

ashton bulk

materials handling



**WAGON TIPPLER
TRAIN UNLOADING SYSTEMS**

AN INTRODUCTION TO THE VARIABLES, PLANNING & KEY DECISIONS OF TRAIN UNLOADING

The selection of Train Unloading System equipment for port, power plant, metals processing facilities or other automated handling operations is always an important choice for what is a critical part of a plant. Any disruption or downtime to the unloading processes can be very costly in halting production processes, transportation or loading of ships. Availability, reliability and dual redundancy are critical.

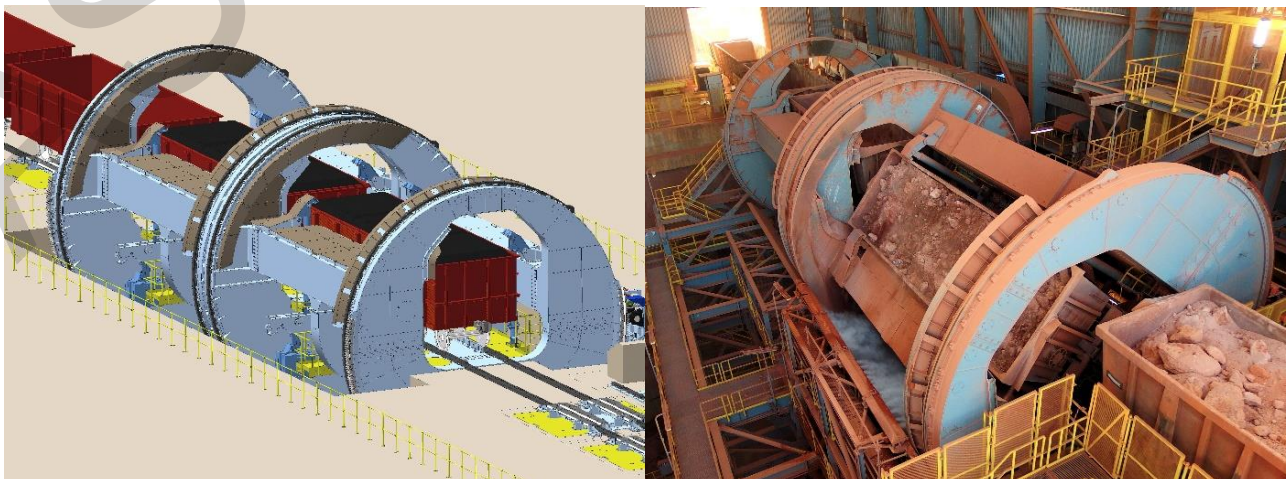
The design life of the equipment, particularly the fatigue life of Wagon Tippers which are subject to arduous stress reversals during unloading, is also vital because the replacement of these machines is costly and can interrupt production for several weeks in cases where operators do not have adequate redundancy or alternative means of unloading built into their facilities. Foresight and planning of the Train Unloading System is therefore as important, if not more important, than any other piece of plant in a port bulk system to ensure life, availability and to optimise installation and operating costs.

This has led to Ashton Bulk Ltd being a first point of contact when planning new systems, optimising current operations and maximising throughput in a consistent and reliable manner. Standardisation is not a word synonymous with train unloading due to the very high number of variables encountered such as wagon size variation, locomotive size and routing, track locations and geological factors which can escalate the costs of civil works. Therefore, each and every aspect of the facility and client's requirements need to be addressed during, as close to, the feasibility stage of a project and, wherever possible, with direct interaction between designers and the key stake holders including the plant operational staff.

Three particular projects where important factors arose during the projects, and that had not been fully specified from the outset, have been undertaken by Ashton Bulk with our global supply partner, Tenova-Takraf GmbH of Leipzig and Lauchhammer, Germany.

CASE STUDY 1 - Compagnie des Bauxites de Guinée (CBG), Kamsar Expansion Project, Guinea, West Africa

CBG have operated two Strachan & Henshaw Ltd Tippers since the 1970's aided by Ashton Bulk in recent years. When a significant upgrade was required to their operations Ashton Bulk and Tenova-Takraf were selected as the preferred designers and supplier. Throughput of up to 25 million tonnes per annum were required utilising a Twin Tippler Unit Train Unloading System. A system with a life requirement of over 4 million operating cycles has been supplied with the backup offered by the Twin Tippler arrangement and spare capacity provided within the Positioner drive system. Particular challenges arose from the port operator requiring the system to handle new rotary coupled rolling stock as well as the existing wagon fleet that was not originally designed for a unit train rotary coupled installation. Ashton Bulk, CBG, Tenova-Takraf, the Fluor Corporation and Systra-Canarail engaged to address the developments and the changes to the system design and operational requirements were implemented by Ashton Bulk. These alterations were possible because the modular manner in which Ashton Bulk design Train Unloading Systems and several decades of our experience adapting to client's evolving requirements. Ultimately the system operated at and above the original throughput requirements. The plant will now be able to function flexibly, handling both old and new rolling stock within the same train.



TWIN SINGLE CAGE TIPPLER ARRANGEMENT AT CBG KAMSAR, GUINEA

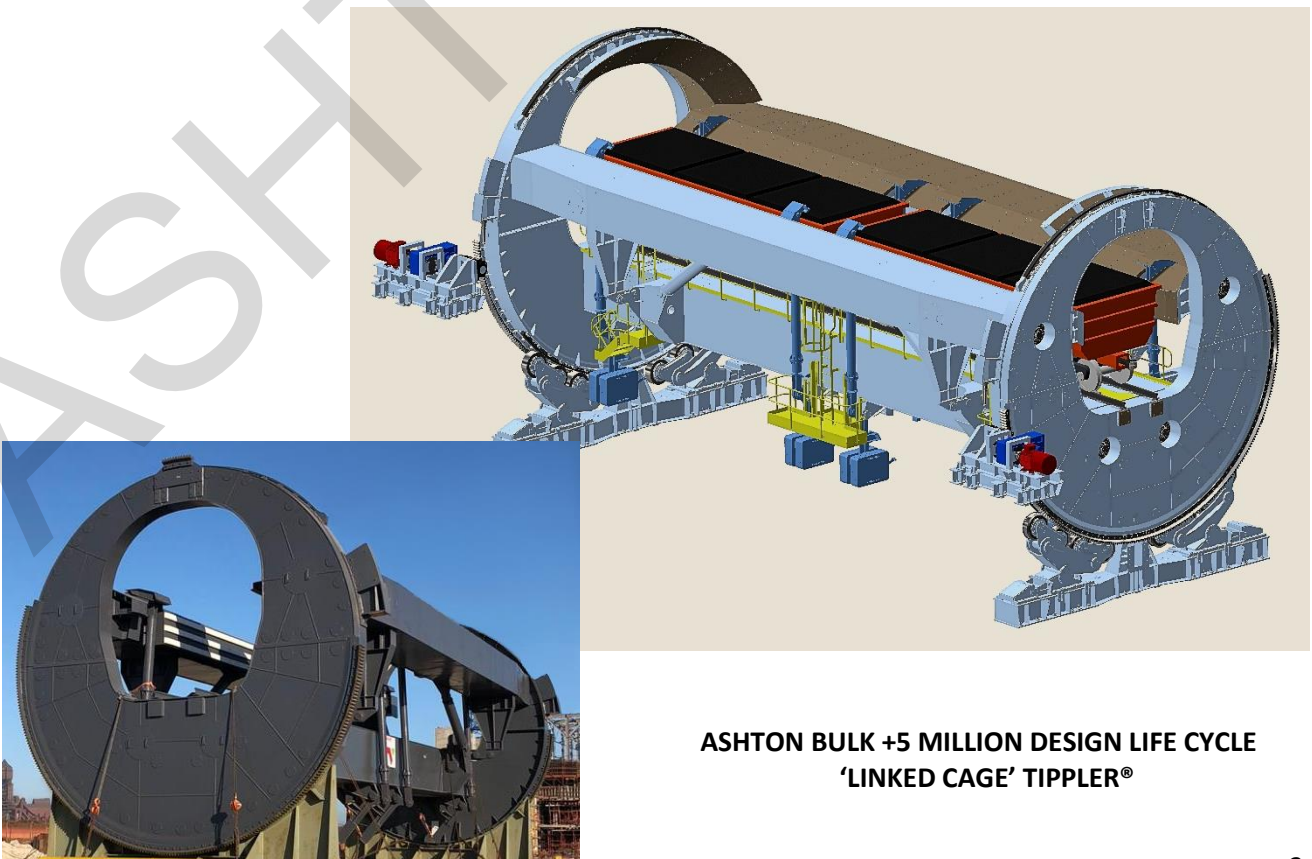
CASE STUDY 2 - Transnet Group Capital, Saldanha Bay Phase 3, South Africa

Transnet's Saldanha Bay port facility in the Western Cape is a long term operator of Unit Train Unloading Systems. Ashton Bulk engineers were involved in the supply of the original Wagon Tippler in 1975 by Strachan & Henshaw. At the time a significant upgrade to their facilities was required in 2016, Ashton Bulk and Tenova-Takraf were selected as the preferred designers and suppliers. Based on the experience of the port operational staff in maintaining and operating the existing equipment, Ashton Bulk's flexible approach and modular designs were able to incorporate engineering features into the system that met our client's stringent requirements. First and foremost in the engineering challenges was to design the equipment in accordance with the latest international design code of practice, EN 13001 – General Principles for Crane Design, the most applicable standard in the absence of dedicated codes of practice for train unloading equipment.

The brief included supplying equipment to achieve in excess of 4 million design life cycles. Following experiences of shortfalls in their existing plant meeting these conditions, Transnet engaged Logan Engineering Consulting (LEC) Pty Ltd of Brisbane Australia to audit the design of all Ashton Bulk engineered equipment. This integrated process led to the development of a new industry leading design of Tandem Tippler Cage structure incorporating a linked method of cage construction.

Although "Pin Jointed" machines have been developed in the past by Strachan & Henshaw (UK) Ltd with the intention of reducing points of stress concentration and structural fatigue cracking in large Tippler Cage structures, the designs of the time only partially achieved these objectives with structural repair required prior to the design life being achieved. The Chartered Engineers engaged in the design and audit of the Ashton Bulk Tandem 'Linked Cage' Tippler® confirmed a minimum design life for the new Saldanha Phase 3 Tippler at 4.8 million design life cycles. Subsequent design enhancements predict a life for future projects exceeding 5 million cycles. This type of machine will be the basis of all tandem rotary type tipplers offered by Ashton Bulk and Tenova-Takraf for port and other types of installation in the future because rigid cage designs and the historic type of pin jointed cage designs, when utilised for large, high duty Tippler applications, have proven not to achieve their operating cycle and design life predictions.

In addition to fundamental improvements in Tippler design principles, the Train Positioner also incorporates features that assist in preventing events such as overload of the machine due to unplanned train brake applications and, in the event these or similar inadvertent incidents do occur, the arrangement of the machines is such that major structural and mechanical parts remain intact with only replacement of secondary equipment being required, thus reducing potential downtime and minimising aftermarket costs.



**ASHTON BULK +5 MILLION DESIGN LIFE CYCLE
'LINKED CAGE' TIPPLER®**

CASE STUDY 3 - Electricity Supply Commission (ESKOM), Majuba Power Station, South Africa

The Unit Train Unloading System at ESKOM's Power Plant at Majuba has underperformed since its installation in the 1980s. The reason for the shortfall in throughput related primarily to the design of the Train Positioner. The wagons utilised at the plant rely on the Train Positioner pushing the train using the pushing pads located at each corner of the wagons. The existing Positioner relied on a bridge structure to straddle the train and engage on either side of the wagons. The flexible nature of the bridge placed too much load on one side of the train and the associated parts of the Positioner, resulting in localised overloads, part failures and a significant shortfall in equipment availability. These factors resulted in coal needing to be delivered to the plant by 700 road trucks per day to make up the shortfall.

Ashton Bulk, having worked with Demcotech, the consulting engineers commissioned to undertake a feasibility study for the upgrade project, were engaged with Tenova-Takraf to design and supply new Train Positioners and Train Holding equipment together undertaking an engineering audit of the existing Wagon Tippers.

With the advent and development of AC variable speed drives, Ashton Bulk, together with our partner company IAC (UK) Ltd, developed a drive system that permitted two Train Positioners to be used, one on each side of the main line track, for hauling the trains instead of the previous bridge system. The Positioners are fully synchronised to ensure equal load sharing to avoid any of the overloading experienced with the previous Train Positioner. This type of system is now a ready replacement for previously installed bridge type Train Positioners and installations that handle wagons with corner pushing capability.

At mid-point in the design engineering process, our client requested that physically differing wagons from the originally specified unit train type be handled by the system. Based on this request Ashton Bulk needed to revise the control system handling methodology and the manner in which the Positioners and Train Holding equipment physically engaged with the trains. These revisions were undertaken in accordance with strict time limits and the required handling rates and throughput of the system were maintained.



MAJUBA BRIDGE TYPE TRAIN POSITIONER REPLACED BY TWIN SYNCHRONISED POSITIONERS

Each of these three case studies highlights the importance of careful consideration of how a Train Unloading System fits into and complements a port infrastructure or other similar facilities and, wherever possible, the importance of consulting experienced engineers and designers in advance of finalising the equipment selection and costings. Equally important is maintaining the involvement of the engineers throughout all phases of the project through to commissioning and to ensure the initially selected system is as adaptable as possible in the event the client's requirements are altered mid project, which is very common in train unloading.

Well planned Train Unloading Systems are not only a science. They need to be based on proven experience and proven design principles due to the large number of inter-related variables that need to be understood. Such variables relate to the directly associated components of the train/wagons/locomotives and indirect, but equally important, factors relating to ground conditions and where/how the offloaded material is to be transported after unloading. When all of these factors are known and considered, the right selection of equipment can be made based on total costs including civil works and infrastructure, not only the costs of the Train Unloading equipment in isolation.

Other subjects that are often not considered at the project planning phase include:

- Whether the number of design life cycles specified equate the years of service life and the annual tonnage of throughput required. Service life of 20 to 25 years requires the number of stress cycles to be specified at no lower than 4 million and targeted at 5 million or more. Several other factors affect this calculation.
- Realistic requirements for standby and dual redundancy. Availability and reliability figures are often quoted in specifications in the high 90% band without reference to other relevant factors. For these levels to be reached, the port operator's policy for spare parts stock, operator capability and the skill and experience levels of maintenance staff need to be considered in parallel with availability and reliability but are usually not included in any detail at the early stages of planning. For instance, the spare parts holding needs to be high and include substantially pre-assembled units that permit rapid replacement to eliminate the time consuming dismantling of complex components in the field. The costs associated with this type of approach can be significant but necessary if 95% plus availability is the true requirement.
- Single line versus multi-line in respect of standby. The immediate mind set when faced with this question is to assume that two lines of equipment twice that of a single line. However, this is not generally the case if the systems are scoped to share hoppers, conveyors and common equipment and, engineering effort is not always double that of a single system. For instance, two single side by side lines, each comprising a Tippler, Positioner and Train Holding Devices, feeding into a common single wagon length hopper has many advantages over a system with only a single line comprising Twin Tipplers in series and utilising one Positioner and one set of Train Holding Devices (refer to Case Studies 1 and 3). Civil works for the dual line can also be less costly in certain circumstances. From an operational point of view, the dual line option working in unison can work at slower speeds incurring less wear and tear on the equipment and rolling stock when producing the same or better throughput. If one system has an unexpected failure, the other can be utilised without incumbrance whilst repairs are undertaken. Whilst the Twin Tipplers in series has apparent standby potential, i.e. one Tippler can operate whilst the other is repaired, in actuality it is difficult to repair one Tippler whilst the other continues to operate with this configuration, particularly when complying with modern health and safety working practices.
- Are the wagons new or existing? If existing, are they suitable for the intended future use.
- Does the locomotive need to pass through the Train Unloading System? Locomotives passing through the Tippler, particularly the larger types, require a cage diameter larger than those where locomotives can be omitted. Tipplers with smaller diameters require shallower civil works and associated costs are significantly lower.
- Are hydraulic systems essential? These systems come with particular skill requirements to ensure they continue to perform after commissioning and handover, skills that are not always available, particularly in remote locations. Environmental factors associated with leakage also affect selection of these systems.
- Is the equipment specified in the tender documents suitable for the application? Can the design life specified be achieved with the type of equipment specified? Can the type of equipment specified be engineered? There are many examples of large, high capacity machines being specified, such as 'C' type multi-wagon Tipplers, to operate in arduous and remote environments that have a limited prospect of providing a client with their expectations which can result in underperformance and early structural failure. If incompatible or fundamentally incorrect types of equipment are designated in enquiry specifications, it is often too late by the time a project or tendering process commences for technical re-appraisal with the implications realised only at a later date.

- The skills of the plant owners operating personnel. A easy solution to the potential lack of suitably trained personnel, or to ensure the system is largely fail-safe, is often to adopt a fully automated approach such as Unit Train systems. These incorporate rotary coupled wagons whereby the operators are not required to do more than initiate the first unloading cycle thereafter no attention is required until the complete train is unloaded. However, simply taking this approach can overlook the situation where unforeseen circumstances occur. Key skills and operator training are still required to fault find, repair and set the system back to work. The familiarity and skills gained by the operators working a manual or semi-automatic system can be more beneficial to ensuring that any system stoppages are rectified based on knowledge gained compared with an automatic system when the operators have not had the same level of regular interaction with the equipment.

In summary, the planning of any Train Unloading project without prior consultation and consideration of the above factors, and others, can lead to system inefficiencies, under performance and cost overruns. Maintaining a high level of expertise throughout the project is important in:

- Devising the system.
- Developing flexible, modular solutions to adapt to changing circumstances and client requirements throughout the project.
- Commissioning the plant in accordance with, or exceeding, the required performance.

Ashton Bulk Limited can provide the level of experience, expertise and know-how to overcome potential pitfalls associated with these types of bespoke systems and ensure clients are provided with the most suitable system and guarantee of performance from the project outset.

We operate as an independent engineering and design company specialising in the supply of fully engineered Train Unloading System designs to international suppliers of bulk materials handling equipment primarily including Tenova-Takraf GmbH on a worldwide basis and Larsen & Toubro in India. Equipment can also be provided directly by Ashton Bulk. We are available to work with project planners and directly with plant owners/operators on a consultancy basis to address individual needs.

Ashton Bulk and our full range of Train Unloading Systems suitable for port and other operations are available to view on our website at www.ashtonbulk.com.



J M Dudman

Managing Director – Ashton Bulk Ltd



ashton bulk
materials handling

