Reinhold Environmental Ltd.

2006 APC Round Table & Expo Presentation

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Electrostatic Precipitator Control Basics

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Electrostatic Precipitator Control Basics

Transformer Rectifier (TR) controls

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Electrostatic Precipitator Control Basics

Rapper controls

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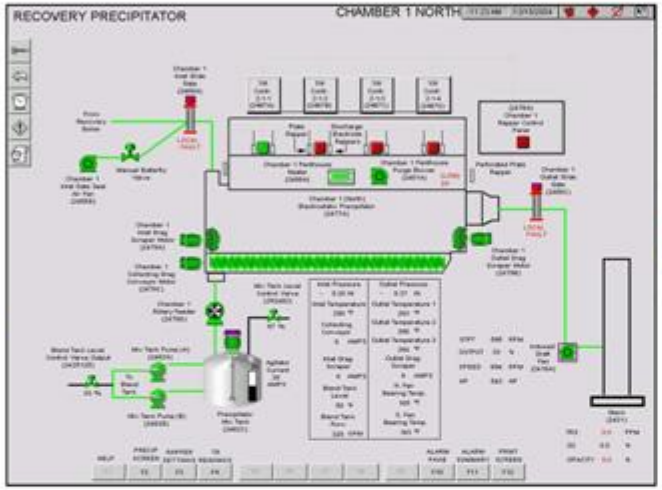
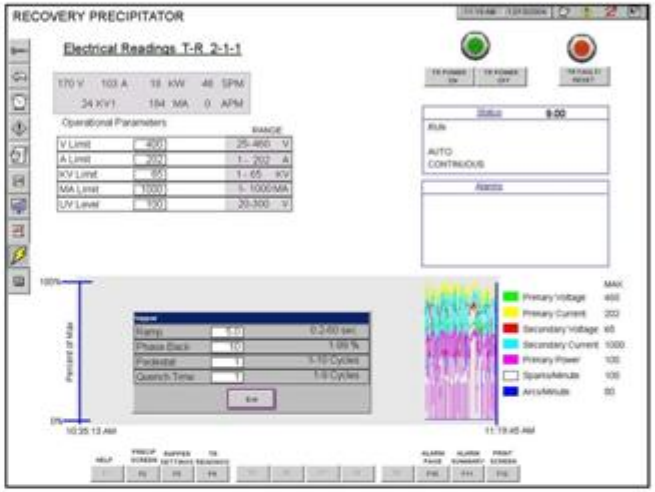
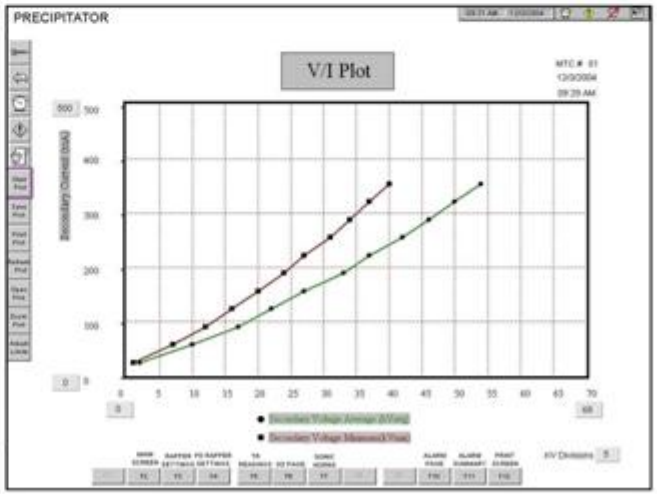
Electrostatic Precipitator Control Basics Central controls







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Purpose of a Transformer Rectifier Control System

- To provide a source of negative high voltage direct current to one or more groups of discharge electrodes in an electrostatic precipitator.
- To monitor and maximize the high voltage in an effort to derive the highest collection efficiency and lowest outlet emissions under varying process and precipitator conditions.

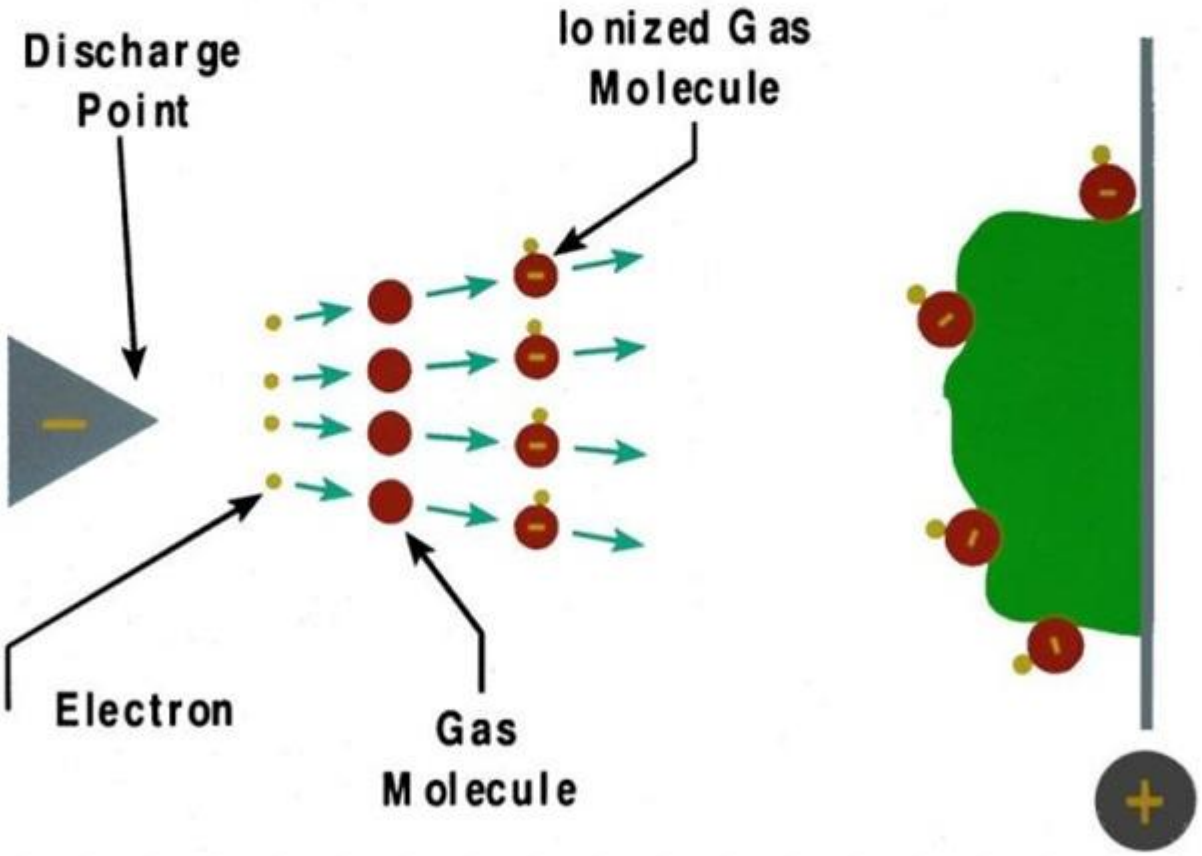
Electrical Ratings

- Input voltage
  - 380 to 575 VAC
  - 50/60 Hz, single phase
- Output voltage
  - 35 to 110 kV DC
- Output current
  - 250 to 3000 mA DC

Major Components

- Control Cabinet
- Control electronics
- Power and safety devices
- Current limiting reactor (CLR)
- Transformer-rectifier (TR)

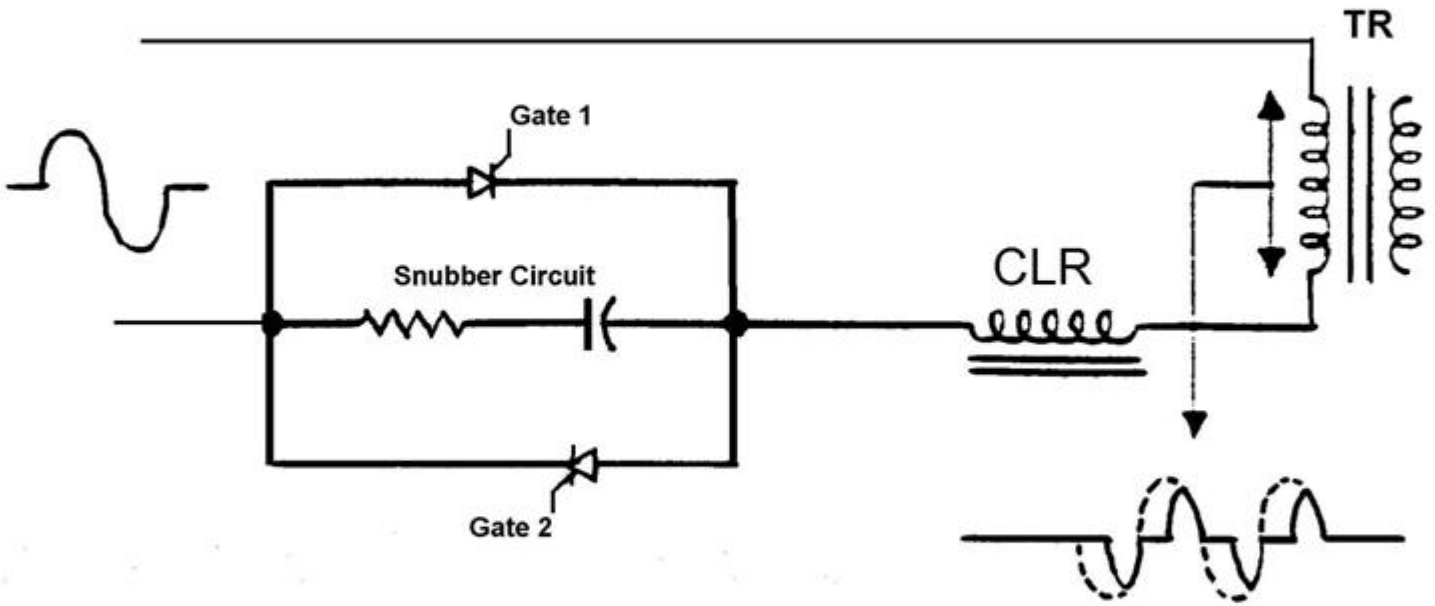
Particle Charging



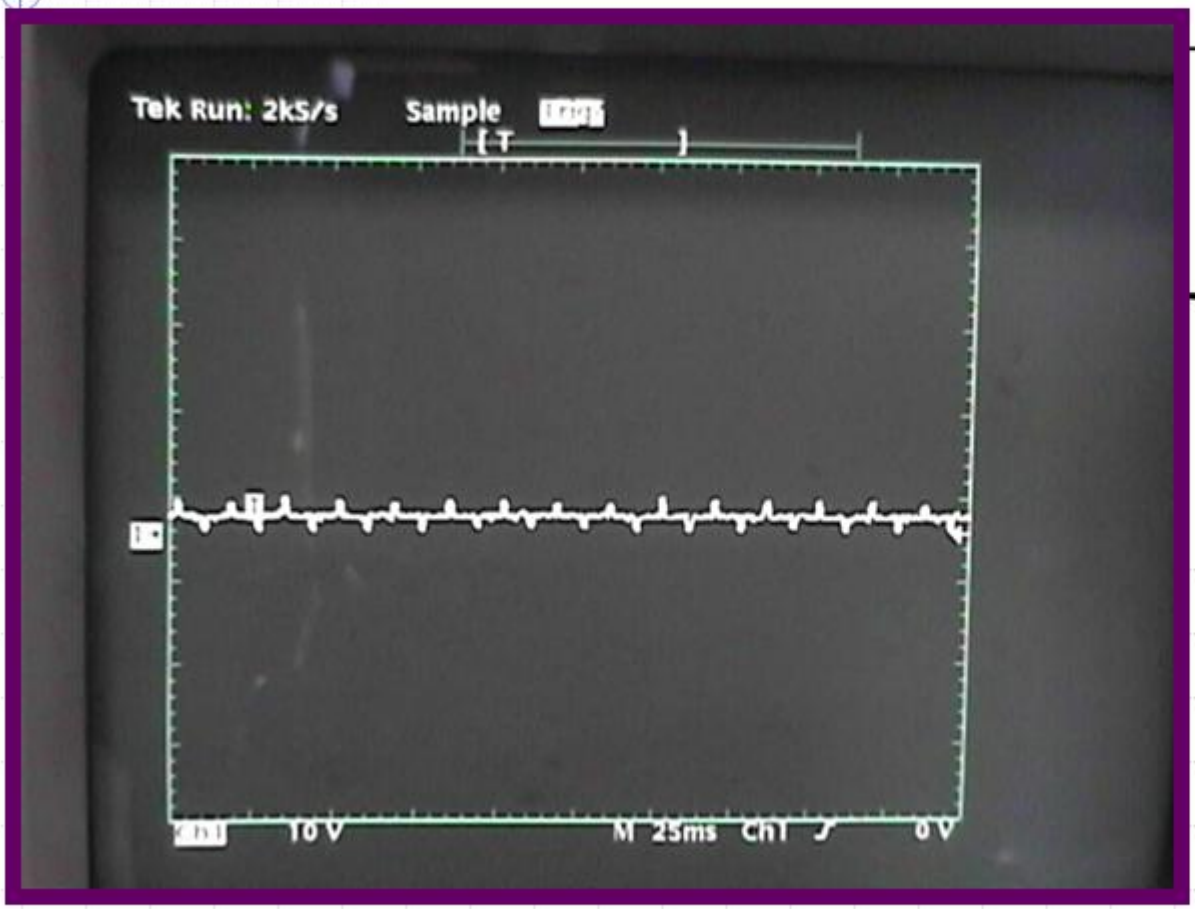
A TR Control Must

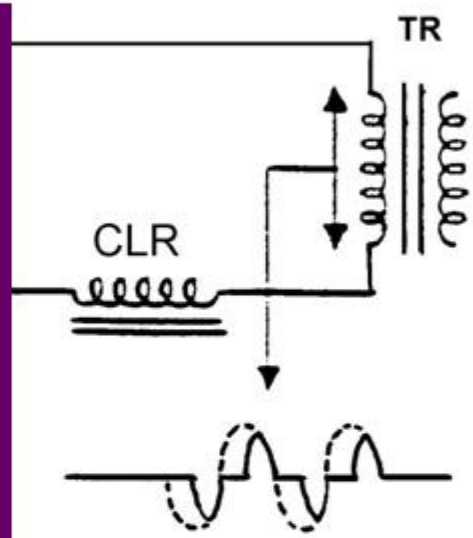
- Sense changes and disruptions in the precipitator
- Automatically adjust power
- Protect system components
- Reduce stress on the TR

SCR Assembly Function

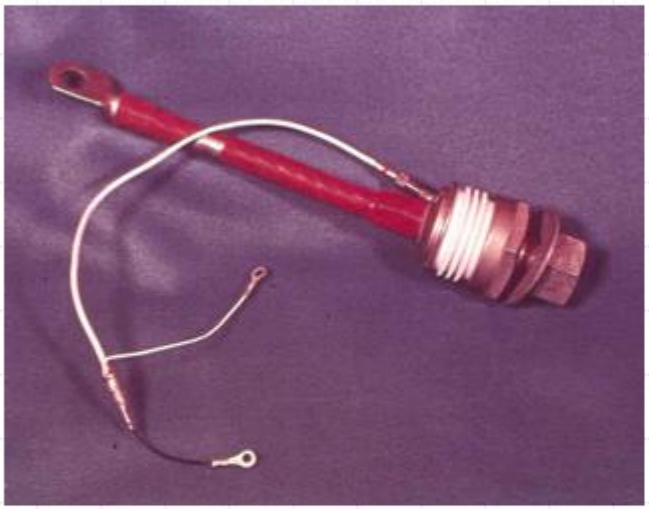


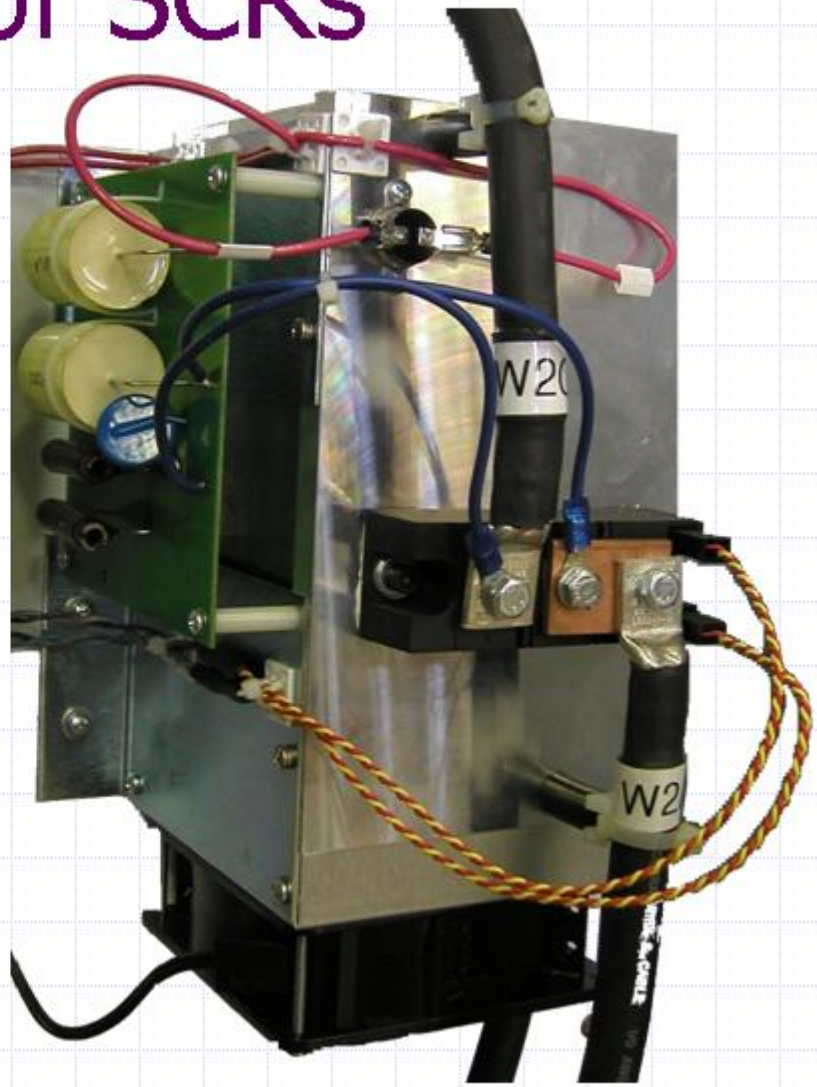
SCR Assembly Function



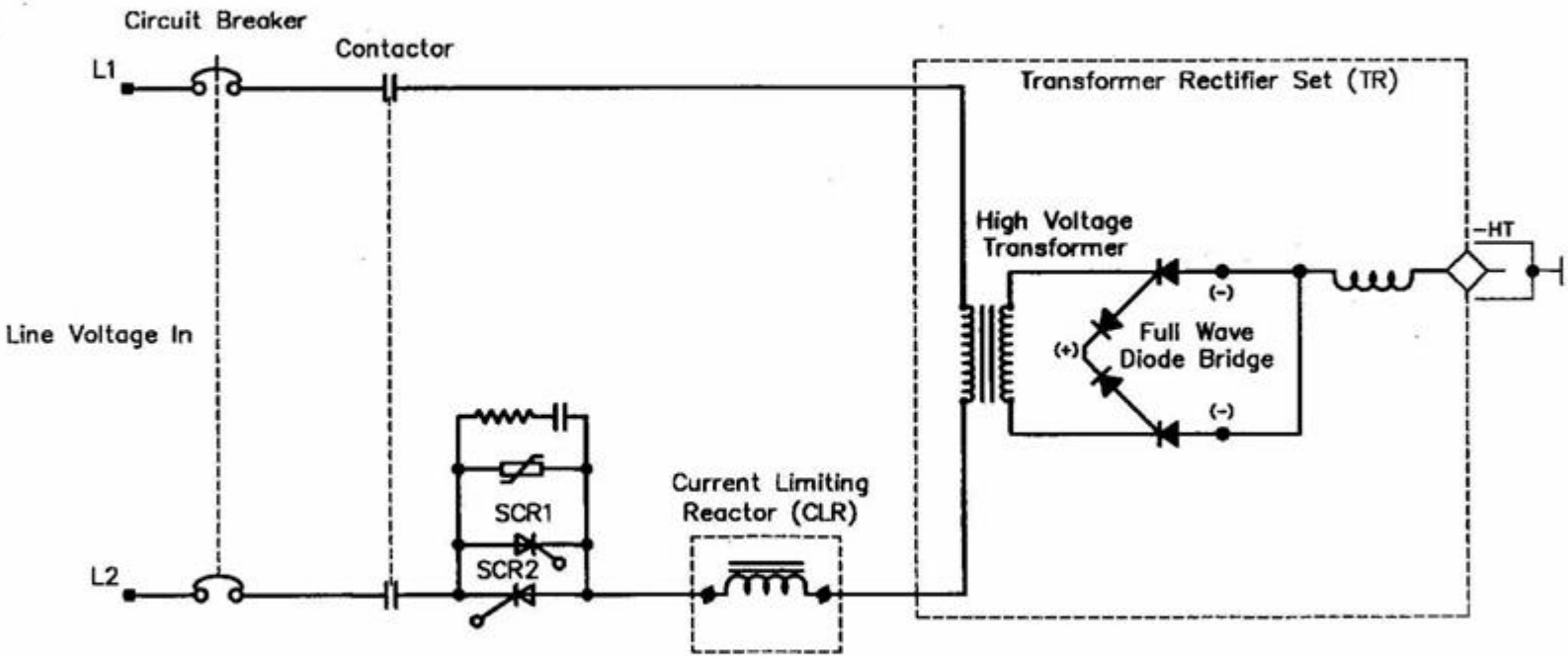


Types of SCRs

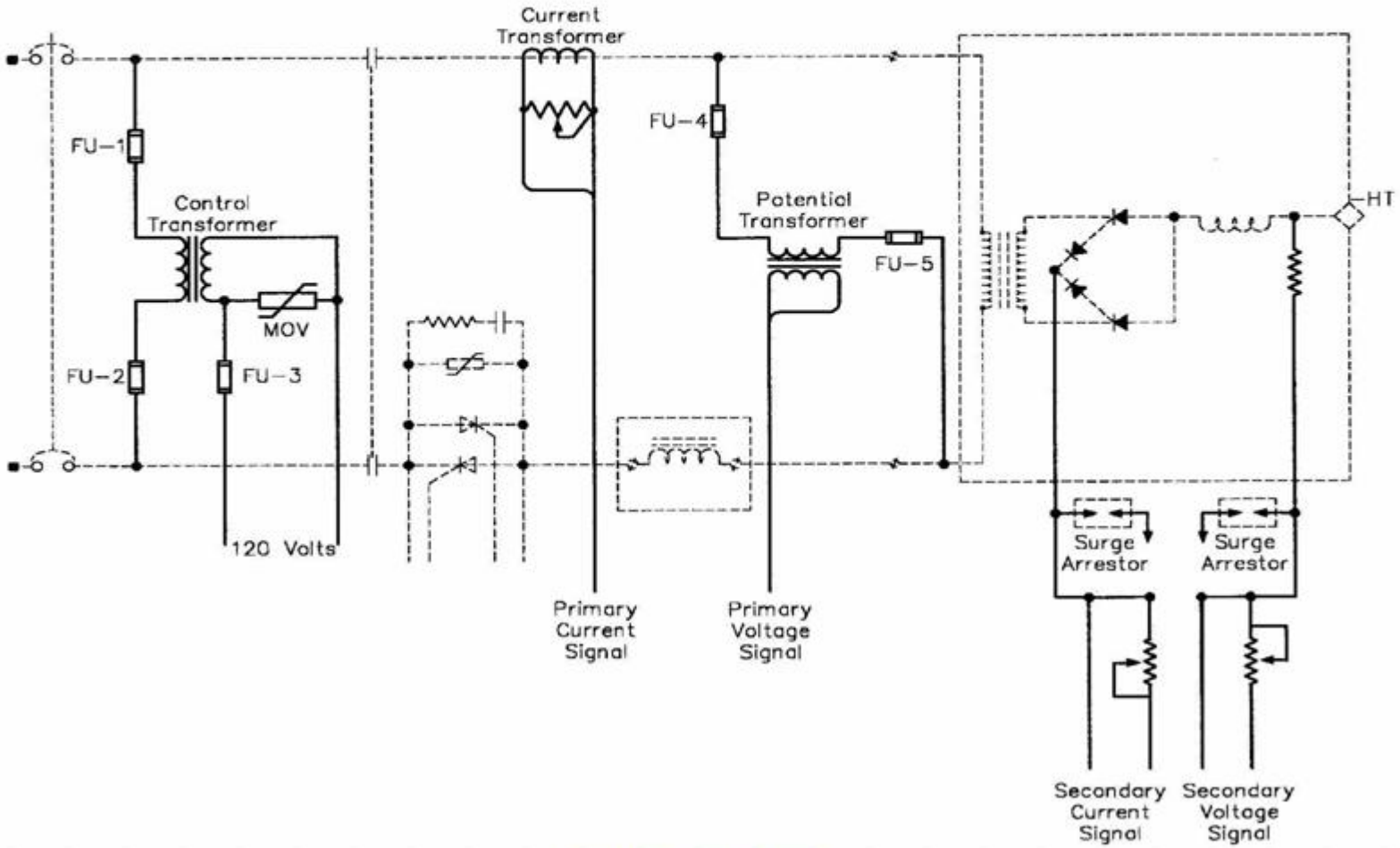




Schematic 1


Circuit Breaker
Contactor
L1
Transformer Rectifier Set (TR)
High Voltage
Transformer
-HT
(-)
Full Wave
Diode Bridge
(+)
(-)
Line Voltage In
SCR1
SCR2
Current Limiting
Reactor (CLR)
L2

Schematic 2


Current Transformer
FU-1
FU-4
Control Transformer
Potential Transformer
FU-5
HT
MOV
FU-2
FU-3
120 Volts
Surge Arrestor
Surge Arrestor
Primary Current Signal
Primary Voltage Signal
Secondary Current Signal
Secondary Voltage Signal

Typical Microprocessor Components

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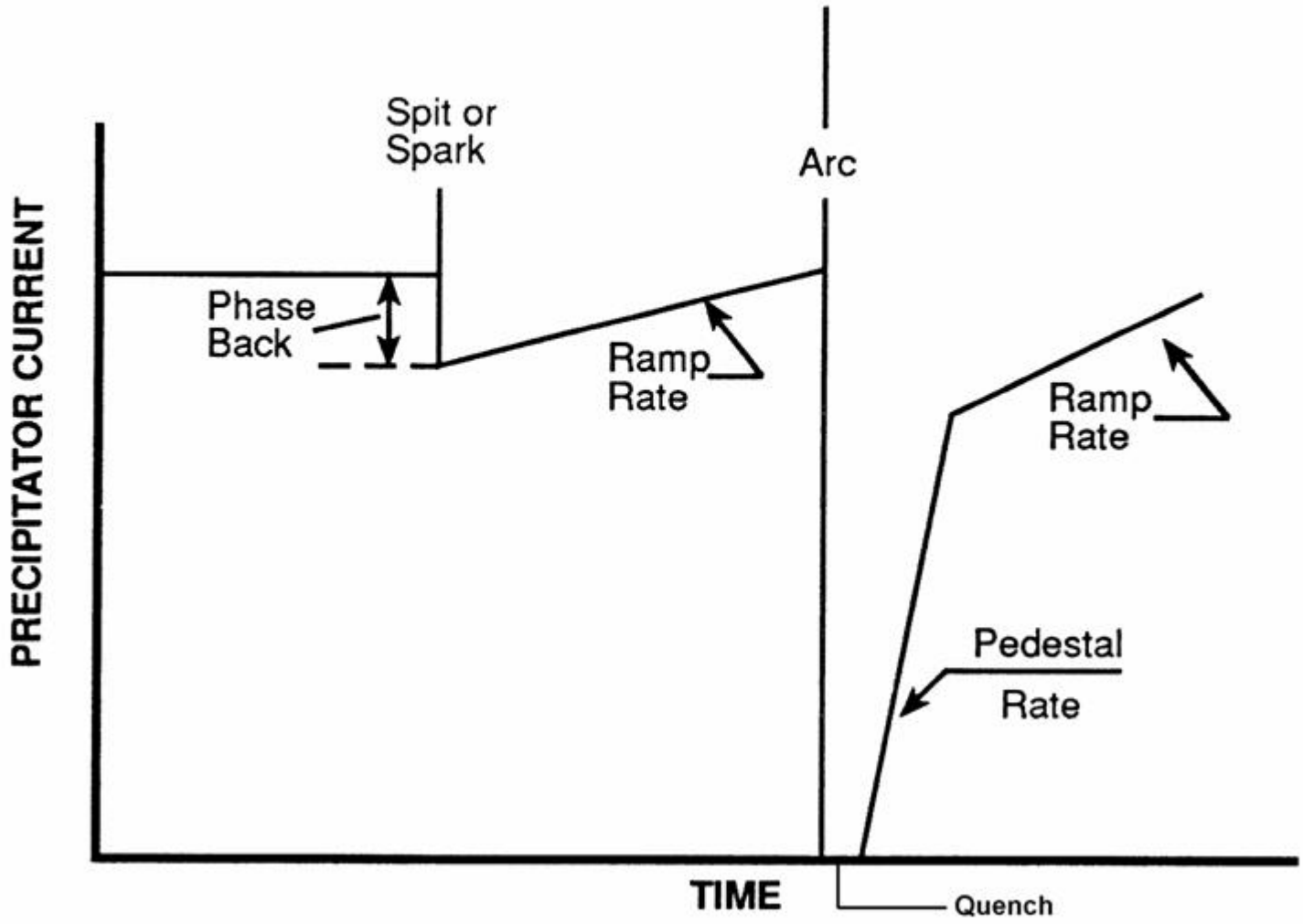
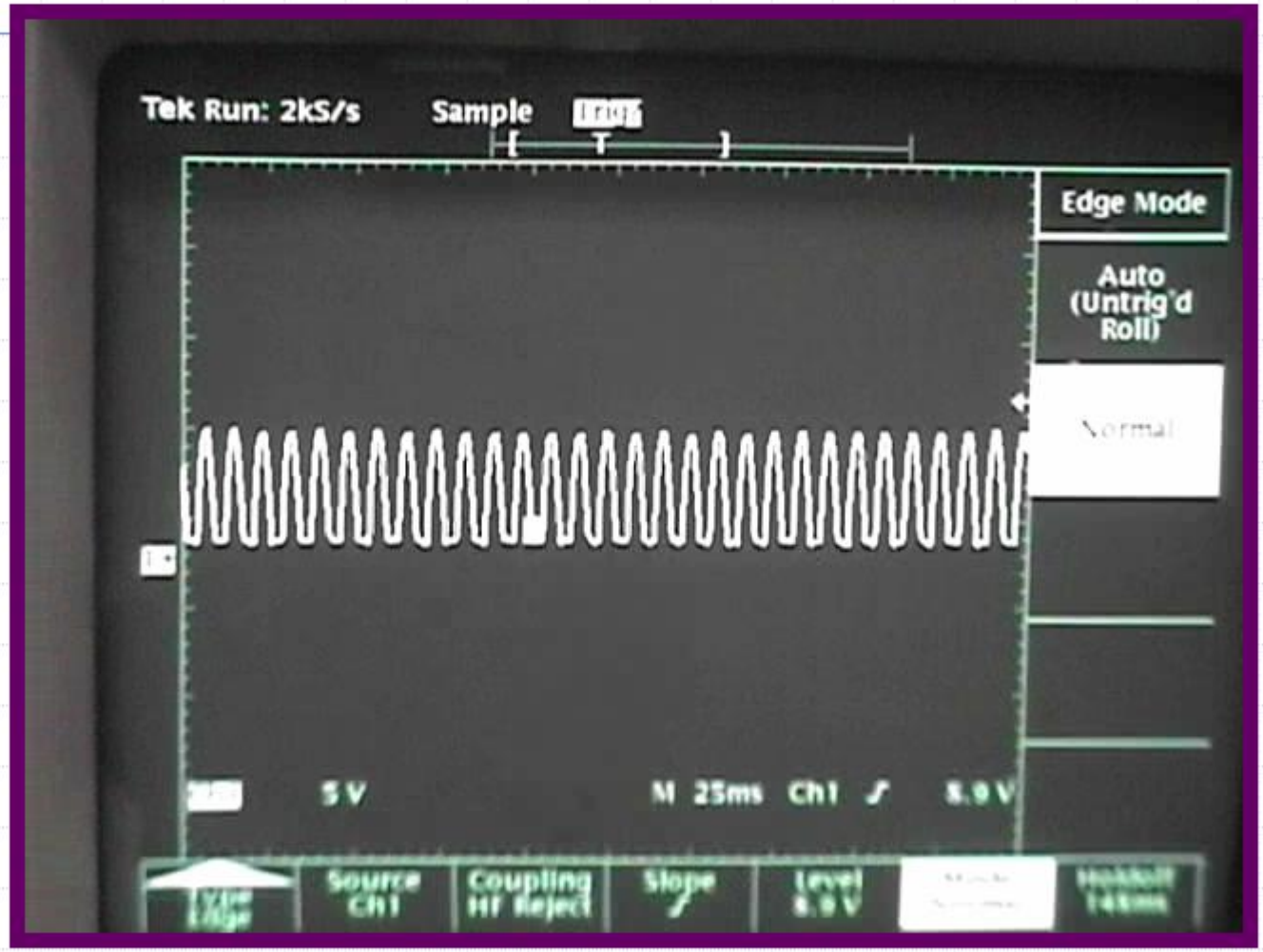
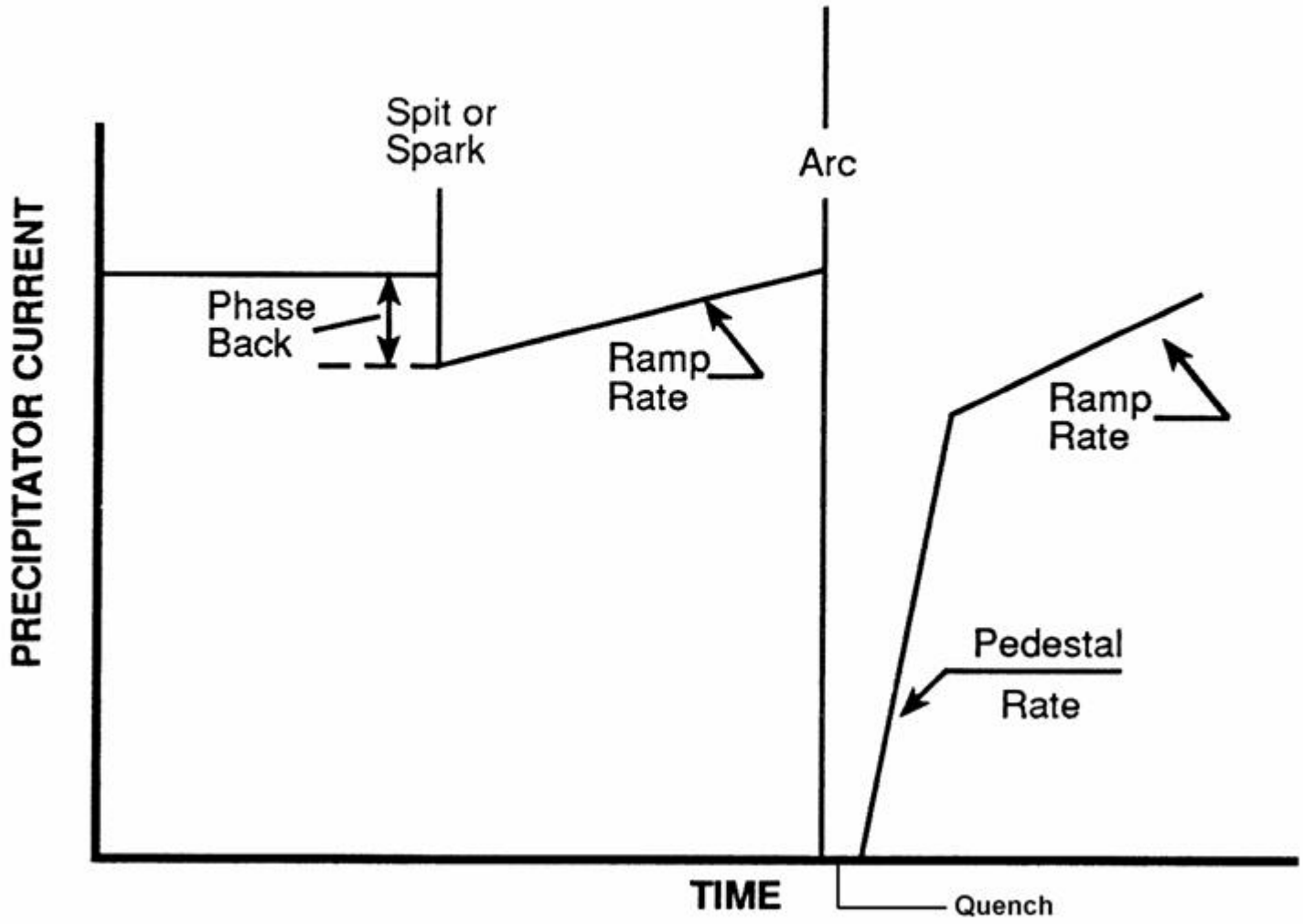
Typical Control Response



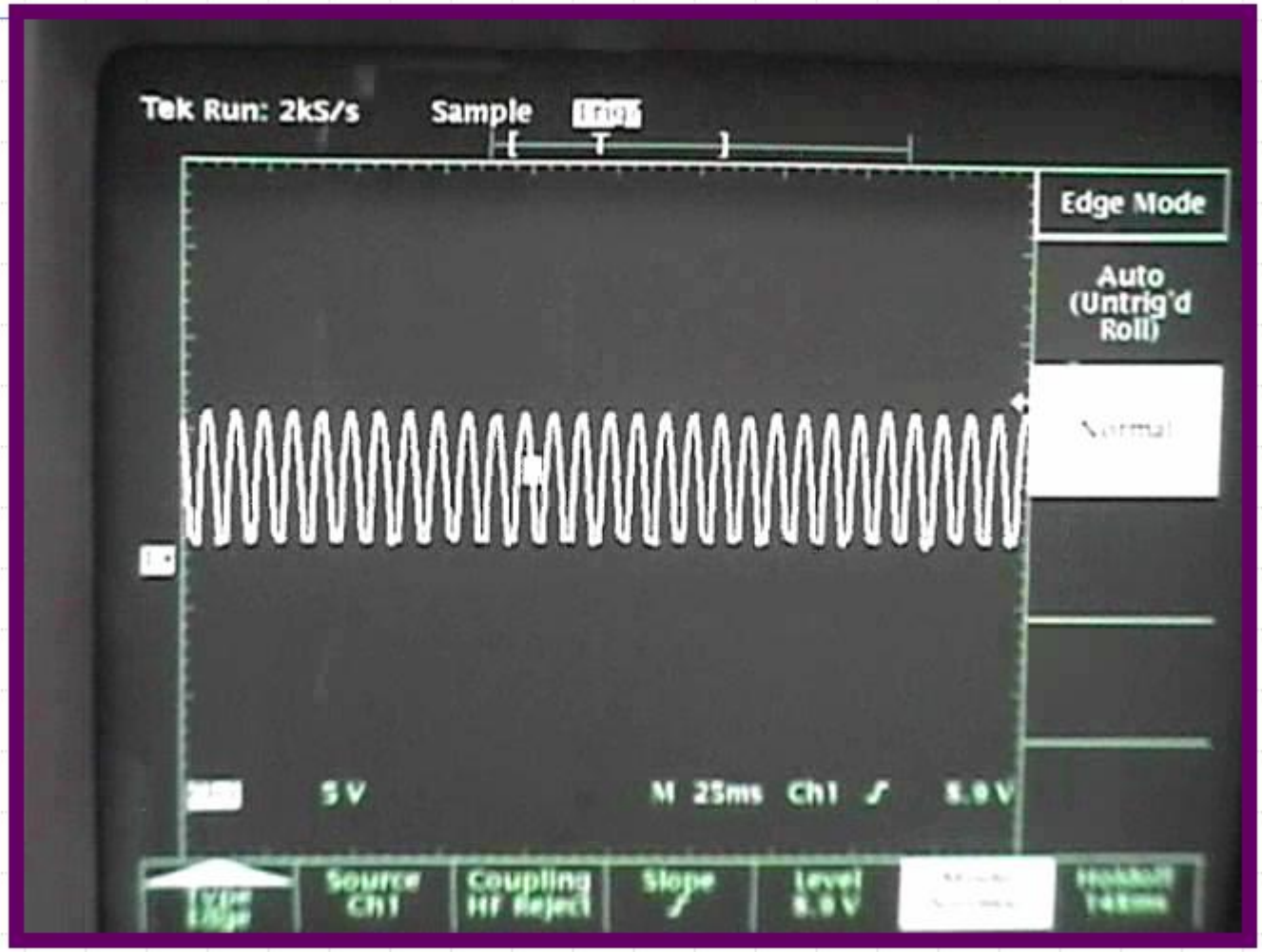
Typical Control Response seen on MA Signal



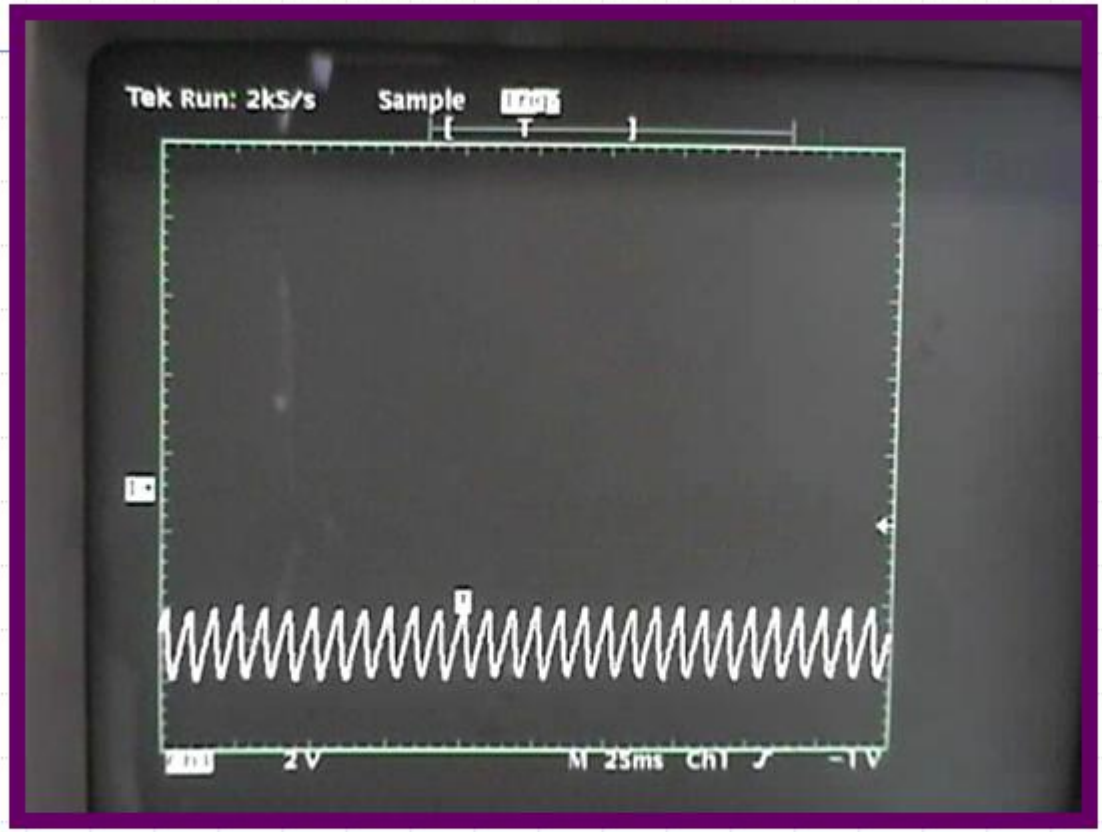
Typical Control Response



Typical Control Response seen on MA Signal



False Control Response – seen on KV Signal



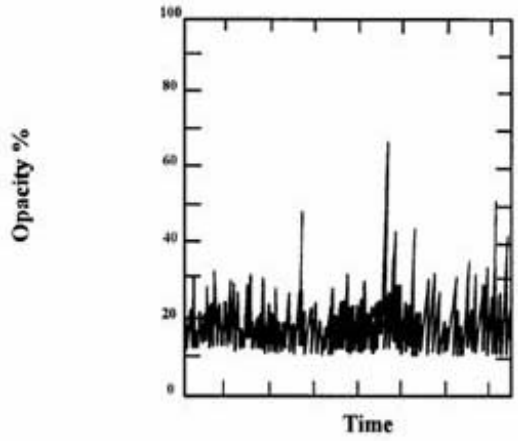
KV Signal "Negative" rises to zero on "Control Response"

Fundamental Control Functions

- Control & Maximize power to the precipitator.
- Detect abnormal conditions and alarm or trip
  - Electronic control malfunctions – "Overcurrent Trip"
  - System alarms – "TR High Temperature"
  - ESP conditions – "Under voltage Trip"
- Limit the electrical levels to the rating of the TR set.

Fundamentals of a Rapper Control System

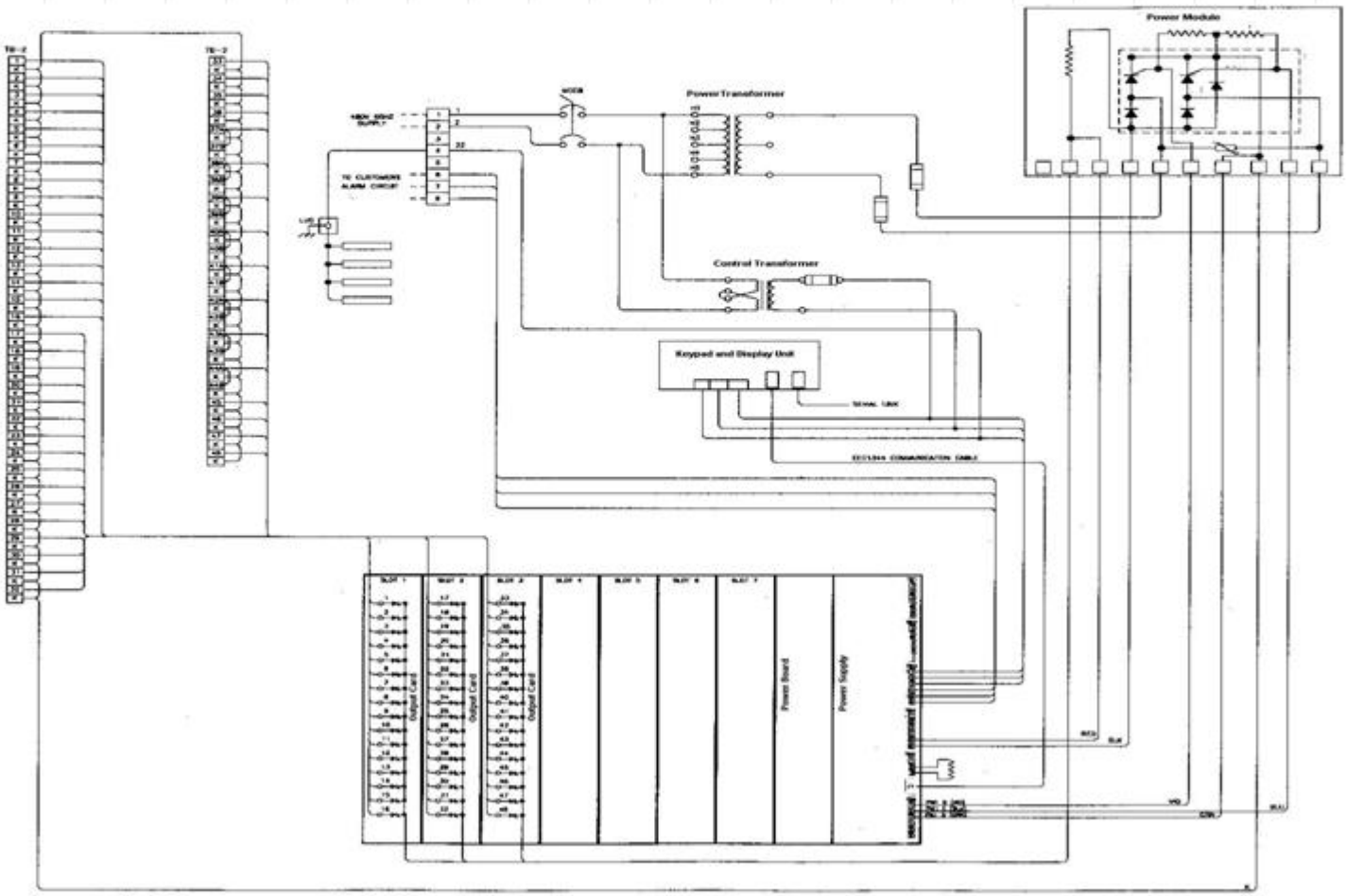
- Energize rappers, electric vibrators, and air solenoids.
- Change the frequency and duration of energization.
- Change the intensity and number of impacts.
- Identify faulty devices and type of fault



Advanced requirements of a Rapper Control System

- Storage of multiple programs to suit various operating conditions.
- Allow inputs from external sources to optimize rapper operation.
- Allow serial communications with TR controls for reduced and off power rapping

Typical Rapper System



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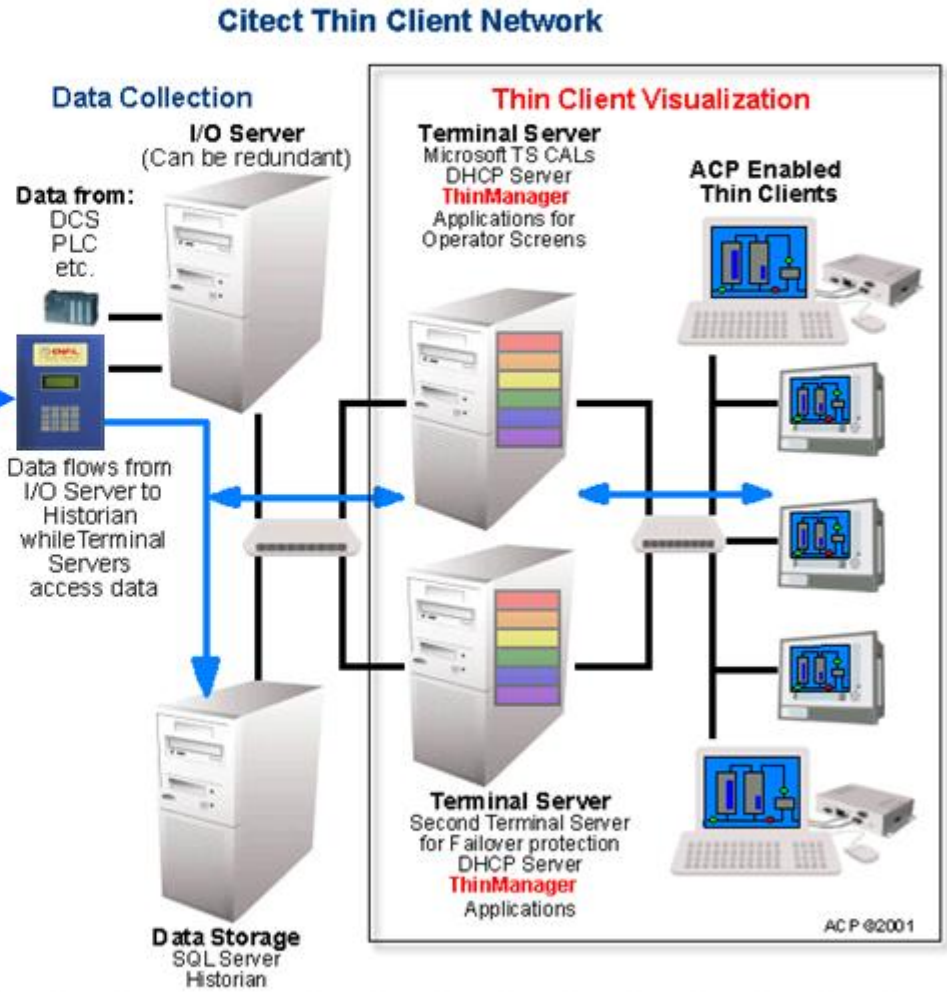
Functions of a Central Control System

- Allows Remote Control, Monitoring, and Data Acquisition for TR and Rapper Controls
- Provides a Graphical User Interface to the Precipitator Controls
- Provides Link to Customer's DCS or PLC
- Allows monitoring of Precipitator Auxiliary Equipment and Boiler Data

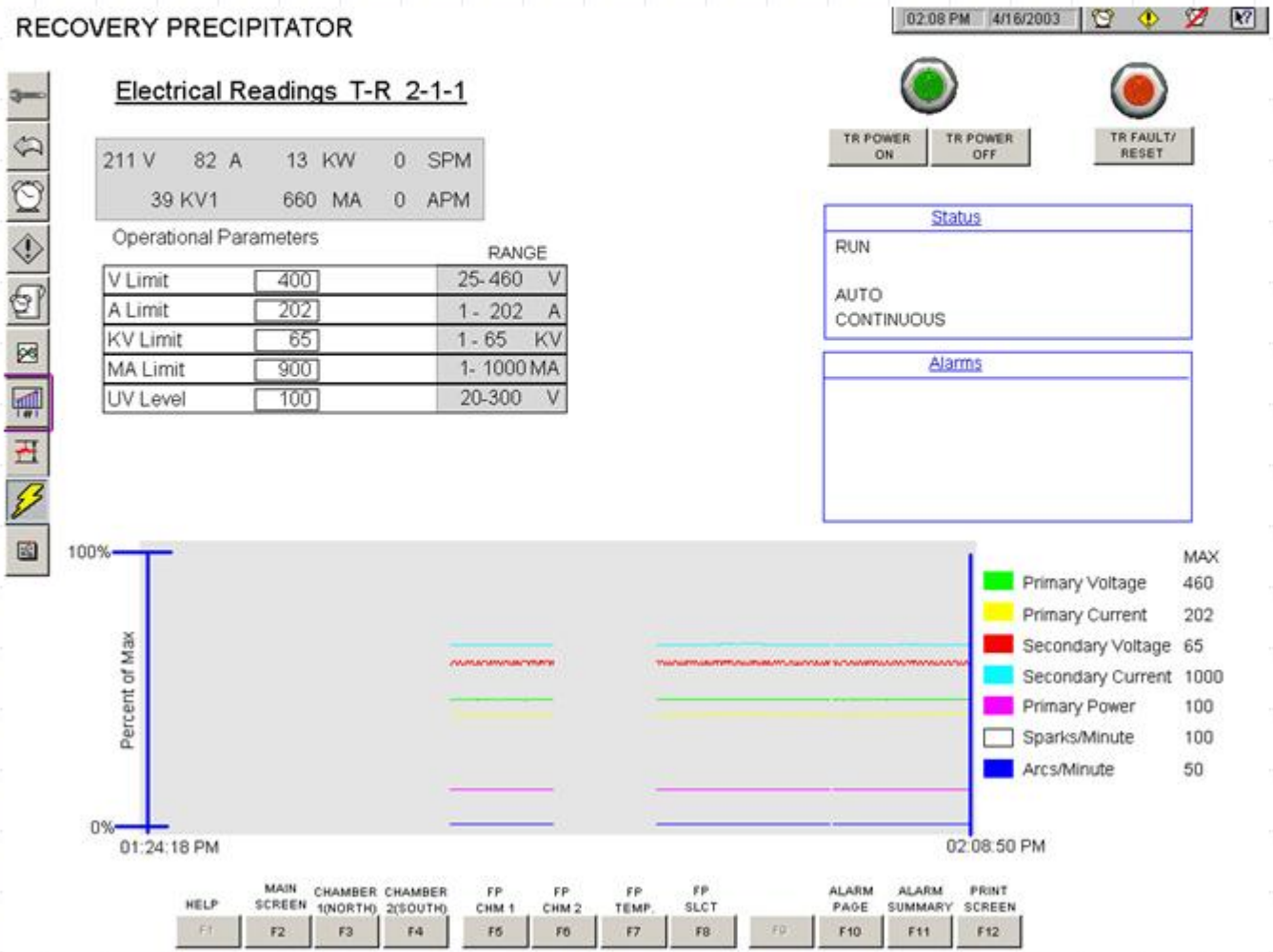
Central System Data Flow

- Computer Based system
- Communicates with EP Controls, Rapper Controls, PLCs and DCS system using varoius combinations of RS232, RS422 or RS485 format

Data from TR and Rapper controls



Functions and Trends



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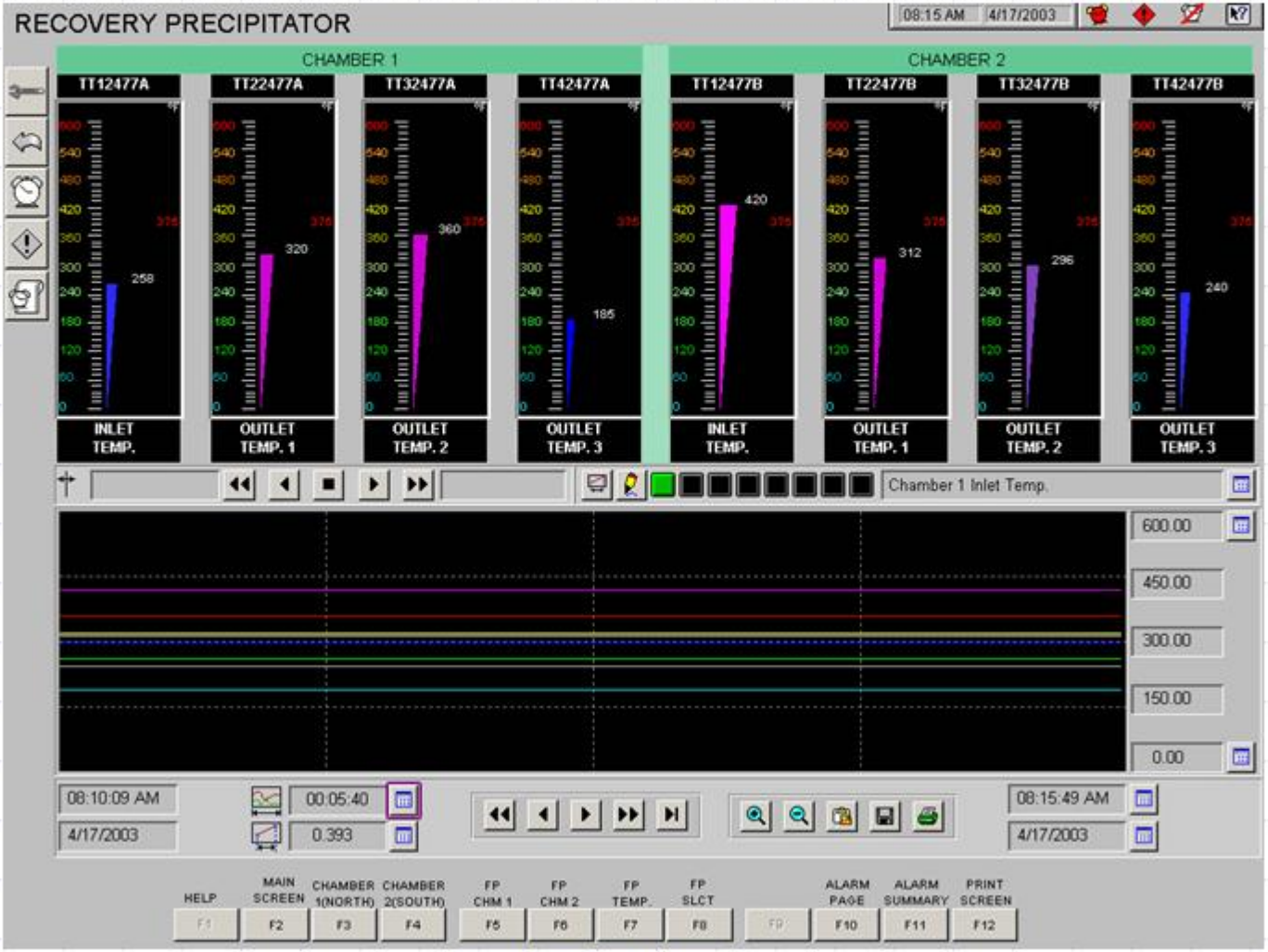
Alarms and Historians



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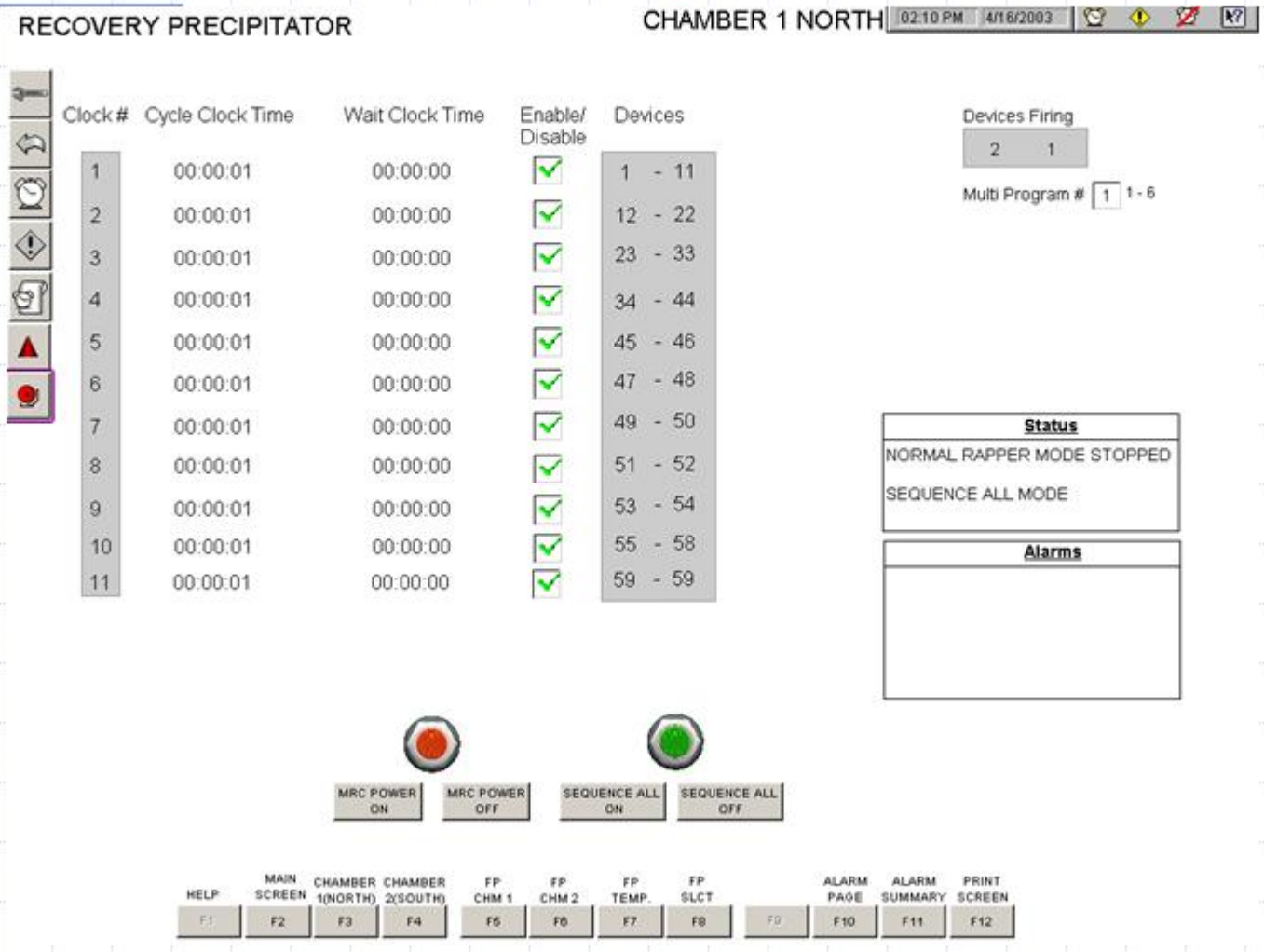
Remote "Tuning"



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Tabular readings

RECOVERY PRECIPITATOR

03:04 PM 4/16/2003

AVERAGED READINGS
(6 Minute Rolling Average)

MTC	2-1-1 T/R 01	2-1-2 T/R 02	2-1-3 T/R 03	2-1-4 T/R 04
VOLTS	207.01	000.00	000.00	000.00
AMPS	079.92	000.00	000.00	000.00
KV1	37.47	00.00	00.00	00.00
MA	0646.51	0000.00	0000.00	0000.00
KW	012.83	000.00	000.00	000.00
SPM	000.00	000.00	000.00	000.00
APM	000.00	000.00	000.00	000.00

MTC	2-2-1 T/R 05	2-2-2 T/R 06	2-2-3 T/R 07	2-2-4 T/R 08
VOLTS	000.00	000.00	000.00	000.00
AMPS	000.00	000.00	000.00	000.00
KV1	00.00	00.00	00.00	00.00
MA	0000.00	0000.00	0000.00	0000.00
KW	000.00	000.00	000.00	000.00
SPM	000.00	000.00	000.00	000.00
APM	000.00	000.00	000.00	000.00

HELP	MAIN SCREEN	CHAMBER 1(NORTH)	CHAMBER 2(SOUTH)	FP CHM 1	FP CHM 2	FP TEMP.	FP SLCT		ALARM PAGE	ALARM SUMMARY	PRINT SCREEN
F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12

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DCS Interface Capability

- "Transceiver" Eliminates the Need for PC Based Central Control System and allows DCS interface.
  - Major benefit is low cost element
- Central control system offers "canned" graphics package as well as DCS link.
  - Major Benefit is inclusion of graphics and supervisory software

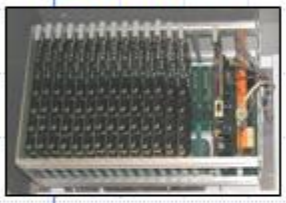
DCS Interface Features and Functions

- Polls Local TR and Rapper Controls and Provides Data for DCS or PLC
- Acts as a Gateway between DCS/PLC and Local Controls
- Modbus RTU Protocol, Data Highway +, etc.
- RS232, 485, or 422 output to DCS/PLC
- Energy Management Inputs and Control

TR Controls (AVC's)

Multiple input Transducers for KV, MA, V, A and SPM

Rapper/Vibrator Controls



Questions?

T/R Cabinets, T/R Sets, Diode Stacks, Voltage Dividers and Bushings

Local Control and Remote Monitoring Systems

Opacity Monitors

DCS & PLC Integration

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