DARLINGTON FUEL HANDLING

TROLLEY AVAILABILITY

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Our Journey to Excellence - Sustaining improved equipment reliability in Fuel Handling at Darlington

Where we were 2005?

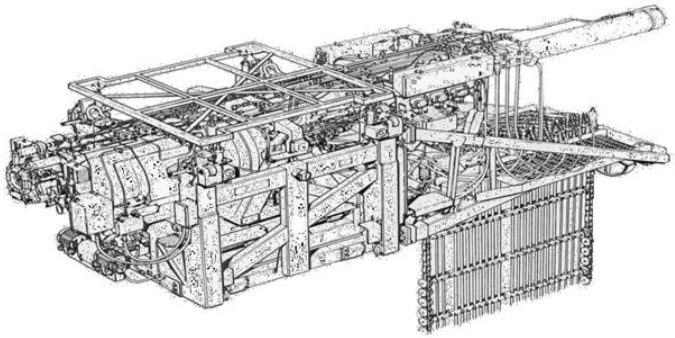
In February 2004 a landmark event occurred at Darlington, the powertrack for fueling machine trolley 2 failed catastrophically, resulting in significant damage. This failure resulted in a unit shutdown, significant repair work, and several months of trolley unavailability. Going forward, the Darlington fuel handling system continued to be plagued with frequent equipment reliability issues. Equipment not performing per design challenged unit average zone levels, staff frustration levels, and the completion of planned maintenance. A deteriorating trend was evident as demonstrated by:

- **Frequent equipment breakdowns (>2/week) impacting fuelling capability, and challenging unit average zone levels and operator frustration levels**
- **High operator intervention required in semi-auto mode due to frequent operation stops –equipment not performing per design**
- **High maintenance frustration – equipment not available to be fixed due to the need to fuel to maintain zone levels**
- **Little planned maintenance due to frequent breakdowns– fire fighting mode**
- **Large maintenance backlogs relative to station targets**

By early 2005, confidence in fuel handling equipment was extremely low, a strategy to recover and sustain reliability was vital to our future operation.

The Problem Statement

Develop a strategy that employs the predictability and rigor necessary to sustain 80% fuelling machine availability levels.



Darlington Fueling Machine Head

The Strategy

Refuse to exist in crisis- stop firefighting

Prior to 2005, maintenance activities were essentially reactive with constantly changing priorities. Planned work took second priority to emergent issues, the practice being to prioritize them as they occurred. Reacting to the latest crisis was exciting and gratifying for staff, the allure of this firefighting culture had become contagious, even the most minor issues were deemed urgent. This constant change of direction was proving very disruptive to planned work, driving up backlogs, and was an extremely inefficient method of performing maintenance in general.

The elimination of this culture was crucial in the implementation and success of our overall strategy.

Create a vision - make maintenance "routine"

A vision to "make maintenance routine" was adopted, the goal; to perform the right maintenance at the right time, safely, efficiently, and per schedule…just routine!
We needed to foster a culture that was intolerant of equipment failures.
As our vision was in sharp contrast to the current process, we had to be resolute and persistent in its promotion and acceptance.

Interface with engineering- do the right work first and integrate projects that improve reliability

The current maintenance program had been largely driven by operations and maintenance staff, the power of the entire team needed to be utilized. Engineering interaction in the program was essential, their integration was key to maximizing our effectiveness. As a complete and integrated team, we could prioritize the work for maximum gain, and implement projects to improve long term reliability.

Increase focus on System Monitoring- be more predictive rather than reactive

More emphasis was required on system monitoring, and the benefits that could be realized from the information being collected. Capitalizing on opportunities to be predictive in our maintenance will reduce emergent work, and contribute to plan stability.

Investigate and evaluate each equipment failure- have corrective actions to prevent repeat failures

Opportunities to learn from equipment failures were being missed, we needed to create and learn from our own OPEX. A mechanism was needed to ensure that failures were documented, evaluated, and that corrective actions were put in place to prevent repeat events.

Develop system teams between Maintenance, Operations, and Engineering- monitor system health and tackle system issues

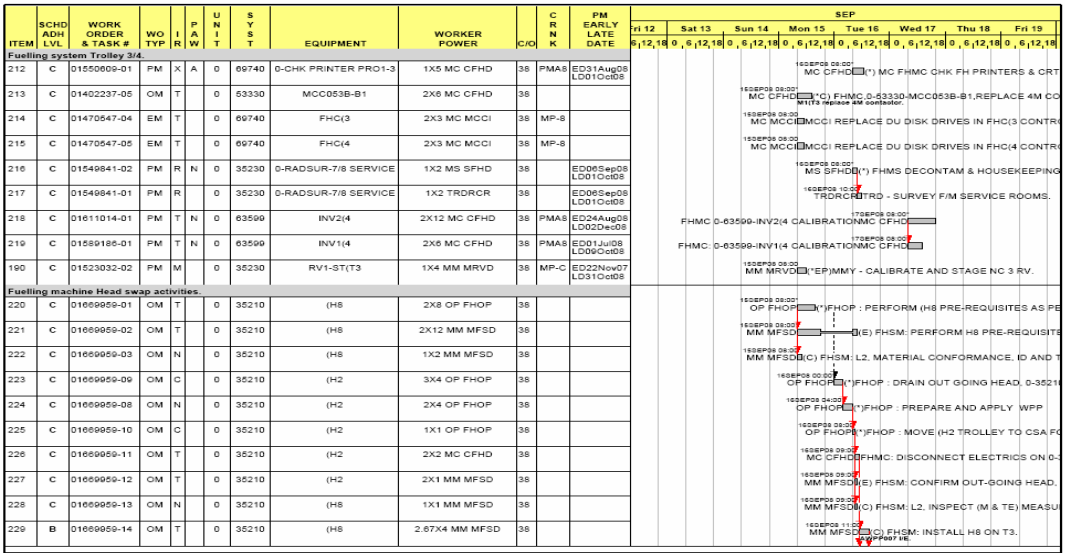
A wealth of willing untapped knowledge existed at floor level, insight into chronic issues and potential solutions were readily accessible to draw upon. A formal team process was required to enable engineering to capitalize on the knowledge held by floor staff.

Implementation

Plan the work and work the plan

Elimination of the firefighting culture was the crucial first step in the implementation of the overall strategy. To gain control and eliminate this practice, an empowered maintenance coordinator was appointed to screen all emergent issues to strict criteria. Jobs that fail to meet that criterion are deferred to a new work committee for review and appropriate placement on the plan. This has resulted in a significant reduction in the amount of unplanned work, and shifted the culture to put the emphasis on planned work, and its protection as priority. Efficiency has improved dramatically, the majority of work now performed is ready to go, and has been placed into the schedule where it best fits with system and resource configuration.

The Fuel Handling Department had existed primarily as its own entity since station commissioning; as such it was a silo that lacked the benefits that station integration offered. We aligned with the 20 week work management process utilized by the station, and through a dedicated maintenance work control presence, integrated with the larger process. A team comprised of representatives from Operations, Maintenance, and Engineering, review work at set intervals as it migrates through the planning process. Work packages that are incomplete or lacking parts are moved back out in the process, or given more focus as appropriate. Emergent work that has been deferred is prioritized, and placed appropriately in the schedule. Work is aligned in the schedule where it best fits the needs of the team as a whole; all 3 groups have input and a vested interest in its successful execution, the common goal.



ITEM	SCHD ADH LVL	WORK ORDER & TASK #	WO TYP	I R	P A W	U N I T	S Y S T	EQUIPMENT	WORKER POWER	C/O	C R N K	PM EARLY LATE DATE
Fuelling system Trolley 3/4.												
212	C	01550809-01	PM	X	A	0	69740	0-CHK PRINTER PRO1-3	1X5 MC CFHD	38	PMAS	ED31Aug08 LD01Oct08
213	C	01402237-05	OM	T		0	53330	MCC053B-B1	2X6 MC CFHD	38		
214	C	01470547-04	EM	T		0	69740	FHC(3	2X3 MC MCCI	38	MP-8	
215	C	01470547-05	EM	T		0	69740	FHC(4	2X3 MC MCCI	38	MP-8	
216	C	01549841-02	PM	R	N	0	35230	0-RADSUR-7/8 SERVICE	1X2 MS SFHD	38		ED06Sep08 LD01Oct08
217	C	01549841-01	PM	R		0	35230	0-RADSUR-7/8 SERVICE	1X2 TRDRCR	38		ED06Sep08 LD01Oct08
218	C	01611014-01	PM	T	N	0	63599	INV2(4	2X12 MC CFHD	38	PMAS	ED24Aug08 LD02Dec08
219	C	01589186-01	PM	T	N	0	63599	INV1(4	2X6 MC CFHD	38	PMAS	ED01Jul08 LD09Oct08
190	C	01523032-02	PM	M		0	35230	RV1-ST(T3	1X4 MM MRVD	38	MP-C	ED22Nov07 LD31Oct08
Fuelling machine Head swap activities.												
220	C	01669959-01	OM	T		0	35210	(H8	2X8 OP FHOP	38		
221	C	01669959-02	OM	T		0	35210	(H8	2X12 MM MFSD	38		
222	C	01669959-03	OM	N		0	35210	(H8	1X2 MM MFSD	38		
223	C	01669959-09	OM	C		0	35210	(H2	3X4 OP FHOP	38		
224	C	01669959-08	OM	N		0	35210	(H2	2X4 OP FHOP	38		
225	C	01669959-10	OM	C		0	35210	(H2	1X1 OP FHOP	38		
226	C	01669959-11	OM	T		0	35210	(H2	2X2 MC CFHD	38		
227	C	01669959-12	OM	T		0	35210	(H2	2X1 MM MFSD	38		
228	C	01669959-13	OM	N		0	35210	(H8	1X1 MM MFSD	38		
229	B	01669959-14	OM	T		0	35210	(H8	2.67X4 MM MFSD	38		

Weekly Schedule

Integration with the station work management system ensured we became part of the bigger picture. Our maintenance coordinator provides that presence and interfaces daily with the station team. A cooperative team effort ensures assistance with issues around parts, a resource, or support. Accountability to the station for schedule adherence and plan completion, maintains our focus on working the plan. Integration also ensures the relentless focus we need imposed, for our planned maintenance windows.

As our equipment is dynamic by design, and has minimal redundancy, we needed to look for alternate opportunities to perform maintenance on a larger scale. The solution was to move as much work into unit outages as possible, and capitalize on the reduced demand for the machines. This required a departure from some of our previous outage roles, but has significantly increased efficiency, as some of our larger scale maintenance is no longer broken up.

Engage the staff

Encourage and acknowledge worker driven solutions, and efficiency gains; act on them wherever possible. We have numerous examples of innovative tooling and process that have originated at floor level. Involving them in system health teams allows them input as to what the pressing issues are, and potential solutions. Most importantly communicate and celebrate successes, engaged staff will accomplish the unthinkable.

Staff Designed Powertrack Chain Replacement Tool

Develop a strategy for spare parts

The issue around spare parts is one that appears to plague all CANDU stations. The lack of station integration prior to 2005 also saw the Fuel Handling Department left out of some larger spare parts initiatives. Quality overhauls, and subsequently equipment reliability, were directly impacted by spare part deficiencies. Integration into the station work management system has helped in elevating our issues within procurement, and putting the power of the system to work for us. As well, we've embarked on some new strategies to secure a reliable supply of spare parts.

Some examples of these initiatives are;

- **Engineering, maintenance and Original Equipment Manufacturer to partner up on solutions to long standing parts issues – learn from the industry**
  Current initiatives include encoders, ITT valves, and water bearing

- **Obtain replacement spare parts at the sub component level, minimizing equipment out of service time during overhaul. Sub component overhauls can be completed offline, after the equipment has been placed back in service.**

- **Head overhaul kit**

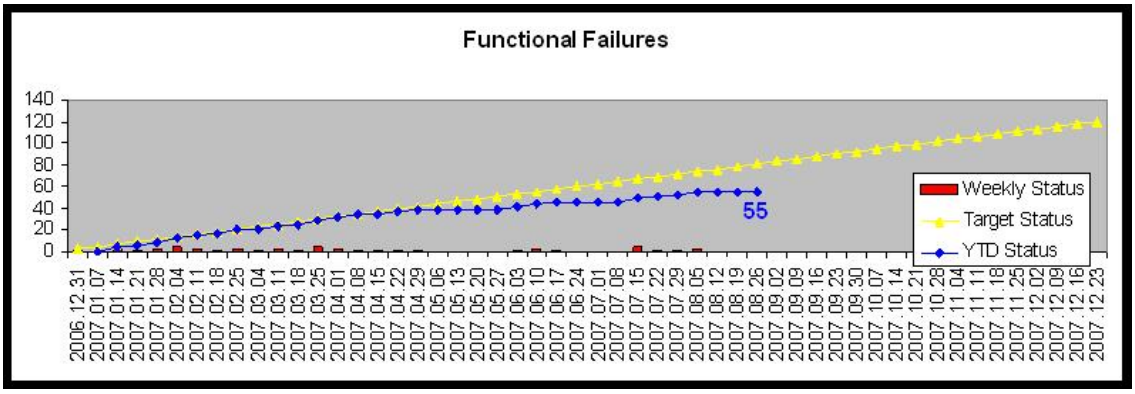
527 items included in the kit – all the parts required to overhaul a fuelling machine head.
1 CAT ID - 1 UTC - 1 Pressure boundary package concept
Original Equipment Manufacturer responsible for procurement engineering, and obsolescence issues associated with the parts.

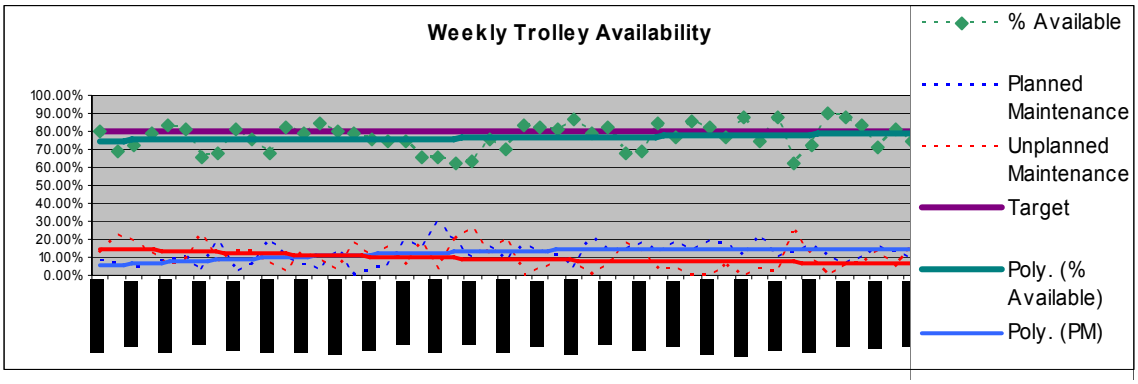
Head Overhaul Parts Kit

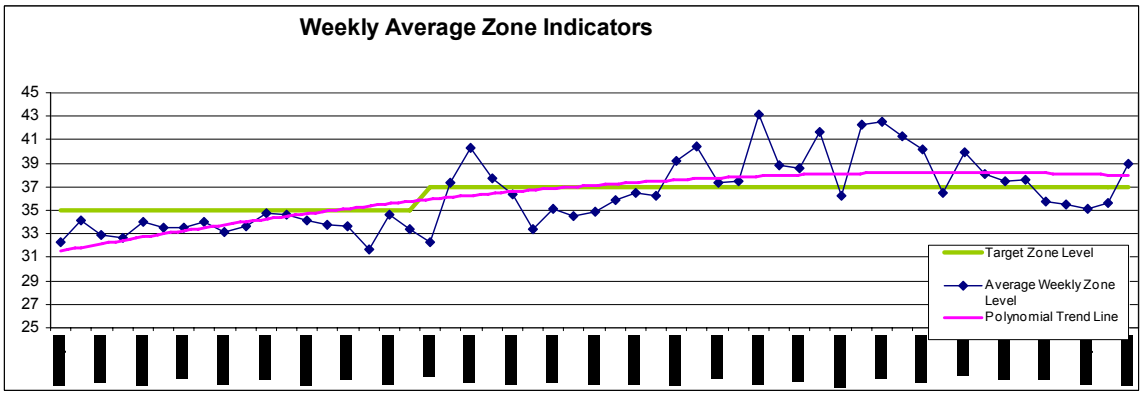
Develop performance indicators

A weekly Fuel Handling report card was developed to ensure that progress is being monitored. The Fuel Handling management team reviews the results weekly, and course corrects where necessary. Maintenance performance is monitored on a weekly, and year to date basis through indicators such as;

- **Unit Average Zone Level (indirectly)**
- **Trolley availability**
- **Functional failures**
- **Planned/Unplanned maintenance**
- **Planned work completion rate**
- **Corrective/Elective maintenance backlogs**







Where are we now?

Fuel handling equipment reliability has increased significantly since the landmark event of 2004. A program to replace 654 powertrack endplates with a superior design was completed in 2007. Continuous video monitoring is in place, along with a continuing program to replace powertrack chain as it approaches a sag tolerance. These endplates were a major contributor to our emergent work, none of the new model have failed to date. All this work has, and continues to be done as planned work, or during outage.

We no longer exist in crisis, when issues do arise; we have the margin provided by increased average zone levels to react in a planned manner. Backlogs are almost non existent, and the protection and execution of planned work is the main focus. This strategy has resulted in a distinctive upward trend as shown in our report card performance indicators below.

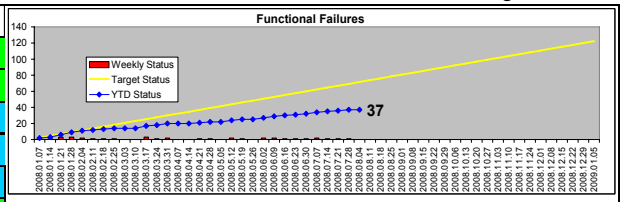
Year to Date	Mar 31, 2006	Dec 19, 2006	Dec 26, 2007	Aug 1, 2008
Average Zone Level	36%	35%	37%	40%
Trolley Availability	71.2%	75.8%	78.9%	79.3%
Plan Completion	58%	65%	81%	87.3%
Corr./Elect. Backlog	1/38	0/27	2/31	0/17
Functional Failures	NA	120 year end	97 year end	37 to date (63/year predicted)

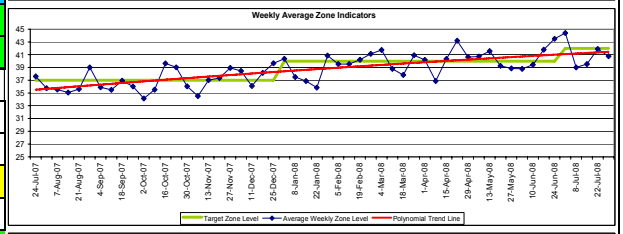
WW 31 *Fuel Handling Report Card* *August 1, 2008*

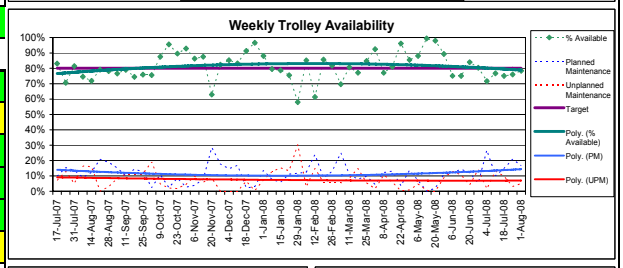
Human Performance		
Last LTA	May 20, 2006	
Last Station EFDR (F/H)	May 20, 2006 (SCR-D-2006-05732)	
Department EFDR F/H Maintenance (7)	0	
Department EFDR F/H Operations (9)	5	May 20, 2008 (SCR-D-2008-06361)
Department EFDR F/H Engineering (2)	1	June 6, 2008 (SCR-D-2008-07250)
Level 1, 2 WP Reportable Events (Target: Under 1)	0	
Level 3 WP Reportable Events (Target: Under 2)	0	

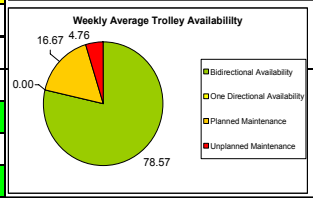
Station Reliability	Weekly	YTD
AZL (Target 42%)	40.75%	40.06%
Trolley availability (Target: 80%)	78.37%	79.34%
Utilization when Available (Target: 80%)	72.09%	80.18%
PRL Completions	0/0	7/7
Overall IPG completion (Target: 85%)	89.16%	87.34%
Rad Dose (Week Target: 34 mrem)	106 mrem	2957 mrem
Sick leave (Monthly Target: 5.76)	6.50	
Preventative Maintenance Deferrals	0	97.00%
On line Corrective Backlog	0	
On line Elective Backlog (Target: Under 30)	17	
NFW Management	3/4	

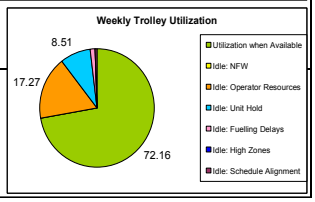
Leadership	Weekly	YTD
Training QCI	94.25%	
FLM Paired Observations	5/5	
Training Attendance (Target: 95%)	94.10%	94.00%
O&C compliance	100%	

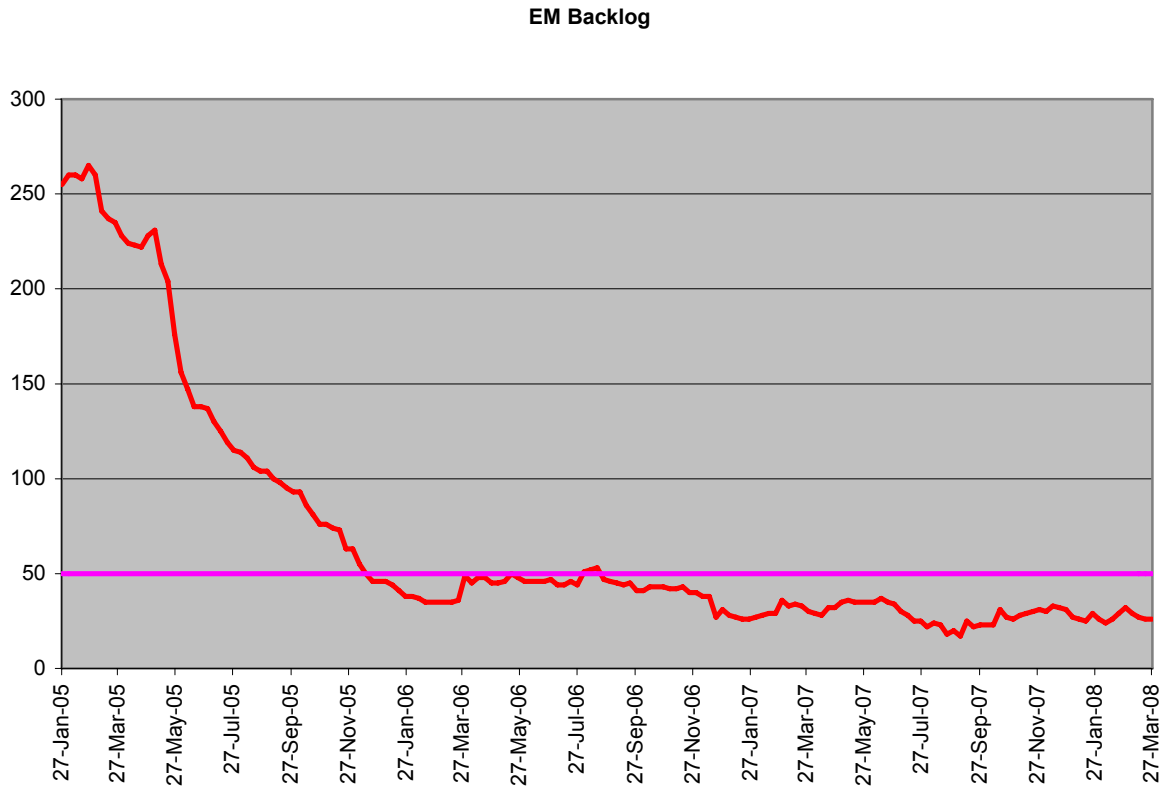












Elective Maintenance Work Order- Backlog Reduction

Going Forward

Much has been accomplished; however improvement is a never ending journey. A floor initiative to relocate trolley filter changes will result in 24 more fuel runs a year. A similar initiative with compressor swaps has already gained 6 runs yearly. Fueling machine head overhauls have been reduced from 16 weeks to 12, a 10 week overhaul is now in our sights. Opportunities to improve are abundant; as this multifaceted team continues in its quest, the challenges of sustaining and further improving equipment reliability are well in our grasp.