



SMOOTH

IS

FAST

Flanders Electric

PROJECT INCEPTION

- CUSTOMER NEEDS

- OPEN ARCHITECTURE PLATFORM
- MACHINE OPTIONS TO MEET THEIR NEEDS
- INCREASED PERFORMANCE
- QUICKER TRANSFER TO AND FROM PROPEL
- SUPPLY OF NON-OEM DEPENDANT COMPONENTS
- MAINTENANCE IMPROVEMENTS
 - FEWER COMPONENTS
 - FEWER FAULTS



PROGRAM INCEPTION

FLANDERS NEEDS

- OPEN ARCHITECTURE FOR IMPLIMENTATION OF OUR MOTORS
- IMPLIMENTATION OF DCS CONTROL SCHEME
- CONTROL CONFIGURATION WITH A MIND TO THE FUTURE
- PARTS COMPATIBILITY AND AVAILABILITY



PROJECT TIMELINE

1ST ATTEMPT

• ABB SOLUTION

- REPROGRAM EXISTING DRIVES
- DRIVES PROVED TO BE INCOMPATIBLE WITH OUR CONTROL SCHEME.
- TOO LONG TO CHANGE MACROS
- LITTLE OR NO ABILITY TO CONFIGURE THEM WITHOUT THE AC-80 OR SOME OTHER OVER RIDING CONTROL DEVICE



PROJECT TIMELINE

2ND ATTEMPT

- SIEMENS SOLUTION
 - PROVIDED OPEN ARCHITECTURE AND PARTS SUPPORT
 - WORKED VERY WELL IN THE LAB AND IN THE SHOP
 - WORKED VERY WELL IN THE FIELD UNTIL WE RAN OUT OF KVAR FOR COMPENSATION OF POWER FACTOR



PROJECT TIMELINE

SUCCESS AT LAST!

3RD ATTEMPT

- AVTRON SOLUTION

- PROVIDED ALL REQUIRED BENEFITS
- SENT LEAD DESIGN ENGINEERS TO THE FIELD TO DESIGN FIRMWARE AND SOFTWARE ON THE FLY
- PROVIDED OPPORTUNITY FOR FUTURE UPGRADES



INSTALLATION (AVTRON)

SCOPE OF WORK

1. INSTALL 3 AVTRON FIRING MODULES
2. INSTALL 48 PULSE TRANSFORMERS
3. INSTALL 3 FEEDBACK BOARDS
4. REWRITE CONTROL LOGIC TO ACCOMMODATE NEW CONTROLLERS
5. FIELD TEST AND COMISSION THE DRIVES



SOUNDS EASY,
RIGHT?



INSTALLATION

WE HAD 7 DAYS TO COMPLETE THE PROJECT OR PUT IT BACK TO THE ORIGINAL ABB SYSTEM!

48 OF THESE PULSE TRANSFORMERS

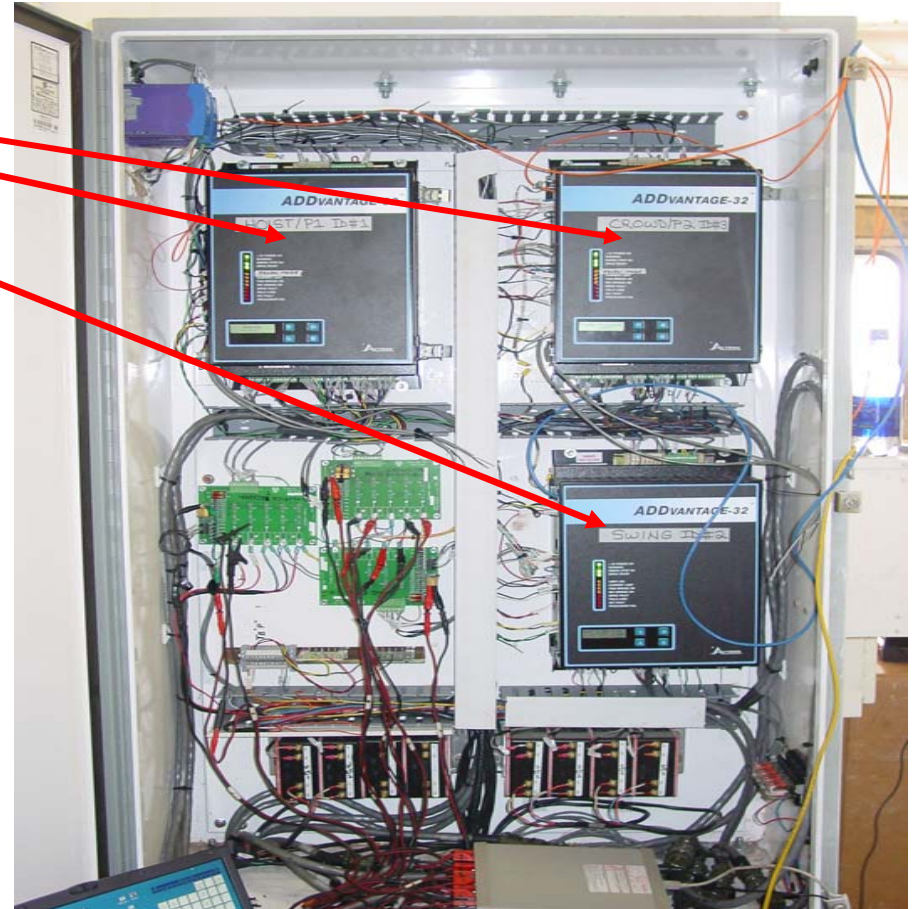
THIS ONE BOARD REPLACES 5 PARTS AND REMOVES MORE THAN 10 CONNECTION POINTS!



INSTALLATION

THREE AFM'S

THESE THREE AFM'S REPLACE 4 ABB
CONTROLLERS!

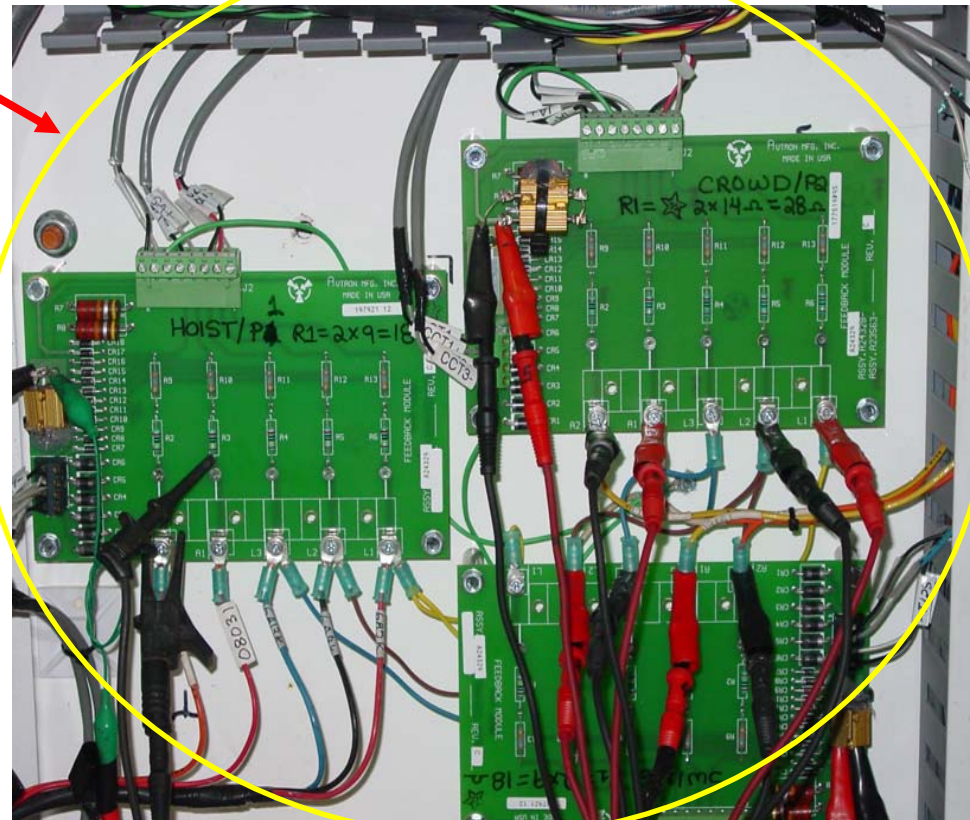


INSTALLATION

THREE OF THESE FEEDBACK BOARDS

- EACH BOARD PROVIDES VOLTAGE AND CURRENT FEEDBACK FOR EACH MOTION

EACH BOARD TAKES THE PLACE OF ALL FEEDBACK RESISTORS, FEEDBACK PANELS, ...



INSTALLATION

EXPANSION OF SLC RACK

- NO NON-ACCESSIBLE AC-80
- EVERY SIGNAL IS TROUBLE-SHOOTABLE BY AVERAGE MINE ELECTRICIAN
- HARDWARE IS AVAILABLE EVERYWHERE ON EARTH (WE ARE WORKING ON THE REST OF THE GALAXY)

NO CLOSED ARCHITECTURE!!



SETUP



SETUP



SETUP

WHAT MAKES ONE CAR FAST, AND THE OTHER SLOWER?

1. TRAINING (PRACTICE/EXPERIENCE)
2. HORSEPOWER

3. BALANCE!!!!!!



SETUP

- SPENT 5 DAYS OBTAINING A PERFECT BALANCE OF MOTIONS

- CROWD
- SWING
- HOIST

VERY EASY TO ADJUST

OPEN
ARCHITECTURE



SETUP

HORSEPOWER + TRAINING +
BALANCE =

SPEED!!!!

PERFORMANCE

1. TRANSFER CYCLE TIMES
 - LESS THAN 2 SECONDS TO AND FROM PROPEL
2. HOIST SPEED
 - JUST OVER 1000 RPM
3. CROWD SPEED
 - MATCHED TO HOIST
4. SWING SPEED
 - SLIGHT INCREASE IN TOP SPEED WITH SMOOTHER ACCEL AND DECEL RATES



PERFORMANCE

OPERATOR TESTIMONIAL

“THIS MACHINE IS TOO SLOW”

SAME OPERATOR WAS SHOWN HIS
CYCLE TIMES FOR 3 PREVIOUS TRUCKS:

TRUCK 1: 27, 24, 18

TRUCK 2: 23, 24, 22

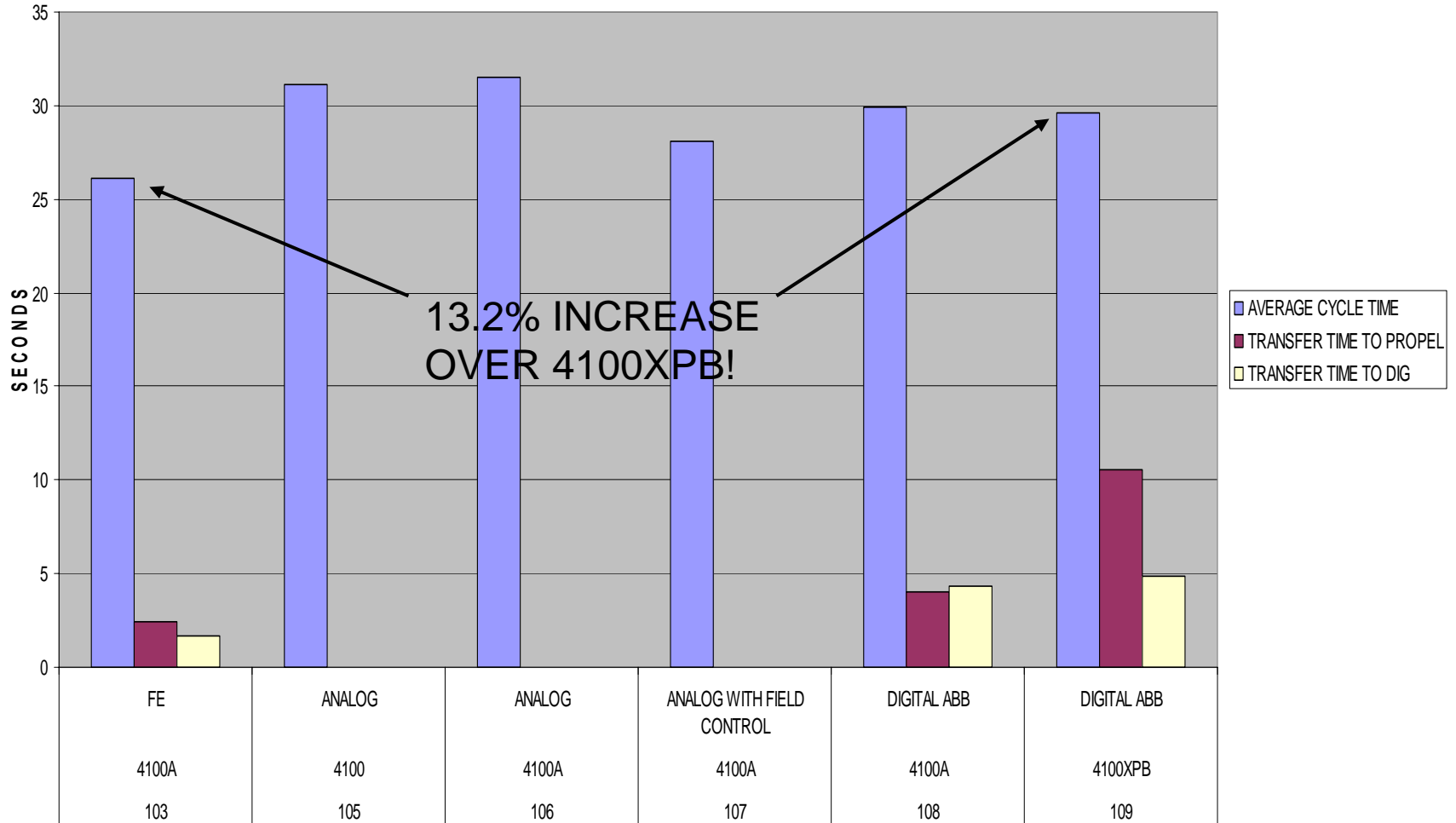
TRUCK 3: 24, 28, 21

AVERAGE CYCLE TIME: 23.4 SECONDS!



PERFORMANCE DATA

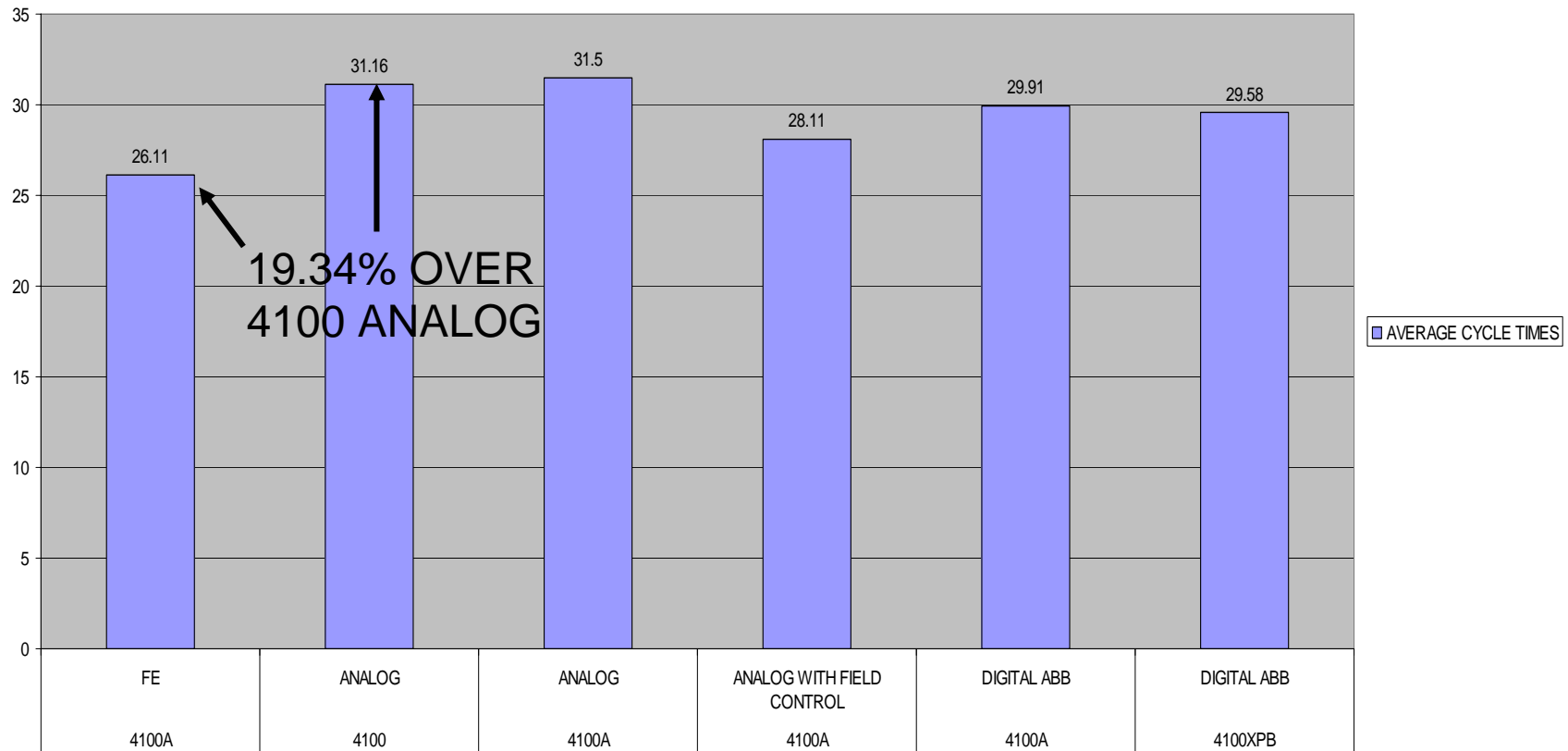
RAW DATA



PERFORMANCE DATA

AVERAGE CYCLE TIMES

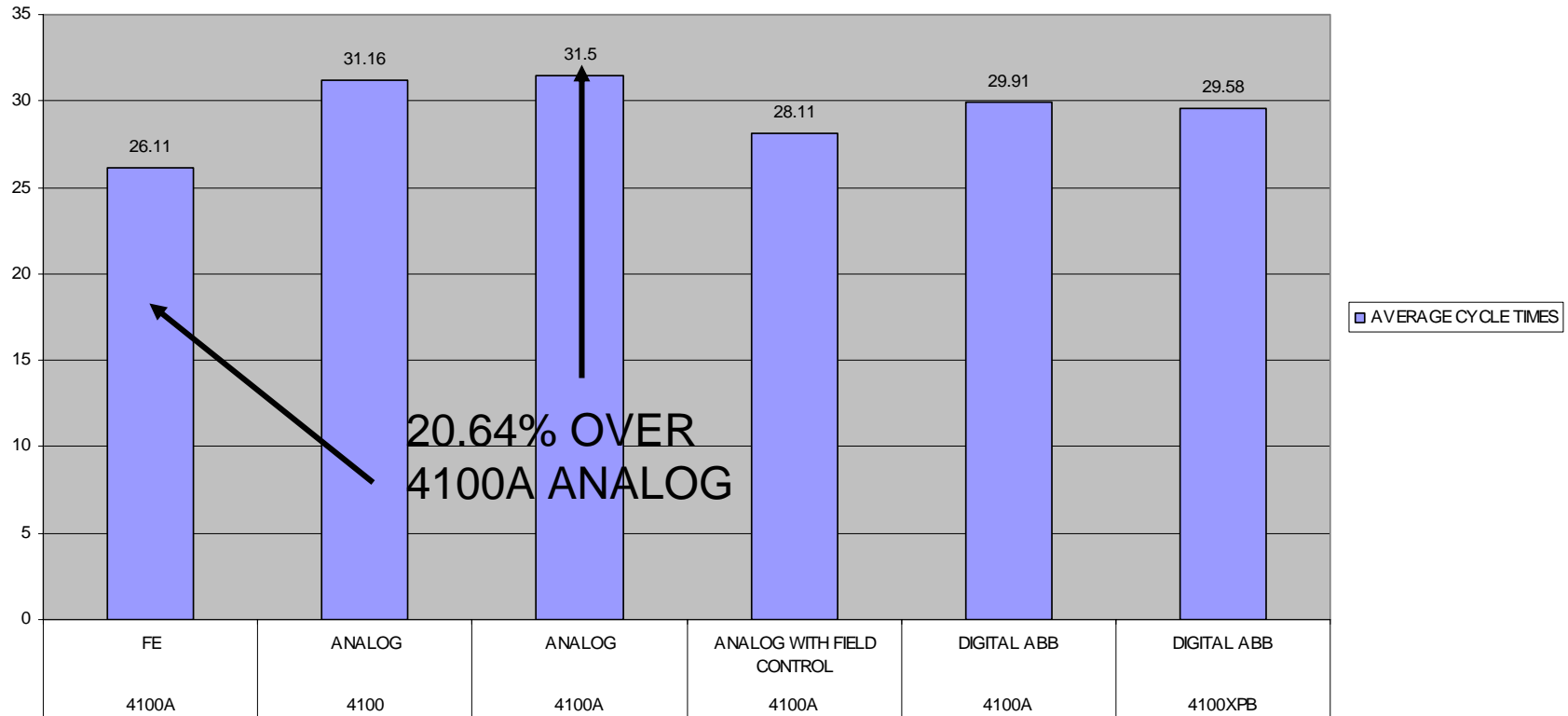
AVERAGE CYCLE TIMES



PERFORMANCE DATA

AVERAGE CYCLE TIMES

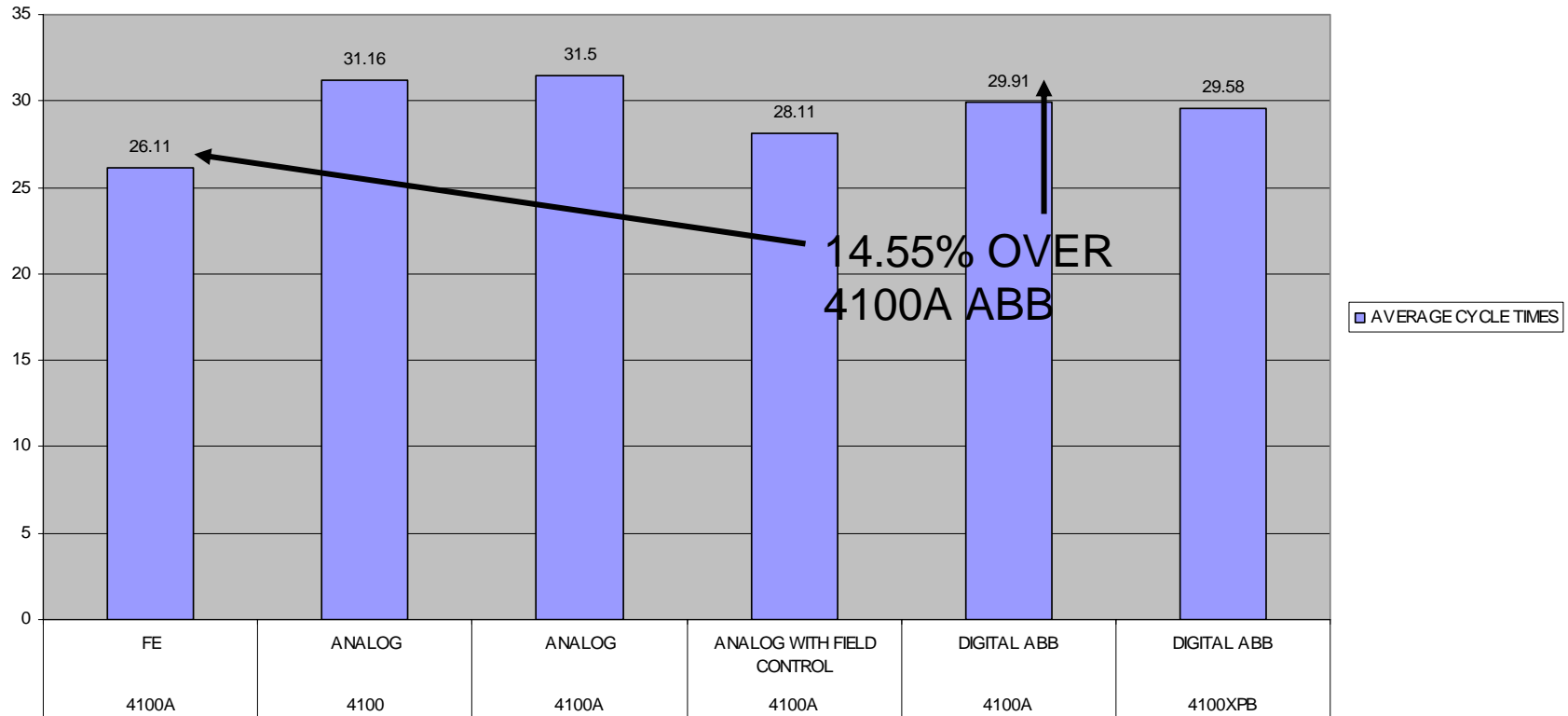
AVERAGE CYCLE TIMES



PERFORMANCE DATA

AVERAGE CYCLE TIMES

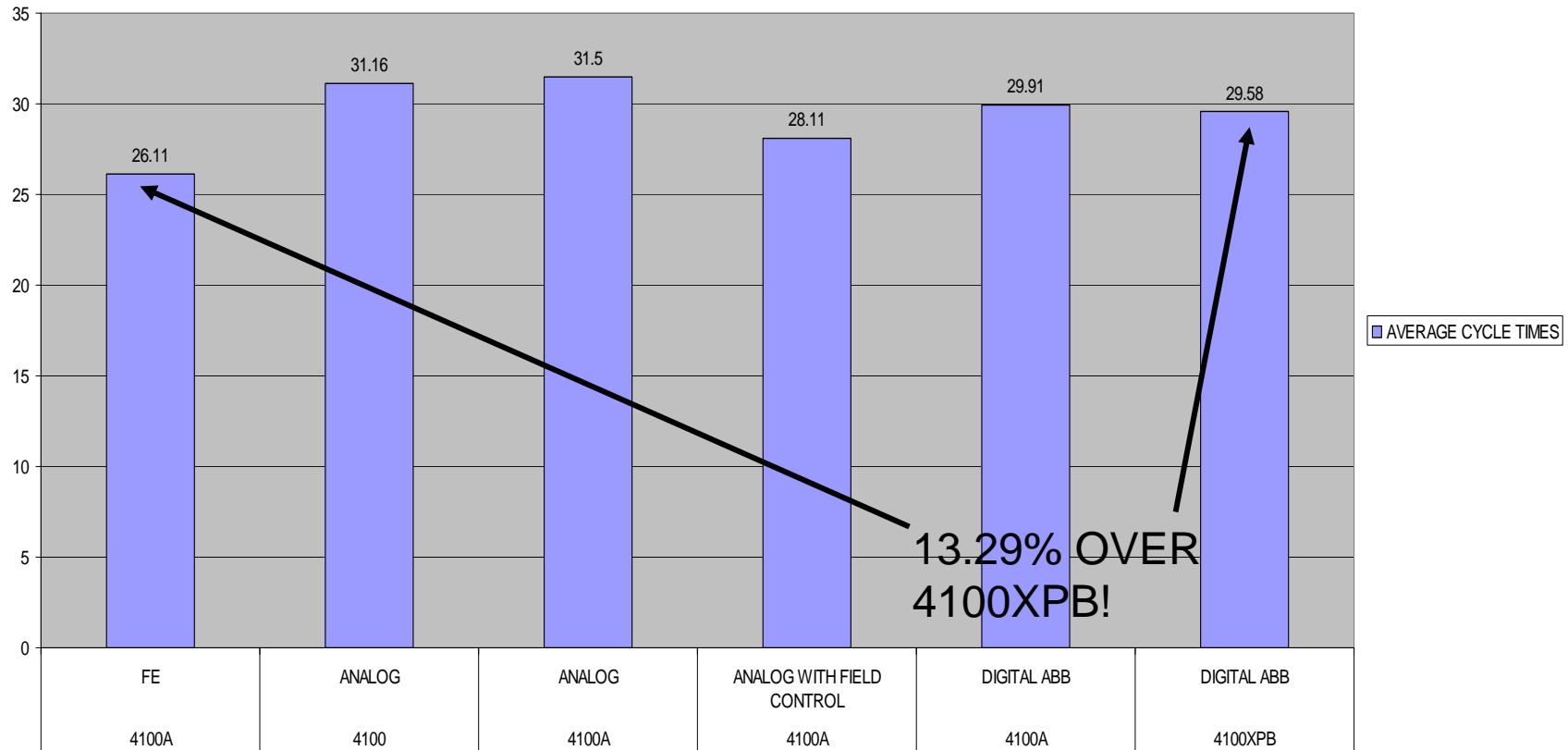
AVERAGE CYCLE TIMES



PERFORMANCE DATA

AVERAGE CYCLE TIMES

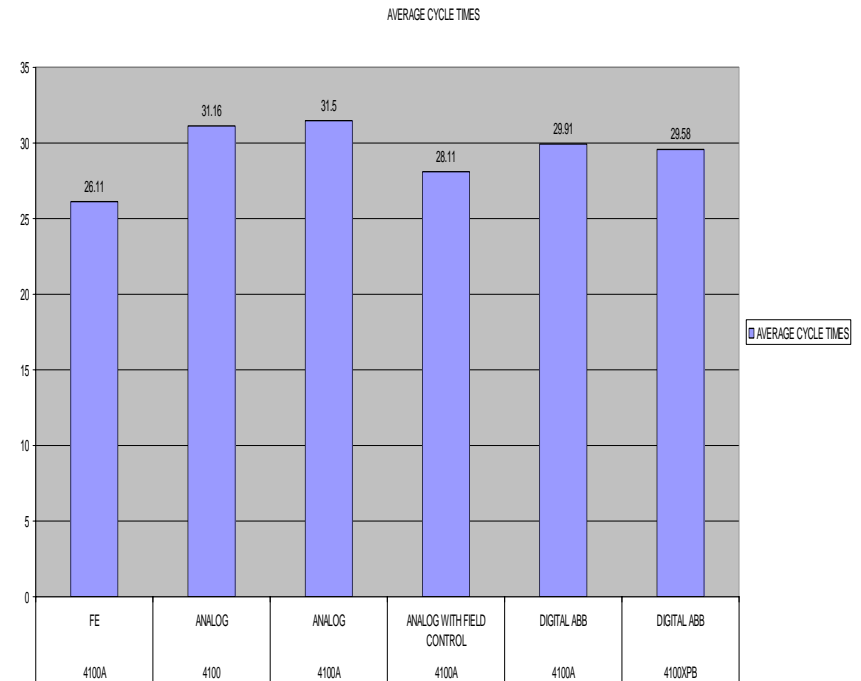
AVERAGE CYCLE TIMES



PERFORMANCE DATA

CYCLE TIME DECREASE:

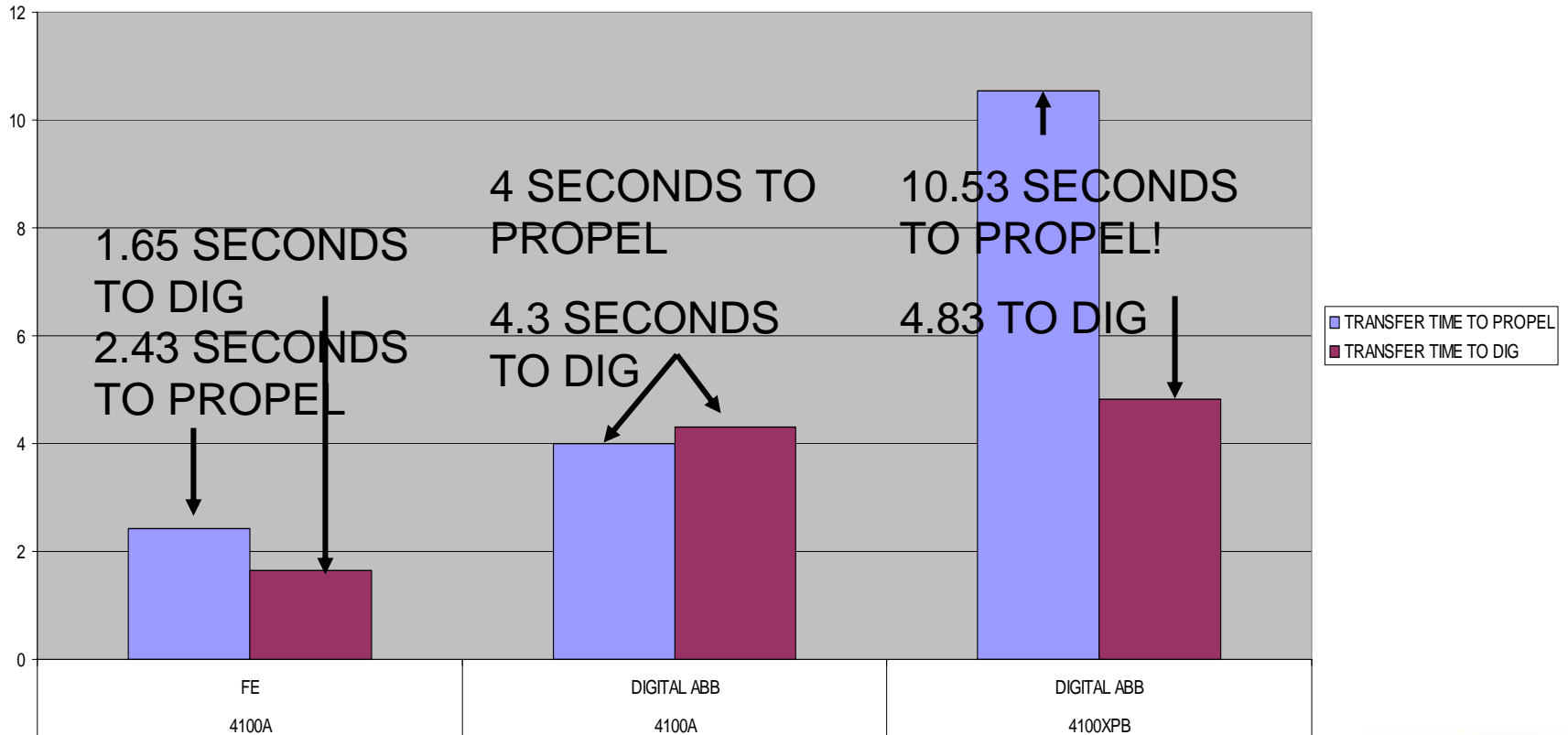
1. 20.64% OVER 4100A ANALOG
2. 14.55% OVER 4100A ABB
3. 13.29% OVER 4100XPB!!!!



PERFORMANCE DATA

TRANSFER TIME ANALYSIS

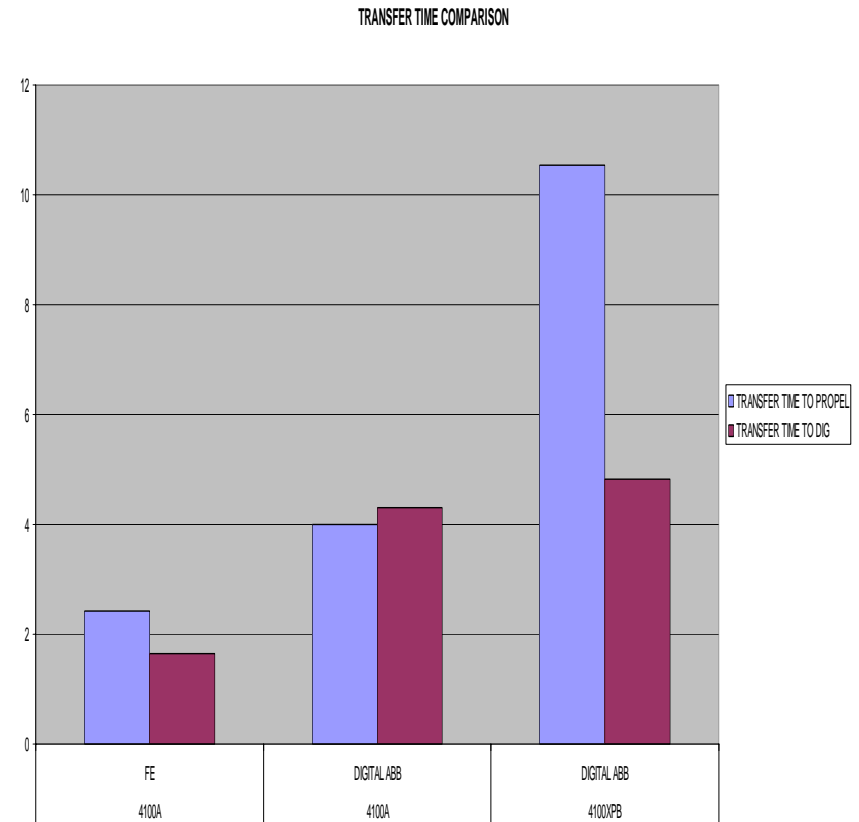
TRANSFER TIME COMPARISON



TRANSFER TIME ANALYSIS

TRANSFER TIMES

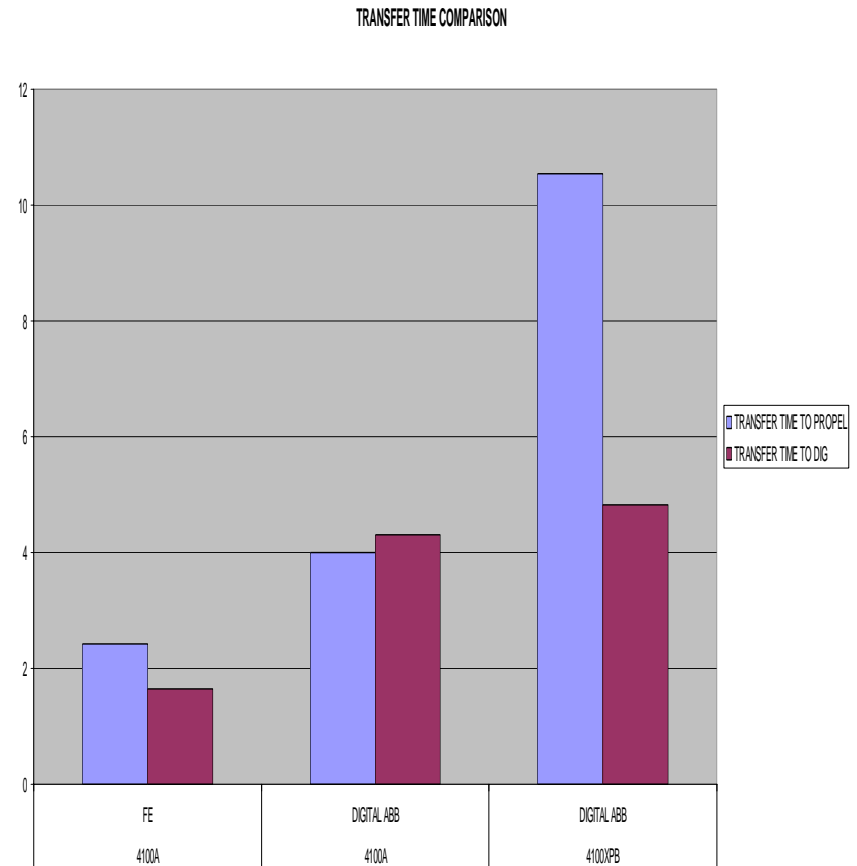
1. 433% FASTER FROM DIG TO PROPEL THAN 4100XPB
2. 164% FASTER FROM DIG TO PROPEL THAN 4100A WITH ABB CONTROL
3. 293% FASTER FROM PROPEL TO DIG THAN 4100XPB
4. 261% FASTER FROM PROPEL TO DIG THAN 4100A WITH ABB CONTROL



TRANSFER TIME ANALYSIS

TRANSLATED TO TIME:

1. 8.1 SECONDS FASTER FROM DIG TO PROPEL THAN 4100XPB
2. 3.2 SECONDS FASTER FROM PROPEL TO DIG THAN 4100XPB
3. YOU LOOSE 11.28 SECONDS EVERY TIME YOU NEED TO PROPEL
4. 1.57 SECONDS FASTER FROM DIG TO PROPEL THAN 4100A ABB
5. 2.65 SECONDS FASTER FROM PROPEL TO DIG THAN 4100A ABB
6. YOU LOOSE 4.2 SECONDS EVERY TIME YOU NEED TO PROPEL



TRANSFER TIME

CASE STUDY

- YOU LOAD 300 TRUCKS PER SHIFT
- YOU WALK EVERY 5 TRUCKS
- THAT IS 60 TIMES PER SHIFT
- 4100 XPB 11.28 SECONDS LOST EVERY TIME
 - THAT IS 677 SECONDS LOST TO TRANSFER
 - = 22.88 CYCLES (ROUGHLY 7.62 TRUCKS PER SHIFT)
- 4100A WITH ABB CONTROL 4.22 SECONDS LOST EVERY CYCLE
 - THAT IS 253 SECONDS LOST TO TRANSFER
 - = 8.5 CYCLES (ROUGHLY 2.8 TRUCKS PER SHIFT)

TOTAL PERFORMANCE

BALANCE CONTROL + RAPID TRANSFER =

1. 4100 XPB (BASED ON 12 HOUR DAY, PROPEL EVERY 5 TRUCKS, AVERAGE CYCLE TIME OF XPB, ASSUMING EVERYONE PROPELS ABOUT THE SAME AMOUNT OF TIME)
 - BASED ON THE ABOVE ASSUMPTION, MACHINE SHOULD LOAD ABOUT 470 TRUCKS PER SHIFT
2. 4100A ABB (BASED ON SAME ASSUMPTIONS AS ABOVE)
 - MACHINE SHOULD LOAD ABOUT 472 TRUCKS PER SHIFT
3. 4100A WITH FLANDERS CONTROL (BASED ON SAME ASSUMPTIONS AS ABOVE)
 - MACHINE SHOULD LOAD ABOUT 546 TRUCKS PER SHIFT
 - 13.8% MORE THAN 4100XPB OR 75 MORE TRUCKS!
 - 13.4% MORE THAN 4100A WITH ABB CONTROL OR 73 MORE TRUCKS!

THANK YOU



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QUESTIONS?

