**Increasing Flexibility for Time of Day Pulping at Alberta Newsprint Company**

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## SUMMARY

In 2005, Alberta Newsprint Company undertook a capital project, known as the "TMP Production Project", to increase the thermo-mechanical pulping (TMP) plant production rate in order to better manage electrical power costs and to improve the heat recovery from high consistency refining.

The TMP plant in its previous configuration had more than adequate capacity to meet the day-to-day production requirements of the paper machine. However, ANC operates in a fully deregulated electrical power market and rigorously practices "Time of Day" (TOD) pulping to minimize electrical power costs. Specifically, this requires operating the TMP plant at high production rate during times when power costs are low and progressively reducing production as power prices rise and exceed predetermined threshold limits. In recent years, pulp demand had increased substantially due to increasing paper machine speed. The higher pulp demand increased refiner uptime resulting in a significant reduction in the flexibility and subsequent cost effectiveness of TOD pulping.

The goals of the TMP Production Project were to de-bottleneck the TMP in order to increase the peak production rate from 800 bone dry metric tonnes per day (BDMT/D) to 900 BDMT/D, while fully utilizing mainline refiner generated steam for clean steam production, and improving operating stability.

This paper will discuss the various unit operations impacted by the project scope, and review the results achieved to date in terms of financial savings, TMP production rates, pulp quality, operating efficiency improvements and heat recovery performance.

# 1. INTRODUCTION

Pulp demand at ANC was increased substantially due to higher paper machine speed and efficiency. Higher pulp demand increased refiner up time resulting in a significant reduction in the TMP mill's ability to curtail pulp production to respond to high electrical power prices without incurring paper production loss on machine. The purpose of this project was to increase the TMP production rate in order to make extra pulp when power prices are comparatively cheaper and to curtail pulp production when power is expensive.

We undertook several bench marking trips, invited major suppliers to make presentations and commissioned Poyry to prepare several feasibility studies. We had considered various options such as increasing the current production rate to 900 or to 1025 BDMT/D, installing larger refiners (Metso's CD76/82), upgrading only one refiner line, etc. Based on capital requirement, rate of return, down time required to implement the project, ease of doing the project and number of changes required, we proceeded with increasing the TMP production rate to 900 BDMT/D from the current rate of 800 BDMT/D (an increase of 100 BDMT/D or 12.5%). The major components of the projects were:

- Installing three new 22,000 HP motors on all the primary refiners for additional horse power needed,
- Replacing all three primary cyclones with fibre accelerators for better steam and fibre separation and to provide uniform feeding to secondary refiners,
- Upgrading the reject system by installing an additional screw press to handle added capacity,
- Installing a smaller second reboiler to capture the extra mainline refiner generated steam and to improve steam generation efficiency and,
- Upgrading mainline medium consistency (MC) pump.

The savings from the project were measured in terms of lower power cost, less bleach chemical usage, additional steam generation from the reboiler, reduced paper loss on machine due to lack of pulp and avoiding the risk of refiner motor failure as these motors were approaching the end of their normal service life. The project was implemented during a 7 day long fall shut down in November 2005.

# 2. DESCRIPTION ON MAJOR UPGRADES

## 2.1. CHIP WASHING SYSTEM UPGRADE

### 2.1.1. APS No. 1 Bin Discharger Modifications

The APS No.1 bin discharger was originally configured with a drag arm type discharger that, for reliability reasons, was quickly replaced with a shark fin type discharger. However, the shark fin discharger only agitated the chips in the center and did not sweep the full bin diameter. Chip bridging occurred regularly forcing the mill to operate this bin at very low levels. As a result, chip retention time was insufficient for proper chip heating and pre-conditioning. Also at times due to insufficient agitation, the amount of chips discharged and subsequently conveyed by the extraction screws was insufficient to maintain target refiner production rate.

Short of replacing the entire bin and/or the complete discharger assembly, we elected to replace the shark fin type discharger with an improved version of the original drag arm type discharger. Since the project implementation we have been able to maintain sufficient chip discharge even during peak TMP production periods.

#### 2.1.2. Chip Pump Replacement and Chip Wash System Upgrade

The old chip pump was undersized for 900 BDMT/D operation and forced the mill to run the chip wash system at temperatures under 65°C. Attempts to raise the chip wash water temperature resulted in rising water levels in the chip sump as the chip pump suction head requirement (NPSHR) exceeded the suction head available (NPSHA).

Considering the existing equipment sizing, plant configuration and available space, the best solution was simply to replace the existing chip pump with a larger model. The Chip Drainer Filtrate pump capacity was also increased to provide more water for the larger chip pump. Also, another cone was added to the existing grit cleaners along with the upgrade of grit cleaners feed pump.

## 2.2. REFINER MOTOR UPGRADE

ANC purchased new rotors and stators for the primary refiner motors to increase motor capacity to 22,000 hp from 20,000 hp. To minimize down time and production losses, the primary refiner motor upgrade required utilizing the existing primary refiner motor frames, inertia blocks and motor anchor bolts. The 20,000 hp motors taken out from primary refiners were installed at secondary refiners replacing 18,000 hp motors. Therefore, there was a total increase of 4,000 hp per refiner line.

## 2.3. FIBER ACCELERATORS (Replacing Primary Cyclones)

#### 2.3.1. Fiber Accelerator Description

The Fiber Accelerator (FA) is a recently designed piece of process equipment developed specifically to separate fibre from refiner generated steam and is intended to replace the pressure cyclones most commonly used for this purpose. Refiner steam and pulp enter the FA through the top nozzle (Figure 1.) where a multi-pocketed rotating element separates the incoming steam and fibre. The fibre discharges through a nozzle located on the bottom portion of the periphery of the FA housing (not visible in this picture) while the steam discharges through the nozzle located in the center of the unit just below the inlet nozzle.

The FA accelerates the fibre to enhance fibre/steam separation. As the steam and fibre flow into the FA, a pocket of the rotating element passes by the inlet nozzle and a small volume of steam and fibre enters. The "filled" pocket quickly moves past the inlet nozzle and the rotating element increases the radial velocity of the fibre and steam causing the fibre to move to the periphery of the FA housing. The outer edge of the rotating element keeps the fibre moving along the interior of the FA housing. The pocket then travels over the fibre discharge nozzle, typically leading to a pressure lock such as a plug screw feeder, where the fibre is expelled from the FA. The pressure lock prevents the steam from discharging through this opening. Once past the fibre discharge nozzle the pocket passes over the steam discharge nozzle located in the center of the FA and the steam discharges the unit at this point.

**Figure 1. Picture of Fiber Accelerator Installed at ANC**

## 2.4. ADDITIONAL REBOILER

The mill has three lines of two stage CD70 mainline refining, and a single CD70 rejects refiner. The mill was originally equipped with a full heat recovery system including a reboiler. However, over the years subsequent TMP capacity upgrades increased the volume of refiner-generated steam and resulted in the situation whereby a significant portion of this steam was discharging to atmosphere. To address this operating inefficiency the mill elected to install a second reboiler in order to fully utilize all mainline refiner generated steam for clean steam production

Previously, ANC had undertaken a series of operating efficiency related projects intended to recapture the fibre and heat energy contained in targeted white water and effluent flows. With the installation of the new reboiler and the steam piping enhancements, the capacity of the ANC recovered steam system now totals approximately 85,000 kg/hour of clean steam at 240 kPag.

## 2.5. REJECT REFINER CAPACITY

To compliment the increased peak production on mainline refiners and retain a reasonable balance between mainline and rejects refining energy, the reject refiner peak production had to increase to 340 BDMT/D. To accomplish this, the supply system to the rejects refiner including process pumps, rejects screw press capacity and the supply chute to the rejects refiner required upgrading and de-bottlenecking.

### 2.5.1. New Rejects Screw Press

ANC added a third screw press to the rejects system by relocating an existing Thune 45 SL screw press. The original TMP design allowed for a third rejects screw press installation. The two existing presses each have a high capacity screw allowing for a maximum production of 170 BDMT/D for each screw. The third press has a capacity of 80 BDMT/D.

## 2.6. MAINLINE AND REJECT SCREENING UPGRADE

### 2.6.1. Mainline Screening

The increased mainline refining capacity from 800 to 900 BDMT/D required a corresponding increase in mainline screening capacity. The passing velocity through the primary screen slots was very high (2.7 m/s). A fourth primary screen was added to reduce the passing velocity and to handle increased production.

### 2.6.2. Rejects Screening

Prior to the TMP Production Project, the rejects screening system consisted of two screens configured into an R1-R2 series screening system. The passing velocities for the two screens were extremely high at 4.2 m/s for the R1 screen and 4.1 m/s for the R2 screen. The project reconfigured the rejects screens from the R1-R2 series configuration to a parallel configuration with two R1 screens again reducing passing velocity

# 3. RESULTS

### 3.1. Financial

Although there were minor savings from such items as reduction of bleach chemical, reduction of natural gas usage and reduction of production loss on paper machine, the majority of savings were based on reduction of electrical power cost. The variable power prices in Province of Alberta (Figure 2.) presented a unique opportunity to reduce power cost at ANC by making extra pulp when power prices are comparatively cheaper and by curtailing production when power is expensive. To calculate the savings in power cost we have developed a formula to calculate % ANC power prices which is a ratio of the ANC daily average power price to daily average power pool price. The daily average power pool price is a simple arithmetic mean of hourly power pool price and the ANC daily average power price is calculated as:

$$ANC\_Daily\_Average\_Power\_Price = \frac{\sum_{h=1}^{24} L_h \times P_h}{\sum_{h=1}^{24} L_h}$$

Where

$L_h$ = ANC average hourly load for hour h (Mw)
$P_h$ = Power pool hour ending price of hour h ($/Mwhr)

Our project target was to reduce %ANC power price to 89.1% after project implementation. The last year % ANC power price was 78.4% (Figure 3.) which is much lower than our target. The last year's very volatile power prices helped to achieve lower % ANC power prices.

To date, all the financial performance targets have been met with the exception of the reduction in natural gas usage. We are looking into the reasons for not achieving the reduction in gas usage. At times, we have more low pressure steam from the reboilers then needed especially during the warm summer months.

### 3.2. Production Rate

The project was implemented during a week long shut down in November 2005. The last refiner motor of 22,000 hp was installed in March 2006. The objective of the project was to increase the production from 800 BDMT/D to 900 BDMT/D. As shown in Figure 4, the target refiner production was achieved in June 2006 and was maintained for next three months.

The peak production on reject refiner has gone up to 340 BDMT/D. The addition of third screw press has helped to improve the overall operation of the reject system.

### 3.3. Refiner Load and Load Variability

After the project implementation, as expected due to the increased production rate, the refiner motor loads went up. The load increase observed in the secondary mainline refiners was more than twice the increase observed in primary refiner load (1.4 MW vs. 0.4MW). This has improved slightly the % load split on secondary to 43.2% from 41.0%. We are targeting the load split above 45%. The total refiner load will go up further once we maintain consistent high production rate.

The refiner load variability has improved on the primary refiners. On the secondary refiners, more work is required to reduce the variation at higher load. The steam handling seems to be the issue.

### 3.4. Fibre Carry-Over

High fibre carry-over rate is a consequence of poor separation efficiencies of steam and fibre and represents a significant operating problem at many TMP plants employing pressurized scraper type cyclone. Prior to the installation of the fiber accelerators, the fibre carry-over problem at ANC was moderate. With the installation of the fiber accelerators the fiber carry-over has reduced significantly as shown in Table 1.

**Table 1. Mainline Refining Fibre Carry-Over Rates**

| | | **Before Project** | **After Project** |
|---|---|---|---|
| **Separation equipment** | Primary Refiner | Pressure Cyclone | Fiber Accelerator |
| | Secondary Refiner | Pressure Cyclone | Pressure Cyclone |
| **Production rate** | BDMT/D | 275 | 290 |
| **Primary refiner fibre carry-over rate** | kg/BDMT | 5.47 | 0.25 |
| **Secondary refiner fibre carry-over rate** | kg/BDMT | 3.11 | 3.11 |
| **Total fibre carry-over rate** | kg/BDMT | 8.58 | 3.36 |

Prior to the Fiber Accelerator installation, fibre carry-over totaled approximately 8.6 kg/BDMT of production. After the installation, total fibre carry-over rate fell to 3.4 kg / BDMT or an overall reduction of 61%. Primary refiner fibre carry-over rates fell from 5.5 kg/BDMT of production to 0.25 kg/BDMT of production or a 95% reduction. The average freeness of the fibre in the reboiler blow down decreased from 365 ml CSF before the Fiber Accelerator installation to 236 ml CSF after the Fiber Accelerator installation indicating that most the fibre carry-over is now coming from the secondary cyclones.

### 3.5. Reduction in Pulp Brightness Loss

With the Fiber Accelerator, the retention time of the fibre flowing from plug screw feeder supply the primary refiner to the secondary refiner pressure cyclone discharge is reduced by 15 to 20 seconds. This significant reduction in fibre retention time decreases the time during which the fibres are exposed to high temperature and pressure, and it was expected to reduce the subsequent loss in pulp brightness.

This effect was measured by sampling the pulp from the primary and secondary blow lines before and after the shut down of the pressure cyclones and the start up of the Fiber Accelerators. Brightness measurements on hand sheets produced from these pulp samples indicated a brightness gain of about 0.6 points as indicated in Table 2.

**Table 2 Brightness data for primary and secondary blow line samples**

| Brightness | Before Project With Pressure cyclone | After Project with Fibre Accelerator | Change |
|---|---|---|---|
| Primary Blow line | 52.4% | 53.2% | 0.80% |
| Secondary Blow line | 53.2% | 54.6% | 1.40% |
| Improvement in Brightness | | | 0.60% |

### 3.6. Pulp Quality

There was no significant change in average fiber length, debris level and pulp hand sheet properties after the project. It seems that we need to run higher blow line consistency to maintain a given freeness at higher production rates. There were issues with the refiner MPC (Model Predictive Control) after the project due to a needed change in various coefficients.

### 3.7. Screen Room Performance

#### 3.7.1. Mainline Screening

The passing velocity on the primary screens has been reduced to 2.0 m/s from 2.7 m/s after adding fourth primary screen and slightly lowering the total feed flow. The passing velocity on S1 screen reduced marginally to 1.25 m/s from 1.4 m/s. Mainline screening debris removal efficiency has increased to 70% after the project. The current debris level is around 0.40% measured by 0.004" Pulmac analyzer.

#### 3.7.2. Reject Screening

After reconfiguring the reject screens into a parallel configuration and increasing the RRM (Reject Rate by Mass) to 25% from 8%, the passing velocity was reduced significantly to 1.7% from 4.2%. We have also replaced the 0.010" slotted baskets with 0.006" wedge wire baskets and installed Ahlstrom LR rotors now running at 850 rpm. The debris removal efficiency has improved to 40% from 20%. We are still working on optimizing the rejects screening system.

### 3.8. TMP Heat Recovery (State-of-The-Art)

#### 3.8.1. TMP Energy Balance Analysis

This analysis considers the energy flows entering and leaving the TMP boundary including the TMP heat recovery system. All major process flows and energy values are derived from a detailed mass and energy balance developed for the TMP Production Project modeling TMP plant operation at a production rate of 925 BDt/d.

Table 3 details the major mass and energy flows entering the TMP process boundary. Electrical energy totals 66% of the total energy flow into the TMP. Refining energy including mainline primary and secondary refining, low consistency refining and rejects refining constitutes the largest energy inflow at 60%. Remaining electrical energy inputs includes the mechanical drives for chip conditioning and conveying, pumps, screens and agitators and so on. The next largest energy flow input into the TMP is white water make-up from the paper machine at 26%.

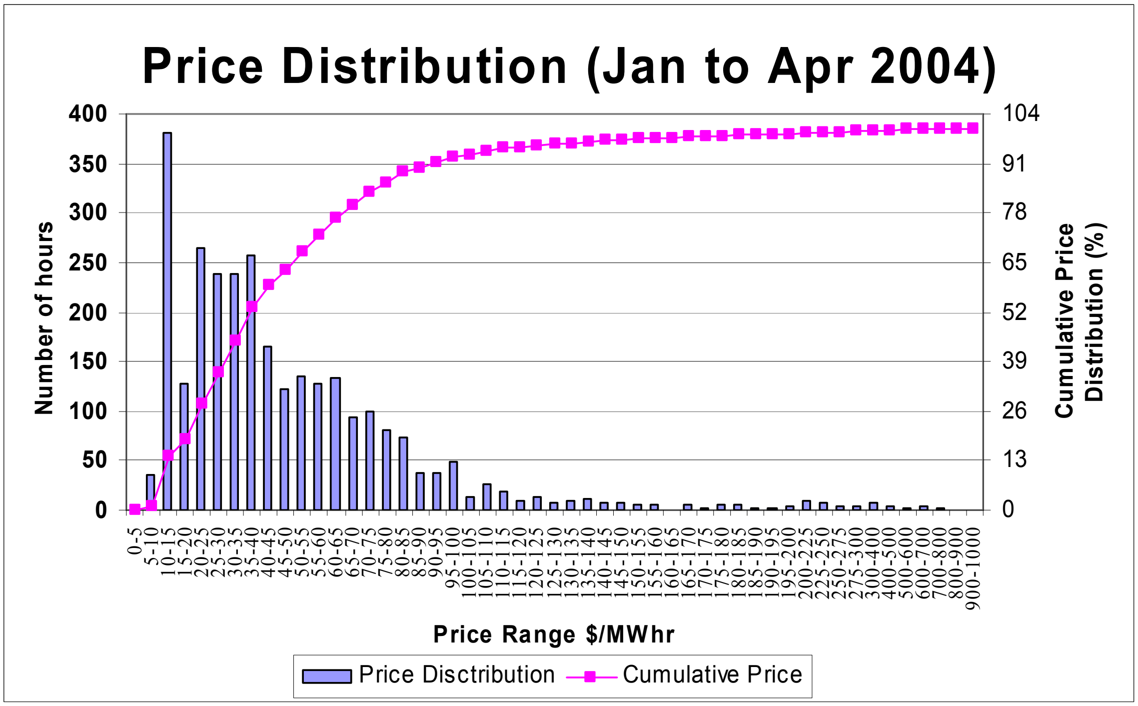
In terms of operating performance, the TMP refiner generated steam and white water heat recovery system now recovers 80% of the combined total of the electrical energy used in the TMP process and the heat energy contained in the process water flows passing through the TMP boundary. Table 3 summarizes the energy flows entering and leaving the TMP process boundary.

## 4. Concluding Remarks

The TMP Production Project was the biggest capital project undertaken in the ANC TMP since the start-up of the mill in 1989. We have been able to achieve the production target of 900 BDMT/D on 3 lines of 2 stage CD70 refiners. The 300 BDMT/D on CD70 refiner at a corresponding freeness of approximately 200 ml is probably the highest production rate in the industry on these refiners. The most of the financial performance targets have been met and some, including the electrical power cost savings, have even been exceeded.

**Acknowledgement**
The authors would like to thank all the people who were involved at the various stages of the project. Above all, we missed dearly our key project team member Dave Jordan who passed away half way into the project. His initial work was the basis of this project. The authors Singh and Mills are also thankful to the management of Alberta Newsprint Company for allowing the publication of this paper.

Figure 2. Power Price Distribution[1] in the Province of Alberta, Canada




[1] The data used in the graph can be downloaded from the website of Alberta Power Pool (www.aeso.ca.)

Fibre 3. % ANC Power Prices

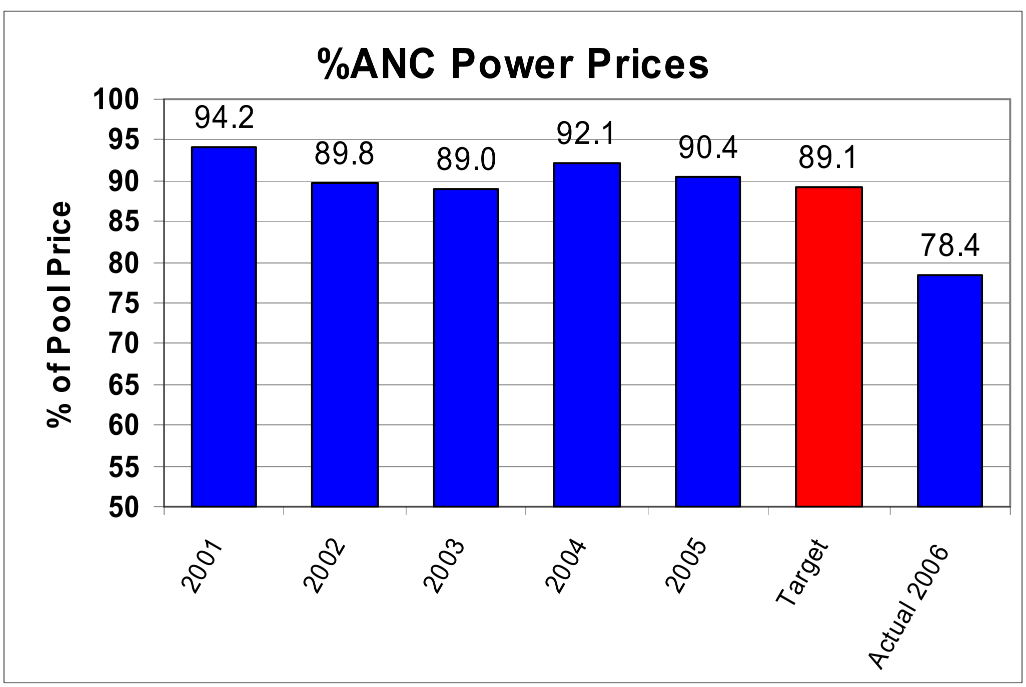
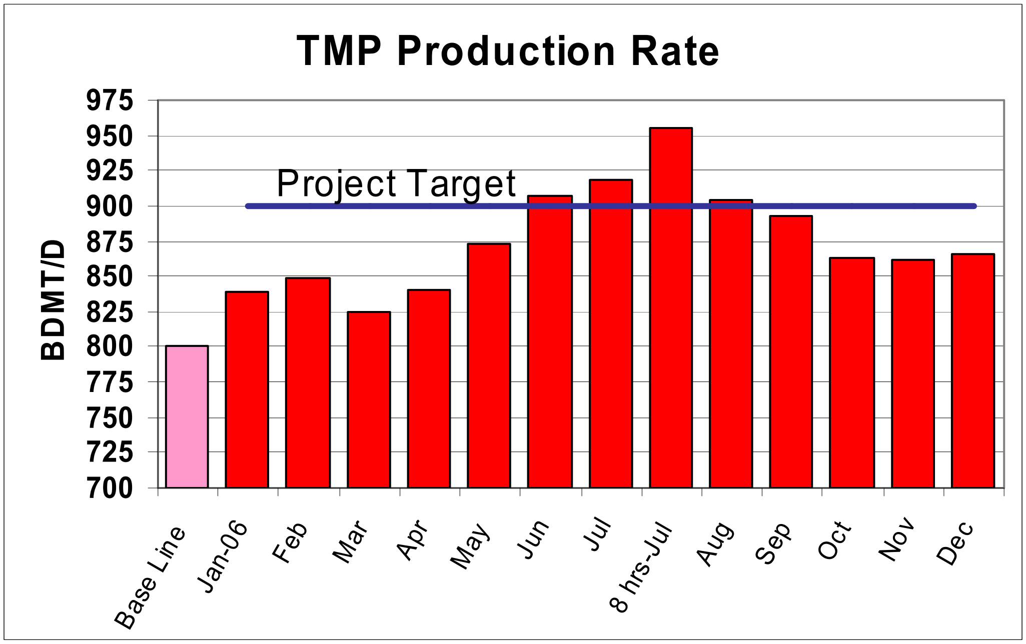


Figure 4. Mainline Refiners Total Production Rate



## Table 3 – Energy flows entering and leaving the TMP process unit

| | | | | | |
|---|---|---|---|---|---|
| **Energy Flows Into TMP** | | | | | |
| **Electrical Energy** | | **SRE** | **Production** | **Energy Flow** | **(%)** |
| Refining | | **kWh/BDt** | **t/hr** | **kW** | |
| Primary Refiners | | 1200 | 39.2 | 47,080 | |
| Secondary Refiner | | 900 | 38.1 | 34,260 | |
| Rejects Refining | | 950 | 14.2 | 13,458 | |
| Low Consistency Refining | | 50 | 38.6 | 1,931 | |
| | | | | **96,729** | 60% |
| **Non Refining Eletrical** | | | | | |
| Pumps, Screens, Agitators, etc. | | | | **9,673** | 6% |
| **Make-up water to the TMP** | | Flow (l/min) | Temp in (°C) | | |
| PM WW to TMP WW Chest | | 10675 | 52 | 38,240 | |
| Cleaner Rejects to Rejects | | 1121 | 52 | 4,034 | |
| | | | | **42,275** | 26% |
| **Clean Steam Generation** | | Flow (l/min) | Temp in (°C) | | |
| Boiler Feed Water | | 1417 | 120 | **11,216** | 7% |
| **Chips to TMP** | | Flow (t/d) | Temp in (°C) | | |
| Chips in | | 948.6 | 2 | **126** | 0% |
| **Total** | | | | **160,019** | 100% |
| **Energy Flows Leaving TMP** | | | | | |
| **Clean Steam Production** | | Steam (kg/s) | Temp (°C) | | |
| Reboiler No.1 | | 14.04 | 138 | 38,330 | |
| Reboiler No.2 | | 8.33 | 142 | 22,775 | |
| | | | | **61,106** | 38% |
| **White Water Heating** Flow | (l/min) | Temp in (°C) | Temp out (°C) | | |
| PM Warm Water Tank | 4730 | 15 | 52 | 12,184 | |
| WW Silo Heating | 4500 | 52 | 80 | 8,684 | |
| | | | | **20,868** | 13% |
| **TMP Stock to PM's** | | Flow (t/d) | Temp in (°C) | | |
| ML Accepts to PMs | | 647.6 | 69 | 22,677 | |
| Reject Accepts to PMs | | 277.4 | 69 | 9,714 | |
| | | | | **32,391** | 20% |
| **Chip Conditioning** | | Steam (kg/s) | Temp (°C) | | |
| APS No.1 | | 2.25 | 119 | 6,083 | |
| APS No.2 | | 0.77 | 119 | 2,072 | |
| Preheaters | | 2.17 | 147 | 5,941 | |
| | | | **Total** | **14,096** | 9% |
| **TMP Water to Effluent Treatment** | | Flow (l/min) | Temp in (°C) | | |
| Chip washing purge water | | 1743 | 75 | 8896 | |
| PSF Pressate to Sewer | | 1742 | 53 | 6354 | |
| Rejects Control Device | | 323 | 70 | 1543 | |
| To Sludge Presses | | 1815 | 32 | 4036 | |
| | | | **Total** | **20,828** | 13% |
| **Other** | | | | | |
| Water Vapour and radiation Losses | | | | **10,730** | 7% |
| **Total** | | | | **160,019** | 100% |

# Increasing Flexibility for Time of Day Pulping at Alberta Newsprint Company

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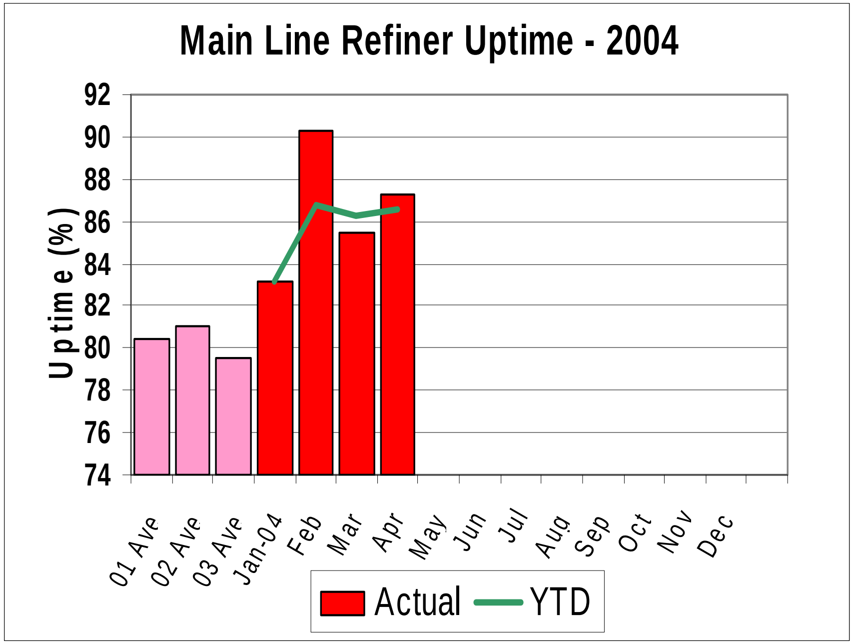
# Time of Day Pulping

- Time in a day when you make pulp to minimize manufacturing cost
  - Varying electrical power cost

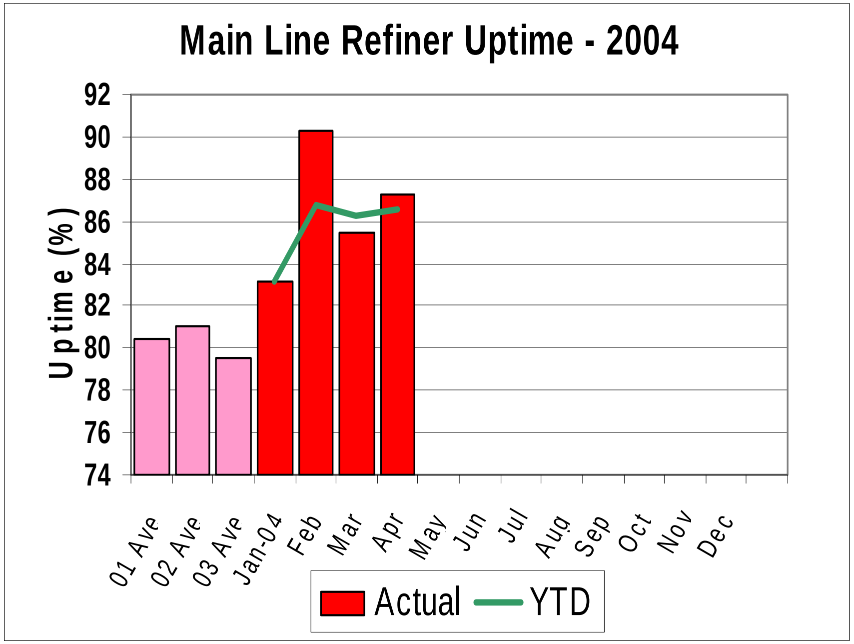


# Flexibility for TOD Pulping

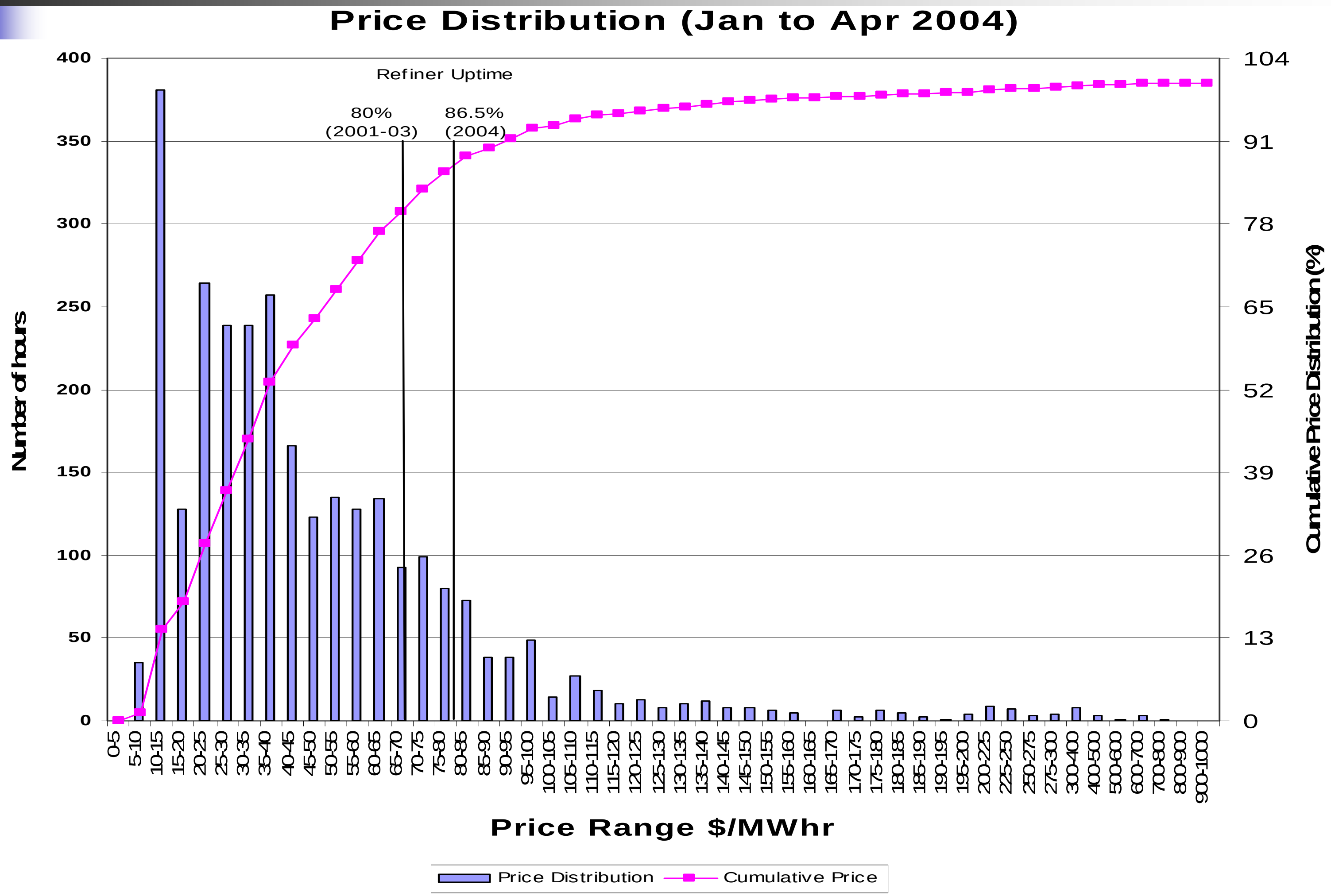
- Can be increased by:
  - Higher pulp production rate than demand on the machine and/or
  - Higher pulp storage

# Refiner Uptime

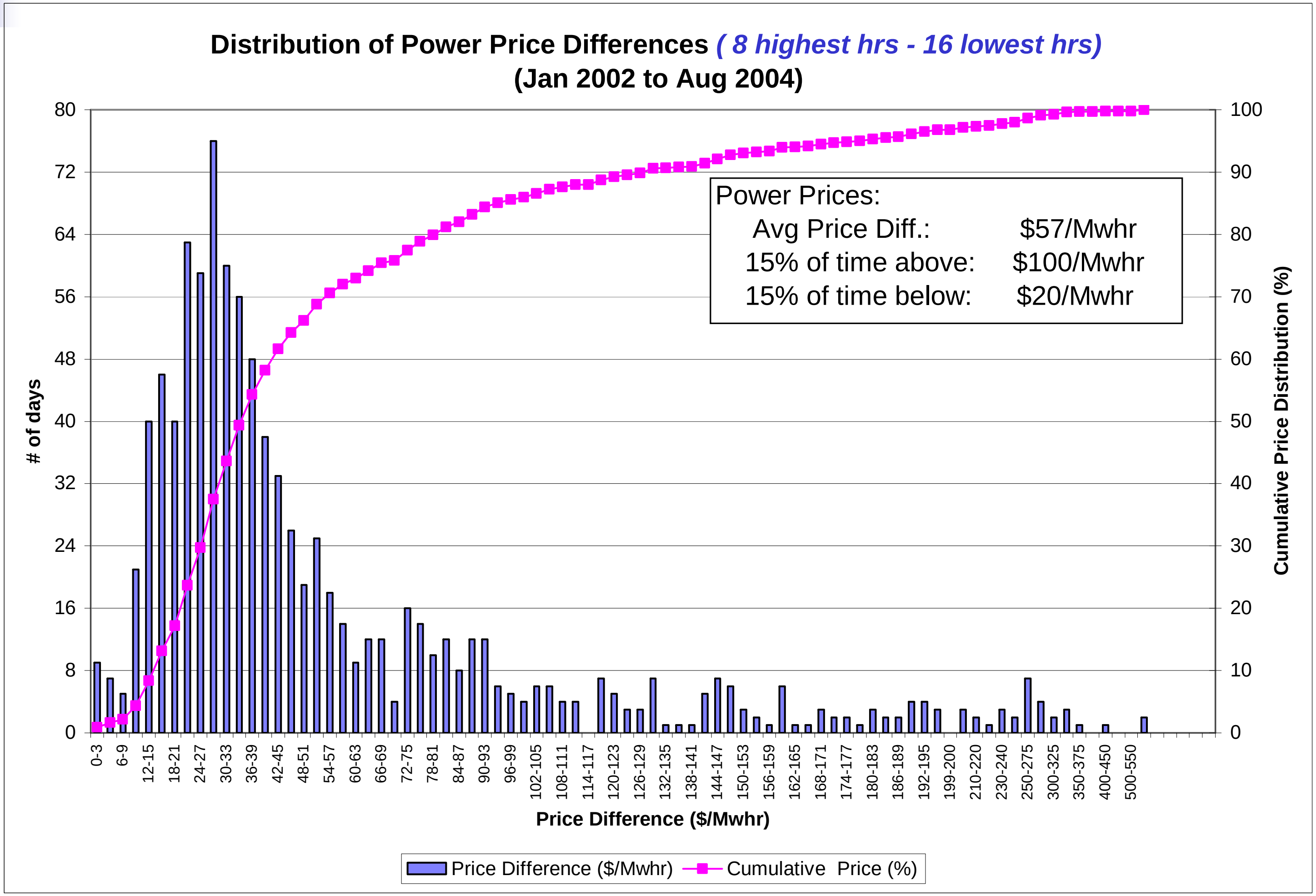
- Higher refiner uptime, mainly due to higher paper machine production
  (resulting in increased usage of higher priced power)



# Higher refiner uptime resulted in increased usage of higher priced power



# Distribution: Power Price Spread



# Why TMP Production Increase?

- Due to higher Paper Machine production (850+ FMT on a day or 800+ FMT/D for an extended period),
  - TMP was left with a little catch-up capacity
  - TMP had significantly lost the ability to respond to high power prices without incurring any production loss on machine (i.e., Refiners were running for longer period)

# Various Options: Benefits & Concerns

| | Options | Benefits | Concerns | TMP Prod Rate (BDTPD) | Project Cost (Million) | IRR (%) (After Tax) |
|---|---|---|---|---|---|---|
| 1 | Do Nothing | -Nothing needs to be done | -Pulp shortage/paper loss on machine<br>-Inability to respond to power prices | 800 | --- | --- |
| 2 | Upgrade one refiner line to 300TPD | -Low capital<br>-Will provide useful data prior to investing big sum<br>-Reasonable IRR | -May not be enough to meet increasing pulp demand<br>-Will delay the implementation of upgrading all the lines | 833 | | |
| 3 | Increase TMP production rate to 900 TPD | -More opportunity to respond to power prices<br>-Reasonable IRR | -Not the best IRR | 900 | | |
| 4 | To 1025 TPD | -More pulp, higher response to power | -Needs a lot of changes in process & equipment | 1025 | | |
| 5 | Replace one refiner line with CD-76 | -More pulp, higher response to power | -Two different sets of equipment (spare??)<br>-Extended down time (more than a month) | 1025 | | |
| 6 | Two stage CD-82 line | -Lots of pulp<br>-State-of-the-Art Technology | -Large capital requirement<br>-Quality & ww issue<br>-Low payback | 1550 | | |

# Option 3: 900 BDMTPD

# 900 BDMTPD: Major Items

- Chip wash system upgrade
- 3 new 22,000 HP refiner motors
- Primary cyclone replacement (3#)
- Reject system upgrade (Additional screw press)
- Bigger mainline MC pump
- Additional mainline screen
- Reject screen reconfiguration
- Additional smaller reboiler

# 900 BDMTPD: Benefits

- Higher TMP Prod Rate (by 100 BDMTPD)
  - Power cost Savings
  - Reduce loss of Paper for lack of pulp
- Brightness gain (0.5%)
  - Reduce bleaching cost
- Additional steam Generation from new Reboiler
- Avoidance of refiner motor rewinding

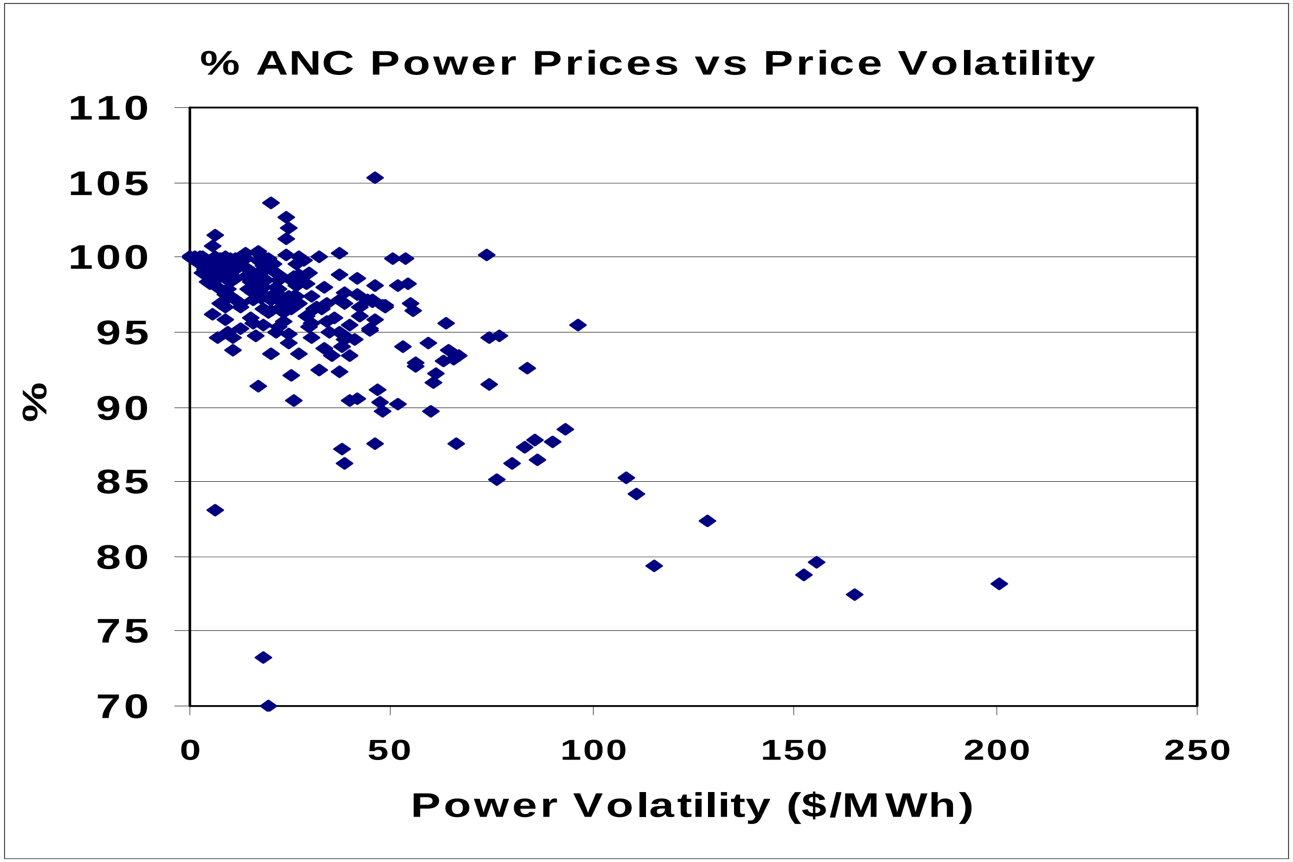
# Results: % ANC Power Price

$$ANC\_Daily\_Average\_Power\_\Pr ice = \frac{\sum_{h=1}^{24} L_h \times P_h}{\sum_{h=1}^{24} L_h}$$

%ANC Power Price = Avg. ANC Price / Avg. Pool Price

Where
$L_h$ = ANC average hourly load for hour h (Mw)
$P_h$ = Power pool hour ending price of hour h ($/Mwhr)

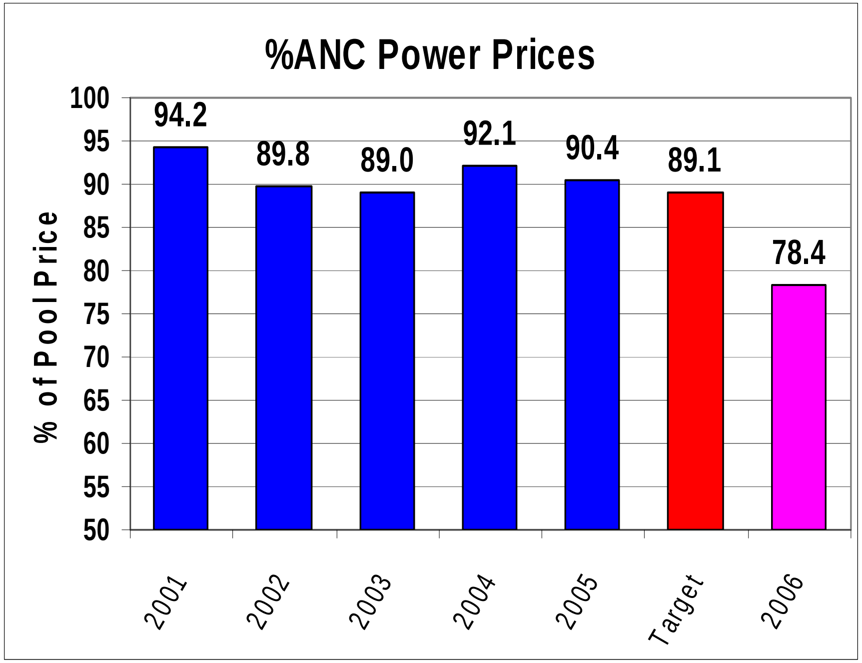
# Results: % ANC Power Price



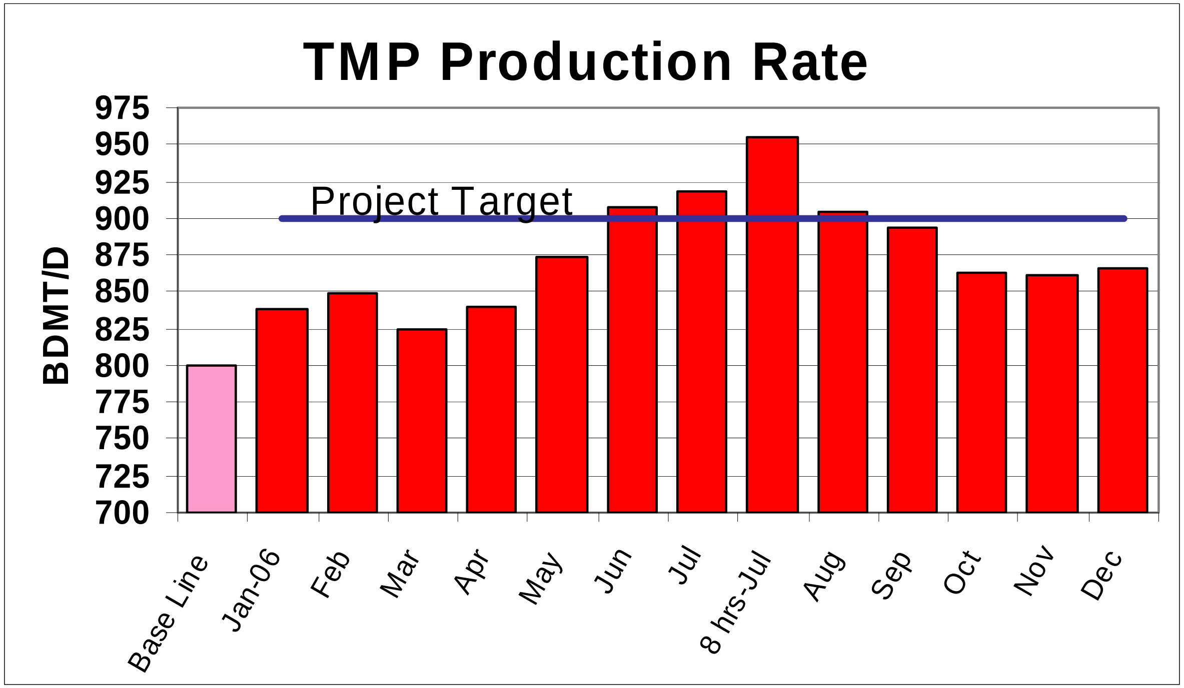
# Results: Financial

- % ANC Power Price
  - Target: 89.1%
  - Actual 2006: 78.4%

  - The very volatile power prices helped to achieve surpass the target.



# Results: Production Rate



# Results: Brightness Gain

| Brightness | Before Project With Pressure cyclone | After Project with Fibre Accelerator | Change |
|---|---|---|---|
| Primary Blow line | 52.4% | 53.2% | 0.80% |
| Secondary Blow line | 53.2% | 54.6% | 1.40% |
| Improvement in Brightness | | | 0.60% |

# Results: Fibre Carryover

| | | Before Project | After Project |
|---|---|---|---|
| **Separation equipment** | Primary Refiner | Pressure Cyclone | Fiber Accelerator |
| | Secondary Refiner | Pressure Cyclone | Pressure Cyclone |
| **Production rate** | BDMT/D | 275 | 290 |
| **Primary refiner fibre carry-over rate** | kg/BDMT | 5.47 | 0.25 |
| **Secondary refiner fibre carry-over rate** | kg/BDMT | 3.11 | 3.11 |
| **Total fibre carry-over rate** | kg/BDMT | 8.58 | 3.36 |

# Results: Refiner Load Variability*

| | Before Project | After Project | Comparison |
|---|---|---|---|
| **Secondary Line 1** | 0.41 | 0.73 | Up |
| **Secondary Line 2** | 1.40 | 1.52 | Up |
| **Secondary Line 3** | 0.34 | 1.50 | Up |

* Covariance calculated from raw motor load data

# Results: Screen Room

| | Before Project | After Project |
|---|---|---|
| Mainline Screens | | |
| Passing Velocity (miss) | 2.7 | 2.0 |
| Debris Removal (%) | 60 | 70 |
| Reject Screens | | |
| Passing Velocity (miss) | 4.2 | 1.7 |
| Debris Removal (%) | 20 | 40 |

# Summary

- Increased pulp production rate to 900 BDMTPD from 800 BDMTPD
- It was the biggest capital project in TMP at ANC
- Achieved most of the financial benefits of the project
- Improved pulp quality after screen room

# Thank You