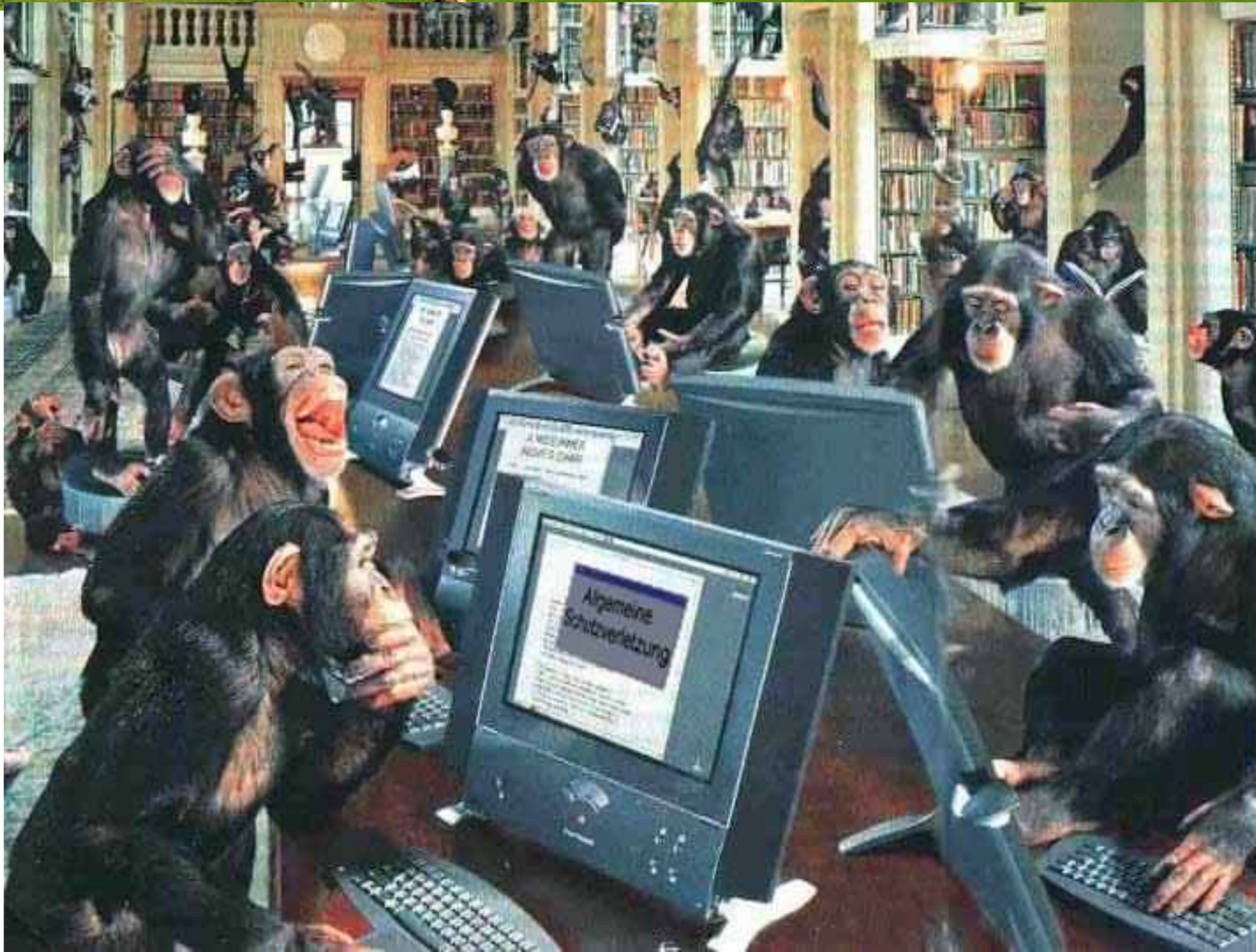
Operational Improvements obtained with better Instrumentation & Automation

Dr Wynand van Dyk – Project Manager
Mr Frans de Beer – Plant Manager – EPC

Lonmin Platinum

LONMIN

Instrumentation Department?



Presentation Outline

- Background to Opencast Project
- Layout of control system
- Example: Pump Automation
- Example: Advanced Flotation Control
- “Return on Investment”
- Conclusions

Opencast Project

- K4 concentrator
  - situated adjacent to the K4 shaft complex
  - Marikana – North West Province SA
  - MF2 circuit
- EPC concentrator
  - situated adjacent to EPL Plant
  - Brits – North West Province SA
  - MF2 circuit with cleaner tails regrind (ISA mill)
- 120 000 tpm Opencast ore for the period of 3-4 years per plant
- Both plants part of long-term Lonmin expansion

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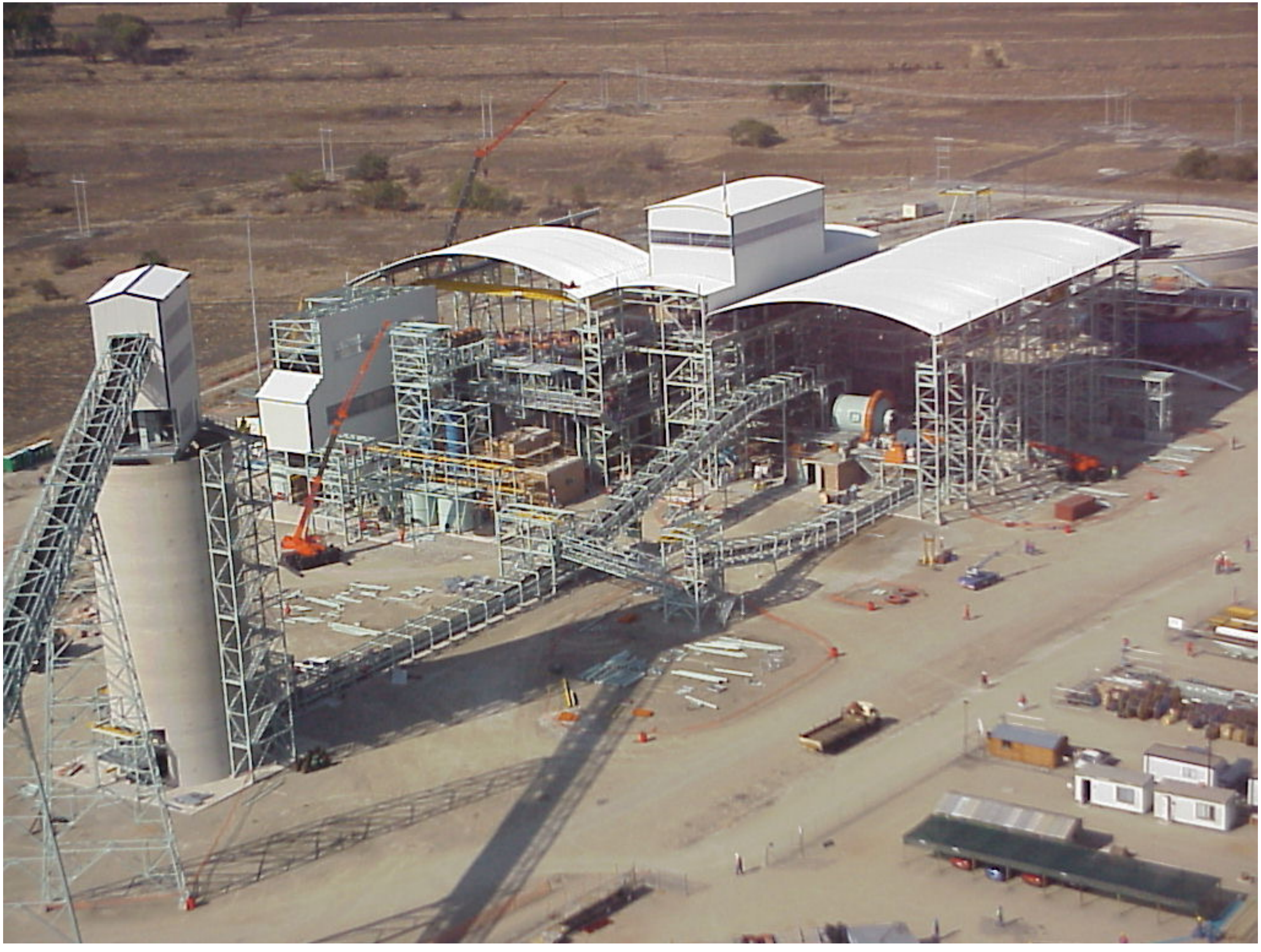
K4 concentrator



EPC concentrator

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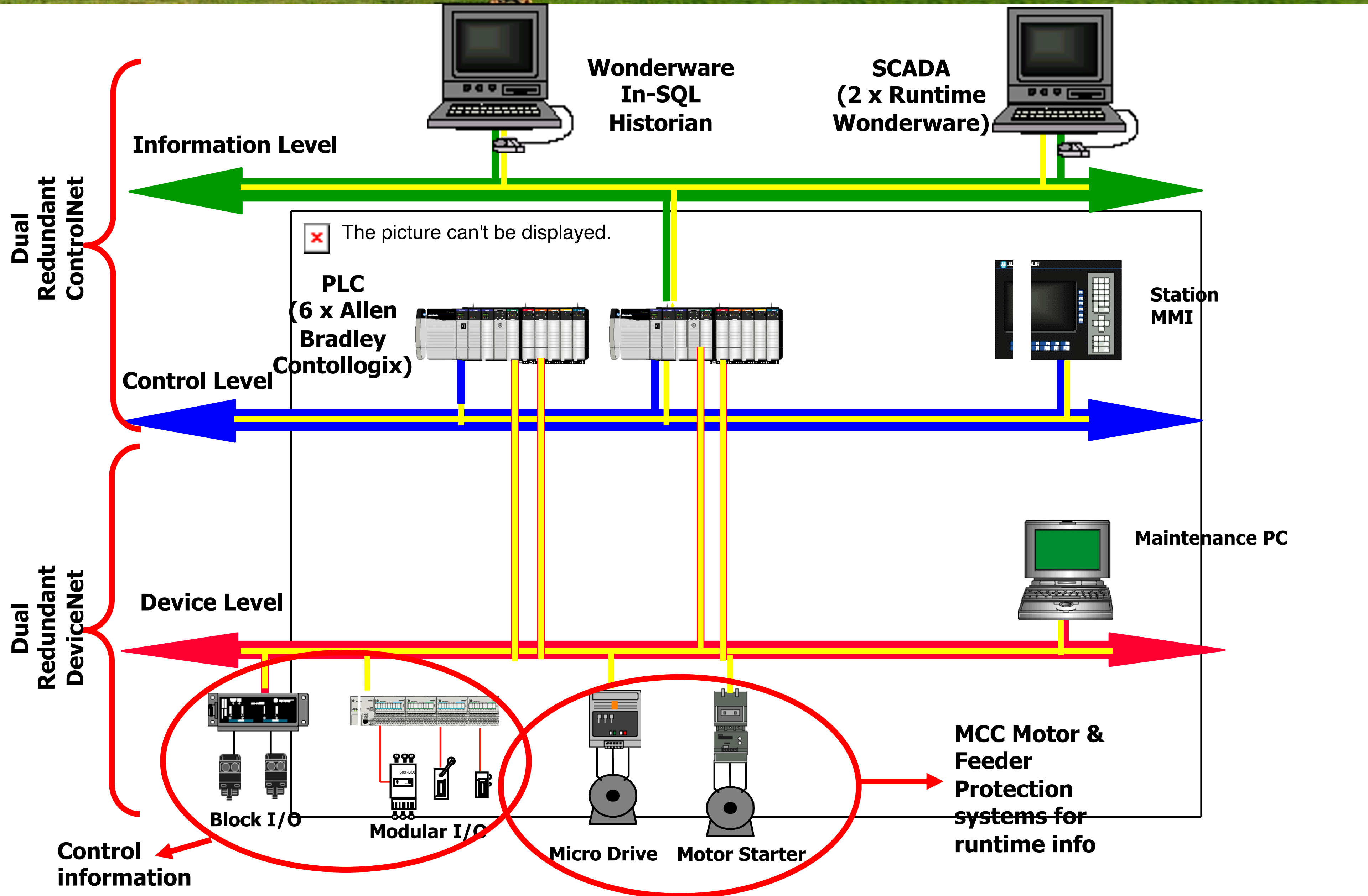
Design Philosophy

- Designed for high availabilities
- Dual redundancy on all minor equipment & pipes
- Fully automated (including MCC's) – manual valves for maintenance only.
- Control Inputs and Outputs per plant:
  - Digital Inputs = 490
  - Analog inputs = 479
  - Digital outputs = 330
  - Analog outputs = 98
  - P & ID loops = 163
  - Motors = 289
- Total E&I (excl HT) = 16.9% of total investment

Control System Layout



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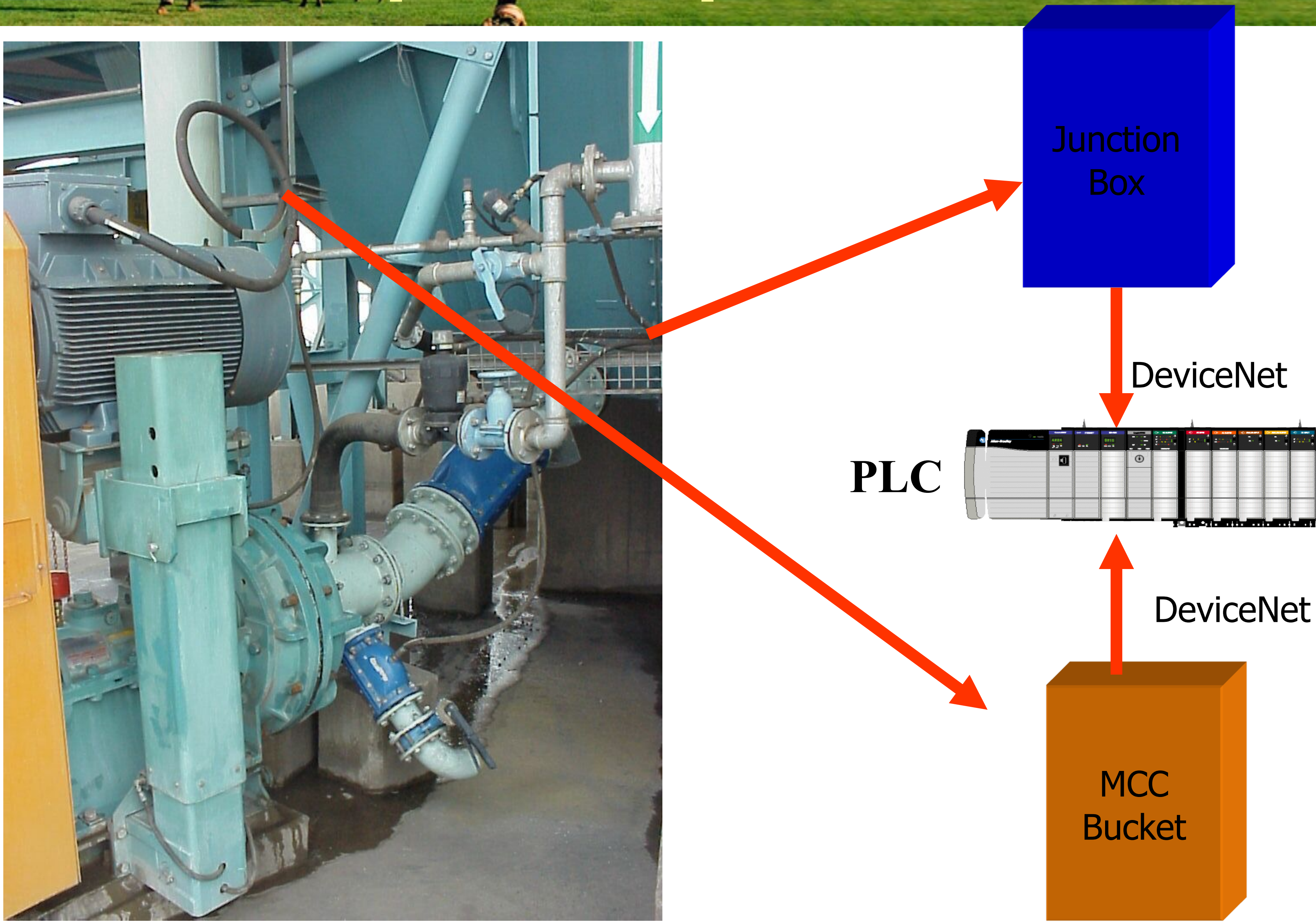
Example: Pump Automation



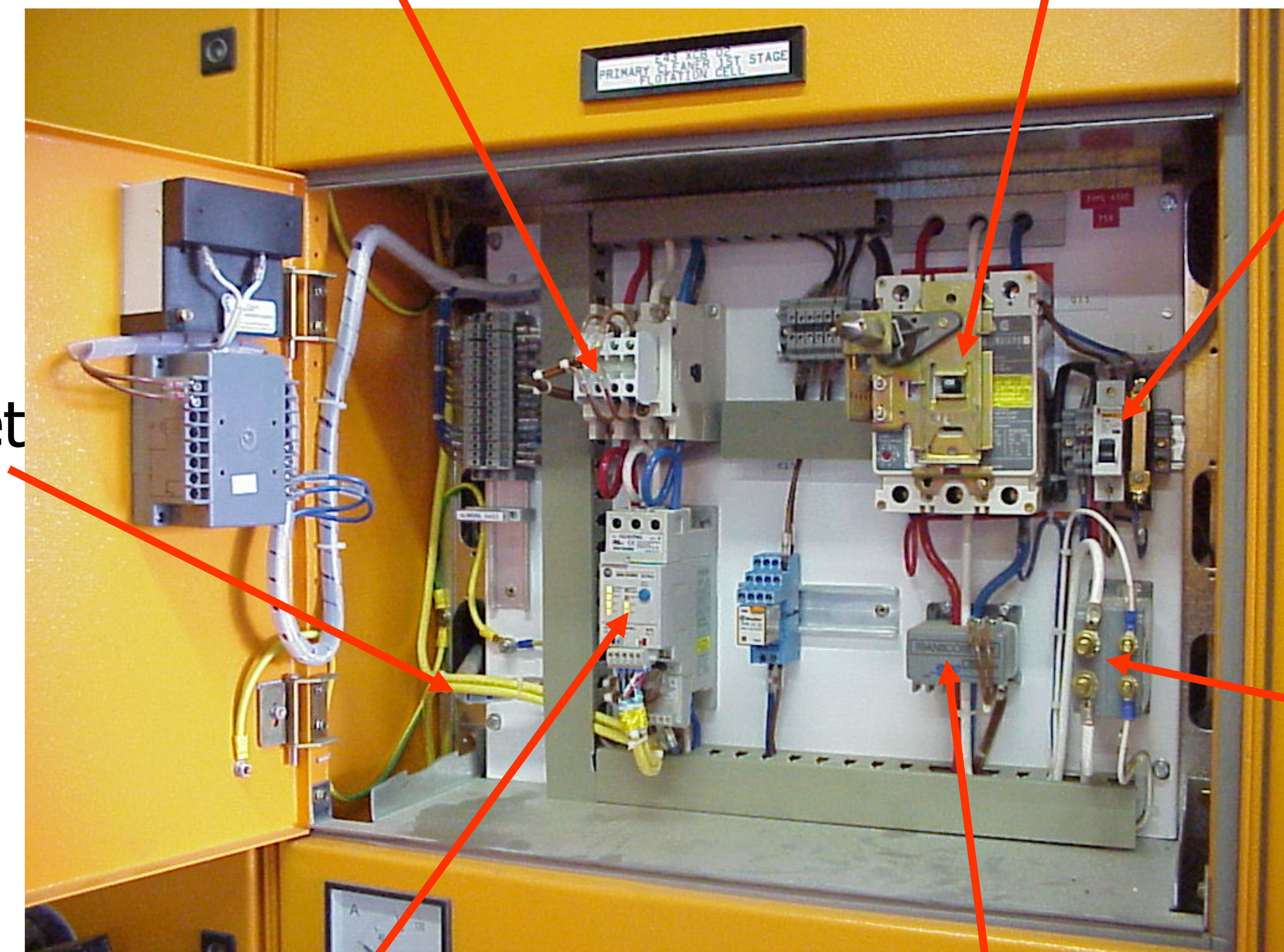
MCC bucket layout

Contactor

Circuit breaker

110V Power Supply

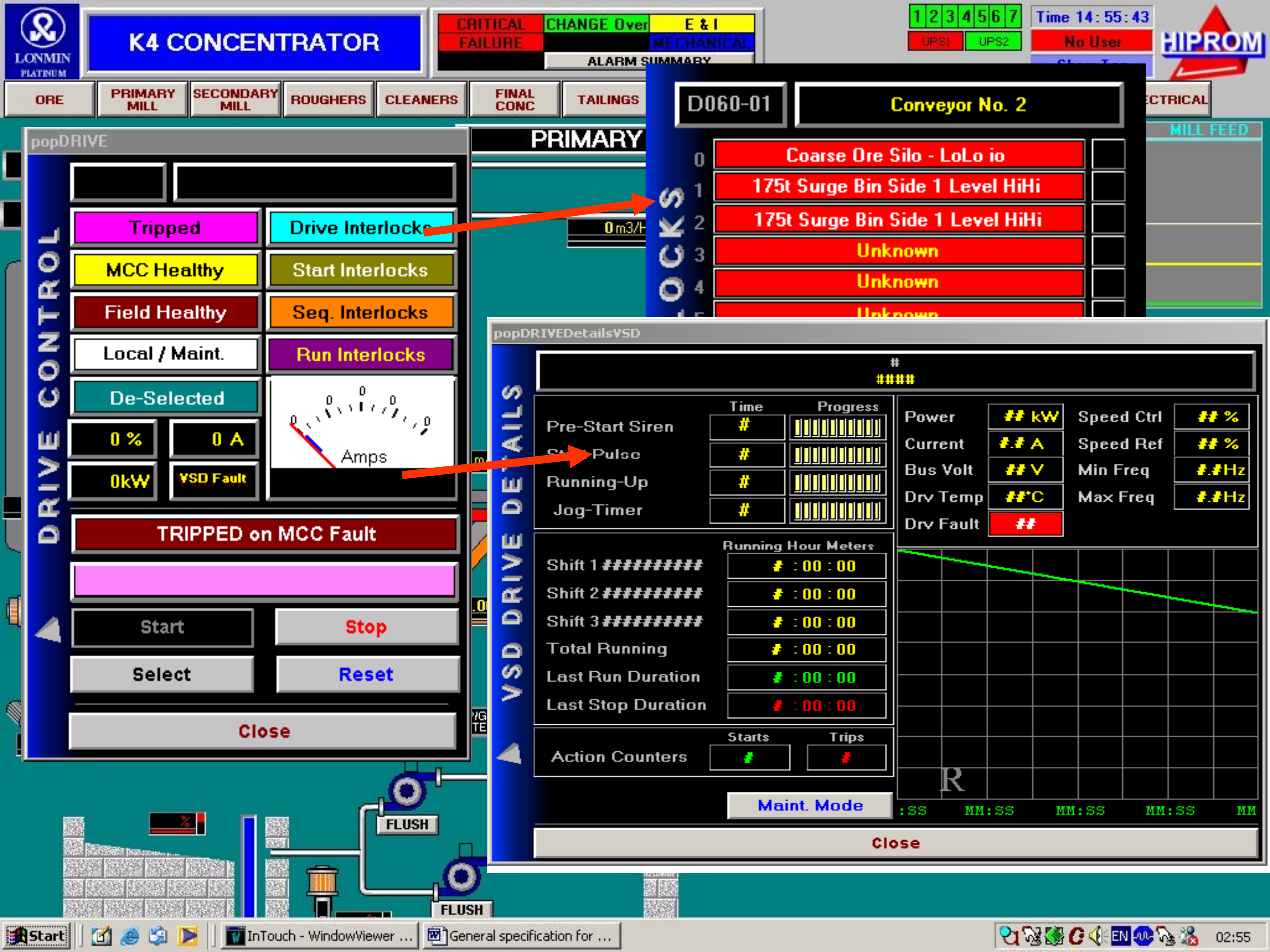
DeviceNet



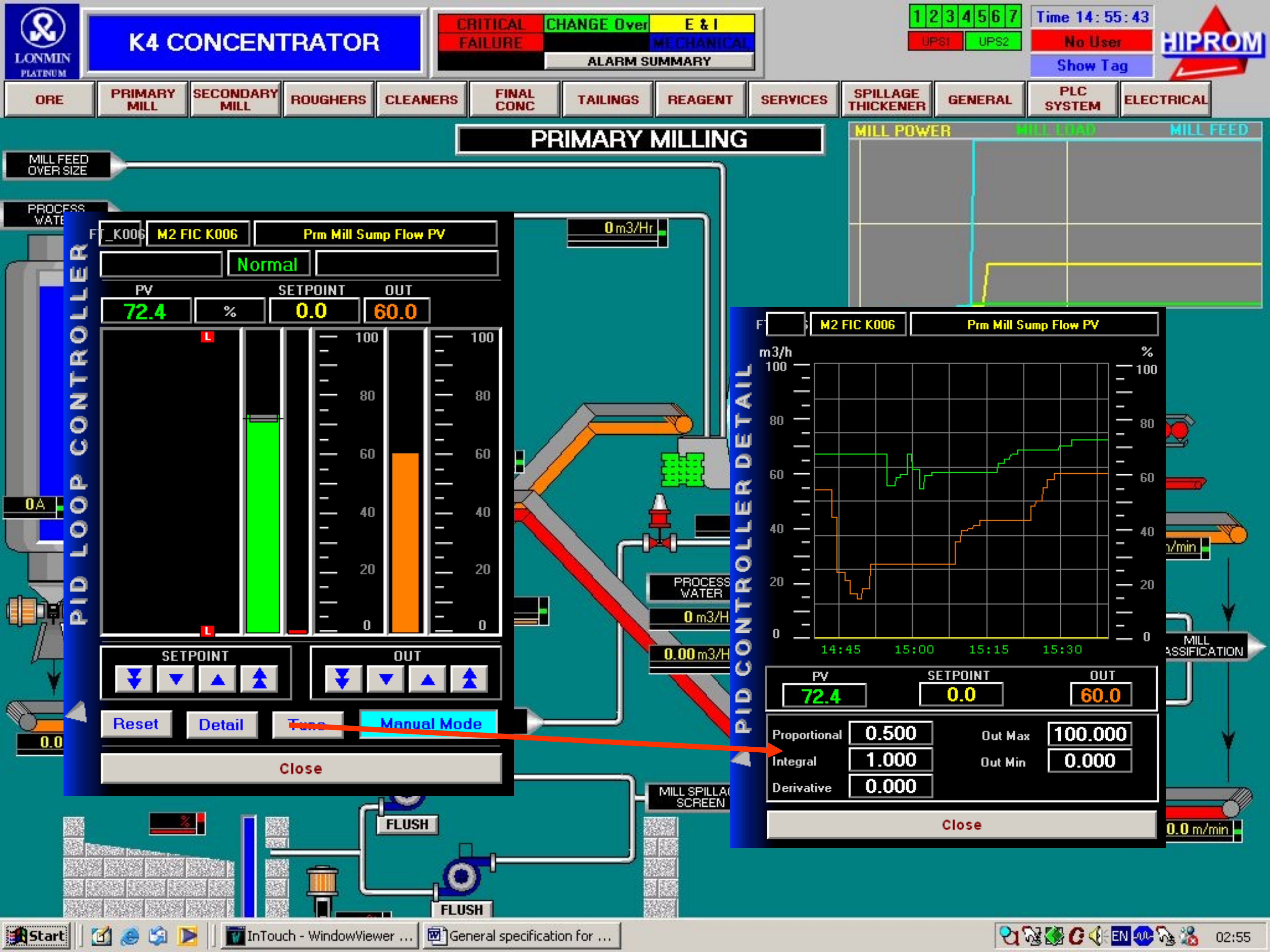
Earth Leakage Protection

Smart Motor Manager

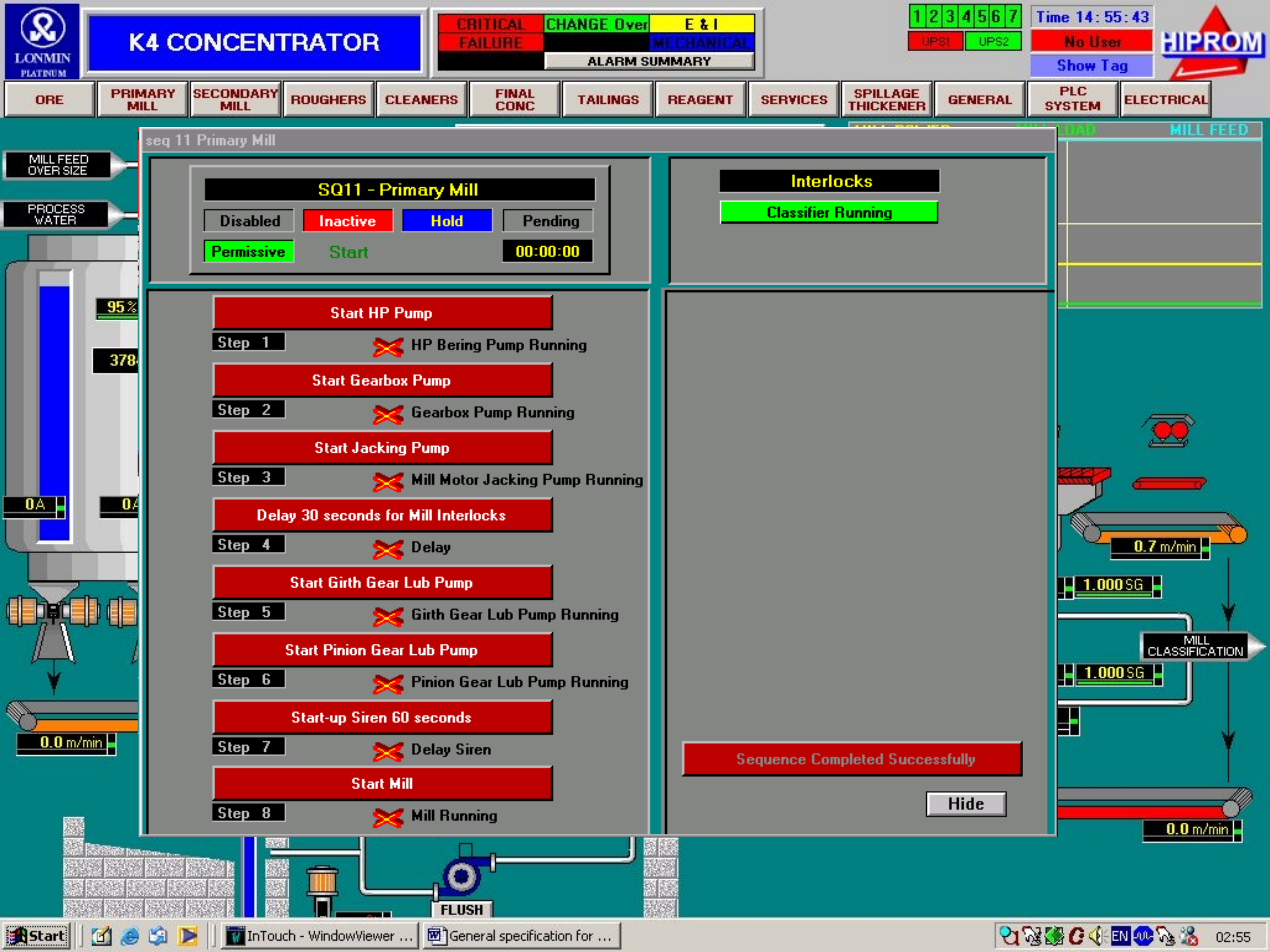
Current Transducer



K4 CONCENTRATOR
CRITICAL
CHANGE Over
E & I
FAILURE
MECHANICAL
ALARM SUMMARY
Time 14:55:43
No User
HIPROM
ORE
PRIMARY MILL
SECONDARY MILL
ROUGHERS
CLEANERS
FINAL CONC
TAILINGS
popDRIVE
DRIVE CONTROL
Tripped
Drive Interlocks
MCC Healthy
Start Interlocks
Field Healthy
Seq. Interlocks
Local / Maint.
Run Interlocks
De-Selected
0 %
0 A
0kW
VSD Fault
Amps
TRIPPED on MCC Fault
Start
Stop
Select
Reset
Close
D060-01
Conveyor No. 2
Coarse Ore Silo - LoLo io
175t Surge Bin Side 1 Level HiHi
175t Surge Bin Side 1 Level HiHi
Unknown
Unknown
popDRIVEDetailsVSD
VSD DRIVE DETAILS
Time
Progress
Pre-Start Siren
Running-Up
Jog-Timer
Power
Current
Bus Volt
Drv Temp
Drv Fault
Speed Ctrl
Speed Ref
Min Freq
Max Freq
Running Hour Meters
Shift 1
Shift 2
Shift 3
Total Running
Last Run Duration
Last Stop Duration
Starts
Trips
Action Counters
Maint. Mode
Close
FLUSH
FLUSH
InTouch - WindowViewer ...
General specification for ...
02:55



K4 CONCENTRATOR
CRITICAL
FAILURE
CHANGE Over
E & I
MECHANICAL
ALARM SUMMARY
UPS1
UPS2
Time 14:55:43
No User
Show Tag
HIPROM
ORE
PRIMARY MILL
SECONDARY MILL
ROUGHERS
CLEANERS
FINAL CONC
TAILINGS
REAGENT
SERVICES
SPILLAGE THICKENER
GENERAL
PLC SYSTEM
ELECTRICAL
PRIMARY MILLING
MILL POWER
MILL LOAD
MILL FEED
MILL FEED OVER SIZE
PID LOOP CONTROLLER
FT_K006
M2 FIC K006
Prm Mill Sump Flow PV
Normal
PV
SETPOINT
OUT
72.4
%
0.0
60.0
SETPOINT
OUT
Reset
Detail
Tune
Manual Mode
Close
PID CONTROLLER DETAIL
M2 FIC K006
Prm Mill Sump Flow PV
m3/h
%
14:45
15:00
15:15
15:30
PV
SETPOINT
OUT
72.4
0.0
60.0
Proportional 0.500
Integral 1.000
Derivative 0.000
Out Max 100.000
Out Min 0.000
Close
PROCESS WATER
0 m3/Hr
0.00 m3/H
MILL SPILLAGE SCREEN
FLUSH
FLUSH
0.0 m/min
Start
InTouch - WindowViewer ...
General specification for ...
02:55



LONMIN PLATINUM
K4 CONCENTRATOR
CRITICAL
CHANGE Over
E & I
FAILURE
MECHANICAL
ALARM SUMMARY
1 2 3 4 5 6 7
UPS1
UPS2
Time 14:55:43
No User
Show Tag
HIPROM
ORE
PRIMARY MILL
SECONDARY MILL
ROUGHERS
CLEANERS
FINAL CONC
TAILINGS
REAGENT
SERVICES
SPILLAGE THICKENER
GENERAL
PLC SYSTEM
ELECTRICAL
MILL FEED
MILL FEED OVER SIZE
PROCESS WATER
seq 11 Primary Mill
SQ11 - Primary Mill
Disabled
Inactive
Hold
Pending
Permissive
Start
00:00:00
Interlocks
Classifier Running
Start HP Pump
Step 1
HP Bering Pump Running
Start Gearbox Pump
Step 2
Gearbox Pump Running
Start Jacking Pump
Step 3
Mill Motor Jacking Pump Running
Delay 30 seconds for Mill Interlocks
Step 4
Delay
Start Girth Gear Lub Pump
Step 5
Girth Gear Lub Pump Running
Start Pinion Gear Lub Pump
Step 6
Pinion Gear Lub Pump Running
Start-up Siren 60 seconds
Step 7
Delay Siren
Start Mill
Step 8
Mill Running
Sequence Completed Successfully
Hide
95 %
0A
0.0 m/min
0.7 m/min
1.000 SG
MILL CLASSIFICATION
1.000 SG
0.0 m/min
FLUSH
Start
InTouch - WindowViewer ...
General specification for ...
EN
02:55

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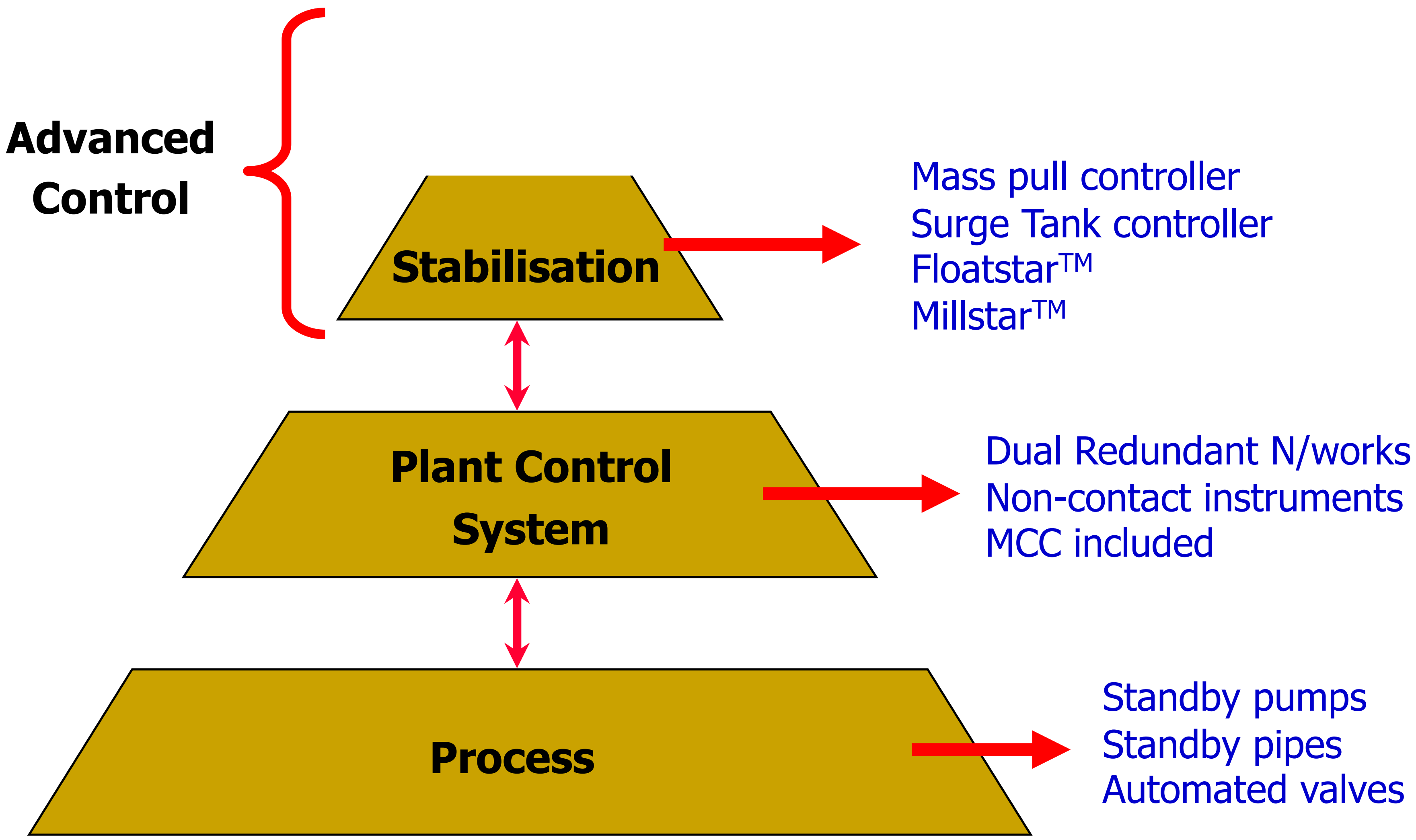
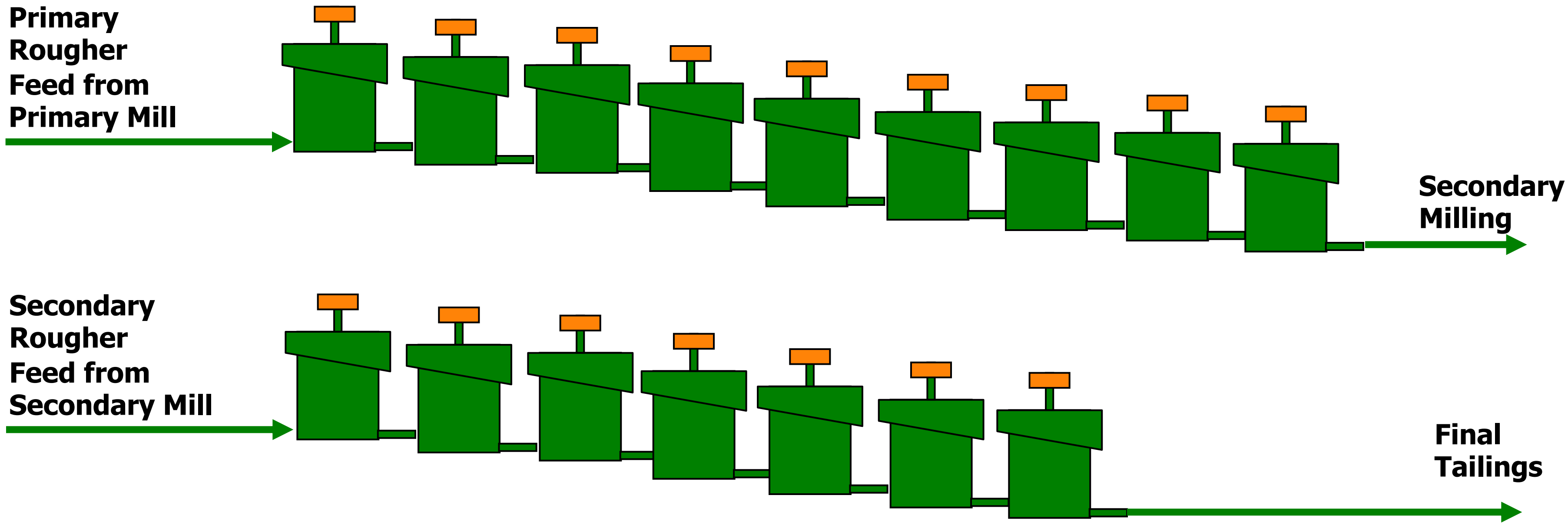
Example: Advanced Flotation Control

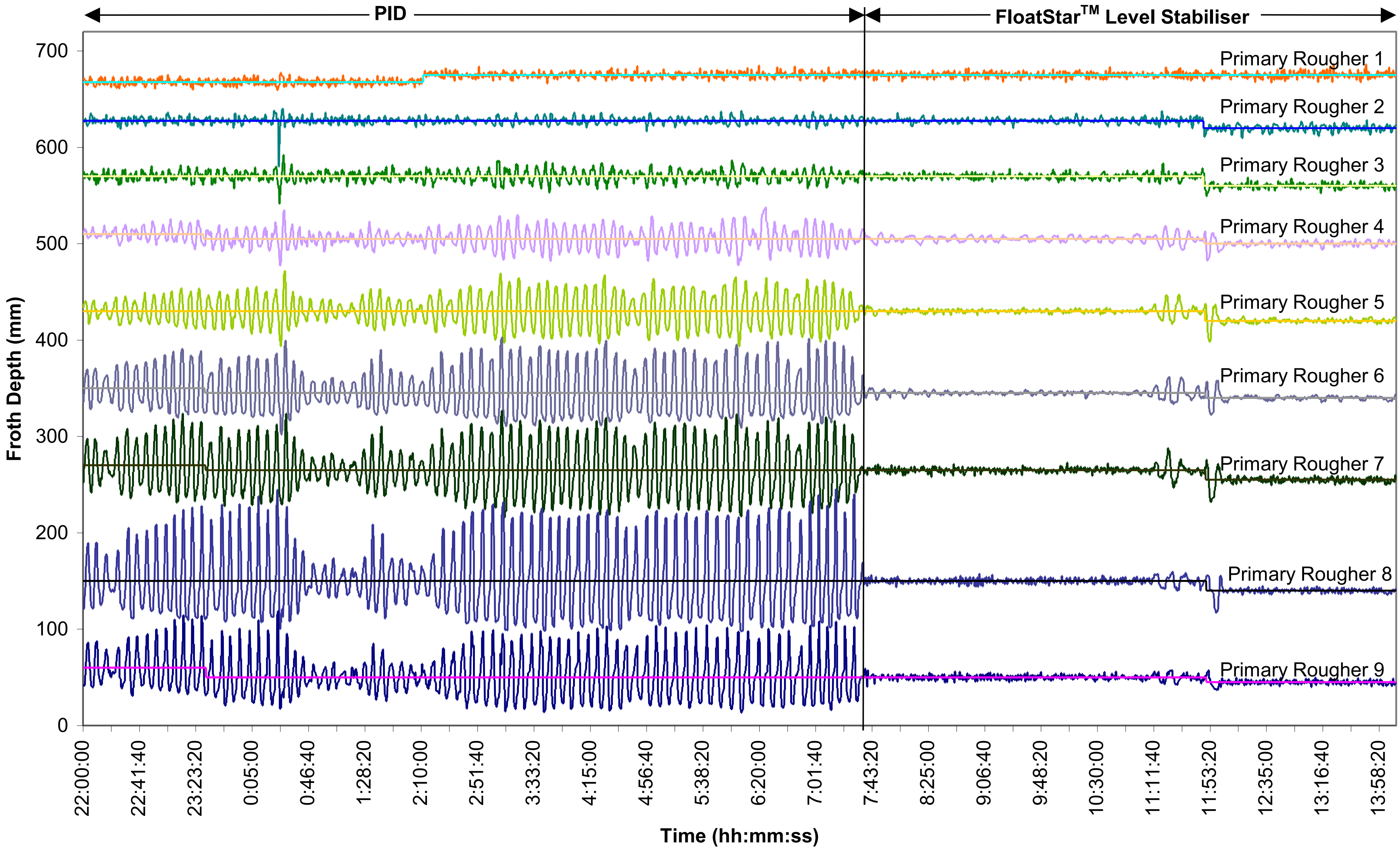


EPC flotation circuit

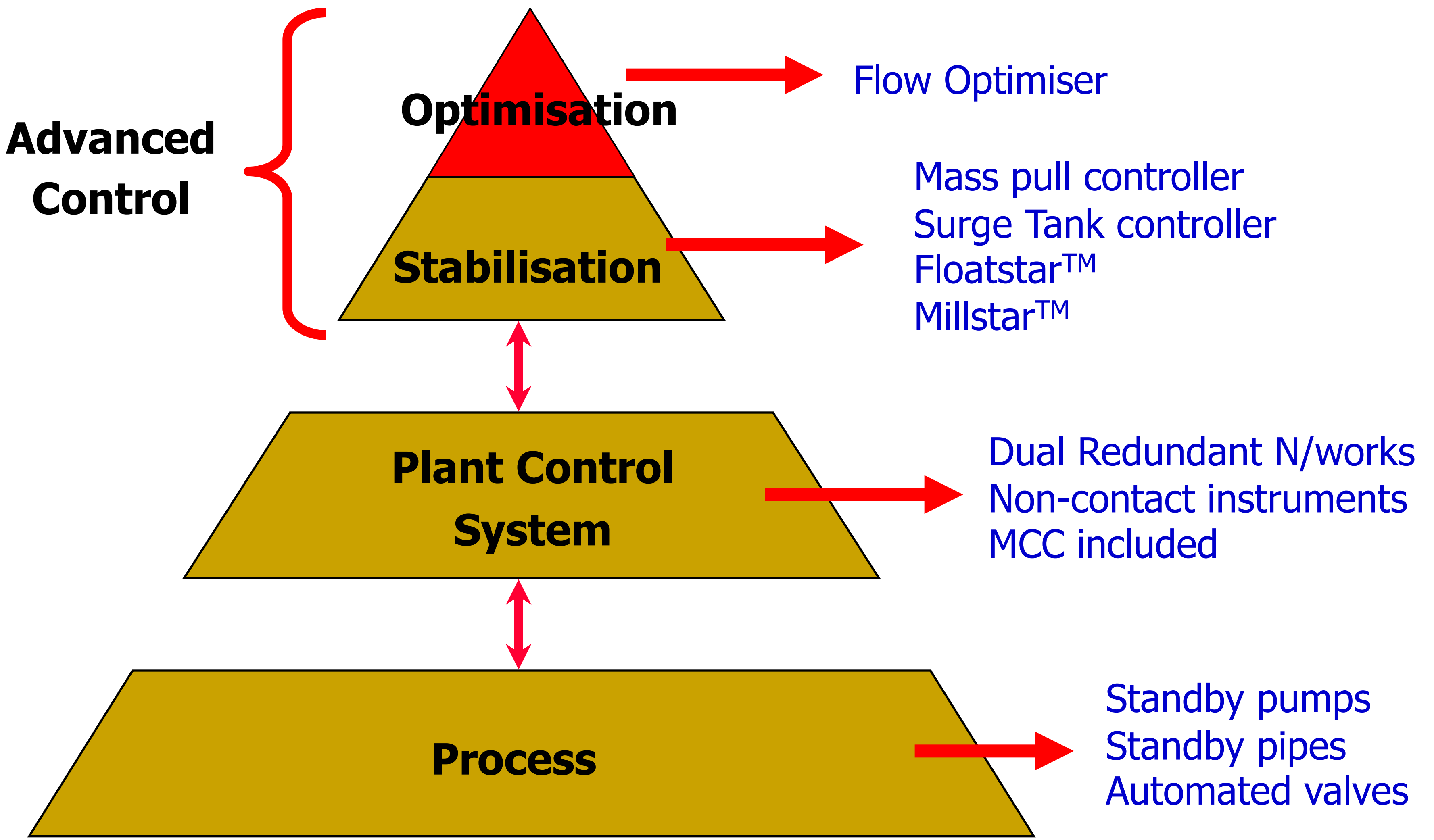
Flotation circuit layout



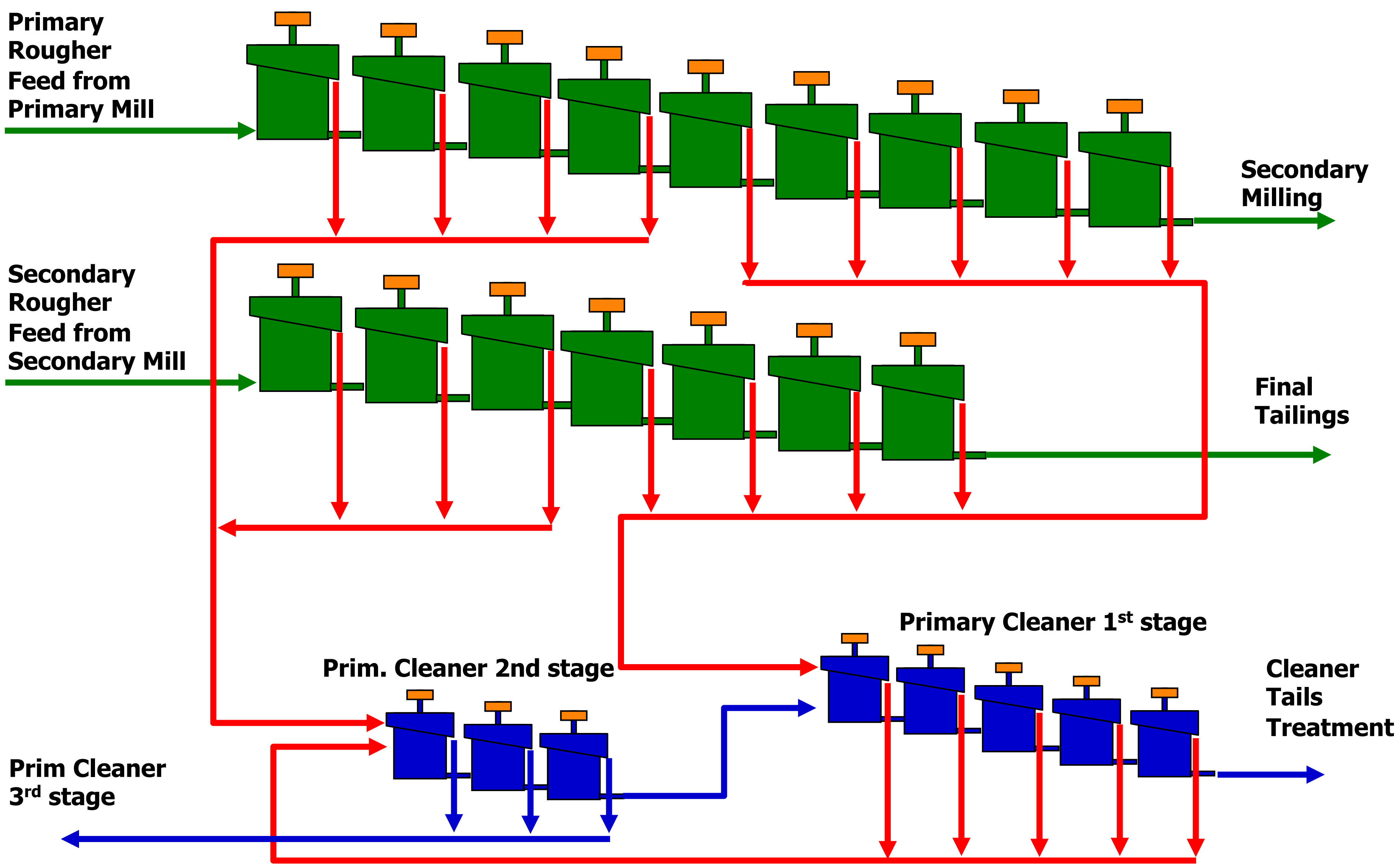
FloatStar™: Level Stabilising



Example: Advanced Flotation Control



Flotation circuit layout



Optimisation Philosophy

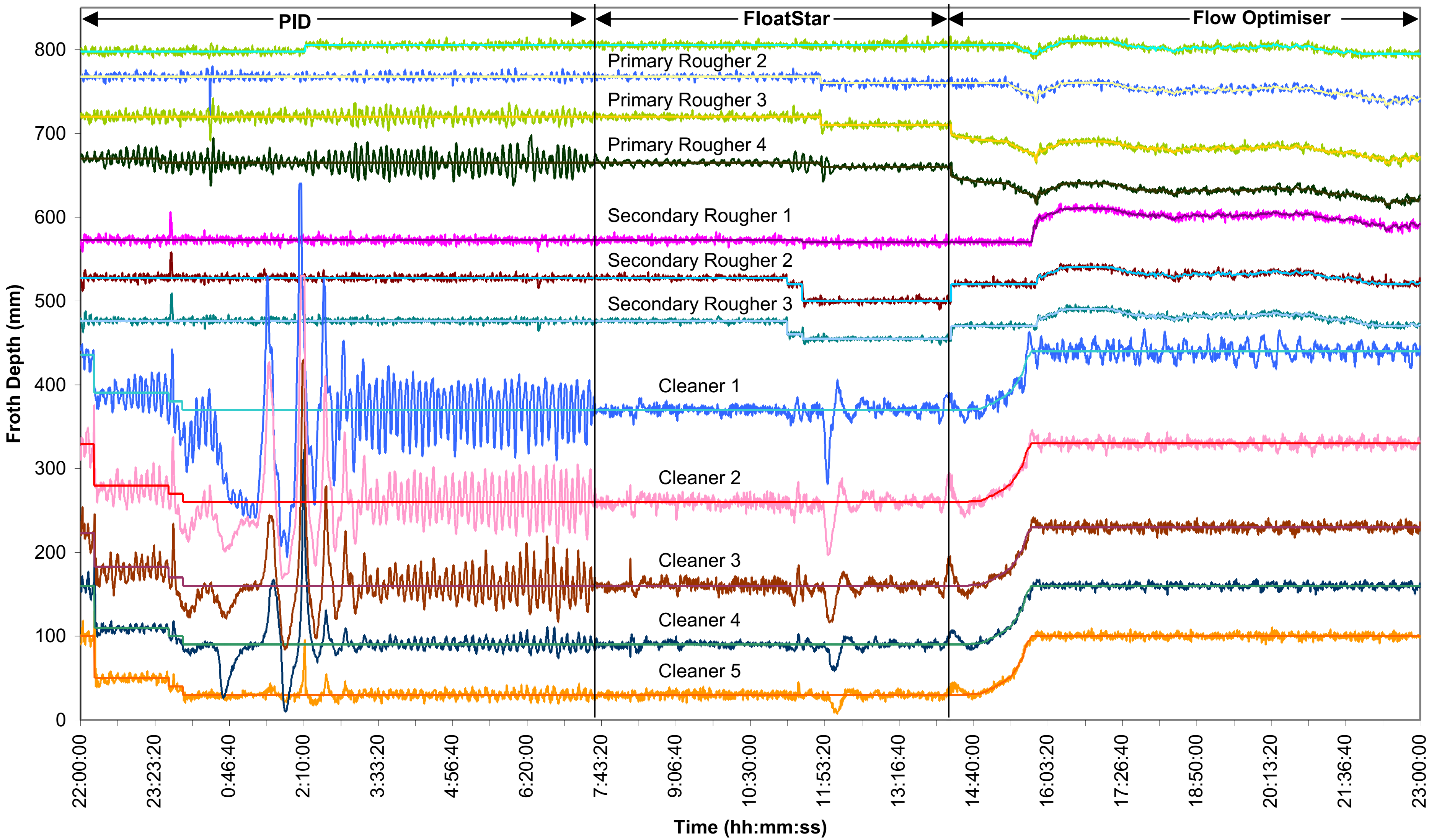
- Stabilise Primary Rougher levels
- Stabilise Secondary Rougher levels
- Stabilise Primary Cleaner 1st stage levels

Stabilise

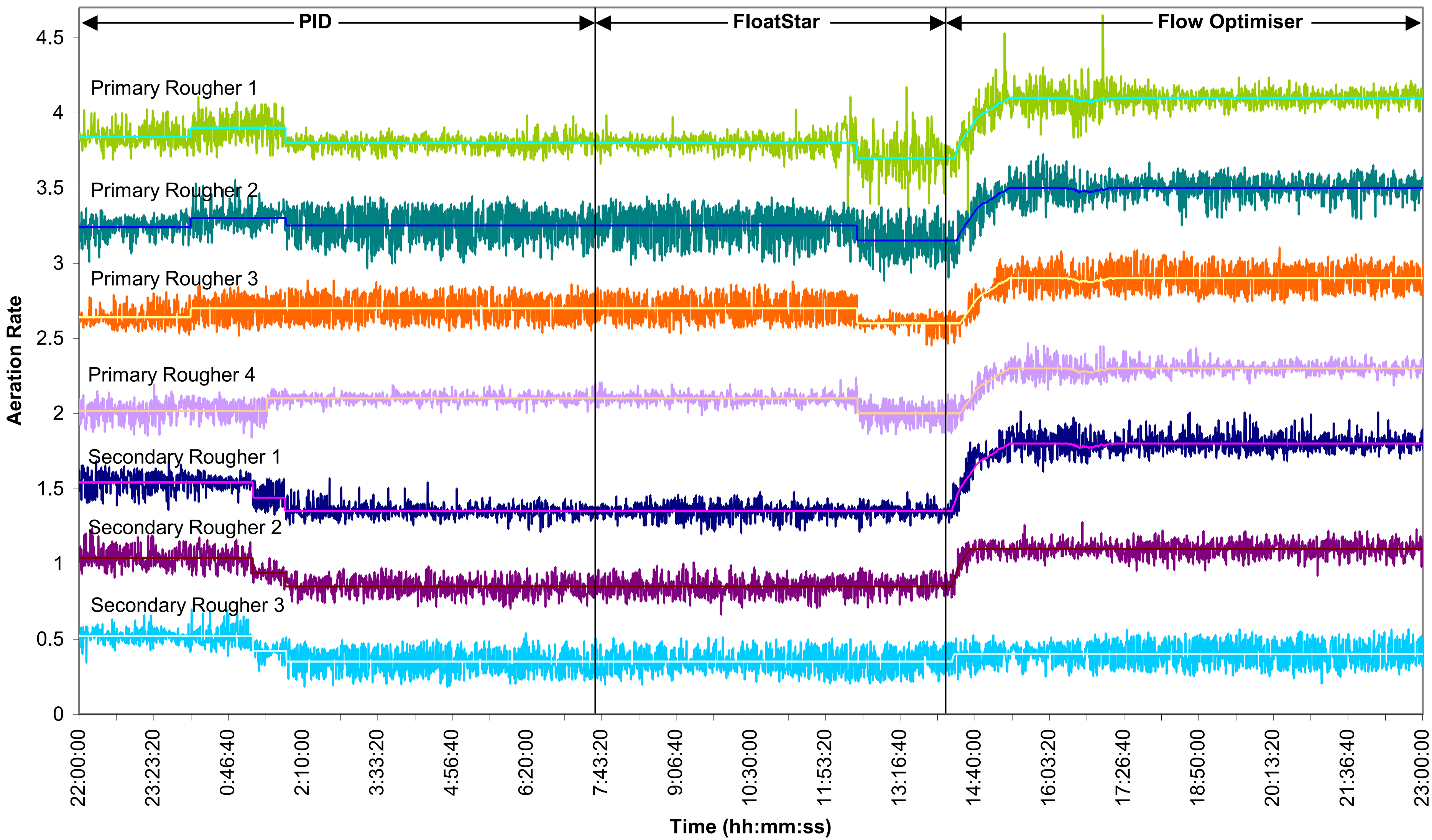
- Control P/C 1st stage flow (residence time)
  - Rougher mass-pull (PR 5-8 & SR 4-7)
    - Aeration rates & levels
- Control P/C 2nd stage flow (residence time)
  - Rougher mass-pull (PR 1-4 & SR 1-3)
    - Aeration rates & levels
  - P/C 1st stage mass-pull
    - Flow (residence time)

Optimise

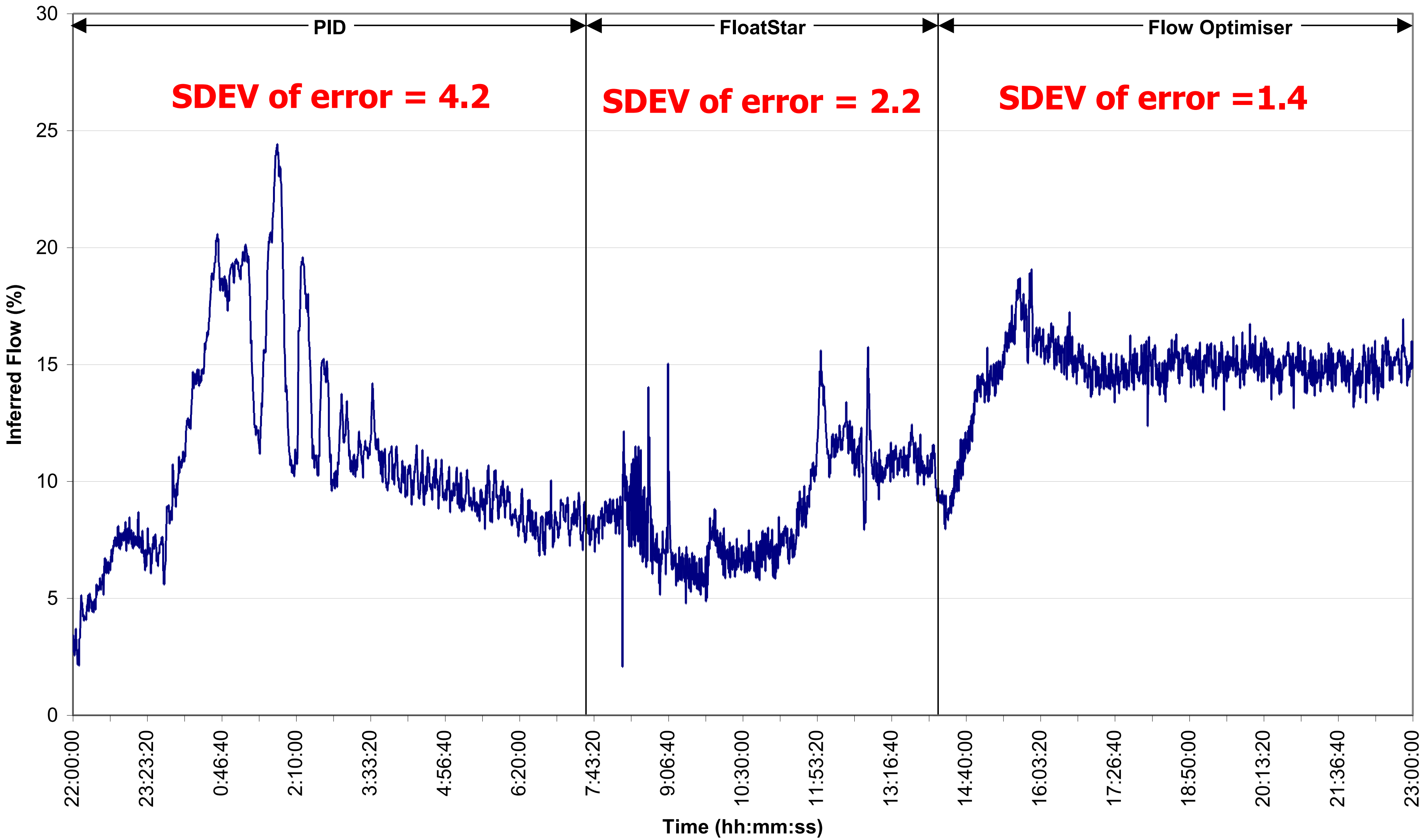
FloatStar™: Flow Optimisation



FloatStar™: Flow Optimisation



FloatStar™: Flow Optimisation



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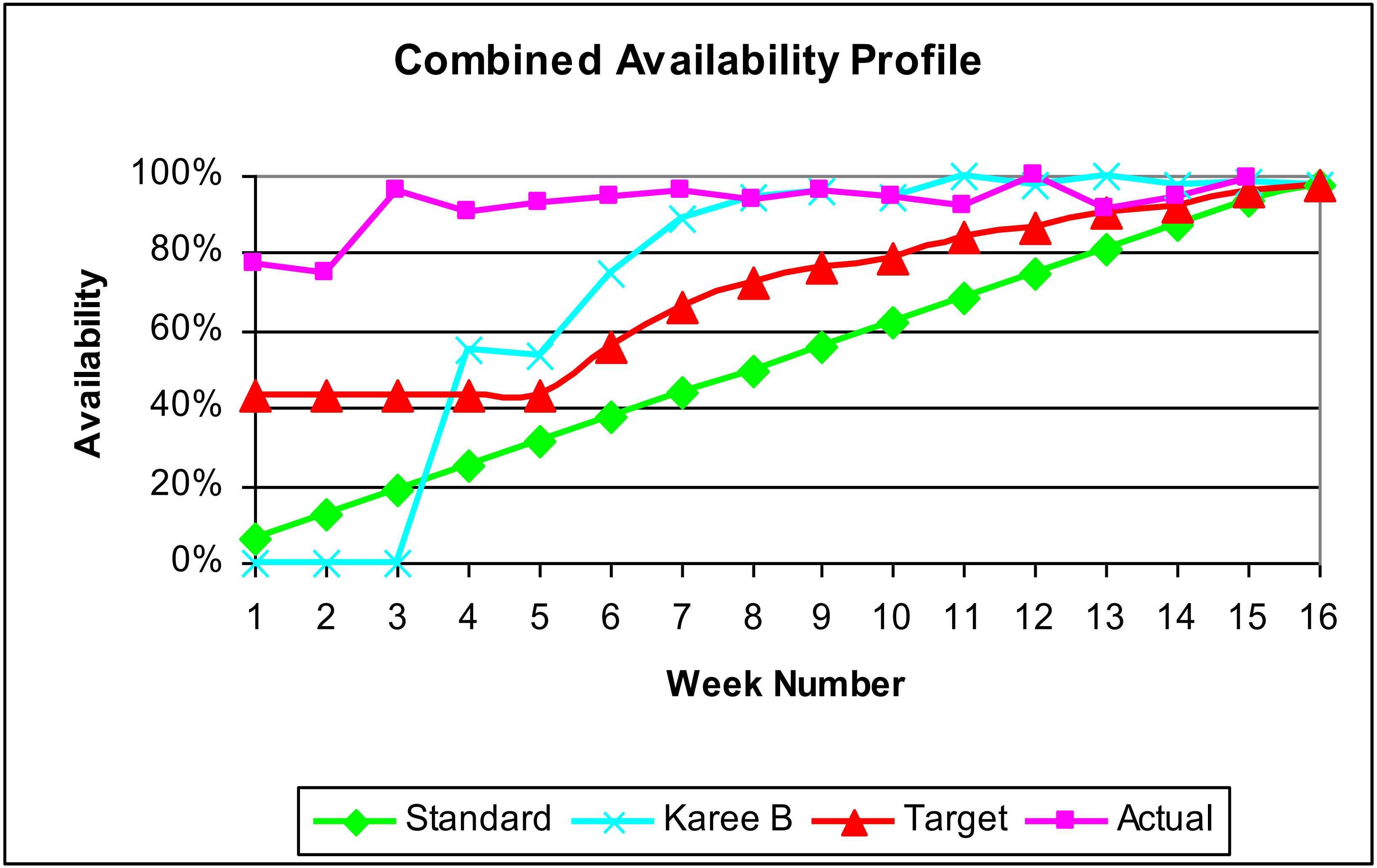
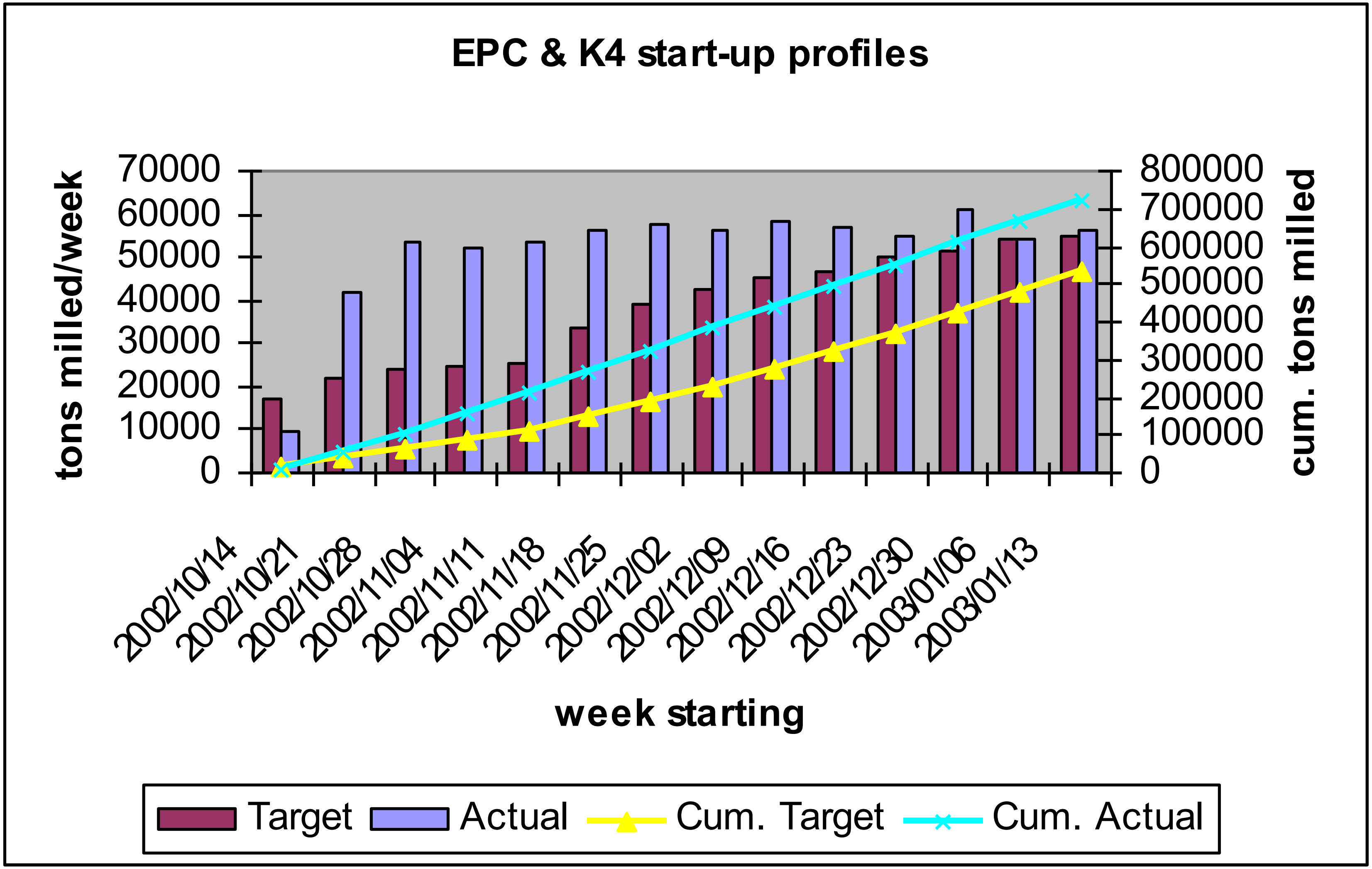
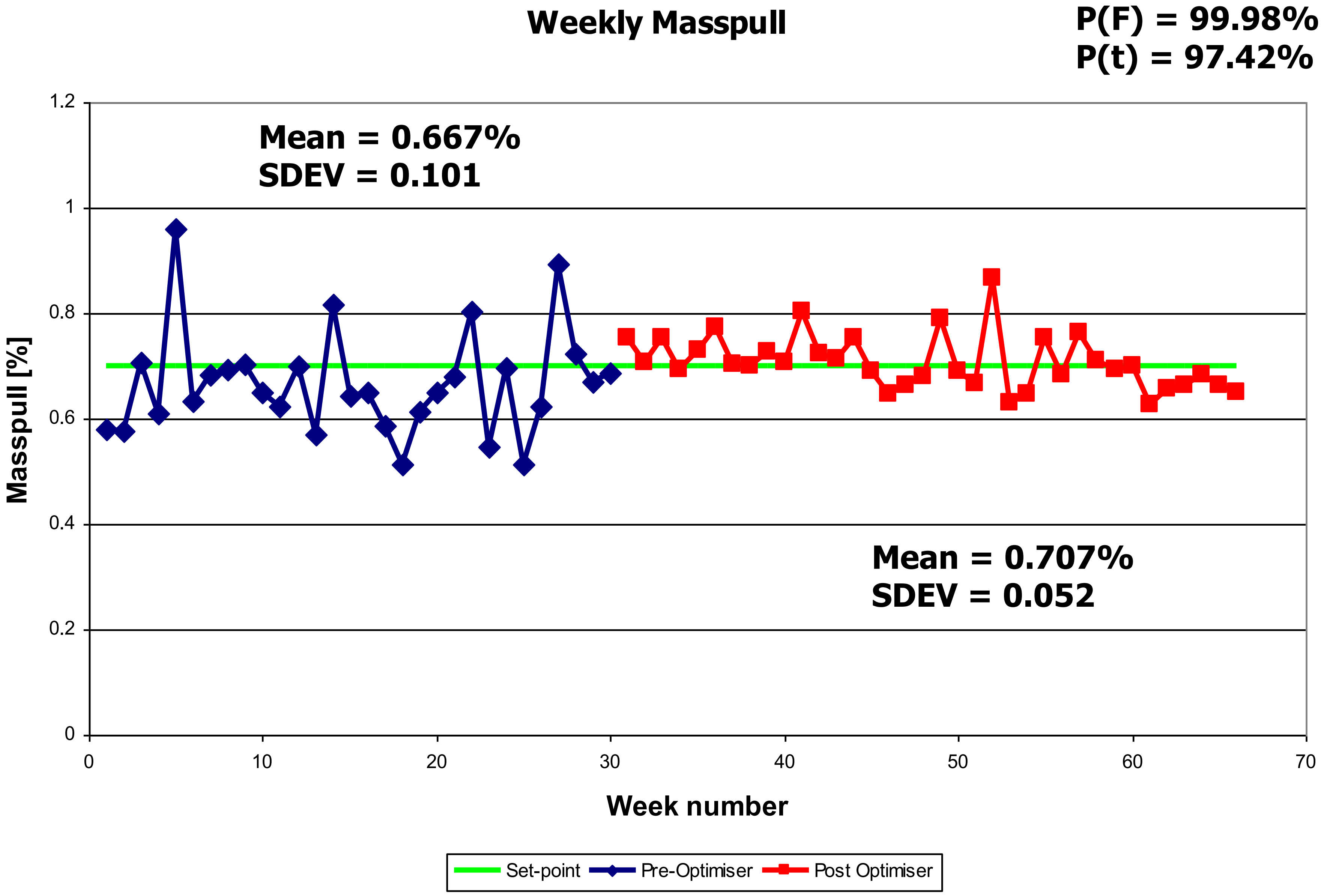
High Plant Availabilities



Rapid Start-up



Improvement in Mass-pull Control

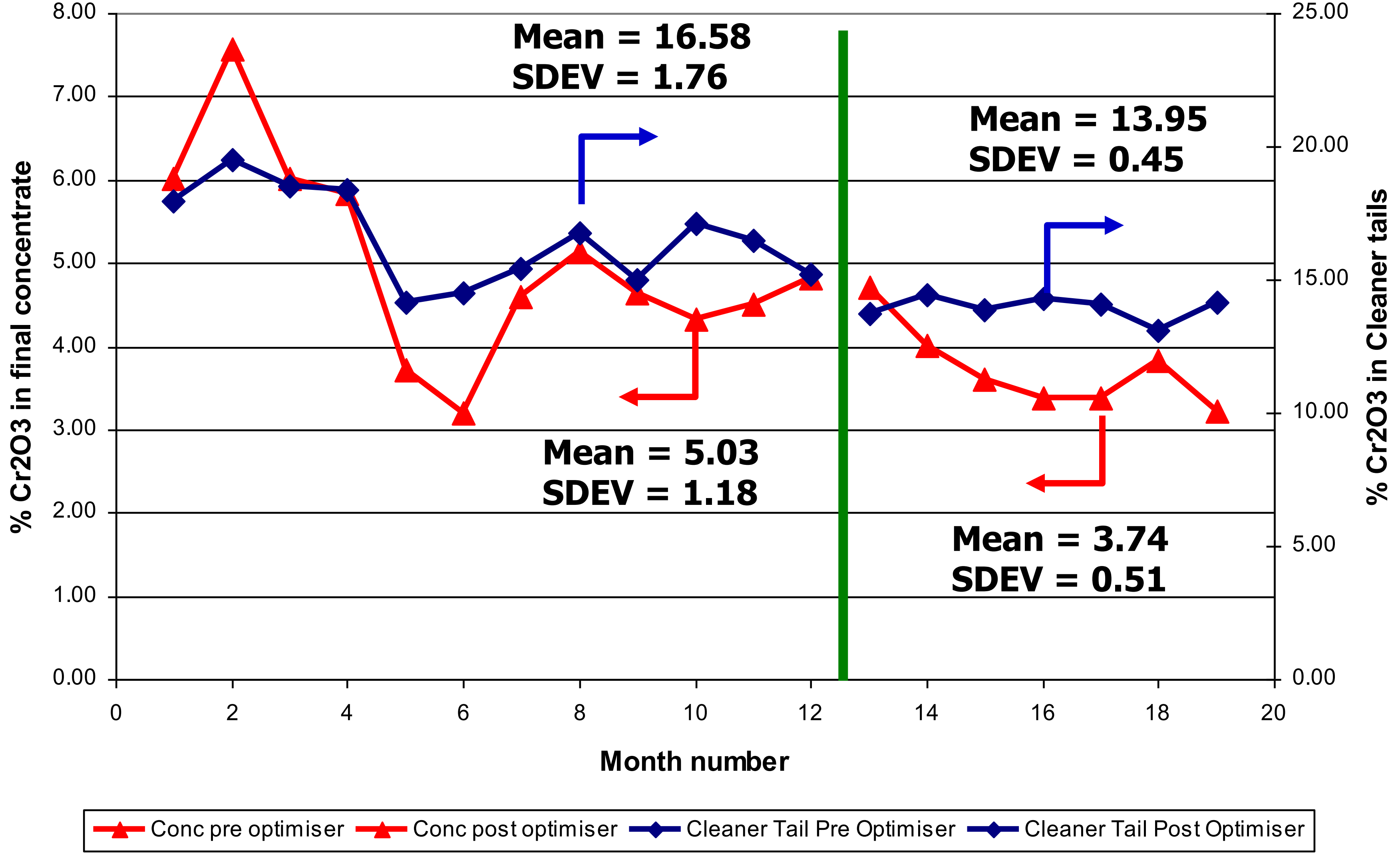


Improvement in Cr2O3 control

P(F) = 97.33%
P(t) = 99.78%

Monthly mean % Cr2O3

P(F) = 99.84%
P(t) = 99.99%



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Summary

	Design	Actual	Impact
Rapid start	**531614 t (16 wks)**	**721439 t (16 wks)**	**Payback reduce by 3.3 weeks**
Plant Availability	**90%**	**97.00%**	**7% increase in throughput**
Cleaner #1 Stability	**24.56 SDEV**	**3.60 SDEV**	**Significant on masspull and Cr2O3 control**
Cleaner #6 Stability	**4.20 SDEV**	**1.44 SDEV**	**Significant on masspull and Cr2O3 control**
Staffing level		**72 total**	**Caution: Do not justify on people reduction**

Conclusions

- Well designed control system architecture essential
    - >99% availability can be obtained through dual redundant networks
    - Reduced costs and ease of maintenance due to localized I/O
    - Reduced size of cable rooms and substations due to networking
    - Reduction in installation cost
- Sort out plant design & control system design BEFORE stabilisation & optimisation
- Stabilise first, then optimise
- High levels of instrumentation & automation no longer “nice to have” and will have significant return on investment.


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