
ZTR

Control Systems

What you have always wanted to know
about idling locomotives.....

.....But were afraid to ask.

ZTR
Control Systems

What I hope to leave you with today is.....

- *An understanding of some of the complexities involved with shutting down and restarting locomotives.*
- *How technology has helped to automate the performance of this task and turn it into a win-win situation.*
- *Some thoughts regarding sharing the costs of the benefits to be reaped*
- *One easy way to protect your investment*

Let's start with some common ground.....

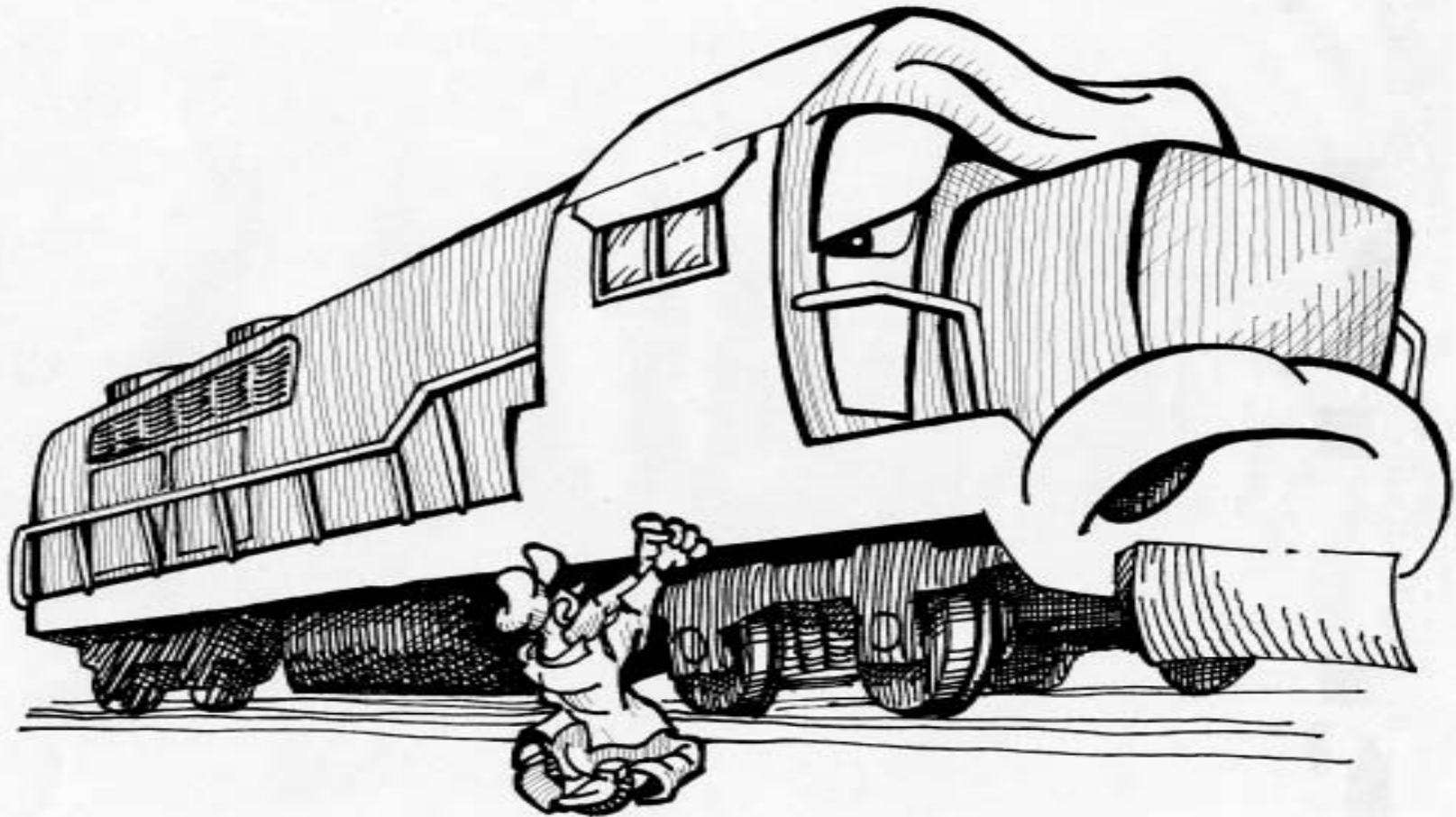
- Shutting down locomotives, when they are not being utilized, saves money and reduces emissions.

*Now if we are all in agreement with this,
then why are we here?*

The answer is.....

-
- Shutting them down is not the problem!

The problem lies inwhat happens after you shut them down...or try to get them to restart.



Some detrimental incidents that can arise while locomotives are shut down include.....

- **Batteries draining**
- **Coolant leaking into the cylinder**
- **Engine becoming “Cold Soaked”**
- **Outside temperature dropping below freezing**
- **The Dump Valve dumping the coolant**

Manually restarting a locomotive engine, can in itself be a challenge.....

- Some locomotives can be 30 to 40 years old
- Dealing with a variety of different engines
- Horsepower ranges from 1000 to 3000+
- Differences in starting systems
- Unknown condition of batteries

Successfully automating the process was complex and required a microprocessor based product like.....

SmartStart



SmartStart was designed to meet stringent objectives..... Included among these was the need to.....

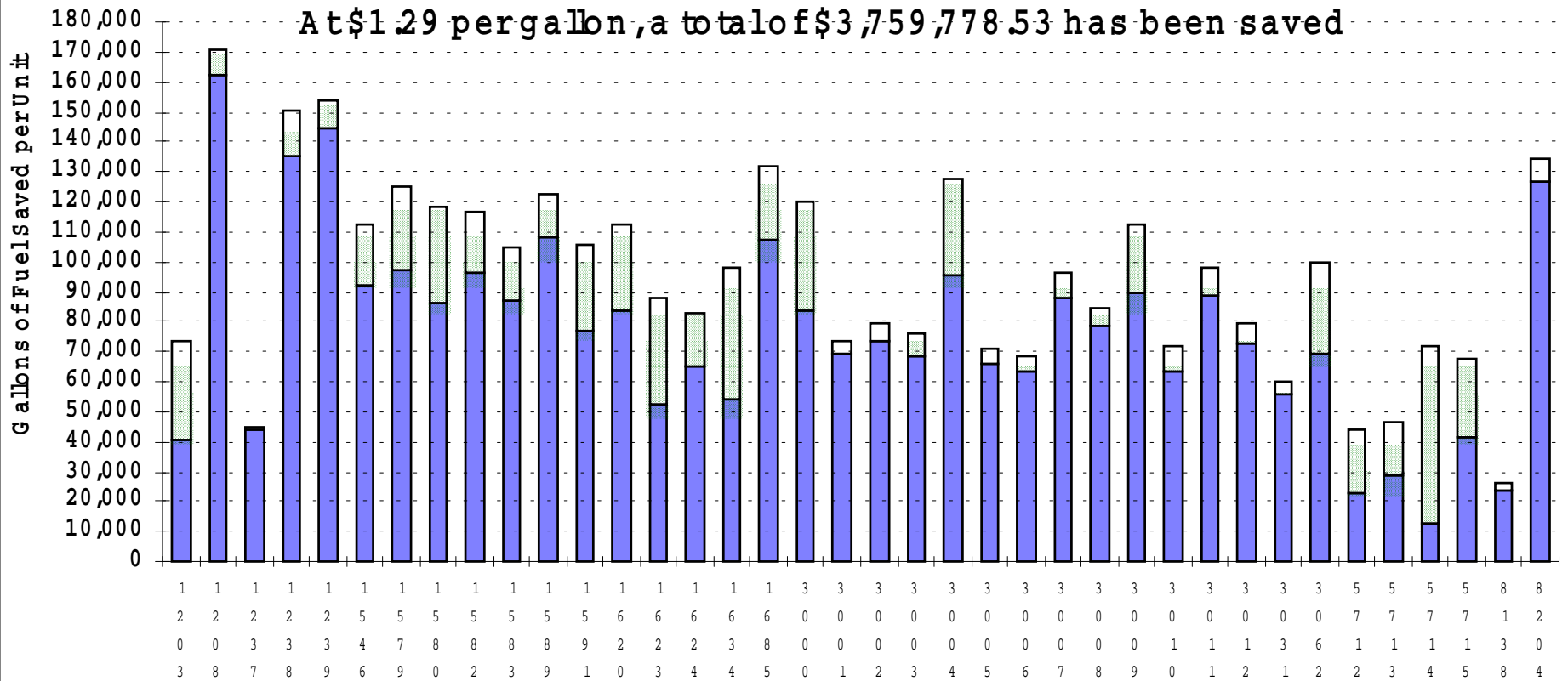
- Determine if the locomotive should or could be shut down.
- Protect it while it was shut down.
- Be able to reliably restart it.
- Perform all of these tasks safely.
- Be durable enough to live in this environment
- Report on how well it performed its job.
- Provide the user with information not just data.

So how has *SmartStart* been doing?

PortCoquitlam Auto-Stop Start Lifetime Fuel Savings to 2002-09-30

Total 12,914,557 gallons by 38 units over average 5.30 years each

At \$1.29 per gallon, a total of \$3,759,778.53 has been saved



Locomotive Unit Numbers

■ Fuel Saved □ Fuel Wasted

SmartStart has saved our users millions and we're still counting.....

- Actual Fuel Savings on *SmartStart* equipped locomotives operating on a Canadian Class 1 railroad:

(Does not include any savings from their active manual shutdown policy)

| | |
|--|-------------------|
| ▪ Number of locomotives tracked | 38 |
| ▪ Average period per locomotive | 5.3 years |
| ▪ Total fuel saved | 2,914,557 gallons |
| ▪ Average fuel saved per locomotive | 76,699 gallons |
| ▪ Average fuel saved per locomotive per year | 14,471 gallons |

- ***At about a buck a gallon for fuelnot a bad payback!***

And....think of the reduction in emissions!

2,914,557 Gallons Saved

4 Gallons Per Hour at Idle = 728,639 Hrs. of Reduced Idle Time

A two cycle engine produces 800 Grams of NO_x per hour at Idle

728,639 Hours of Reduced Idle X 800 Grams = 582,911,200 Grams of NO_x

582,911,200 Grams/454grams per lb. = 1,283,945 lbs./2000 lbs. per ton =

642 Tons of NO_x or 17 Tons Per Locomotive

17 Tons/5.30 Years = 3.2 Tons per Locomotive Per Year

*How do we
compile
these
statistics?*

*Now think of
the potential
for tracking
emissions
reductions,
credits, etc.*



SmartStart - Hotstart Emissions Report

Roll Road:

Location: Op/Center
Demo

Road Number: 2133



Reporting Period

| | Installation | Previous Report | Current Report | Since Installation | Previous Report |
|-------|--------------|-----------------|----------------|--------------------|-----------------|
| Date: | 8/28/2002 | 11/30/2003 | 12/9/2003 | Days: 463.0 | 9.0 |
| Time: | 14:43:01 | 13:18:39 | 14:15:50 | Hours: 11231.5 | 217.0 |

Summary

| | | |
|--|---------|------|
| Gallons of fuel saved by SmartStart - Hotstart | 14889.4 | 63.0 |
| Shutdown hours due to SmartStart - Hotstart | 2972.0 | 14.0 |

Reduction of Emissions

(Does not include emissions by Kim Hotstart DDHS)

| | | |
|--|--------|------|
| Reduction in NOx due to SmartStart - Hotstart (pounds) | 5237.0 | 24.7 |
| Reduction in PM due to SmartStart - Hotstart (pounds) | 170.2 | 0.8 |

(These calculations based on locomotive emissions as published by the EPA
Engine: EMD 12 Stroke Notch Position - Idle NOx = 800 g/hr PM = 26 g/hr)

| | | |
|---|-----|-----|
| SmartStart - Hotstart reduced the average weighted factor of NOx (g/bhp-hr) by (See table below) | 0.9 | 0.2 |
|---|-----|-----|

Table

LOCOMOTIVE ENGINE EMISSIONS - BASELINE DIESEL FUEL

| Engine | Notch | Engine Speed | Fuel Flow (lb/hr) | BHP | PM (g/hr) | HC (g/hr) | CO (g/hr) | NOx (g/hr) |
|---------------|-------|--------------|-------------------|-----|-----------|-----------|-----------|------------|
| EMD 12-645E3B | Idle | 300 | 27 | 12 | 21.0 | 88.0 | 297.0 | 776.0 |

As published in a joint paper to the ASME (Vol 113, July 1991) by the AAR and Southwest Research Institute

What is preventing systems such as *SmartStart* from being applied to locomotives?

- The 3 M's
 - Money
 - Manpower
 - Motivation

- *Given that Money can usually solve items two and threethe question then is how do you get the funding?*

One way to ask your Federal, State or Local Government to Assist

- Obviously there are benefits to be gained by all of these organizations as well.
- But like any good business person, they want to get a high return on their investment.

There have been several concepts put forth to accomplish this type of funding. To that list, I add another that may be of interest.

Shared Savings

Here is how it would work...

Initial System Costs per Locomotive (With Volumes)

- **SmartStart System Costs**
- **Remote Monitoring Costs**
- **Installation Costs**

Approximately \$15,000

*Historical Annual Payback in Fuel Savings
Alone....*

\$14,471

(Based on 38 systems monitored for 5.3 years)

*Let's be conservative and use \$6,000 Annually
in our scenario.....*

The Arrangement.....

- **The locomotive user/owner would be funded the full amount up front.**
- **The funding government body would receive \$3,000 per year from the recipient on the investment over a five year period.**
- **At the end of five years, the cost to the funding government body to support emission reductions would be the cost of money.**
- **The cost per ton on NO_x reduced is minimal.**

The Win-Win.....

- **Locomotive User/Owner**

- No initial outlay of capital
- System pays for itself out of actual fuel savings
- Owns the equipment and reaps all savings after the fifth year.

- **The Funding Agency**

- Reduction in emissions
- Payback on investment
- Minimal cost per ton of NO_x reduced

Now you may be thinking.....

*Hmmmm.....sounds good....but then how do I
protect my investment?*

After all.....

This guy's Irish..... and it is St. Paddy's Day!

Now think in terms of:

- **Wireless Remote Downloading of Information from the Locomotive**

- **GPS**

- **Geo Fencing**

- **Secure Access to the Information over the Web**

We have been.....

Transmission Path

Satellite Link



Operations Center Service



Access through the Internet

Welcome to MSN.com - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Refresh Home Search Favorites History Mail

Address Y:\My Documents\SmartStart\Documentation\EPA\Welcome to MSN_com.htm Go Links

Buy stocks for only \$4. FREE Microsoft Money 2003.

msn. MSN Home My MSN Sign In Help Tuesday, May 6

MSN Home | My MSN | Hotmail | Search | Shopping | Money | People & Chat

Search the Web: Search

Top 20 Mother's Day presents: chocolates, jewelry & more

Get a free price quote.

5 ways to make his mother love you

Find Mom a gift by price range: \$10 to \$1,300

MDay Flowers starting at \$30: 1800FLOWERS

MSN Internet Services

Internet Access Specials MSN 8 Software

Find

Air Tickets

Today on MSN

- Report: Saddam got \$1B from Iraq bank
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- Internet toilet to debut
- Top 5 biz golf courses

Mind & Body

- What is chronic fatigue?
- See if you could pass the US citizenship test
- Free beauty samples
- Find out your snacking personality

Your Business

- Check your credit (free)
- [How to travel safely](#)
- Why groomers toss garters

Urban areas & allergies

Is your city making you sick? Find out why

6 ways you can cope

Get any promises in writing & other tips

- Travel perks soldiers get as a 'thank you'
- Does home ownership really cut your taxes?

MSN Channels

- Autos
- Business
- Careers
- City Guides
- Entertainment
- Family
- Fitness & Recreation
- Games
- Health
- House & Home
- Kids
- Learning & Research
- Love & Relationships
- Mother's Day**
- News

MSN Top Headlines more... CNBC on MSN Money more...

http://go.msn.com/0000/5/24.asp?target=http://www.bcentral.com/resources/travel.asp?cobrand=msn&LID=3800 Local intranet

Performance at a Glance.....

Report Management - Microsoft Internet Explorer

Address: http://lcco.ztr.com/Reports.asp

ZTR Control Systems - Report Management

2133

Reports | GPS | Help/Info | Home

| Unit | Location | Date | % Parked Idle Reduced | Cumulative Savings | Average Savings per month |
|------|-------------------|---------------------|-----------------------|--------------------|---------------------------|
| 2133 | OpCenter Download | 2004-03-12 14:59:14 | 0 | \$ 13535.20 | \$ 712.38 |
| 2133 | OpCenter Download | 2004-03-11 15:32:14 | 26 | \$ 13535.20 | \$ 712.38 |
| 2133 | OpCenter Download | 2004-03-10 17:32:24 | 100 | \$ 13519.57 | \$ 711.56 |
| 2133 | OpCenter Download | 2004-03-10 15:20:14 | 97 | \$ 13512.68 | \$ 711.19 |
| 2133 | OpCenter Download | 2004-03-09 12:28:58 | 99 | \$ 13447.24 | \$ 707.75 |
| 2133 | OpCenter Download | 2004-03-04 14:41:24 | 100 | \$ 13363.71 | \$ 703.35 |
| 2133 | OpCenter Download | 2004-03-04 13:51:43 | 98 | \$ 13360.88 | \$ 703.20 |
| 2133 | OpCenter Download | 2004-02-10 13:26:22 | 0 | \$ 13890.89 | \$ 771.72 |
| 2133 | OpCenter Download | 2004-02-01 13:00:18 | 0 | \$ 13890.89 | \$ 771.72 |
| 2133 | OpCenter Download | 2004-01-25 13:03:18 | 0 | \$ 13890.89 | \$ 817.11 |
| 2133 | OpCenter Download | 2004-01-18 13:03:17 | 0 | \$ 13890.89 | \$ 817.11 |
| 2133 | OpCenter Download | 2004-01-14 15:08:17 | 100 | \$ 13890.89 | \$ 817.11 |
| 2133 | OpCenter Download | 2004-01-04 13:03:16 | 95 | \$ 13871.45 | \$ 815.97 |
| 2133 | OpCenter Download | 2003-12-28 12:58:41 | 83 | \$ 13739.42 | \$ 858.71 |
| 2133 | OpCenter Download | 2003-12-10 18:14:10 | 99 | \$ 13496.02 | \$ 843.50 |
| 2133 | OpCenter Download | 2003-12-09 14:15:50 | 71 | \$ 13400.44 | \$ 837.53 |
| 2133 | OpCenter Download | 2003-11-30 13:18:39 | 65 | \$ 13343.74 | \$ 809.58 |
| 2133 | OpCenter Download | 2003-11-23 12:58:34 | 59 | \$ 13291.49 | \$ 806.10 |
| 2133 | OpCenter Download | 2003-11-16 13:03:13 | 99 | \$ 13103.17 | \$ 873.54 |
| 2133 | OpCenter Download | 2003-11-09 12:58:33 | 82 | \$ 12619.13 | \$ 841.28 |

Available Reports

SmartStart Detail
 SmartStart Summary
 SmartStart Duty Cycle

Done Internet



SmartStart - Hotstart Detail Report

Rail Road: Burlington Northern Santa Fe Location: OpCenter Demo
Road Number: 2133



Reporting Period

| | Installation | Previous Report | Current Report | Since Installation | Previous Report |
|-------|--------------|-----------------|----------------|--------------------|-----------------|
| Date: | 8/30/2002 | 1/25/2004 | 2/1/2004 | Days: 520.0 | 7.0 |
| Time: | 13:07:45 | 13:03:18 | 13:00:18 | Hours: 12479.9 | 168.0 |

Locomotive Operating Statistics (Hours)

| | Since Installation | | Since Previous Report |
|-----------------------|--------------------|--------------|-----------------------|
| In Service Hours: | 10147.5 | = 422.8 Days | 168.0 = 7.0 Days |
| Out of Service Hours: | 2332.4 | = 97.2 Days | 0.0 = 0.0 Days |

| | Since Installation | Since Prev. Report | Since Installation | Since Previous Report | |
|------------------|--------------------|--------------------|--------------------|-----------------------|-------|
| ENGINE SHUTDOWN: | 4953.0 | 0.0 | IDLING: | 4356.2 | 145.9 |
| Manual: | 1859.9 | 0.0 | Working Idle: | 2747.0 | 69.8 |
| SmartStart: | 3093.1 | 0.0 | Parked Idle: | 1609.2 | 76.1 |
| ENGINE RUN: | 5194.5 | 168.0 | PARKED IDLE: | 1609.2 | 76.1 |
| Loading: | 838.3 | 22.1 | Unavoidable Idle: | 790.1 | 32.6 |
| Idling: | 4356.2 | 145.9 | Manageable Idle: | 819.1 | 43.5 |

Unsatisfied Parameters Preventing Shutdown (Hours)

| UNAVOIDABLE | | | | | |
|------------------|-------|------|------------------|------|-----|
| Ambient Temp: | 644.5 | 32.5 | Water Temp: | 55.9 | 0.0 |
| Dump Valve Temp: | 84.2 | 0.1 | High Water Temp: | 0.0 | 0.0 |

| MANAGEABLE | | | | | |
|------------------------|-------|------|------------------|------|-----|
| Brake Pressure: | 464.7 | 76.2 | Battery Voltage: | 0.0 | 0.0 |
| Battery Charging: | 142.8 | 0.1 | Extended Idle: | 14.7 | 0.0 |
| Reverser not Centered: | 280.8 | 0.0 | SS Switch Off: | 30.3 | 0.0 |
| System Override: | 132.6 | 0.7 | | | |

Reason(s) for Restart After SmartStart Shutdown (Counts) - Hotstart Shutdown (Counts)

| | | | | | |
|-----------------|-----|---|------------------|----|---|
| Brake Pressure: | 229 | 0 | Ambient Temp: | 18 | 0 |
| Water Temp: | 133 | 0 | Battery Voltage: | 0 | 0 |

GPS Latest Position.....

GPS Positions - Microsoft Internet Explorer

Address <http://lcco.ztr.com/GPSInfo.asp>

ZTR Control Systems - GPS Positions

2133

Reports | GPS | Help/Info | Home

Selected Unit Info

Unit ID:
Date:
Latitude:
Longitude:
Speed:
Heading:

Plotting Options

[View Latest Position](#)

[View All Positions](#)

Positions List

| Date | Longitude | Latitude |
|------------|-----------|----------|
| 2003-08-10 | -87.7169 | 41.8207 |
| 2003-06-10 | -87.7181 | 41.8207 |
| 2003-06-10 | -87.7181 | 41.8208 |
| 2003-06-06 | -87.7182 | 41.8203 |
| 2003-06-05 | -87.7184 | 41.8198 |
| 2003-06-02 | -87.7677 | 41.8372 |
| 2003-05-14 | -90.3795 | 40.9201 |
| 2003-03-25 | -87.7171 | 41.8204 |
| 2003-03-14 | -87.7057 | 41.8044 |
| 2003-02-24 | -87.7179 | 41.8208 |
| 2003-01-27 | -87.7659 | 41.8375 |
| 2003-01-27 | -87.7659 | 41.8374 |

Chicago Metro Area

2003-05-10
13-48.37

0 7122 M

Done Internet

GPS Historical View.....

GPS Positions - Microsoft Internet Explorer
Address: http://lcca.ztr.com/GPSInfo.asp

ZTR Control Systems - GPS Positions

2133

Reports | GPS | Help/Info | Home

Selected Unit Info

Unit ID:
Date:
Latitude:
Longitude:
Speed:
Heading:

Plotting Options

View Latest Position
View All Positions

Positions List

| Date | Longitude | Latitude |
|------------|-----------|----------|
| 2003-08-10 | -87.7169 | 41.8207 |
| 2003-06-10 | -87.7181 | 41.8208 |
| 2003-06-10 | -87.7181 | 41.8208 |
| 2003-06-06 | -87.7182 | 41.8203 |
| 2003-06-05 | -87.7184 | 41.8198 |
| 2003-06-02 | -87.7677 | 41.8372 |
| 2003-05-14 | -90.3796 | 40.9201 |
| 2003-03-25 | -87.7171 | 41.8204 |
| 2003-03-14 | -87.7057 | 41.8044 |
| 2003-02-24 | -87.7179 | 41.8208 |
| 2003-01-27 | -87.7659 | 41.8375 |
| 2003-01-27 | -87.7659 | 41.8374 |

Minneapolis-Saint Paul Metro Area
Milwaukee Metro Area
Chicago Metro Area

56 KM

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In closing, I would like to say that ZTR Control Systems has been in the business of making the reduction of emissions a win-win situation for locomotive owners and the environmental community, for over 15 years. We plan to stay the course and to offer solutions that will continue this tradition. Let us know how we can help.

Thank You

HAPPY

ST. PATRICKS

DAY

