Setting a new precedent for grouting at power plants

Five Star Products

The installation and support of a nuclear containment vessel bottom head (CVBH) is critically laborious in detail and extraordinary in complexity. Several of the new nuclear power plants under construction in the United States — Georgia Power Plant Vogtle in Georgia and South Carolina — underwent placement of CVBHs. CB&I engineers sought a more efficient grouting process to secure the CVBH, which serves as the foundation for the containment vessel that houses the nuclear reactor. The CVBH was assembled on-site at a weight of 900 tons.

Five Star Products Inc.'s personnel, with the project's engineers, developed a new grouting process rather than employing embedded pipes. A hose placement and extraction method would be required to grout the CVBHs. While pumping in grout, the bowl-shaped CVBH could not be allowed to deflect during the placement process. The grout had to be applied in such a way as not to leave any air pockets or voids, assuring a complete seal and an effective bearing area (EBA).

The process of pumping in grout, in terms of flow volume and grout fluidity, was crucial. Five Star Products was willing to take this new and unusual approach to the next level, which became known as the Spoke Grouting Line Method. Five Star personnel worked with engineers David Zito (now retired from CB&I) and Joseph Emanuele (formerly with CB&I) to develop the Spoke Grouting Line Method solution. Constructability reviews involved in-depth studies of the design, the materials and the construction means and methods to arrive at a streamlined construction process and ensure success. At the time, the standard procedure for grouting the CVBH was pumping grout through embedded pipe. The new process was worked out in a computer model, followed by miniature mock-ups that were stress tested to determine uplift potential and validate assumptions. The model proved out, and Five Star Fluid Grout 100 was used as the material. With a formalized plan in place, Five Star personnel and the project engineers selected the mixing and pumping equipment, determined the rate of placement, and assessed the number of crews needed, crew shifts and placement of grouting lines.

In brief, the grouting process included four sets of tandem pump lines placed in equidistant positions around the circumference of the CVBH footprint, converging at its center point. Grout was pumped outward from the center point to fill, in sequence, each spherical area. As the grout pumped in, the hoses (inserted in a four-point pattern) were methodically extracted to remain on the leading edge of discharge, thereby encasing the entire interior of the bottom head, leaving no gaps or air pockets. The flow of the grout played a critical role in the process. This function required highly precise calculations by the Five Star team, accounting for the varying temperature of the bottom head, the temperature of the hoses and grout fluidity itself to assure the grout would not set up prematurely. "Think of a spiderweb built by adding spokes all connected from the center point out," suggested Emanuele.

In total, 16 hours of pumping thousands of pounds of Fluid Grout 100 and working throughout day and night shifts successfully completed the work. Five Star technical service personnel managed the pumping process throughout the installation. In grouting operations, one normally thinks in cubic feet (liters), but these grouting operations were so large it was measured in cubic yards (cubic meters). Each CVBH grouting required approximately 40 cubic yards (30 cubic meters).

The result of the project was another industry first for Five Star. Its development of the Spoke Grouting Line Method truly set a new precedent in grouting CVBHs. Five Star Products provides industrial construction and rehabilitation solutions through proprietary formulations, including high-performance cement and epoxy-based products. The company is known for over 100 patents and many "grouting firsts." It is based in Shelton, Connecticut.

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