

# An engineering benchmark

**The NLNGPlus project added two 4.1m t/y production trains at Nigeria LNG's Bonny Island liquefaction facility, almost doubling plant capacity. The expansion was one of the largest construction projects executed in Africa and has set a performance benchmark for future mega-projects. By Peter Rano, senior vice-president and executive project manager, CB&I**

**T**HE NLNGPlus project was distinctive. Not only did just one mechanical erection contractor construct Train 4, where typically a number of sub-contractors would be required for a project of this scope, but it was completed despite various logistical challenges:

- Location – the facility is accessible only by water, which is problematic for contractors trying to bring heavy equipment, parts and machinery to the site;
- Manpower – the remote location meant contractors had to make housing arrangements for construction staff, as well as ensure their safety; and
- Schedule – the pressure was on to complete the project in a short, 27-month time frame.

These challenging conditions can be overcome with careful planning, experience and extensive knowledge of the local community. Chicago Bridge & Iron (CB&I) was contracted by TSKJ, the main contractor for the NLNGPlus project, to provide civil and mechanical erection services for Train 4. By understanding the issues involved and creating a methodology for addressing them in ways that benefit all concerned, LNG projects such as this one can be completed safely, on time and on budget.

## Logistics issues

With any large project, planning is required – even before winning the award. For Train 4, CB&I began planning after receiving the first inquiry from the customer – about a year before it was awarded the contract. On receiving the contract, an extensive and robust project-controls system was implemented. A team of 12 oversaw construction activities and monitored aspects such as overall progress; progress by discipline; all key quantities installed; quality and safety performance; and work-hours and efficiency factors.

For information management, databases and a scheduling software system were used. The databases contained daily, weekly and six-week schedules – used to monitor field-pipe spool erection as well as field-pipe welding – as well as other work plans for components with their own completion schedules.

Solid working relationships between all parties were essential in the development of a project of this magnitude. Throughout the project, CB&I maintained close co-ordination with TSKJ.

Extensive pre-planning was also necessary for the project's heavy-lift programme, especially because space at the project site was limited. For heavy lifts, the crew used luffing boom cranes, which can be placed right next to the unit and have jibs that stand

straight up on top of the boom. Because of this, the cranes can lift about 25 metres further than straight-laced boom cranes.

CB&I utilised 40 cranes to lift the acid-gas removal absorber vessel and main cryogenic heat exchanger into place. To mobilise the cranes, and other construction equipment, a combination of chartered ships and commercial shipping lines was used. For the larger cargo, the contractor arranged for ships to call at the offloading facility on Bonny Island. Commercial carriers called at Port Harcourt, from where equipment was carried by river barge to the project site.

Despite the amount of planning, the 27-month time frame was tight. To meet the schedule, several essential practices were established. As well as setting up a pipe shop, one of the most valuable tools used to improve the schedule was specifically developed automatic welding equipment utilised on the train's piping prefabrication, which achieved exceptional weld-acceptance rates. A temporary electrical-distribution system was set up to provide power to all locations in the process train, ensuring maximum utilisation time without the need for extensive relocation of equipment.

Because of the large size and scope of the project, the crew size at Bonny Island peaked at 3,250, including all directly hired and contracted employees. Although the remoteness of the site created housing issues, the greatest challenge was finding the manpower with the skills necessary to carry out the project.

## Workforce issues

Hiring local workers is an effective way to utilise local resources. It benefits the local community, helps the company establish a local presence and meets local-content requirements of the owner or host country. However, despite the advantages involved, direct hiring requires more planning, as well as additional time and expense to train the new recruits.

A solid understanding of local labour practices and regulations is crucial before the contractor can develop a process to staff its projects. CB&I has created a three-step process: discover the indigenous talent; develop the talent through a carefully designed training programme; and extend this training throughout the life cycle of a project. Although simple and logical, executing this plan is a challenge.

Discovering indigenous talent involves visits to the region before a project begins. During this period, the hiring/project manager can assess the availability and capability of local resources. The visits also pro-



Peter Rano

vide opportunities to develop a network with local recruiters who can help set up the hiring process, provide information about local communities and facilitate communications with candidates. The information obtained from this network is critical in developing project schedules and budgets, as the availability of local skills will greatly influence the efficiency of the project.

After assessing the local talent pool, a recruiting process involving interviews, skills tests and aptitude evaluations is devised. For Train 4, CB&I interviewed and hired nearly 2,500 local recruits. Once the process was under way, a training programme was initiated to develop the required skill sets. A training centre with classrooms, a weld lab and areas dedicated to teaching specific crafts was set up. The training programme consisted of 18 courses for direct-hire local employees. While several of these courses were skill-specific, such as welding procedure and rigging, others were more general, such as the safety induction course and first-aid training – required for all employees.

Safety training is essential, regardless of the skill-level of the crew. Accident prevention, first aid, hazard recognition, respiratory protection, lockout/tagout, electrical safety and any other course that ensures safe practices should be included for all recruits. As new skills are learned, safe practices should be incorporated into every component of the training programme, then reinforced through demonstration, repetition and refresher courses.



For Train 4, CB&I interviewed and hired nearly 2,500 local recruits

The training programme is tailored to meet the needs of the project and the available applicants. Depending on the skill-level of the locals, it may be necessary to establish a training programme that could take a year or more to complete. The programme for Bonny Island consisted of four distinct layers:

- Train the trainers – the contractor may bring in supervisors from outside the country to train locals with the aptitude to teach the other local employees, creating a team of local trainers. These trainers teach in the regional language, understand local customs and identify with the individuals being trained;

- Adapt applicable skills – train individuals with applicable skills that can be easily adapted to meet those required for the project. Often, these individuals can be trained relatively quickly and may also be able to assist in the training of future applicants;

- Train in stages – while some recruits may not have applicable skills, they may show an aptitude for a required skill. They will require more training, but

may progress in stages, eventually learning more difficult tasks. For example, a person learning to weld – after receiving training and earning basic certification – may begin by welding plates, but could progress to carbon-steel pipe and more difficult metals; and

- Develop fundamentals – train individuals who need foundation skills before they are ready to learn a craft. This may include basic reading, writing and mathematics, as well as listening and other core learning skills. After mastering core skills, they will be ready to move into training programmes that teach specific job skills, such as data-entry or accounting. This type of training can require significant lead time that must be considered during project scheduling, but the benefits include the enhancement of the potential talent pool for the project, as well as improving the local population's skill level.

Once the training programme is complete, recruits begin on-the-job training – an integral part of the progression of the project. Safety remains a focus of on-the-job training, with policies followed diligently on all job sites and part of every activity.

Experienced supervisors who can help to train, mentor and coach local crews are essential. Supervisors look for opportunities to develop employees' skills by moving them to different activities and promoting them to more challenging applications. Consequently, the project site becomes a training ground for future supervisors.

Some employees trained by the contractor remain with the company and move on to work on projects in other countries, while others leave when the project is completed and remain as skilled workers in their native country. But regardless of what they do, the contractor's objective has been achieved: to find skilled workers who can help complete the project safely and to deliver a high quality project on time. When the contractor returns to the region, it will find skilled labour.

### Completed safely, on time and on budget

Despite the size of the Bonny Island project and the challenges involved, Train 4 was completed safely, on time and on budget. The work was carried out by more than 3,000 crew members, of 21 different nationalities, most of them local. Around 10m work-hours were completed without a single lost-time incident.

The training programme was very successful, with more than 300 welders tested and yielding a very high success rate. These workers made a significant contribution to the project's exceptional quality performance. Numerous personnel were trained to operate cranes and other machinery, and many who started out as unskilled workers progressed to skilled assignments.

The project faced a number of challenges that were overcome. These same practices can be applied anywhere in the world. Planning is the key to delivering a successful project for both contractors and owners. Experienced leadership, knowledge of the local community and innovative work practices will ensure large-scope LNG projects are completed safely, on time and within budget. ■