Questions to be responded to by the firm submitting the application

Why do you think this project should receive an award? How does it demonstrate:

- Innovation, quality, and professional excellence
- Transparency and integrity in the management and project implementation
- Sustainability and respect for the environment

Qasim International Container Terminal – Terminal 2 Project was a specialized container terminal invested by DP World Karachi on BOT basis, which is located at Port Qasim, Karachi, Pakistan. The project was completed on 29th Dec 2010. The budget of the project is in line with market prices. It has been successfully put into operation for more than four years since 12th Jan 2011.

The contract for QICT-T2 project was based on FIDIC *Conditions of Contract for Construction, for Building and Engineering works designed by the Employer*, First edition, 1999. The design and construction were in accordance of the international standard such as Britain Standard and European Standard. CCCC-FHDI carried out the design optimization and was one of the general contracting parties of Joint Venture for the project construction.

The project is comprised of two berths 727m long quay wall, catering for maximum 100,000 DWT container ships, and 16 hectares reclamation for container yard. The design level of berth pocket is -16.0m below chart datum. The annual throughput capacity of terminals was over 1million TEUs. According to the geological data and operation requirements, a Combination Structure of Steel Tubular pile and Sheet Pile was adopted in an innovative way for the optimal scheme of the quay wall. By this method, it had successfully overcome the complex & unique geological conditions in Port Qasim, and reduced the high cost of original scheme of the project.

The project has been awarded a number of National, Provincial and Association awards in China, including the second prize of 2013 National Excellent Design Award, the first prize of Outstanding Achievement of National Construction Project Management, 2010 Excellent Quality Management Team of National Transportation Sector, the second prize of 2012 Science and Technology Prize of China Water Transportation Construction Industry Association. The project has benefited from one National Patent in China and contributed to the publishing of more than 10 papers at the National level journals.

1. Innovation, Quality, and Professional Excellence

➢ Innovation Application of Combination of Steel Tubular Pile and Sheet Pile Structure in the Project

The Employer called for tenders in December, 2007 for the submission of tenders in February, 2008. The clarifications and negotiations were set in April 2008, which coincided with the Global Financial Crisis. Consequently, the market prices of materials rose suddenly and sharply. The project was a Lump Sum price Contract subject to Price Adjustment for abnormal variations in price of materials. Due to the 2008 financial crisis the project cost was estimated to increase by more than US$10

million compared to the original bidding price and exceeded the Employer's budget. The project was thus confronted with serious risk of suspension.

After careful study and analysis, as per the condition of contract, CCCC-FHDI proposed innovative, Optimal and cost effective Design to replace the successive Bored concrete piles structure in the original Bidding Document.

The optimization Ideas included: 1) Focus on optimization of the front quay wall structure which accounted 51% of the total cost; 2) Comparison with other type of wharf structure; 3) Adoption of sheet pile structure, and reduction of cost of quay wall. Without following the sheet pile structure commonly used in China, CCCC-FHDI innovatively adopted the combination structure of Steel Tubular piles and Sheet Pile. This combination structure was proved to successfully take the most advantages of steel tubular piles in bending bearing capacity and break the limitation of the resistance of bending for sheet piles. Hence, the combination structure satisfactorily met the design requirements of deep water, high load and seismic intensity.

By comparing with various types of quay wall structures in domestic & abroad and the comprehensive analysis of site conditions, the combination structure of steel tubular piles and sheet pile was considered suitable for this project. This structure consisted of three parts of steel tubular pile, sheet pile and clutch. Further, the structure shape could be adjusted mechanically to accommodate any abnormal pilling deviation conditions such as offset of 300mm, rate of slope more than 50:1, ensuring the smooth driving of piles.

CCCC-FHDI carried out Economic Benefit Analysis between the optimal design scheme and the original design scheme. In the respect of Main Material Consumption, it shown that the option of Steel Tubular & Sheet Pile was taking only 42.3% Concrete, 32.8% Reinforce Steel and 89.5% Steel Tubular/Sheet Pile / Rod that consumed in original Option of Bored concrete piles.

We also compared the combination of steel tubular and sheet pile structure with other kinds of quay wall structure such as square block structure, caisson gravity structure and piles structure for open type wharf. The results indicated that combination steel tubular and sheet pile structure was of less cost of project, long durability, medium complexity and high earthquake resistance, which was most suitable for this project.

The Optimized structure was accepted by Engineer and the Optimized cost was appreciated by Employer, and the contract was finally awarded on 9th July 2008.The adoption of combination of steel tubular and sheet pile structure did not only counteract the price increases, but also reduced the tender price by 7million USD.

The optimized structure of Steel Tubular pile and Sheet Pile was awarded Patent of "Utility Model" in China with Patent No: 2012201528406.

Adoption of this new type of combination structure is suitable to the complex geological condition in Port Qasim of Pakistan. It is of great benefit to overcome the tremendous pressure due to the sharp price rising of material especially the steel, concrete and diesel in the Global Financial Crisis before the Bid Awarding. The Innovation not only helped to ensure the smooth implementation of the project, but

also creatively explored a win-win situation for the Employer, Engineer and the Contractor. Proudly for FHDI, it provides valuable engineering experiences for the Port Qasim development and set up a good reference for other projects as well.

- **Innovative of New Technology - Combination of Pile Diving & Drilling & Re-Driving for Steel Tubular Pile Construction**

The diameter of steel tubular pile of Combination structure is 2m with embedded depth of 15m, while the geology condition in pile driving area was very complicated and hard for driving this large diameter piles. From -18 m to - 21 m, the pile had to penetrate the sand gravel cemented soil (partially stone) layer of 6m to 9m in thickness, with SPT more than 80 blows. It was therefore of a great difficulty in the construction.

Further, the acceptable pile driving deviation for this Combination structure was very stringent. To ensure the smooth construction, the plane deviation of driving steel tubular piles should be no more than 100mm, while the slope should be less than 1/75, and the deviation of pile center distance should be no more than 80 mm.

After intensive researches, an innovative pile driving process was proposed by FHDI to meet these requirements. The new pile driving procedure was: 1) Construction Preparation; 2) Temporary Trestle Installation; 3) Preliminary driving of Tubular Pile; 4) Rotated drilling inside Tubular Pile; 5) Re-driving of Tubular Pile to Design Level; 6) Construction of Sheet Pile; 7) Inspection and Acceptance of Construction; 8) Next construction procedure.

The implementation of above innovated pile driving was found effective at site. The construction succeeded in reaching the design bottom level and the high deviation limit of piles. The pile driving process was smooth and high efficiency by accomplishing three (3) groups of combination structures (10m long of quay wall) in every two (2) days. The large strain testing results showed that the steel tubular piles performed very high bearing capacity, which not only met the design bearing capacity requirement, but also provided good condition for the subsequent construction of quay wall and anchor structure.

- **Design and Practice for Joint-less Long Crane Beam**

During the joint survey and investigation to the existing Phase I terminal at the beginning of the QICT-T2 project by CCCC-FHDI with the Employer, it's observed that the different settlement and deformation of the quay wall had resulted in distortion of surface structure of terminal, making difficult the movement of quay crane, rail damages in the structural joints which required frequent maintenance and hence affecting the normal operation of the terminal.

Through consultation and analysis of the existing projects, CCCC-FHDI summarized the common grounds of application of joint-less long crane beam design which concluded: 1) The Pile foundation under quay wall constrained the structural deformation between rigidity and freedom; 2) The bearing layer for pile foundation was the medium to hard geological layer; 3) Bypass in high temperature areas. Examples were mainly distributed in Germany, Britain and Netherlands.

CCCC-FHDI considered the key issue for QICT-T2 project was the influence of seasonal temperature difference and uneven settlement. The requirements of joint-less long crane beam were completely different from the codes and standards of China, therefore no implementation and practical experiences could be referred in China. CCCC-FHDI decided to use ANSYS software to simulate the effect of three kinds of load combinations on the structure. The result showed that the structure was feasible theoretically. And appropriate increase of steel ratio of peripheral structure could solve the influence of seasonal temperature difference.

The implementation of 615m joint-less long quay wall structure was successful and performed well at site, and no crack appeared after four (4) years operation. It not only met the requirements of the Employer but also achieved good benefits in the respect of technology innovation and cost.

2. Transparency and Integrity in the Management and Project Implementation

CCCC-FHDI input FIDIC integrity management system combined the FIDIC project management to create integrity management mechanism.

Strictly follow the advance disclosure regulation. The bidding rate of the subcontract and procurement reached 100%. Bid opening complied with two-step strategy, the first is to open technical proposal, while the second is to open financial proposal. Standard of bid evaluation was “Quality First”.

Priority has always been granted to the profit of the Employer and Quality of project first during the Design optimization and site construction. Utilization of reasonable design scheme to resolve the construction problems at site, expedite the program and progress and meet the time completion requirement of Employer.

By creating transparent engineering projects, all major decisions have been in accordance with the Contract and be kept in record. All design documents and construction activities must obtain the approval of Employer prior to construction to ensure the accomplishment of relevant procedures.

Set up legal team in QICT-T2 in cooperation with local veteran lawyers to guide the project in all respects according to FIDIC contract, local laws and regulations.

Create an honest & transparent Engineering Project. CCCC-FHDI tried best endeavor to achieve "Zero Disciplinary Violations, Zero Malfeasance", create double-qualified project of "High-Quality and Excellent Management”. Also we set up “Honest Culture" board, publish articles of honesty, post honesty Motto and etc, which contributed to cultivate employee’s morality and created an honest culture in QICT-T2 project..

Satisfied Audit result. QICT-T2 project were completely legal compliance in the third party Audit in all respects especially the utilization of project funds.

3. Sustainability and Respect for the Environment

Pakistan is an Islamic country. We respect the local religious and beliefs by setting up temporary places for the convenient and facilitate of prayer of local Employees.

Ensure the employees’ health and safety, and preservation of environment through

strengthening HSE control. Construction team carried out the safe production responsibility system, established safety operating rules. No accident occurred during more than 30months period of construction. Drinking water was provided at each 500m to secure the workers have safe drinking water.

Hundred meters away from construction site it was the mangrove forests of Karachi. Special attentions were paid to prevent the pollution and damages to the mangrove forests during construction. All rubbish on the ship was brought to land. Oil boom was set up at construction site to prevent oil spill & damage to marine environment.

Promote the development of local economy, increase employment rate and maintain the social security. After the completion of QICT-T2 project, large-scale container vessels could be accommodated, and the economic hinterland covers Pakistan and Afghanistan. It has significant meaning to promote the GDP and economic development of both countries. At the meantime, the operation and construction of terminal, port management, transit and warehousing, transportation, and ship repair/ maintenance has contributed to provide about 900 jobs opportunity to local people. The decrease of unemployment also has significantly help to maintain city order.

CCCC-FHDI input the concept of Sustainable Development into design plan. During the project construction, FHDI carried out two optimizations with full consideration of Sustainable Development:

1) The access road in the rear side was to be backfilled with quarry run material. FHDI proposed to utilize waste slag stone stockpiled in steel mill nearby to replace the quarry run, and slag stone could meet the requirements. Finally, with approval of employer, 200,000m³ slag stone was used to replace the quarry run material, which not only effectively avoided the mountain mining and long distance of transportation but also beneficially resolved the treatment of waste slag stone for steel mill and minimized the environmental disturbance to the port surroundings.

2) 300m long of stone bund was planned behind the terminal. FHDI carefully studied the site situation and utilized the earlier completion of neighbored project to form a good shelter. FHDI changed the stone bund to sand bund structure by utilizing the excavated sand after stack preloading. Through this method, it saved QICT-T2 project of 137,000m³ stone material and avoided the disposal of 500,000m³ sand, which was used as pre-loading surcharge for reclamation treatment of the project. Further, the extra sand was completely utilized by backfilling to form nearly 70,000m^2 land area for subsequent project. Thus, the environmental influence was avoided with implementation of sustainable development in QICT-T2 project.

What services did the member firm provide to the project? Please describe briefly.

CCCC-FHDI Engineering Company Ltd. is the design Contractor of the optimal design of Quay wall for QICT-T2 project. In addition, CCCC-FHDI participated in the project management for the construction QICT-T2 Project, in association with China Harbour Engineering Company.

Please use additional pages as needed. Maximum 5 pages per project.