superior Boiler Works, was critical in realizing the success of the plant. It was truly a joint effort of design and fabrication between Nationwide Boiler and Superior Boiler's engineering and

fabrication teams. The envelope was successfully pushed in both sizing and fabricating the myriad components involved, all while maintaining Nationwide Boiler's high standards of function, operation, reliability, and aesthetics. TB

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