

## Ivara EXP Drives Implementation of RCM2 Analysis at Dofasco to Increase Asset Utilization Rate by 8%

*Dofasco is one of Canada's largest steel producers. Product lines include hot rolled, cold rolled, galvanized, Extragal™, Galvalume™ and tinplate flat rolled steels, as well as tubular products, laser-welded blanks and Zyplex™, a proprietary laminate. The company's Hamilton, ON, operations are among the most efficient and technologically advanced of any steel plant in North America. The TS16949 registered steelmaking complex encompasses multiple capital-intensive manufacturing facilities or business units, all of which are ISO 14001 registered.*

### The Situation

Dofasco's Central Shipping operation is located within its 730-acre Hamilton, Ontario complex. 85% of all production is stored and then shipped from the Central Shipping site which is comprised of ten one-acre facilities and handles over 2,200 coils of steel daily. The coils consist of in-process material and finished customer product.



Figure 1: Central Shipping Stacker Crane

Central Shipping is critical to Dofasco's success from both a customer service and an internal production perspective. Customers expect on-time delivery and four weeks of inventory to be available at all times. Dofasco's internal manufacturing divisions expect the storage of in-process material between manufacturing stages to ensure uninterrupted production.

The stacker crane is a critical asset that ensures operations at Central Shipping are continuous and uninterrupted. Unlike a traditional fixed cab crane, the operator of the stacker crane moves up and down the mast and along the bridge with the product. This style of crane allows for greater speed, control and accuracy when loading and unloading coils between racks and trucks. This strategic asset is in operation seven days a week, 24 hours a day at the Central Shipping facility.

With stacker crane utilization rates at 90%, Dofasco required a 6% increase to ensure that growing production and storage demands were met. Yet, higher volumes were resulting in a high incidence of stacker crane failures. In spite of ongoing crane upgrades, the failures persisted. Maintenance staff needed to better understand and address these failures to improve stacker crane reliability and meet Dofasco's crane utilization target of 96%.

### The Challenge

A failure of particular concern was a loss of crane control known as a "kickout". The stacker crane's digital radio system would occasionally register a loss of power, automatically causing the control mechanisms to fail, or kickout. For example, should a kickout occur the operator would quickly need to exercise a series of steps to regain control and slow down the bridge or trolley.

Maintenance, in investigating the cause of the kickout failure, believed that the radio was causing the problems and recommended a newer radio control system.

To eliminate the kickouts and build a technically sound maintenance program, a cross functional task force was formed to conduct an in-depth failure analysis. The objective was to support Dofasco's goal of achieving a 96% stacker crane utilization rate.

### The Solution

The Reliability-Centered Maintenance methodology from Aladon, RCM2, was selected to determine the root source of the failures and identify the maintenance program needed to improve the reliability of the stacker crane. With the potential for serious health and safety consequences associated with a stacker crane failure, RCM2 was seen as the right methodology since it would provide the most complete understanding of all known and unknown failure

modes. It would also serve as the foundation of a technically sound maintenance program.

The RCM2 analysis was conducted using teams of five to six subject matter experts comprised of maintenance, operations and engineering. The most problematic stacker crane was selected for the first analysis. Since eight of the ten stacker cranes in Central Shipping were very similar in design, the analysis results from one crane were to be templated to the other cranes. To conduct the process effectively, the crane system was broken into three manageable analysis sub-systems: the bridge, the trolley and the hoist. Since a loss of control during bridging was considered to have the greatest potential consequence, the bridge sub-system was analysed first.

In summary, the three RCM2 analyses revealed 71 distinct functions of the stacker crane, 95 functional failures and 632 failure modes, of which, over 500 had safety and operational consequences should they occur. The RCM2 analyses helped to confirm to Operations the need to upgrade the radio control system, but more importantly, the analysis identified a problem with the electrical feed to the radio.

A fixed angle iron collector assembly transfers electricity from the bridge of the crane to the hoist and to the carriage which traverses the bridge. Steel collector shoes pick up electricity from the angle iron and travel with the carriage, sliding along the feed rails. A slight curve along the feed rail was discovered, which caused a slight and very brief separation of the collector shoes from the angle iron. The radio responds to this separation by shutting off the power to the crane. This disconnect was the primary source of the radio kickouts and as a result, a physical upgrade to replace the feed rail system with a hardwired festoon system was completed. Also, the main collector system was upgraded to spring-loaded collector shoes.

In total, 645 maintenance tasks were identified to manage all of the failure modes identified in the RCM2 analyses. Approximately 80% of those tasks were condition monitoring inspections which requires the collection of massive amounts of data related to the health of the equipment. While RCM2 is an effective tool to identify a complete proactive maintenance program, it is only effective if the recommendations are implemented in a system to manage this asset health data. Dofasco operators and maintenance personnel used paper to collect and record inspection readings.

In many cases, these employees used their personal notebooks to record inspection findings.



Figure 2: Personal Notebooks for Performing Inspections

Instead of relying on paper record keeping, Dofasco is now utilizing Ivvara EXP reliability software to implement the maintenance program that resulted from the RCM2 analyses. Dofasco, an Ivvara partner in the development and marketing of the solution, is now a large-scale user.

With the maintenance program captured in Ivvara EXP, the collection, storage, display, analysis and management of all maintenance program information is automated. As inspection data is collected on electronic handheld devices, EXP identifies potential failures and recommends the right maintenance task to be executed at the right time, allowing Dofasco to optimize the reliability of the stacker crane.

In addition, a detailed hierarchy of the stacker crane's bridge, hoist, trolley and their respective sub systems was built into EXP. By creating the asset hierarchy down to the level where conditions are monitored, maintenance is able to see the functional states of each component and create work orders in the CMMS against each specific component. This capability has enabled Dofasco to better analyze spending history, which helps to highlight growing problems.

### Results

With the implementation of the RCM2 analyses in Ivvara EXP, Dofasco's Central Shipping department has surpassed its 96% stacker crane utilization target, achieving 98% utilization.

Most importantly, the failure event has been addressed. Aladon's RCM2 methodology provided Dofasco with the most comprehensive and thorough understanding of the functions and failures of the stacker crane. The analyses allowed the team to zero

in on the primary source of the failure that previous investigations had not uncovered.

In addition, the collaborative nature of the RCM2 analyses helped to justify the maintenance case to upgrade the remote control system already underway throughout Central Shipping. Operations and maintenance personnel now have a much better understanding of how the equipment functions, how it fails and the specific proactive maintenance that is required.

Improvements in stacker crane reliability have also led to a 21% decrease in reactive maintenance work. Overall, 84% of maintenance work is now proactive.

The output of the three RCM2 analyses conducted on the stacker crane resulted in a 500 page report detailing 645 maintenance tasks. While RCM2 effectively identified the maintenance tasks, Ivvara EXP translated the 500 page report into a living maintenance program that drives the execution of the right maintenance work at the right time.



Figure 3: Output of RCM Analyses

Equally important, Ivvara EXP captures the knowledge of experienced maintenance and operations workers who had previously recorded valuable equipment information, such as condition monitoring routes and condition tolerance levels, in their personal pocket books. EXP captures their years of knowledge, making it available so that it can be leveraged for the long term.

Ivvara EXP also allows Central Shipping to realize more value from their CMMS. By creating an asset hierarchy in EXP to a level where conditions are monitored, maintenance is now able to assign work against the specific component within the stacker

crane instead of a generic crane category, as was previously recorded. The CMMS now has a more valuable work history that zeros in on the specific assets within the stacker crane requiring the most work. This improvement has enhanced Central Shipping's ability to schedule, plan and budget maintenance resources.

## Conclusion

The ability for Central Shipping to store and then ship over 90,000 tons of in-process material during a planned manufacturing operations downtime demonstrates the criticality and reliability of the warehouse operation. In addition, normal customer inventory shipments of 3,990,000 tons a year are contingent on the stacker cranes operating at a very high level of reliability. With RCM2 and Ivvara EXP, the safety risks posed by the kickouts have been addressed and the resulting increased crane utilization ensures that Central Shipping continues to meet Dofasco's growing production and customer demands.