COMPLEXITY, DIFFICULTY AND OPTIMISATION ASSOCIATED WITH THE CONSTRUCTION OF RG TANNA COAL TERMINAL BERTH 4 AND SHIPLOADER 3

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Andrew Mattiske[1]

ABSTRACT

John Holland Pty Ltd in association with their client the Central Queensland Ports Authority (CQPA) have delivered the vital fourth berth and third coal Outloading stream at Queensland's RG Tanna Coal Terminal. This terminal expansion was an essential response to the current global demand for coal and was delivered by its scheduled completion date, in a boom resource market where project program overruns are prevalent.

The terminal expansion comprised the addition of a third Outloading conveyor stream to feed a new third 6,000 tonne per hour Shiploader. Achieving this required the construction of a 400 metre long wharf extension, 800 metres of additional wharf widening, onshore and offshore transfer towers, a new wharf approach jetty, 1.5 kilometres of onshore conveyor works and the manufacture and installation of a new Shiploader.

INTRODUCTION

The challenge for John Holland was to deliver this project in quick time with minimal disruption to the existing coal handling operations and shipping movements. The construction methodologies adopted for the project met this challenge, delivering complex high risk works safely in a marine environment. John Holland undertook much of the work using direct labour and employed its marine experience to develop, amongst other things, "over the top" piling solutions to facilitate safe and speedy construction. John Holland successfully managed the complex interface between the manufacture and delivery of the 500 tonne Shiploader and the Berth construction works, ensuring delivery of the overall program.

SCOPE OF WORK

John Holland has played a major role in Central Queensland Ports Authority's largest ever capital works program. Their role in the program centered on an expansion to the RG Tanna Coal Terminal, located at Gladstone in Queensland. The John Holland Scope of Works included civil, structural, mechanical and electrical works associated with the construction of coal handling plant and equipment, the construction of marine structures and the manufacture and erection of a third shiploader.

[1] John Holland Pty Ltd, 1000 Anne Street, Fortitude Valley, 4006, Queensland.
andrew.mattiske@jhg.com.au

Construction of **Berth 4**, a 400 metre long wharf extension to existing Berths 2 and 3 to provide for a new Shiploader and a fourth 220,000 dwt vessel. The wharf consisted of a structural steel superstructure supported on steel tubular piles. Key construction activities included:

- The installation of driven steel tubular piles 1,200mm in diameter, average length of 42m, average weight of 23 tonnes, in 30 bents.
- The manufacture and installation of approximately 3,500 tonnes of structural steel.
- Installation of precast concrete deck units.
- Installation of fenders, frontal frames, and mooring hooks.
- Supply and installation of all wharf services and wharf furniture all similar to existing.
- Construction of a new substructure for a transfer tower and sampling plant installed at the intersection of the new approach jetty and wharf extension. The sample plant was classified as a hazardous area and so required specialist electrical equipment and instillation techniques.
- Construction of a new substation at the commencement of Berth 4.
- Construction of 8 berthing dolphins and 2 mooring dolphins

Existing **Berths 2 and 3** were also widened to support a new conveyor and associated walkways and a new roadway along the back of the Berths that joined a similar road along Berth 4. This involved a landward extension of the existing steel superstructure comprising a headstock extension and an additional pile per bent. The Wharves are fully decked between rail girders.

Figure 1 - Works at RG Tanna Coal Terminal

Construction of new 250 metre long **approach jetty** including dual traffic lanes, supporting new conveyor gantries. Jetty substructure comprises 14 new jetty bents (steel piles/headstocks). The roadway was fully decked with prestressed precast concrete deck units.

Construction of a 1.5 km of **onshore conveyor** to deliver coal over the new approach jetty, picking up coal from all stockpiles. This work included concrete footings, transfer towers, conveyor structures including walkways, handrails, cable tray supports, pipe supports, cladding, sealed roadway including drainage and kerbs.

Installation and commissioning of all landside conveyor mechanical and electrical components.

The new 6,000tph **Shiploader 3**, constructed in offsite in Brisbane is similar to the existing two shiploaders on the wharf. Its design is based on that of the existing machines updated to comply with changes to Australian Standards and to implement a number of improvements. It will be capable of loading into carriers of up to 225,000 DWT with a beam of 55m.

Figure 2 - Shiploader 3 assembly in Brisbane

The ship loader consists of the following components:

- A four corner tripod portal construction with a 14m rail gauge. The main fabricated structural components include a seaward mounting beam, which takes loads directly from the headstock via a pylon. The landward mounting beam and pendulum leg, on which rests the seaward end of the main beam and machine house structure with an internal counterweight. A back strut which connects the headstock with the upper cross beam at the top end of the diagonal main beams.
- The boom which is a truss structure which is luffed via the headstock with a winching arrangement mounted in the machine house. The boom also features a travelling cabin and travelling maintenance platform.
- The Shiploader conveyor with a conveyor bow through the boom pivot, over the shuttle car and to telescoping and tilting discharge chute.
- A tripper car that connects the wharf conveyor with the boom conveyor. The tripper has its own powered conveyor and an intermediate transfer from the wharf conveyor.

- As the tripper for Shiploader 3 is separated from the Shiploader itself by 3 conveyors and a roadway, the machine also features a transfer bridge supported on the rail near the transfer point.

The fabrication of all Shiploader structures was undertaken at John Holland's Richland's facility, one of Australia's largest fabrication and corrosion protection facilities. Items such as bogies and winches which involved a large amount of machining were manufactured by specialist subcontractors.

The Shiploader was assembled including the transfer bridge at a site leased from Forgac Cairncross Dockyard in Brisbane. All manufactured components were delivered by road to this pre-assembly area. Pre commissioning was undertaken at the completion of assembly work utilising temporary power supplies and prior to load-out.

A Heavy Lift Vessel was then employed to transport the Shiploader from Brisbane to Gladstone, with the transfer bridge separately secured on the ship's deck. The Shiploader was offloaded directly from the Heavy Lift Vessel onto the end of the existing Berth 3.

The Transfer Bridge was also offloaded onto Berth 3 and fitted to the Shiploader using wharf based cranes. The Shiploader tripper was assembled on site in Gladstone and lifted onto the Berth using a barge mounted crane.

CONTRACT FRAMEWORK

The work undertaken by John Holland for this project was covered by three contracts: an early works package, a contract to manufacture and construct a Third Shiploader and a package encompassing a major wharf extension. All contracts were construct only, lump sum, contracts based on Australian Standard AS2124.

Construction only contracts of this type are primarily designed to allocate and separate risk and to keep the parties at arm's length. They generally include a robust set of commercial conditions and are accompanied by a well developed design. This type of contract not only meets the State Governments probity requirements but provides the Client an acceptable capital cost risk profile.

Marine works of this type however are complicated tasks with high levels of risk for both contractor and client. The works were weather dependant, were undertaken in an operating environment where minimal disruption to coal handling and shipping movements was mandatory and construction included the inherent dangers of working over water and using heavy equipment at sea. Often projects with this risk profile are delivered under an alliance contract.

Irrespective of the type of contract used for the project, the project team, including client, superintendents and contractor adopted a collaborative, best for project, approach to delivering the project. In this case the collaborative approach was achieved without the benefit of an alliance contract, demonstrating a common understanding of the needs and aspirations of the parties.

Powerful foundation relationships were formed with the senior executive managers of each organisation early. This Executive Leadership Team maintained regular leadership forums to discuss the direction and progress of the project and provide leadership to the project team. Meetings were held as regularly as fortnightly on-site through the intense completion and commission phases of the contract.

PROJECT ENVIRONMENT

The challenge undertaken by John Holland was to deliver an upgrade to the R G Tanna Coal Terminal, in quick time and with minimal disruption to existing coal handling operations and shipping movements. Due to pressure brought to bear on coal infrastructure by the resources boom, meeting this challenge was critical to Queensland's Coal Industry and Australia's reputation as coal exporter in the Asia Pacific region.

Construction tasks of this type, which include all construction disciplines working together to achieve a common outcome, are complex by their very nature.

Project Completion Critical

The Client required the project to be completed in quick time to meet market and funding requirements. This condition itself added to the complexity of the project. Undertaking high risk construction activities safely in both a marine environment and within an operating terminal required detailed construction methodology and a high level of experience in marine construction.

Minimise Disruption Coal Handling Operations and Shipping Movements.

Construction works were not to disrupt existing Coal Handling Operations and shipping movements. The Port operated, prior to the upgrade, with three berths and two Shiploaders continually around the clock, with shipping movements governed by both the coal loading activities and the tides. Fully laden ships require a high tide to allow movement from the Berths.

To ensure minimal disruption the Port operations were physically separated from construction activities. This restricted available construction lay down area and resulted in interface activities being undertaken during maintenance shutdowns.

Sensitive Marine Environment

Works were undertaken in a sensitive marine environment where much of the construction was carried out over water. Piles were driven into the sea bed and there was also a high risk of coal spills in the Port during commissioning. The rear of the existing Shiploader 1 was adjacent to the Berth 2 & 3 widening construction crew and often the nominated ship hatch to be loaded was in line with the construction work front. During loading and clean down operations there was a potential for coal and wash-down slurry to spill onto the construction works areas. This was a sensitive issue for all involved but was successfully managed at first by the Site Safety team and then on a day to day basis by the construction supervisors.

Introduction of Marine Security Identification Cards

In May 2005, the Australian Government introduced amendments to the Maritime Transport Security Act 2003 in an effort to further secure the nation's maritime and offshore industries. These amendments led to the introduction of maritime security identity cards (MSIC) to ensure that those working in these critical industries are subject to appropriate background checking as now occurs in the aviation industry.

As a nationally recognised form of maritime and offshore industry identification, the MSIC distinguishes the holder as having met the minimum background checking requirements. It is now mandatory for all maritime industry workers and contractors who operate within maritime security zones at ports, ships and oil and gas facilities to carry a card, or be supervised by someone with a card.

The Act came into effect Australia-wide in January 2007, in the middle of the wharf construction. There were significant delays and costs in obtaining cards and ongoing security checking regimes would have impacted on construction efficiency. John Holland obtained MSIC's for selected personnel and a security fence was constructed to isolate the construction area from Port Operations. This allowed construction activities to continue without interruption, yet still comply with the requirements of the Act. During stages of construction access outside the fenced off area was complicated by a need to provide supervision and escorts for short term construction resources.

SHIPLOADER CONSTRUCTION

Selection of the Shiploader 3 construction location

The 500 tonne Shiploader 3 required a large assembly area for construction, which was at odds with the limited construction lay down area available at the site. This meant that the Shiploader was manufactured and assembled away from the site and then transported to Gladstone to be installed to meet the required program. While this approach ensured minimal disruption to Coal Terminal operations, it added the complexity of transportation and lifting of large equipment at sea.

One of the key issues discussed with CQPA during the tender negotiation period was John Holland's selection of an off site assembly location in Brisbane. Based on experience gained from the previous construction of Shiploader 2 "on the Berth", John Holland was able to evaluate the cost premium of involving a Heavy Lift Vessel against the inefficiencies of working on the existing Berth and the impact on construction productivity and Coal Terminal operations.

The success of this strategy became apparent when the Shiploader was placed onto the new berth structure in two days over the 2006 Christmas break in Gladstone, on program and with minimal disruption to Port Operations. Any works on the Shiploader Boom and Coal Discharge Chute required the boom to be extended into the quay. To ensure safe operations at all times, one of the restrictions imposed by the Regional Harbour Master was that the Boom be raised clear of the berth during all Ship Movements at the berth occupied by the Shiploader.

Heavy Lift Vessel Availability

The incorporation of a Heavy Lift Vessel into the Shiploader 3 works program introduced many technical and logistical challenges.

The number of Heavy Lift Vessels available worldwide with the capability to lift a machine of this size and weight, safely transport it at sea, and finally position the machine onto rail lines, on a wharf designed to accommodate much larger ships, is extremely limited. Considerable technical evaluation was necessary to ensure that the final design parameters were complimentary to the ship's capabilities and that the Shiploader's structure itself had sufficient integral strength to withstand the worst-case acceleration forces that might be encountered both during the voyage and during the lifting process.

Due to the current boom in construction of mining and offshore infrastructure, such ships are much in demand. Once an appropriate vessel was identified, it was necessary to place a firm booking for the ship nine months in advance. Once the booking was accepted, the ship's owners undertook to position the vessel at Brisbane, for loading within a narrow time window. Such an early alignment of the shipping and construction schedules imposed both a strict discipline and an added sense of urgency to the project's management.

The "Happy Ranger" was chosen for the project, one of 4 sister vessels from the fleet of the Dutch heavy lift specialists, BigLift. The "Happy R" type ships have a long history of carrying Shiploaders, including many to and from Australian ports. These ships are equipped with two cranes each capable of lifting 400 tonnes, with an outreach of 18 metres from the ship's side, and combinable up to 800 tonnes.

Many months before the ship was due at Brisbane, detailed stowage plans were drawn, engineered lifting simulations were prepared, and the final size and positions of the lifting points agreed with the Shiploader's designers. The proposed lashing and securing methods and materials were reviewed for adequacy and compatibility with the Shiploader's structure.

Final preparation included weighing the machine and ensuring that no loose items were left unsecured for the voyage. This included a review of all installed components such as switchboards and installation of temporary bracing of each item as required.

In addition to the Shiploader 500 tonne and Transfer Bridge 35 tonne, 24 tonnes of construction equipment were also transported on the Heavy Lift Vessel.

To provide optimum stability for both Heavy Lift Vessel and machine, the boom was required to be in an upright position during the voyage. However this meant the combined height of the Heavy Lift Vessel and Shiploader 3 was too great to pass under the Gateway Bridge, the only crossing on the Brisbane River downstream from the Dockyard. The solution was to take a temporary power pack and a rigging crew on the trip to lower the boom horizontally for the passage under the bridge, and return it to the vertical position for the sea passage. The Heavy Lift Vessel's ballast pumps were used to adjust the trim as the position of the centre of gravity of the boom changed position during this operation.

Once the boom was raised to the vertical position after passing the Gateway Bridge a boom lift on the Heavy Lift Vessels deck was used to install temporary props connecting the boom back to the main Shiploader 3 structure.

Figure 3 - Shiploader 3 & Heavy Lift Vessel on Brisbane River

Loading the Shiploader took place within the impounded waters of a dry dock in Brisbane. The gates to the dry dock were in place ensuring that the height of the Heavy Lift Vessel deck could be maintained relative to the quay and the cargo. At Gladstone, the opposite situation applied. The Heavy Lift Vessel berthed alongside the new berth at R.G. Tanna Coal Terminal and prepared her cranes for lifting the massive structure. It was necessary to wait for the next rising tide, to raise the Heavy Lift Vessel sufficiently to achieve the necessary height relative to the height of the wharf and place the Shiploader on to its rails. The Shiploader was lifted and slewed out from the Heavy Lift Vessel's side; the operation was and had to be completed before the tide started to fall.

Shiploader structural modifications to facilitate handling

A number of modifications were made to the permanent Shiploader structure to allow it to be skated on land, loaded onto the Heavy Lift Vessel and to withstand the rigours of the ocean transit.

The assembly site in Brisbane had a set of piled concrete beams that were to form the "runway" to relocate the Shiploader from the assembly area to the edge of the dock. To allow the Shiploader to span between these beams, extensive modifications were required to the portal structural. These included extension to the main girders, increase in fabricated plate thickness and material grade. In addition to this a pair of stress bars were attached to the structure and tensioned to introduce a hog into the structure to provide additional capacity. Lifting lugs and substantial struts were added between the front and rear bogie rows. Without these struts the Shiploader would have “collapsed” when lifted.

As the Shiploader all up weight was close to the lifting capacity of the Heavy Lift Vessel cranes, it was necessary to weigh the completed machine. This activity was performed by the assembly crew using a number of hydraulic jacks and pressure transducers.

The rigging configuration, governed by the machine structure, necessitated the location of lifting lugs lower than the Centre of Gravity, an inherently unstable condition. During the weighing period the boom was raised to a number of different angles allowing the location of the Centre of Gravity at a known boom angle to be confirmed.

At the completion of Shiploader 3 assembly works it was skated into position on the edge of the dock with the aid of hydraulic jacks and lifted onto the deck of the Heavy Lift Ship by the on board cranes.

Interface between the Berth 4 and Shiploader construction programs

The program for the manufacture and delivery of Shiploader 3 needed to be integrated with that of Berth 4 Construction. It was John Holland’s responsibility to manage this complex interface even though the work was awarded as two separate contracts. The Berth 4 technical specification and contract milestones defined the interface points and team workshops indentified a number of critical issues that needed to be addressed. These included available space to construct and store the tripper, location of Shiploader 3 to allow cranes to operate on wharf strongpoint’s, especially to allow the installation of the transfer bridge and co-ordination of electrical infrastructure to provide power to the new Shiploader. The location of the Shiploader also complicated access in a very busy area of the wharf. Significant co-ordination was required to ensure the Shiploader and Berth construction did not obstruct each other. The compressed time frame required the establishment of amenities for both the Shiploader construction and commissioning crew, which had the potential to block access to other Berth 4 works.

WHARF CONSTRUCTION

Equipment Mobilisation & Demobilisation

Conventional methodology required the assembly of the 280t capacity crawler crane on the end of the existing Berth. To avoid overstressing the existing wharf structure and avoid disruption to operations the 280t capacity crawler crane was fully assembled onshore and then loaded onto the Jack Up barge and towed out to the end of the existing Berth 3. Once in position, the barge was raised and the crane walked onto the Berth. At the completion of the wharf, the crane was then disassembled into smaller units and barged back to shore.

New access roads and hardstand to minimise disruption to plant

John Holland established a separate security controlled gate and access road to the RG Tanna Coal Terminal. This new entrance minimised the impact of both personnel and material movements on the other facility users. It was typical for five or six trucks to be sitting at the front gate at the start of each day ready for offloading.

Preassembly and load out facility

John Holland developed a preassembly and load out facility at the Berth 4 construction site. This facilitated the preassembly of a number of structures reducing the amount of work over water. It also housed a painting facility for minor repairs to structures delivered to the site. Limited storage areas meant this facility had to be operated efficiently.

Works included the final assembly of the Berth piles. Piling tube was delivered to site in standard lengths and welded together to form pile casings of specified length. The site team developed a series of rails and trolleys, on two dedicated piling beds, to allow the submerged-arc welding equipment to be moved efficiently between each of the two welds required to complete the assembly of the piles into their final 40m lengths.

The preassembly and load out facility was also used to facilitate construction and installation of the Shiploader 3 Tripper. The Tripper was preassembled at the facility, test lifted to confirm its weight before being dismantled and transported to the load out jetty. At the jetty a barge mounted crane loaded the Tripper components onto a barge which was towed to the Shiploader where its assembly was completed. The final lift into position was undertaken at night to take advantage of the near still wind conditions and the high tide required to place the tripper into location.

Other preassembly works undertaken included the construction and full fitout of conveyor modules and splicing of Berth 4 headstocks, pre-assembly of handrail and grating onto walkways and prepping of all precast deck units.

Development of Piling and Access Systems

During the tender period for the Berth 4 Contract extensive design works was undertaken to develop and value the "Temporary Works" systems required to ensure timely, safe and cost effective piling installation. Once the Contract was awarded the works program required that the design, detailing and fabrication of these systems be completed concurrently. An aggressive target of 12 weeks to driving of the first pile was proposed and subsequently achieved.

Three major piling and access systems were developed for Berth 2 & 3 Widening, Berth 4 Construction and the Approach Jetty Construction. Each of these three systems used a substantially different construction concept.

When developing each of these systems a key consideration was human movement and access was incorporated to allow tradesman to complete welding and cutting activities safely over water. Fabricated walkways were developed to allow access between structures and to keep scaffolding to a minimum.

The **Berth 2 & 3 Widening System** utilised a cantilevered piling support frame that was serviced by a Barge Mounted 200 tonne capacity crawler crane. The support frame was mounted on load skates and launched forward using an onboard winch system.

Following the completion of piling and headstocks using this system an 80 tonne capacity crawler crane was placed onto the structure to complete the installation of precast deck units, adjacent conveyor structure and service infrastructure.

The **Berth 4 System** utilised a cantilevered piling support frame structure that included an onboard 280 tonne capacity crawler crane. A crane of this capacity was necessary to handle the required 14t piling hammer and the four row pile configuration of the new Berth.

The third system consisted of a piling frame mounted on a Jack-up Barge used in conjunction with a 200t capacity crawler crane located on the barge deck. This system was developed to construct the **Approach Jetty** and the isolated mooring dolphins located at the end of the Berth 4 structure.

Dolphin Construction

The Berth 4 structure incorporates ten (10) dolphin structures consisting of 7 piles, a welded headstock and $120m^3$ of concrete. Eight (8) of these were located enclosed within the Berth 4 structure with a further two isolated at the end of the Berth. A piling gate system was developed to allow piling of the enclosed dolphins using the Berth 4 system 280t capacity crawler crane. The Approach Jetty piling system was modified to allow the Jack-up Barge to complete the two (2) mooring dolphins that were independent or 'isolated' structures at the end of the new Berth.

A reusable fabricated steel formwork system was developed to allow the placement of the $120m^3$ of concrete required for each of the ten (10) dolphins within the tidal zone. A mechanism to allow the soffit to drop down for removal was also incorporated. Timing of the installation of reinforcement, wash down and placement of concrete was governed by the timing and height of the tide. At high tide the access platforms and soffit formwork were usually underwater.

Transfer Tower Construction

The largest of the two transfer towers constructed was at the interface of the approach jetty and the widening of Berths 2 and 3. Works on this structure commenced prior to completion of the roadway from either direction.

A tower crane which had the capacity to lift loads from trucks parked on the existing wharf roadway was employed to service this area. CQPA initially insisted that truck movements were too disruptive to operations and all materials were to be transported to the work front via barges. CQPA subsequently approved truck unloading from the wharf roadway after a number of risk assessments, workshops with operations personnel and the implementation of a traffic management plan.

The transfer tower housed a sample plant used to determine the characteristics of the exported coal. The presence of large amounts of fine coal dust in the area implied the possibility of an explosion. To minimise this risk, the area was classified as a hazardous area. The electrical design, installation and equipment had to then comply with very rigorous Australian Standards. The installation was then audited by a third party to ensure compliance with Standards and statutory requirements.

Figure 4 - Shiploader 3 on the end of Berth 3, Berth 4 Works Underway

Survey and Set Out

Survey and set out on a steel framed wharf presented a unique problem in that it is in a constant state of motion, be it thermal expansion or Shiploader vibration. The exiting berths had a total length of 1,000m and the construction of Berth 4 added a further 400m to this structure. Depending upon atmospheric conditions the linear expansion of this structure varied from 10 – 300mm. In addition to thermal affects, the operation of the Shiploaders and activities of construction plan induced not only vibration but regularly produced a temporary bend into the permanent structure of up to 25mm.

The design required that piles, Shiploader rails and conveyor centrelines were located to tolerances that were fractions of the movements experienced necessitating constant monitoring and adjustment by the site survey teams.

SHUTDOWNS AND COMMISSIONING

John Holland's scope of work included a number of shutdowns to upgrade or tie into existing processes and equipment. The most complex of these was the upgrade of the two existing Shiploaders, undertaken during two planned 14 day outages a month apart. During these periods both the Boom Conveyor and Tripper Conveyor drives were replaced to enable the machines to operate at 6,000tph, up from the original 4,000tph. These works, in conjunction with other structural, mechanical and electrical upgrades were planned and monitored to the hour and were undertaken around the clock to ensure the downtime was minimised. Dry Commissioning (running belts without coal) of the installed equipment was undertaken by John Holland.

The outloading stream project required two stages of commissioning: Stage 1 required the shiploader and the outloading conveyors to be operational with temporary head and tail locations, and Stage 2 required the extension of the on shore conveyor CC5B to its full length and the berth conveyor CC6B to the end of Berth 4 with all equipment in the final location. Stage 1 allowed CQPA to outload using Shiploader 3 on Berths 2 and 3. This shakedown period was essential in fine tuning the operation of the outloading stream while construction continued on berth 4. Stage 2 saw the completion of the works.

A commissioning team was established made up of members of the CQPA operations, designers and the John Holland construction crew. The overall commissioning manager was a CQPA representative; however John Holland engineers were responsible for the completion and commissioning of the Shiploader and Berth, the most complex process in the Terminal.

The transition from Stage 1 to Stage 2 involved the relocation of tail and head equipment and restitution of the temporary locations. All of this had to be done during a shutdown and required detailed coordination between structural, mechanical, electrical and control system crews, all of which required access to the same locations. John Holland were able to convince CQPA to allow the installation of spare drives in the final location to shorten the shutdown period and to allow pre-commissioning of electrical and mechanical components ahead of the shutdown.

The shutdown was preceded by a week of unseasonal cold, wet and windy weather. John Holland was able to reschedule tasks around the weather at short notice to meet the shutdown dates. The operational requirements of the port also impacted on the shutdown date and required programming flexibility where shipping dates determined the shutdown window.

John Holland worked closely with CQPA and the control system contractor to minimise the risk of unforeseen delays. Lessons learnt on previously installed equipment were applied and open communications between the commissioning team, electricians, mechanical fitters and control system specialists allowed equipment to be progressively commissioned in parallel with construction activities.

CONCLUSION

All of these issues and requirements acting together presented John Holland with a truly complex task involving a large number of resources and requiring a dedicated team to ensure a successful project delivery. John Holland has met this challenge, as evidenced by the project outcomes that follow.

Figure 5 - Completed Berth 4 and Associated Works

KEYWORDS

ACAA, CQPA, Central Queensland Ports Authority, John Holland Pty Ltd, Berth 4, Shiploader 3, RG Tanna Coal Terminal, Wharf

REFERENCES

RG Tanna Coal Terminal, Shiploader 3 Contract Scope of Work & Technical Specification; CQPA & HMIDE

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