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Quay Crane Refurbishments in relation to Energy & Data Management Systems

In the recent years Conductix-Wampfler was part of many quay crane refurbishment jobs and sees this global trend as a chance for ports & terminals to increase the cranes' ability to serve larger vessels and additionally fulfil technical upgrades on the crane at the same time.

As a full line supplier for any electrification and data needs on quay cranes Conductix-Wampfler knows the key points for successful crane heightening or boom extension in terms of electrification and data management needs. In relation to the products manufactured from Conductix-Wampfler different technical hurdles have been observed that need proper technical analysis in order to make sure the products fulfil its service reliable for the next period of crane lifetime

Heightening

Crane heightening reflect a major challenge in structural aspects as well as the calculation of main hoist rope drum capacity and the necessary power needed to reach the box movement target of the quay crane with its additional height. For sure these are the major investments that need to be done when quay cranes are upgraded.

Very often both Power Cable Reel and Spreader Cable Reel are affected from such heightening jobs done on the crane due to higher portal beam, higher power requirement and of course higher boom. Fine calculation tools are used to review the installed system and its abilities and a new calculation on the reeling systems is started. Major background is the additional cable weight due to the height increase that needs to be considered for a proper torque to operate on the required speed and acceleration parameters. The gearbox abilities are crosschecked to make sure the ratio and output torque is sufficient for the increased height operation. These calculations go hand in hand for all reel types installed on the application and may result in no change at all, if the current system had enough margin. In other cases a spool change, motor change or gearbox change might be required. If it turns out that the motor power output is not sufficient to carry



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on operations on the required parameters a change of electric motor might require an inverter size increase as well.

When heightening the bottom beam, crane gantry travel length will be limited if the cable is not changed for the additional height. Alternatively, one can check and decrease the spare turns and dead turns on the reel. Nevertheless, if the terminal decides to equip a new cable and keep the existing spare turns, a review of spool capacity is the next step in the total review of the cable reel system. In case the spool capacity is not sufficient, its size would need to be adapted which may influence the gearbox-motor-inverter sizing.



Additionally, the age and condition of the cable reel system should be considered. While some terminals might have had low operating hours on the crane before the heightening others might have had high volumes over the years. If the reeling system is very old or has long working hours, it may make sense to upgrade it whatever the result of the system recalculation. These upgrades can be of different nature whether it is an update of the inverter and its software for smoother cable handling or a general preventive maintenance on

key components in the gearboxes or slip rings.

It should not be forgotten that a re-commissioning of both gantry cable reels as well as spreader cable reel is in all cases mandatory to ensure perfect cable handling. Fine tuning of reel parameters do increase cable lifetime significantly.

The target should always be that after the heightening job the cable reel system operates at least as long as the further predicted crane lifetime after the refurbishment.

Data Link

Secure connection to a data network is mandatory for modern cranes operations, and many terminals upgrade their cranes with a Fiber Optics link to the control tower: the main power cable is changed for a version with FO, and the Power Cable Reel is recalculated and upgraded. Using a compact, reliable accumulator Fiber-Optic Rotary Joint (often named TFO) is a critical success factor for these projects.

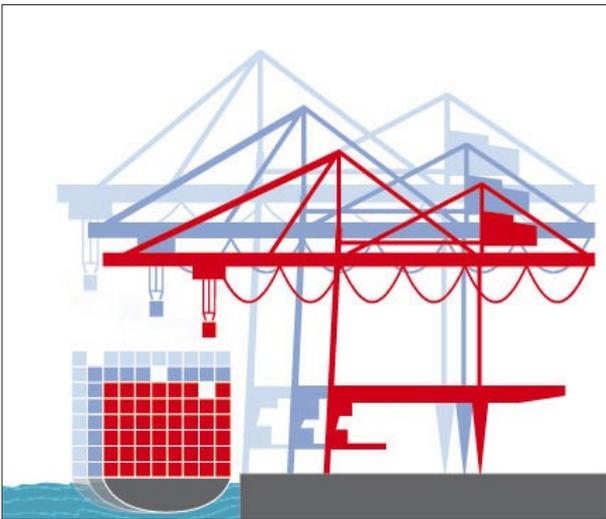
If the crane is upgraded to remote operation, the Fiber Optics option may be required for the Spreader Cable Reel, to connect the spreader on-board cameras.

In general a crane heightening project is a good opportunity to install secure reliable data links along all power transmission systems.



Boom Extension

Boom extensions are in a trend tending to the wider vessels and are usually done when these vessel classes should be able to call a terminal. Non-dependant on the technology used for the main trolley power supply the system needs to be reviewed in order to make sure it can carry the additional travel from different perspectives.



Festoon systems as the most mature technology are calculated from suppliers with a certain length addition of cables to avoid heavy cable snapping during operations. Once the travel length increases while the cable length remains the same the addition factor decreases. It is up to the supplier to decide whether it is still suitable from a real-life operational point of view considering speed and acceleration of the system. In most cases the festoon system has its “reserves” for anything less than 4m of additional travel which is an average boom extension figure.

A potential boom extension in relation with conductor rails is as well relatively easy to realize as an additional rail can be connected onto the end of the boom. As the last meters of the rail installation are anyway only a buffer zone a short addition of rails is already sufficient,

and no voltage drop or signal loss topics on the data rail need to be considered.

In perspective of cable chains, the average extension of 4m is already not that easy to realize. The position of the fixing point as well as the calculated reserve in the chain sections determines how much more travel is necessary. Further cables might need to be repulled which creates high workload for an extension of the travel length. Repositioning of the towing arm or fixed part most of the time fails related to the fixed cable installation on the crane. All in all, the technology needs likely the most difficult adaption compared to the other solutions.

Yet to increase the lifetime of the crane it might make sense to re-think the technology in general. While having the crane out of operation for a decent time for the heightening and/or boom extension there is sufficient time to exchange the technology if it is of interest of the terminal. A potential scenario might be to go onto the same technology as other existing machines in the terminal or the experience with another technology has been better. In this case a completely new system designed on the exact travel length will restart crane lifetime of the electrification and data management system which is from an OPEX view for sure interesting. While exchanging the main trolley power supply system with the same technology the workload increases when the technology is changed. The following matrix should give an indication on the different technology setups and their exchange efforts based on our experience on Ship-To-Shore cranes

	CRANE DOWNTIME	INVESTMENT	MECHANICAL WORKS	ELECTRICAL WORKS
CHAIN ► CHAIN	LOW	MEDIUM	LOW	LOW
CHAIN ► RAILS	MEDIUM	MEDIUM	LOW	MEDIUM
CHAIN ► FESTOON	MEDIUM	HIGH	HIGH	MEDIUM
FESTOON ► FESTOON	VERY LOW	MEDIUM	VERY LOW	VERY LOW
FESTOON ► RAILS	MEDIUM	LOW	MEDIUM	MEDIUM
FESTOON ► CHAINS	HIGH	HIGH	HIGH	MEDIUM

Summary:

Crane heightening and boom extensions require terminals to review and refurbish key components like cable reels or main trolley power supply. Crane age is always a key factor to define the scope of the refurbishment project. OPEX might increase significantly after the crane upgrade if key components are not reviewed during the upgrade process together with the suppliers.

Operational limitations may also be caused if the power and data link systems are not carefully considered during the improvement project e.g. limits of crane gantry length, speed and acceleration, spreader depth, speed and acceleration. The expected operational downtime of the crane can be used for small upgrades while a complete system change for sure needs to be considered in the complete project with a longer duration.