APB Marine Limited

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Our ref: BL/ SW/SE 012

Understanding of the Requirement

- At what point would the Caissons and infrastructure become uneconomical to repair.
- APB Marine's opinion as to the life of the Lock and lock gates if repairs are carried out.
- We will also address the likely cost of commissioning a new lock complete in its entirety?
- APB Marine will provide similar comments in relation to the repair / renewal of operating equipment over a 10-year period?
- APB Marine will comment on maintenance issues that have been flagged up during previous inspections.
- APB Marine will estimate as to the likely cost of the repairs and when we consider they will have to be carried out?
- APB Marine will comment on the locks operating in an area of special environmental concern.
- APB Marine will comment on what this means on a practical level for the facility, and the likely increase in costs to them?
- Independent report on the capitalisation cost and operating costs for the four (4) caissons and infrastructure going forward from 2021 onwards.
- It should be noted that we do not comment on the road bridge between.

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Introduction

APB Marine Limited - a specialist Marine Consultancy offering services to the Maritime Industry globally. APB Marine creates specific approaches that are tailored to our Clients' requirements.

"Our skill is in selecting and applying the right approach to each project. Owners can either miss opportunities or get caught up in too low a level of detail. Our approach to project management is based on a real understanding of shipbuilding and Clients' needs and can therefore cut costs considerably".

Specialising in:-.

- Ocean Towage Terminal Towage and Harbour Towage
- Naval Architecture
- Civil Construction Projects
- Salvage – Wet & Dry
- Ports & Docks – Assessment of Services
- International Ship & Yacht Building
- Marine Engineering & Ship Systems
- Renewable Energies Off Shore
- Dispute Resolution

Offering:-

- Project Management of new Vessels, from specification to delivery.
- Project Management including specifications and preparation for Dry-docking and damage repairs, to overseeing projects to ensure our clients receive real value for money.
- Project management from and reclamation to harbour and quay constructions
- We offer a flexible service from technical assistance on a day-to-day basis, to full time on-site supervision under our project management tariff. We are experienced in managing complex and difficult projects and are fully conversant with ISM, ISPS & Regulatory Authority compliance of (MCA) and other Designated Authorities.

Instruction From

This is to certify that the undersigned did at the request of Phil Taylor, Kent Wire, Chatham Docks, Chatham, request to carry out a report, to establish the approach and coverage on 'Capital Expenditure and Operational Expenditure' and any other relevant points which need to be considered with respect to the technical aspect of benchmarking both operational costs and capitalisation cost in the past and going forward without prejudice to liability, on Thursday 11th February 2021.

History

Chatham Docks was constructed in 1871 for use by the Royal Navy, Chatham Docks became available for commercial use in 1984 through a 999-year lease signed by the Secretary of State for Defence and Medway Chatham Dock Company. The site is owned by Peel Property Limited who acquired Chatham Docks in September 2006. The day-to-day operation of Chatham Docks is controlled by Peel Ports, while the ownership of the land is controlled by Peel L&P. It is understood that the owner of the port wishes to build a residential development on the site. The Medway Plan 2003 Policy ED1 through to ED9 states that any development of the land that results in the loss of the existing industry that is presently in place is not permitted.

Peel Holdings have indicated that the cost of refurbishing the Four Lock Gates is 30 million pounds and consider continuing with Chatham Docks as a commercial port hub in the South East of England not to be cost effective.

The current caissons were replaced by the Navy in the middle of 1960's.

The Four Lock Gates were refurnished in 2011 at a cost of 6 million pounds. The refurbishment is considered to be effective until the year 2027 when the port consider they would require 30 million pounds to bring the lock gates into as new condition.

It should be noted that during the 2011 refurbishment of the Lock Gates no attention was made to the granite sills. The granite sills have been noted to have been worn, dished and chipped.

Each caisson has a covered wooden roadway designed for transport traffic around the dock complex. It should be noted that from the Port Plan there is a connecting caisson/roadway between the east and the west dock.

The North Locks are used mostly for marine traffic to enter and exit the port and the South Lock used only when required by Port Operations.

Limitations

The report is based on historical documentation and our experience of planned maintenance systems for locks and dry docks in the maritime industry. It should be noted that this is a desktop review.

Lock Operations

The Locks are made up of four (4) caissons that are pulled into / slotted into the central island between the North and the South Locks when floating i.e., ballast removed.

The caissons were built as floating objects and are registered as such. The caissons can be removed for vessel access approximately two and a half (2.5) hours either side of high water.

The caissons are ballasted and de-ballasted to ensure floatation to enable the keel to clear the granite seals and through electric/hydraulic chain system are pulled into a recess chamber in the island between the North and South locks.

The North and South locks are able to be opened and utilized at the same time.

Due to perceived lack of maintenance, from the supplied report of 2011 attached, to the lock system, the North Locks are primarily used to the detriment of the South Lock being maintained to the required standard. (The more they are used the better they will operate without fault, as problems are found and rectified when required).

Technical Overview

The caissons built in the mid-1960's have a lower air chamber, a tidal ballast chamber and a dummy ballast tank. On the deck of the caisson there is a timber deck attached to the steel plate deck, internal access is via manholes into the varying chambers of the caisson.

The caisson has three (3) chambers:

- Lower air chamber
- Mid tidal chamber
- Dummy tank

The keel has timber seals in either green heart wood or purple heart wood and these are attached to the caissons to make a seal with the granite sills.

This arrangement seals the water into the lock and Chatham Dock during the period around low water when vessels cannot enter the dock.

The mechanical and electrical systems are housed locally on the island between the north and the south docks. It is our understanding that the granite seals are in poor condition due to erosion and dishing noted in the report of 2011 and will, at some period, after 2027 need to be addressed and made good. We will comment on our estimated cost to make good the granite seals later in this report.

We have not considered the road bridge between the West and East Dock, nor have we considered the condition of the quay walls around the said dock system.

The caissons are ballasted down to make a seal with the sill and when required de-ballasted to draw the caisson into the recess in the island between the North and South Locks. This subsequently allows the Locks to be operated approximately three (3) hours either side of tidal high-water Chatham.

Due to the reduction of maintenance which APB Marine Limited consider is no longer sufficient from Owners, the North Locks are predominantly used for vessel locking into the port. Hence the silting and maintenance of the South Locks would be key to any refurbishing of the Lock to enable the North Lock still to be used.

During this phase of upgrade only one set of Locks could be used.

From the required use of the locks system, we consider that only one set of locks is required to service the port and if made efficient would be suitable.

Thus, to refurbish a set of Locks the overall CAPEX cost would be greatly reduced and the OPEX costs going forward would also be reduced.

Caisson Life Cycle

The caisson life cycle is dependent on the OPEX (Operating Expenditure) costs.

The analogy we would give is that of a broom! If the broom is maintained so when the head wears out it in changed/required maintenance. When the handle wears out this too is changed/required maintenance, the broom can last indefinitely.

The same applied to the Lock system. The longevity of the lock system is entirely dependent on the un-planned maintenance, planned maintenance, and refurbishing schedules carried out as and when required and the owners to ensure budgetary finance is in place to cover these maintenances.

If well maintained, internally and externally, the caisson can have a lifecycle of many years, verging on indefinite life span as analysed above. The inspection periods of the caisson should be at five (5) year cycles and at each cycle, ultrasonic thickness measurements (UTM) should be taken and when the average diminution thickness reaches twenty-five (25) percent plate replacement should be considered. It is our understanding that during the inspection in 2011 the caissons were found to be in good order and be able without any major steel replacement until 2027.

The extent and cost of steel replacement is dependant on areas of thickness deemed above the twenty-five (25) percent diminution. We would recommend that if steel replacement is required the caissons could be removed for repair at a steel repairing facility.

The refurbishment of the granite seals would not have a lifecycle term, but we would expect these to last many years based on the granite hardness and stone porosity used.

To affect a full repair of the granite seals the dock area would be required to be shuttered to affect a cofferdam to allow access to granite seals. We will, in this report, comment on the estimated cost to carry this out.

The maintenance of the locks must incorporate the mechanical electrical and hydraulic systems to enable the locks to operate smoothly.

This work can be carried out at any time between the five and ten (5-10) years refit and refurbishing cycles.

The OPEX costs are dependent on a maintenance system that is planned to ensure that failure of equipment is through its end of lifecycle and not through failure.

We would suggest an annual cost of £50,000.00 for maintaining the lock infrastructure between the five and ten (5-10) years refit and refurbishing cycles, reducing once the systems are in good condition.

Specific points as to the lock system

- *At what point would the Caissons and infrastructure become uneconomical to repair.*

  The caissons are built of steel and as such require to be maintained both internally and externally with corrosion protective coatings (paint). The caissons steel should be checked for thickness (UTM) and the steel replaced when the diminution reached twenty-five percent (25%) loss of steel due to corrosion.

  The caissons become uneconomic for repair once the cost of bringing the caissons back to the required standard, (as should be outlined in the owner's procedures and operating criteria), comes close to the cost of build a new caisson.

  We estimate this cost to be £2.2 million for each caisson.

  It has been noted that the Port Owners have decided to limit the maintenance of the lock system and have a maintenance programme to keep the locks operating, primarily the North Lock until the lease runs out in 2025.

  From the report in 2011 it was noted that the maintenance to the Lock system was not longer sufficient and this has, in our opinion, remained the case.

  For required budgetary costs required a full assessment would need to be carried out as soon as is practical before 2025.

  It would be necessary to carry out a full survey of the lock system and assess what would need to be corrected in a three (3) tier system:

  1. Critical Item

- Those items that are required to be done immediately to ensure the lock can maintain their requirement to keep water into the port and to maintain the ability for the vessels to enter and leave the Port at required times.
- It should be noted access to the Port is approximately three (3) hours either side of High Water.
- Steel work on the caissons would require the locks to be closed if the caissons require significant steel replacement.

2. Items that can the carried out over a planned maintenance cycle that require significant refurbishment over the planned maintenance cycle. (This we consider to be over a five (5) year period).

3. Item that the lock system would benefit to be fitted and changed to make the lock system more efficient and more economical to run.

- *APB Marine Limited's opinion as to the life of the Lock and Lock Gates if repairs are carried out.*

With a good, planned maintenance system overseeing the condition of the Lock System the locks have an indeterminable age.

That said the Owners have decided to let the maintenance required to keep the locks to a high standard for continuous operation going forward lapse. They have decided to let the Lock maintenance be carried out to a minimum to continue to be operable until the previous life expectant overhauls/refit expires in 2027.

If maintenance requirement had been carried out continuously to a high standard through schedule refit periods (i.e., every five (5) years) and during the periods between the five (5) year schedules proper planned maintenance and equipment upgrades had been carried out the lock system would have had an indeterminate age.

- *APB Marine Limited will provide similar comments in relation to the repair/renewal of operating equipment over a ten (10) year period?*

The required maintenance of a lock system is dependent on the thoroughness of the recommended inspections and surveys at each maintenance schedules. (For this we would recommend the inspection to be every five (5) years (mid-term inspection) and ten (10) years (full term inspection).

The inspection, five (5) year, would be in the form of Ultrasonic Thickness Measurement (UTM) of the caissons steel works.

Diver's report of the sill condition, caisson keel and hard wood timber seals.

Assessment of the report and a plan to rectify and required defects that could interrupt the operation of the locks.

From this a planned maintenance system is complied to have defects repaired or equipment replaced as and when the Lock Operations determine that repairs can be carried out.

We would suggest refit schedules can be in two (2) parts.

- Major survey inspection where the caisson is potentially removed to plate renewal at the major refit period recommended at ten (10) years. (Dependent on the inspection report).

- Interim refit inspection carried out at five (5) year intervals. Please note the UTM readings can be taken internally.

- Items and equipment accessible for the locks to operate without down time can be itemised within the five (5) year planned maintenance programme can repaired, replaced and upgraded as required itemised from the full system survey which we would recommend is carried out to establish the present condition of the lock system.

  From the report from 2011 the following was noted as requiring attention and as such the items listed below are expected, if the systems are used, are likely to have deteriorated.

  - Replacement of the skid plate
  - Replacement of the caisson keel plate per caisson
  - Replacement of the seals to each caisson
  - Structural steel replacement and repairs to each caisson
  - Upgrade to the electrical operational systems
  - Upgrade to the hydraulic systems
  - Extensive overhaul to the machinery and equipment working towards a full upgrade
  - Replace the chain pully system working towards a steel wire replacement system

- *APB Marine Limited will comment on maintenance issues that have been flagged up during previous inspections.*

  The last known inspection of the Lock System was carried out in 2011 with the following defects noted:

  - The granite sills are worn, dished, chipped and require flattening. This can only be done during a fully planned refurbishing programme with the caissons removed.
  - The timber sills have been worn away and require replacement.
  - The metal keel on the bottom of the caisson has been worn away and needs to be replaced.
  - Structural repairs are required internally and externally (steel replacement).

  The above can only be carried out during a full refit and would require the lock (North or South) to be cofferdamed to allow access to the granite sills for repair and would enable the caisson to be removed to a repair facility.

  - Mechanical equipment has and is continuing to deteriorate.
  - The hydraulic system is in a poor state of repair.

- The electrical systems are in a poor state of repair.

The above can be rectified during a required standard planned maintenance program.

It should be noted that for a planned maintenance system to be effective the proper financial package would need to in in place. For example, an annual budget (£50,000.00) for the repairs would need to be in place along with a refit budget per five (5) years and a full refit budget at each ten (10) years period to cover caisson steel replacement. It should be noted that cofferdaming will only be required for sill repairs.

The planned maintenance should be concentrated on the known required repairs.

- Make good the granite sills.
- Make good the lock vertical sealing arrangement.
- Replacement of the skid plate.
- Replacement of the caisson keel plate per caisson.
- Replacement of the sills to each caisson.
- Structural steel replacement and repairs to each caisson.
- Caisson corrosion protective system (paint).
- Upgrade to the electrical operational systems.
- Upgrade to the hydraulic systems.
- Extensive overhaul to the machinery and equipment working towards a full upgrade.
- Replace the chain pully system working towards a steel wire replacement system.

- *APB Marine Limited will estimate as to the likely cost of the repairs and when we consider they will have to be carried out?*

The likely cost of repairs to keep the lock system operating beyond 2015 are as follows:

- Carry out in 2021 a full inspection/condition survey to quantify the actual condition of the lock system at present to include all items.
- Likely cost £30,000.00.

- From the supplied report of 2011
  - Budget for the Critical Item
    - Those items that are required to be done immediately to ensure the Lock can maintain their requirement to keep water into the Port and to maintain the ability for the vessels to enter and leave the Port at required times.
    - It should be noted access to the Port is approximately two and a half (2.5) hours either side of High Water.
    - Steel work on the caissons will require the Locks to be closed if the caissons require significant steel replacement.
    - Budget for the critical items £2,000,000,00.
  - Budget for the required repair over the five (5) year planned maintenance schedule.

- Items that can be carried out over a planned maintenance cycle that require significant refurbishment over the planned maintenance cycle (suggest five (5) year cycles).
- £1,500,000.00 over the next five (5) years to include.
- Electrical Works (repair and upgrades)
- Hydraulic Works (repair and upgrades)
- Ongoing maintenance burden

- Budget for item that the lock system would benefit to be fitted and changed to make the lock system more efficient and more economical to run.

- System engineering upgrades

  - £500,000.00 over the next ten (10) years

- We have estimated the costs to initially make good the locks for continuing use going forward past 2025 from the items outlined below.

  - Full survey of the lock system
  - Replacement of the skid plate
  - Replacement of the caisson keel plate per caisson
  - Replacement of the sills to each caisson
  - Structural steel replacement and repairs to each caisson
  - Upgrade to the electrical operational systems
  - Upgrade to the hydraulic systems
  - Extensive overhaul to the machinery and equipment working towards a full upgrade.
  - Replace the chain pully system working towards a steel wire replacement system.
  - We estimate this to be £5,000,000.00.

It should be noted that the actual required costs are dependant on the report as to the diminution condition of the caisson steel replacement requirement.

For example, the refurbishment costs of the caisson against the cost of full replacement to include the design costs at £60,000.00.

- *APB Marine Limited will comment on the Locks operating in an area of special environmental concern.*

  - The port of Medway is close to areas of special environmental importance.
  - Medway Estuary has a history of industry and commerce dating back to the Industrial Revolution. In recent years, many efforts have helped to protect the estuary in the form of Marine Protected Areas (MPAs), conserving rare species and habitats with international importance.

- The locks also ensure the pollution if spilled into the dock area does not impact on the conservation of rare species and habitats with international importance within the River Medway MPAs.
- The locks also form a barrier to resist tidal flooding of the immediate area around the port complex.
- To ensure the port surrounding area is protected the locks should be in reasonable condition as is the Thames Barrier that protects the low-lying areas of London is and/or when a tidal surge happens in the river Medway.

- *APB Marine Limited will comment on what this means on a practical level for the facility, and the likely increase in costs to them?*

  - Flooding of the port surrounding area will potentially have a great impact on the commercial and economic businesses in this area and the potential recovery costs to businesses would likely far exceed the full lock replacement cost indicated by Peel L&P at £30,000,000.00.

- *We will also address the likely cost of commissioning a new lock complete in its entirety.*

  - APB Marine Limited have looked at an estimated cost of replacing the complete lock system and have, to enable the port to continue to operate, split the work into North Locks and South Locks.
  - APB Marine Limited consider this to be as follows for the South Dock and the North Dock:

Design of a new caisson lock system		£60,000.00
Cofferdam the South Dock		£150,000.00
Cofferdam for the North Dock		£150,000.00
Refurbish the granite sills South Dock		£100,000.00
Refurbish the granite sills North Dock		£100,000.00
Remove and float away the two (2) caissons	South Dock	£60,000.00
Remove and float away the two (2) caissons	North Dock	£60,000.00
Build two new caissons South Dock		£4,500,000.00
Build two new caissons South Dock		£4,500,000.00
Operational systems for the locks (Electrical & Hydraulic)		£400,000.00
Dredging and tug requirement as applicable		£1,000,000.00
Total estimated cost for as full system		**£11.080,000.00**

- APB Marine Limited would suggest a contingency of 10% be in the final budgeted total.
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Total budgetary estimated cost for as full system **£12,188,000.00**

- It should be noted that the estimation from Peel L&P, the Owners, have put an estimated cost of £30,000,000.00 for the above work and we fell this to be excessive.
- *Capitalisation costs (CAPEX) and operating costs (OPEX) for the four (4) caissons and infrastructure going forward from 2021 and from 2025 onwards.*

CAPEX

Year 2021	Full survey and inspection of the locks system in its entirety to establish the actual required works going forward.
From the report	Prepare the schedule from 2025 onward as to an agreed requirement
2025	From the UTM diminution of the caisson steel the caisson repairs could be capitalised between minor caisson repairs of £100,000.00 per caisson upward to requiring a new caisson at £2,400,000.00. The granite sills could be repaired rather than the sill being renewed with modern composite materials estimated at £100,000.00 per sill. Either way this would require the lock North or South to be out of commission to have a cofferdam constructed to carry out any repairs to the sills at £150,000.00 per Lock System.

OPEX

2025	The OPEX costs we would estimate at between £50,000.00 per annum to run the present system, to £100,000.00 to upgrade the systems over a ten (10) year planned maintenance system.

Conclusion

It is clear that owners have not funded the maintenance of the lock system adequately and the operating mechanisms i.e. mechanical and electrical equipment is in poor repair.

The lock operating infrastructure is relatively inexpensive against the replacement cost of the caissons and as such we would consider a phased approach to bringing the locks back to a satisfactory condition to be the way forward.

Survey of the lock maintenance requirement for the next 10 years inspection cycle
Phase 1 South Lock sills repair

Phase 2 North Lock sills repair

APB Marine Ltd consider that the caissons are likely to be of a condition to be suitable for further use with potentially minor steel works as no major works appeared to be required as noted from the report of 2011. It should be noted the steel quality in the sixties was of a high quality and as such we do not expect the caissons will require too much steel replacement.

A UTM inspection of the caissons would be required to confirm this but as there is no record of the caissons leaking water internally, thus we feel the steel is at present relatively sound.

The steel replacement if required would be in the ballasting spaces and provided the coating remained intact the corrosion should be of a minimum.

The corrosion of the void spaces, (not ballasting voids), should, we feel be of a minimum as this type of caisson corrode from the ballast voids internal spaces outwards.

The major maintenance is to ensure the lock is able to seal. The caisson must seal against the sill and vertical pillars to be effective.

The green and purple heart wood seals are costly and could be replaced with a more cost-effective product.

From our knowledge of this type of lock, we feel the sills are the areas which we would recommend the initial funds should be concentrated on. I.e., phase 2 and phase 2

Once the sills are sound and the caissons in an operable condition, the other items that enable the lock to operate successfully can be addressed going forward. We would also comment that road traffic over the locks should be stopped or at leased minimised as this contributed to the damage to the sills.

APB Marine Ltd consider that a financial input of £3,500,000.00 would be needed to re-establish the lock system to an acceptable level, pending continued financing of a maintenance system as noted in the recommended inspection to establish actual condition.

Once the lock sills are addressed the remaining works can be planned against the operational requirements of the port within the planned maintenance system.

APB Marine would question the need for a two (2), lock system against the port traffic noted, so we consider that how the funds are allocated to the maintenance can also be structured. Thus ensuring the lock system will have an increased reliability. Once the planned maintenance is in place this will effectively reduce the cost of required maintenance going forward as its easiry to repair than replace machinery and equipment.

For APB Marine Ltd

S W Evans
Principle Surveyor – APB Marine Limited
M.I.MarEST., I.I.M.S., S.C.M.S., MECAL., R.I.N.A

Dated 15th March 2021

Attached to this document:

- K2 Consultancy – Chatham Lock Caisson Refurbishment