Preparing for Nuclear Power — Round Two

Here's a look at how Fluor is readying its welding programs for when construction begins on the next set of U.S. nuclear power plants

BY MATTHEW COX AND GARY R. CANNELL

Recently, there has been significant interest and justification for resuming nuclear power plant construction in the United States. The two primary reasons for this are the rising cost of energy (global demand has strained current power-generating capacity), and a desire to produce "clean" energy that will not contribute to global greenhouse gas effects.

It has been nearly 30 years since the last nuclear power plant started construction in the United States. Although there are no nuclear power plants currently under construction, several applications for permits have been submitted to the Nuclear Regulatory Commission and local governments. It is estimated that plant construction may resume as soon as 2012.

The Fluor Nuclear Power group is currently performing engineering and procurement activities and preparing for the construction of two advanced boiling water reactors to be built near Bay City, Tex. Nuclear plant construction is not new to Fluor; however, since the completion of units at Callaway, Wolf Creek, and V.C. Summer some 25 years ago, Fluor has not been actively involved in nuclear new-build construction. As a result, the company's American Society of Mechanical Engineers (ASME) construction certifications were allowed to lapse. One of the first efforts in preparation for the upcoming STP project was to renew these certifications.

Welding plays a key role in the construction of nuclear power plants and therefore assumes a critical role in the certification process. This article provides a review of the preparation/demonstration activities associated with the Fluor Nuclear Power welding program in conjunction with renewal of ASME certifications for the construction of nuclear power plants.

Challenge

As noted above, Fluor was actively involved in the construction of nuclear power plants during the 1970s and 1980s. Many of the company's employees who had been involved with that work are now either retired or have moved on to other careers. Some of the company's procedures and manuals for nuclear power construction no longer exist and those that remained are out of date with respect to how Fluor does business today and current ASME codes and standards.

A project team, consisting of several experienced employees who had either worked on prior nuclear construction jobs or were involved with plant maintenance/modifications at operating facilities, was assembled to renew the ASME nuclear construction certifications. Among the many project tasks, including preparation of the quality assurance manual, procurement procedures, and construction procedures, was establishment of a nuclear welding program. Fluor has an existing and comprehensive program/organization for controlling nonnuclear welding activities, and there was some discussion about integrating the nuclear scope into that program. It was decided, however, that differences in philosophy and approach were significant enough to warrant separate programs. The challenge was to establish a nuclear welding program to support ASME certification renewal as well as provide a basis and structure to meet the needs of large-scale, commercial nuclear plant construction.

Nuclear Welding Program

Welding Manual

The company's construction strategy includes use of a corporate welding manual that contains general procedures and practices from which project-specific manuals are written to control work at the project

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Fig. 1 — The completed survey vessel.

Fig. 2 — Portion of the root not welded and partial weld deposition of remaining head to shell joint.

level. Project-specific manuals are needed to address unique conditions and practices required by the client, local codes and standards, craft issues/concerns, etc.

Fluor welding engineers prepared the corporate nuclear welding manual and then a specific manual for the renewal of the ASME certifications (named the N-Stamp Project). The project manual contained the normal elements of a welding program including requirements for Welding Procedure Specification (WPS) preparation and qualification, filler material procurement and control, repair welding, etc. What was new or different in this manual vs. that for a typical non-nuclear program was the incorporation of quality requirements unique to ASME *Boiler and Pressure Vessel Code,* Section III, Division 1. Close coordination with the quality assurance manual requirements for materials procurement and storage (filler metals), testing [Procedure Qualification Records (PQRs)], qualification, etc., was required to ensure code compliance.

Preparation for ASME Survey

Roles and Responsibilities. With the welding manual and the other program procedures complete, a detailed project organization with specific roles and responsibilities was developed in preparation for the ASME survey. A corporate welding engineer was assigned responsibility for preparation/approval of the corporate welding manual. Performance and qualification of project WPSs were also assigned to the corporate welding engineer. A project welding engineer reported up through Construction Engineering and had responsibility for all field welding activities.

Welding Facility and Materials Control. The ASME stamps were to be assigned to and controlled by the Fluor corporate office in Greenville, S.C. To accommodate survey activities, a temporary welding and fabrication facility was constructed. The facility included the basic hand tools, power tools, and welding equipment that would be necessary to weld the survey vessel.

A secure storage area was designated for filler material storage and measuring/test equipment. Project-assigned personnel controlled these areas for issuing and receiving purposes. Size, quantity, heat numbers, and serial numbers were among the features used to track the use of these materials and special equipment. In addition, this area had to meet storage- and cleanliness requirements based on procedures, codes, and manufacturers' recommendations.

WPS, PQR, and Welder Certifications. Two gas tungsten arc welding WPSs were required to fabricate the survey vessel — Fig. 1. Materials for fabricating the vessel included carbon steel to itself and to stainless steel. The original plan called for utilizing existing Fluor PQRs to support the two WPSs; however, due to some minor uncertainties regarding existing PQR test data and the desire to run through the new welding manual qualification process, new PQRs were completed.

Filler material and test coupons for both procedure and performance qualification were obtained in accordance with project procurement procedures. Two welders were qualified in accordance with ASME Section IX requirements and draft WPSs prepared for qualification testing. Procedure qualification record test coupons were welded per Section IX and documented in accordance with the welding manual requirements. The completed coupons were sent for evaluation to a testing lab that had been qualified according to Fluor nuclear power procedures. Procedure qualification record testing met all specified acceptance criteria of ASME Section IX and Section III, Subsection NB. The corporate welding engineer certified the PQRs as accurate, then placed them into the corporate welding manual. Copies of the qualified WPSs were placed in both the corporate and project welding manuals.

Materials Procurement. All quality-related materials were purchased from a supplier that had been audited and qualified to the Fluor procurement program and standards. The major components purchased for the survey vessel included pipe, fittings, heads, plate, and the welding filler metal. Actual purchase of the safety-related materials proved somewhat challenging. Each piece of material required a specific set of supporting documents that accompanied it throughout the purchasing process. Examples of supporting documents included Certified Material Test Reports, test documentation, packing lists, Certificates of Compliance, technical data, storage data, and receiving instructions.

Good, regular communication with the suppliers was key to obtaining correct materials having all the required supporting documentation. Once the materials were delivered, the receiving process had to be strictly followed. No materials could be used for construction until the receiving process was completed in accordance with procedures.

Work Package and Traveler. A work package process and traveler were developed to track quality-related and inspection activities during fabrication of the

survey vessel. Hold points were identified at various steps in the traveler for QC, and in some cases the authorized inspector, to examine the work and processes being performed.

Preliminary Survey. A preliminary survey was designed and conducted to identify any deficiencies in the procedures and processes put together for the actual ASME survey. Fluor conducted this preliminary survey with the assistance of a contracted authorized inspection agency. The authorized inspector performed the role of the ASME survey team during the preliminary survey. Several "observations and findings" were identified requiring corrective actions be taken to several of the written procedures and processes.

Welding of the Survey Vessel. Fabrication of the vessel began once the construction program procedures were in place. Welding activities were conducted just as they would be in the field, including work package sign-offs, inspections, etc. The vessel was not fully welded, as can be seen in Fig. 2; this was done to allow the ASME survey team to review critical points in the welding cycle, such as joint fitup, root pass deposition, and root backside condition. This also allowed the survey team to witness welding activities, should they ask to do so.

Survey and Results

The ASME survey team carefully and thoroughly reviewed the prepared procedures and processes. Welding procedures were scrutinized and reviewed to ensure compliance to code requirements. The survey team interviewed both the corporate and project welding engineers, asking about the use of essential, nonessential, and supplementary essential variables; PQR notation; and welder certification. In addition, the survey team witnessed the actual welding of the survey vessel. The welder was even questioned regarding such things as joint fitup, preheat, and location and use of the applicable WPS. All in all, questions were readily and reasonably answered to the satisfaction of the survey team.

At the conclusion of the several-days-long survey, the N-Stamp project team met with the ASME survey team for a briefing on the survey results. The survey proved successful and Fluor was awarded its N, NA, and NPT ASME Stamps.

Lessons Learned

Fluor welding engineers discovered the following through the survey experience:

- The ability to efficiently and correctly procure materials will be critical to project cost and schedule. Because of additional safety and quality requirements, materials for nuclear construction generally take more time to procure than those for nonnuclear applications. Working closely with vendors and clearly putting expectations on the table at the outset of the procurement process will be important.

- Verbatim compliance to procedures and processes will be required. Personnel will not have the luxury of revising established processes "on the fly," even if it is deemed justified. Procedures and processes must first be revised and approved, prior to any change in performing the work. This concept was reiterated several times during the preliminary survey as well as the actual ASME survey.

- Fabrication welding of the small survey vessel provided the opportunity to get a feel for how welding will be performed on a full-scale nuclear new-build project. All personnel involved in nuclear welding must be fully indoctrinated in the ASME process. As noted previously, there will be a steep learning curve for many of those involved in the upcoming projects. Fluor will continue to emphasize the importance of this aspect within its nuclear welding program.

Producing "clean" energy is a reason for interest in resuming nuclear power plant construction

Moving Forward

As noted previously, the primary challenge will be to train a new group of engineering and construction staff members for nuclear new-build construction. The effort expended and experience gained from the N-Stamp Project, including the development of a nuclear welding program, will provide the company with a good basis and structure to successfully move forward with the construction of nuclear power plants.♦

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