



realtimepower

Real Time Power, Inc

Achieving Consistent, Low-Damage Start-ups
on Coal-Fired Generation Units

01-19-10

www.realtimetype.net

Power Plants

Ironbridge (E.ON)

- 2 x 500 MW wall-fired



West Burton (EDF)

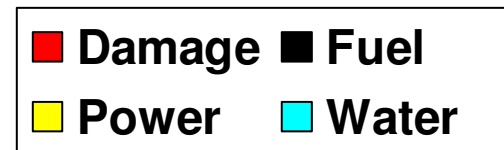
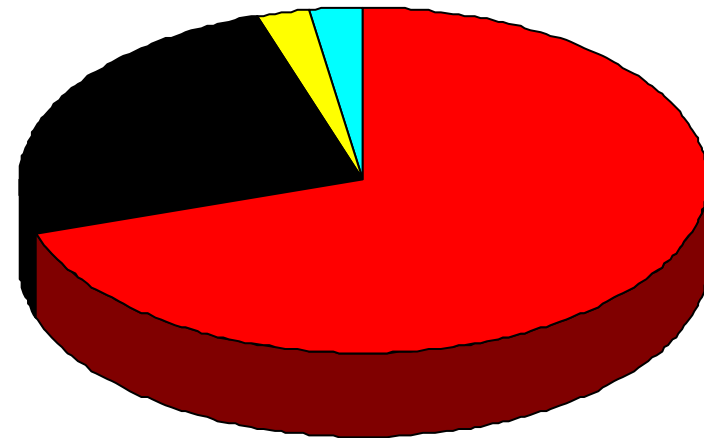
- 4 x 500 MW tangentially-fired



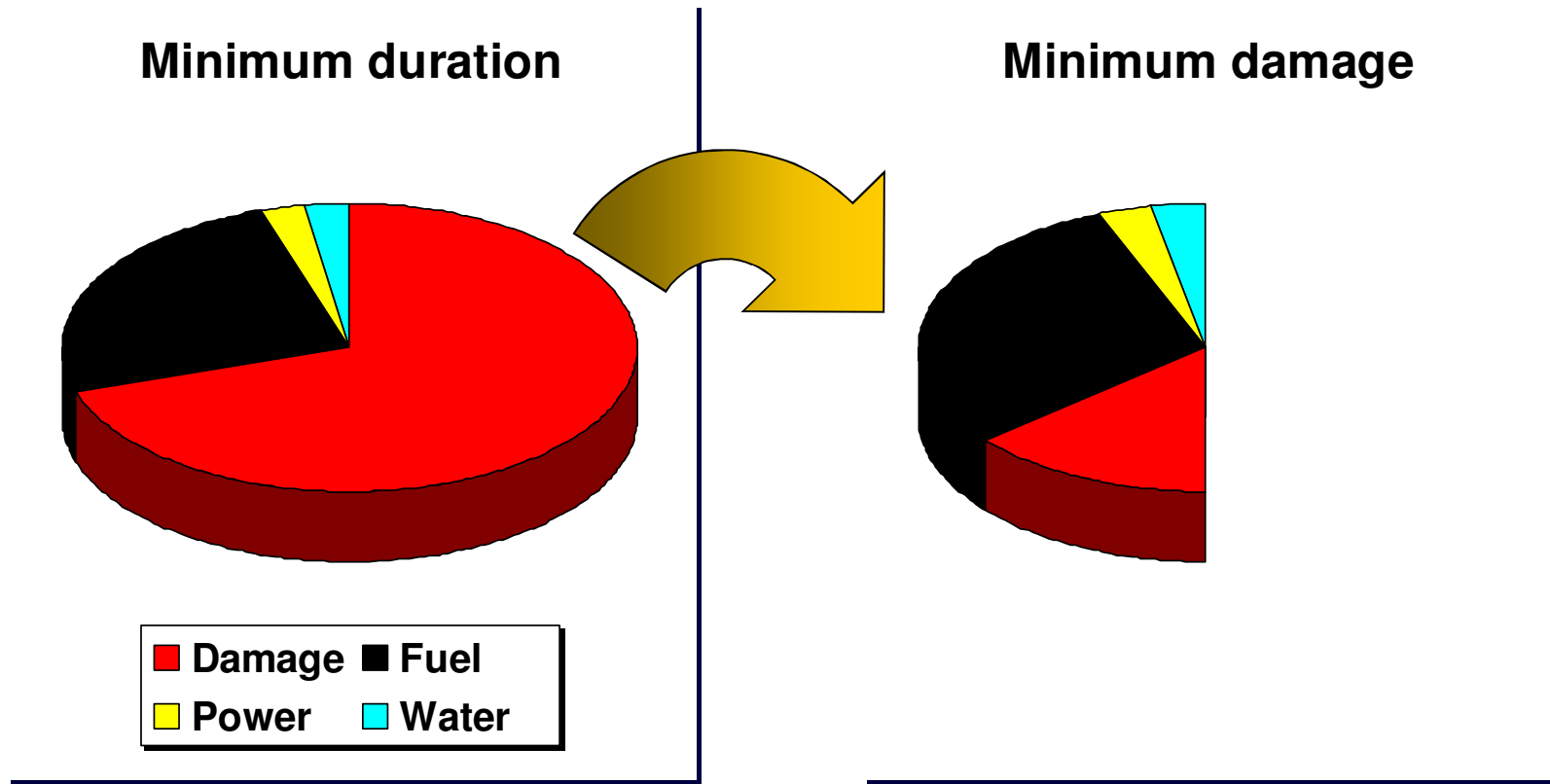
Business Case

- Minimization of start-up costs
- Most significant start-up cost is plant damage (reduced lifetime)
- Therefore greatest benefits are obtained by minimising plant damage during start-ups

Start-up Costs

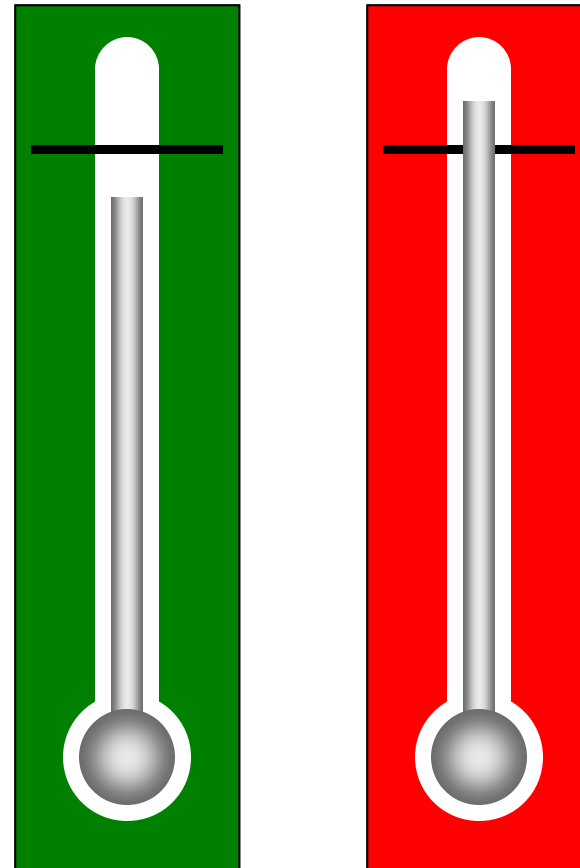


Main Objective



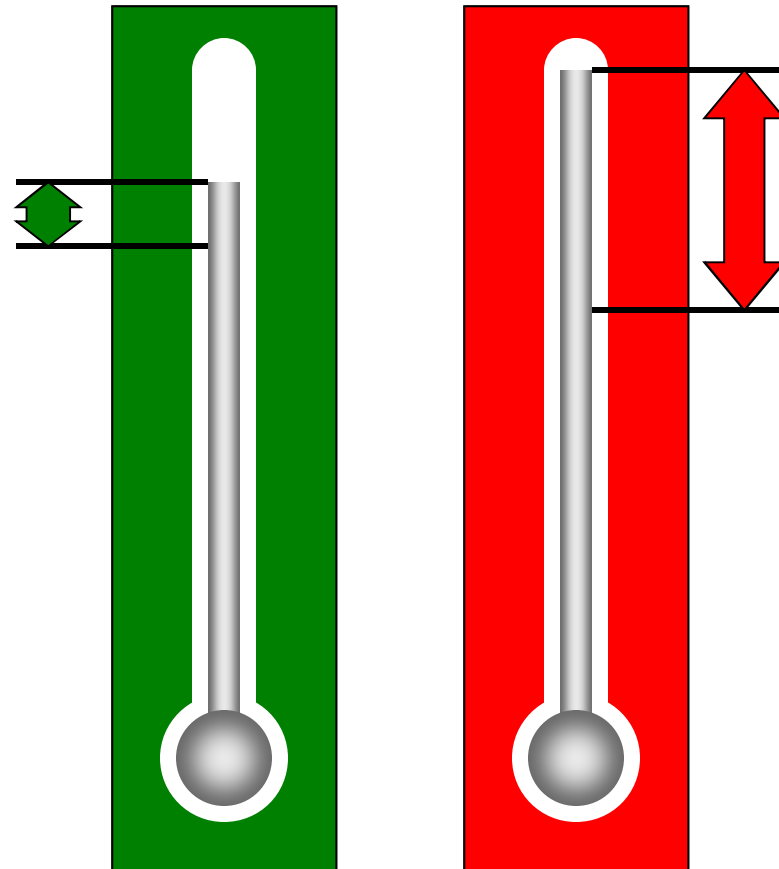
Minimizing Plant Damage

- Prevent excessively high temperatures



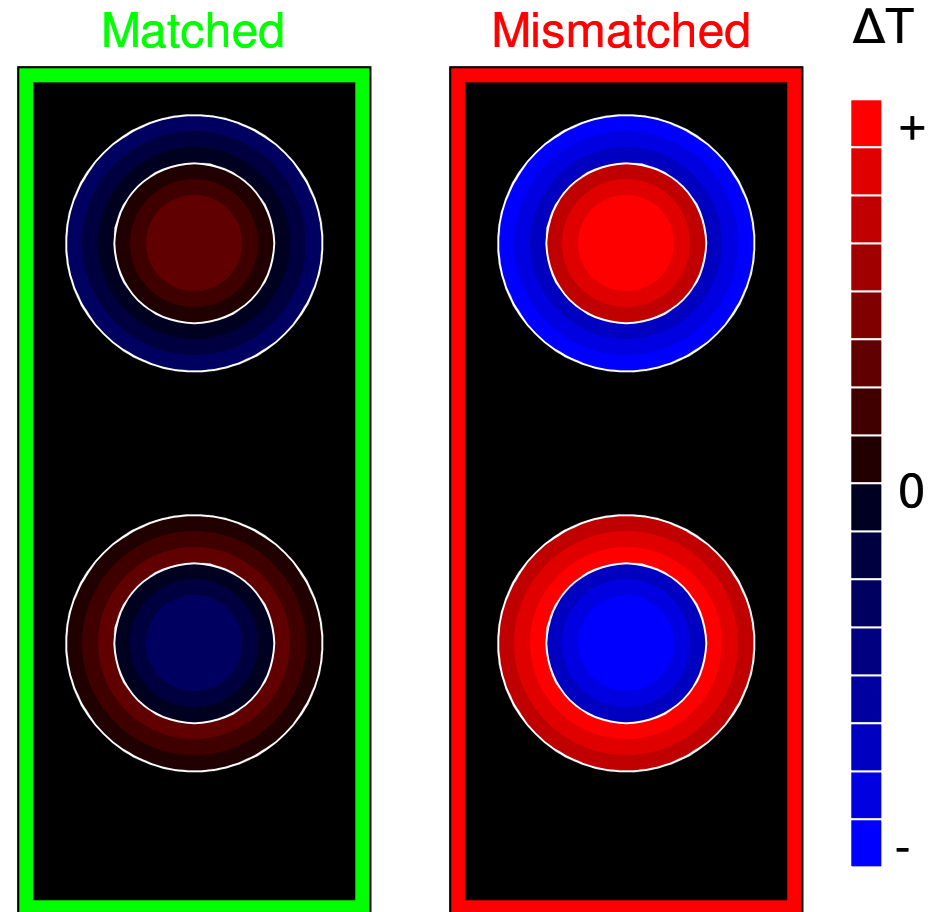
Minimizing Plant Damage

- Prevent excessively high temperatures
- Prevent excessively high rates of change of temperature



Minimizing Plant Damage

- Prevent excessively high temperatures
- Prevent excessively high rates of change of temperature
- Prevent excessively high temperature differences between steam and metal when re-establishing steam flows



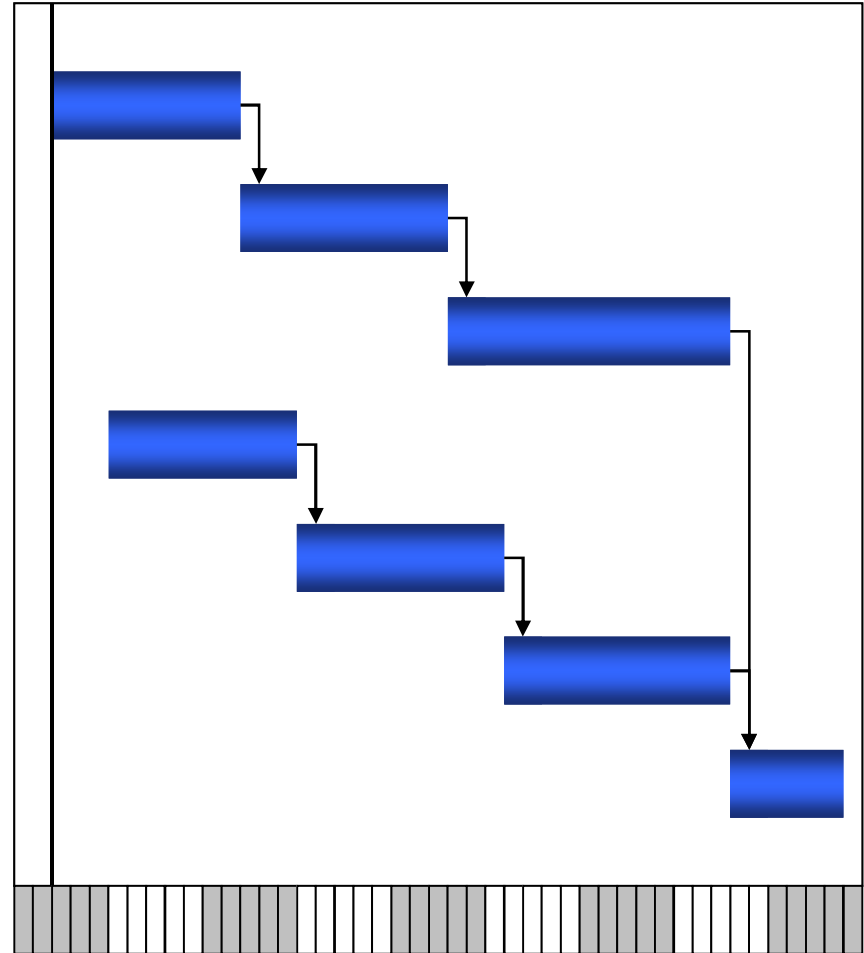
Good planning is needed

- The minimization of plant damage requires that unit start-ups are well planned
- Enough time must be allowed for purging and establishing initial firing
- Enough time must be allowed for achieving temperature matches



Good execution is needed

- The minimization of plant damage requires that unit start-ups are well executed
- Actions must be performed at the correct time in order for boiler and turbine to be ready at synchronization
- Parallel activities must be precisely coordinated



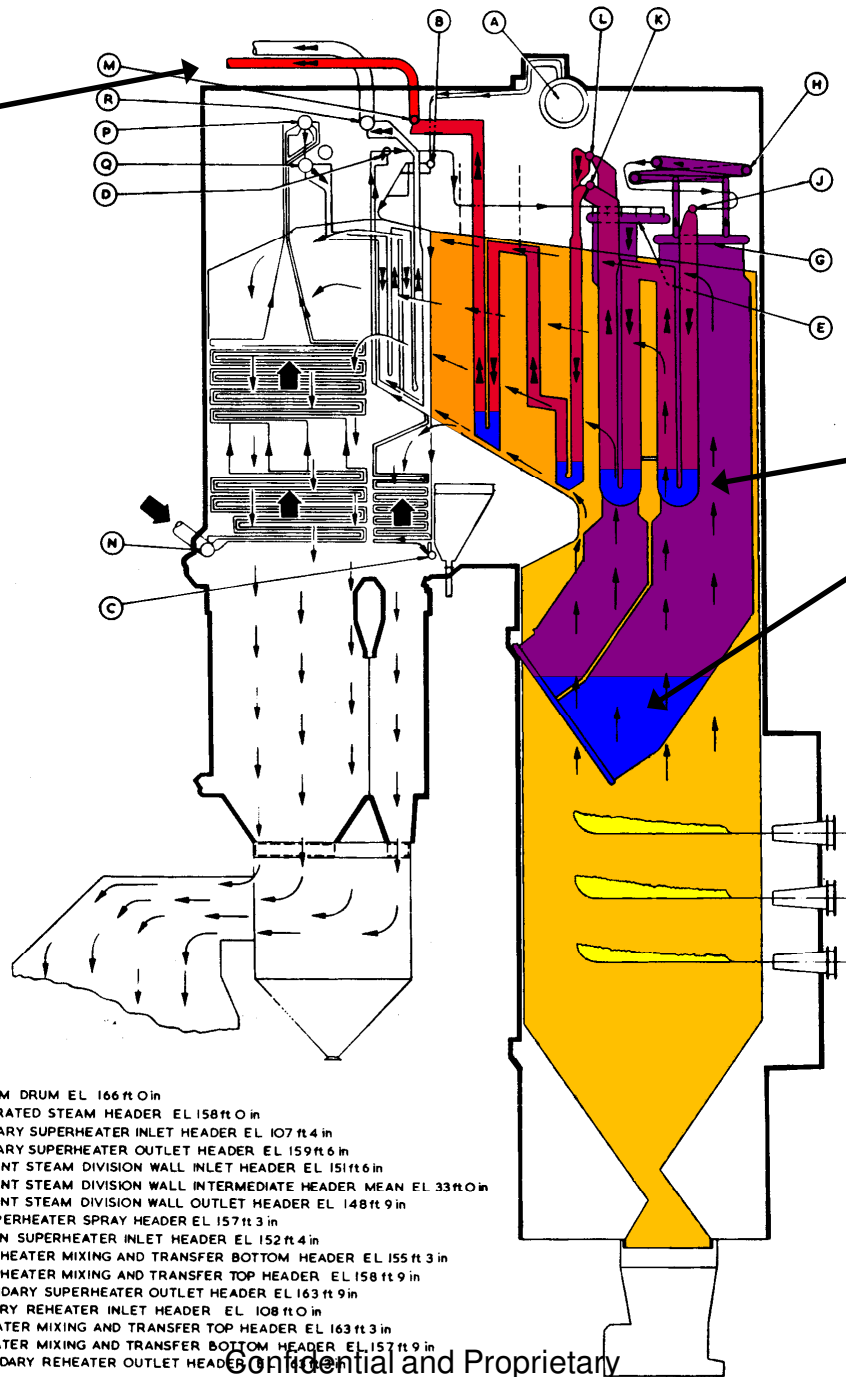
Good Planning & Execution

- Design approach defines the start-up procedure as a project plan (Gantt chart)
- It goes further than MS Project by adding actions and checks to each task
- Plan is then automatically updated and executed in real-time at start-up
- Task durations are calculated based upon the state of the unit



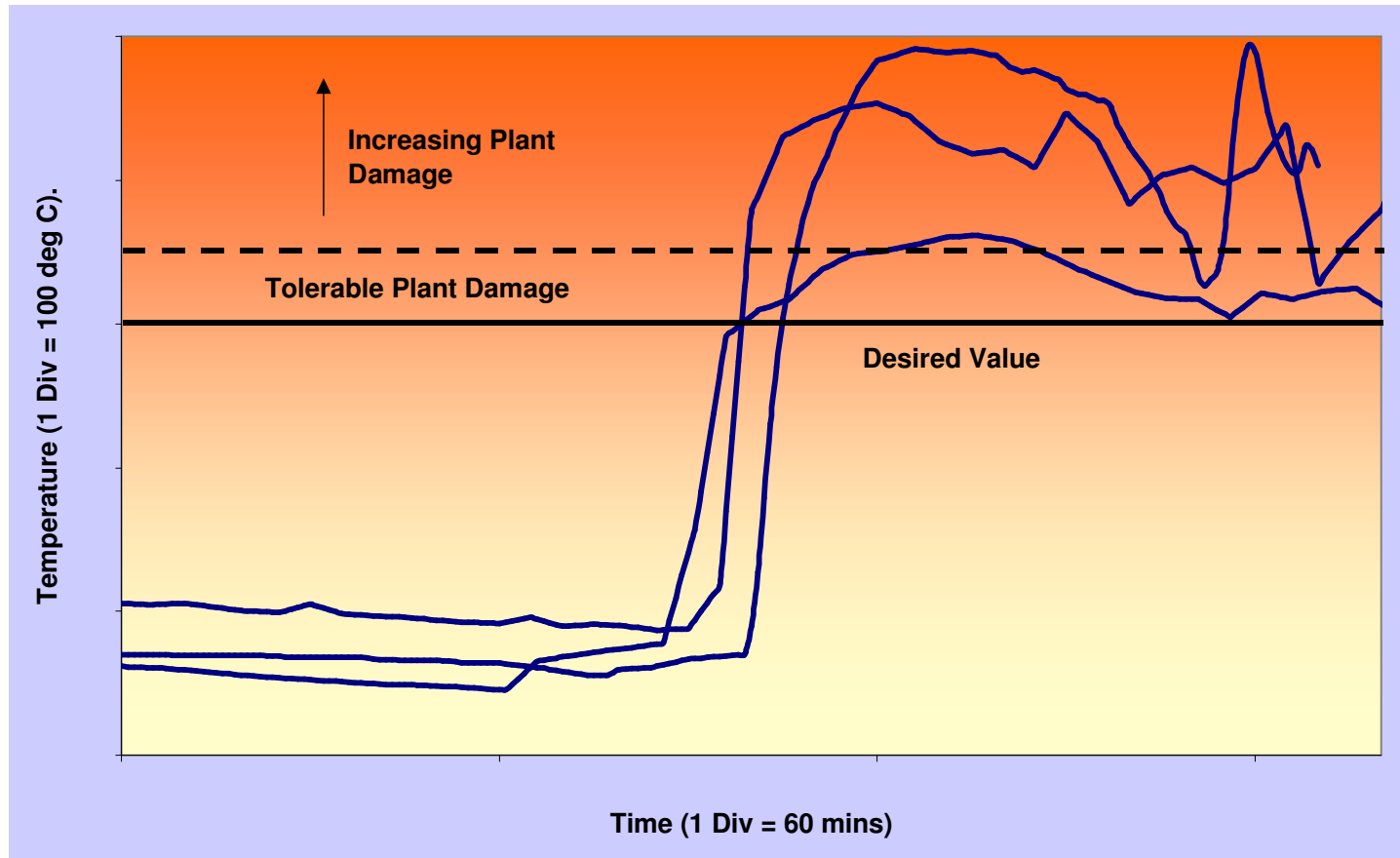
Minimize thermal shocks at final superheater outlet

Avoid tube leaks in initial superheater sections



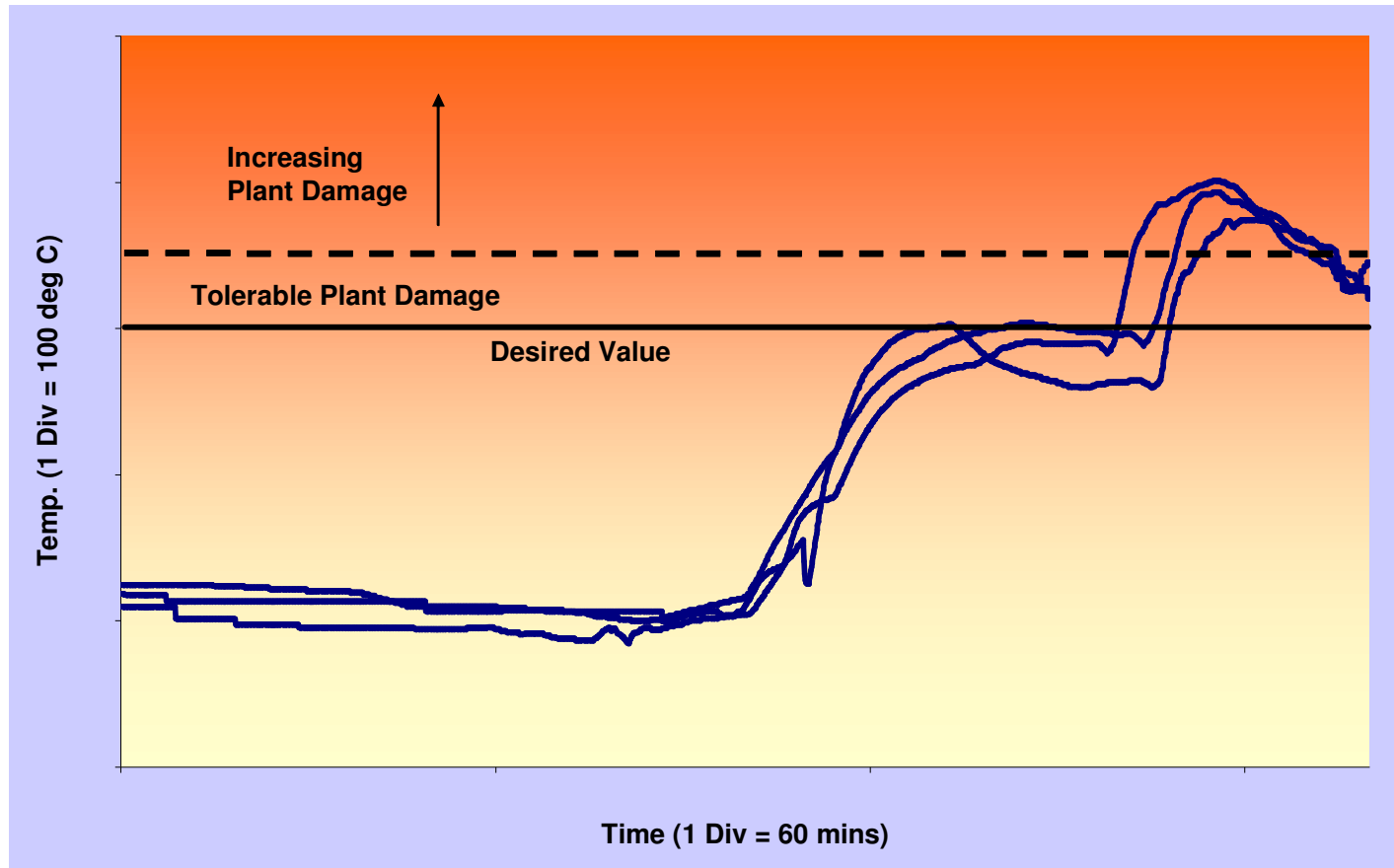
- A STEAM DRUM EL 166 ft 0 in
- B SATURATED STEAM HEADER EL 158 ft 0 in
- C PRIMARY SUPERHEATER INLET HEADER EL 107 ft 4 in
- D PRIMARY SUPERHEATER OUTLET HEADER EL 159 ft 6 in
- E RADIANT STEAM DIVISION WALL INLET HEADER EL 151 ft 6 in
- F RADIANT STEAM DIVISION WALL INTERMEDIATE HEADER MEAN EL 33 ft 0 in
- G RADIANT STEAM DIVISION WALL OUTLET HEADER EL 148 ft 9 in
- H DESUPERHEATER SPRAY HEADER EL 157 ft 3 in
- J PLATEN SUPERHEATER INLET HEADER EL 152 ft 4 in
- K SUPERHEATER MIXING AND TRANSFER BOTTOM HEADER EL 155 ft 3 in
- L SUPERHEATER MIXING AND TRANSFER TOP HEADER EL 158 ft 9 in
- M SECONDARY SUPERHEATER OUTLET HEADER EL 163 ft 9 in
- N PRIMARY REHEATER INLET HEADER EL 108 ft 0 in
- P REHEATER MIXING AND TRANSFER TOP HEADER EL 163 ft 3 in
- Q REHEATER MIXING AND TRANSFER BOTTOM HEADER EL 157 ft 9 in
- R SECONDARY REHEATER OUTLET HEADER EL 140 ft 0 in

Variations in maximum platen metal temperatures during manual starts



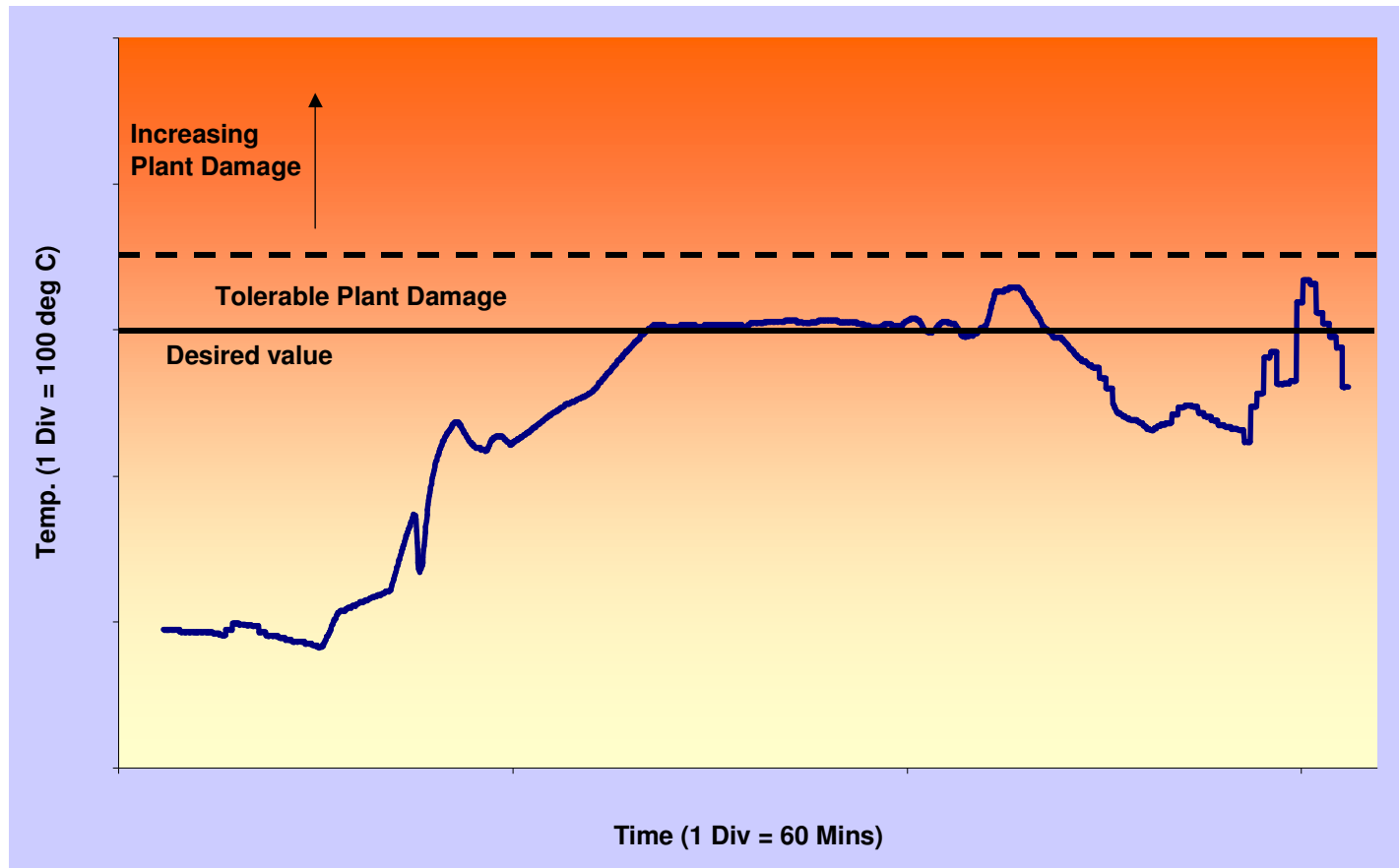
RTP

Variations in maximum platen metal temperatures for automated starts



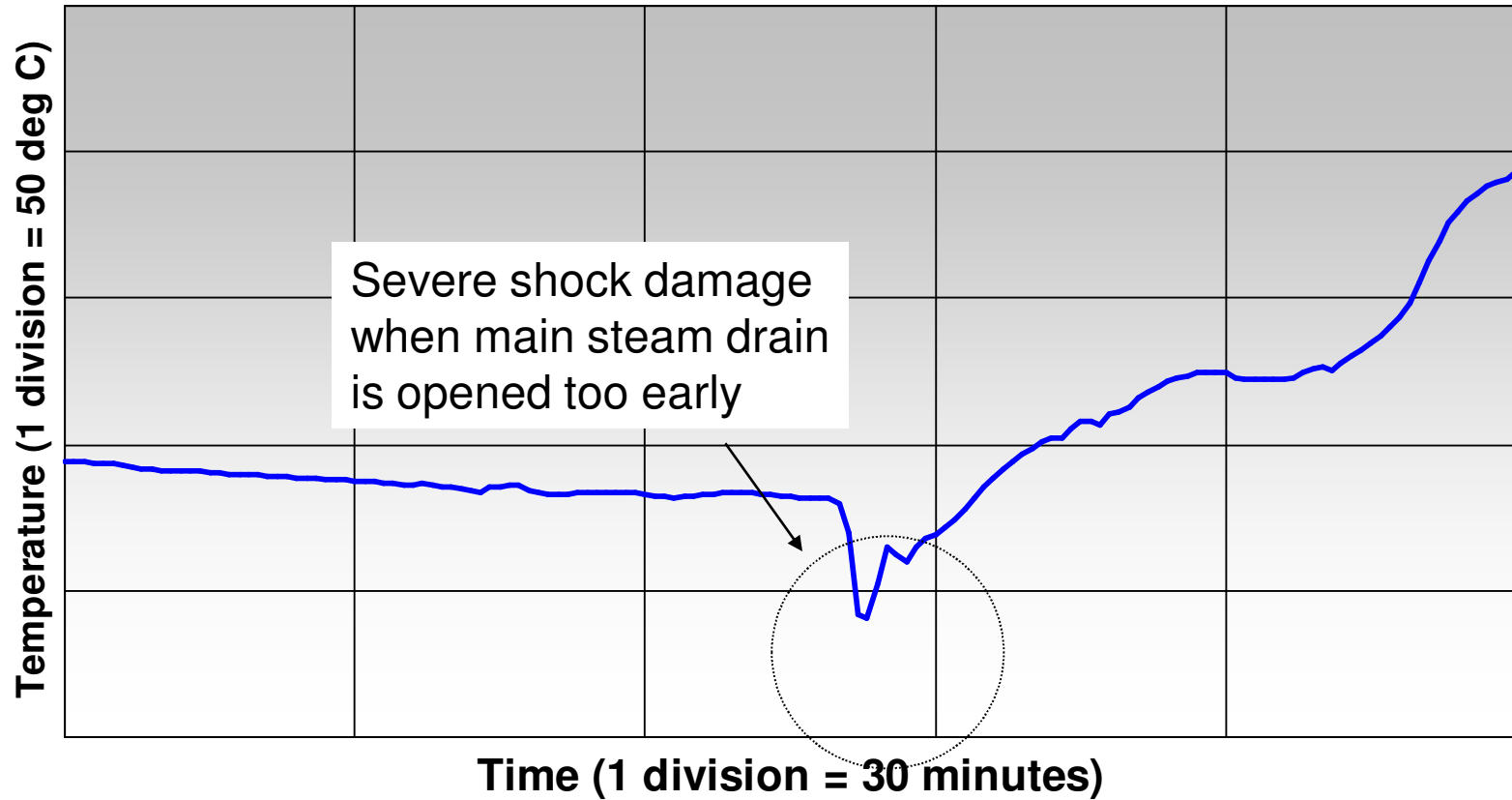
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Consistency permits further optimization

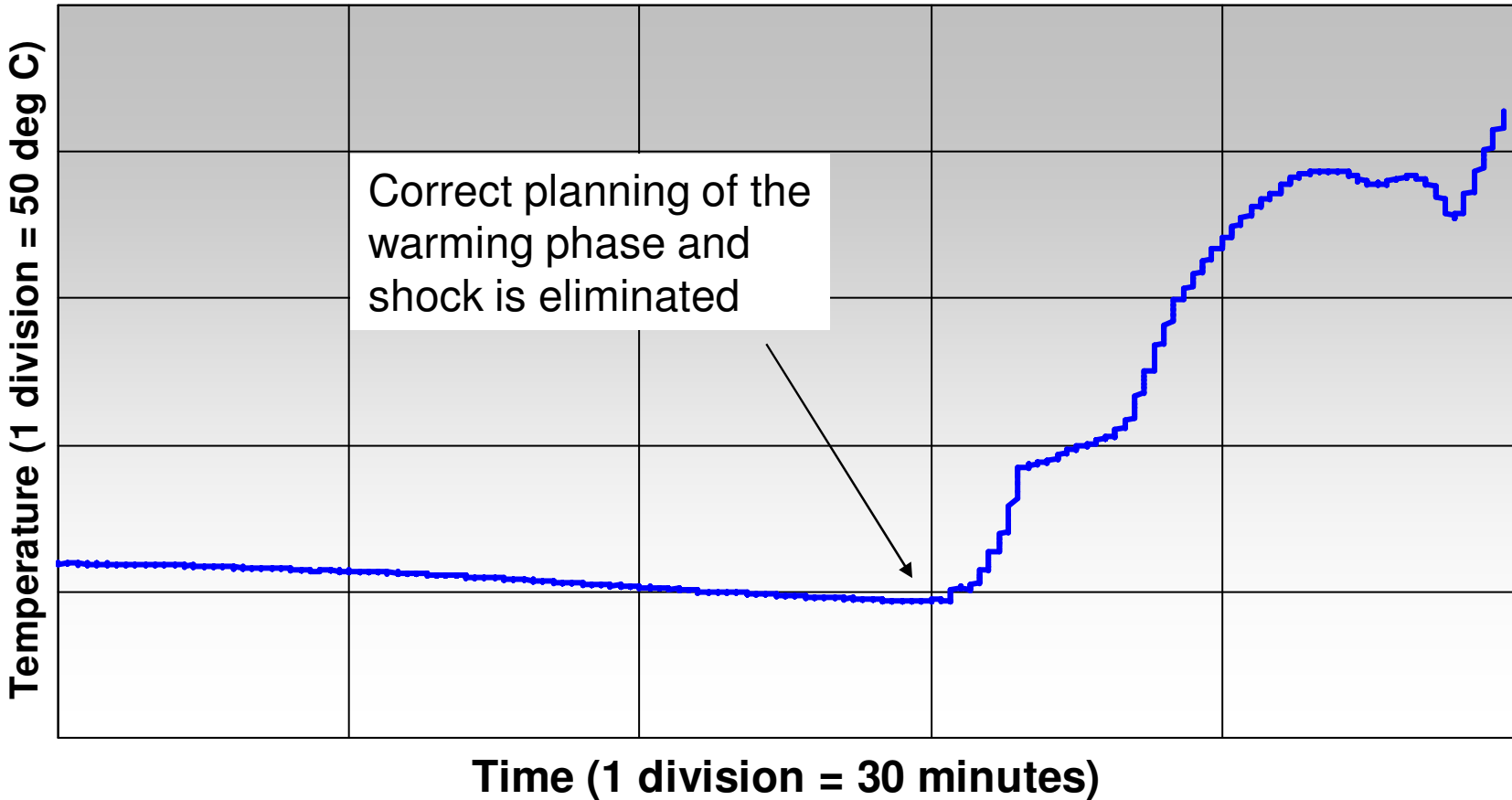


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Main steam temperature during a manual start-up

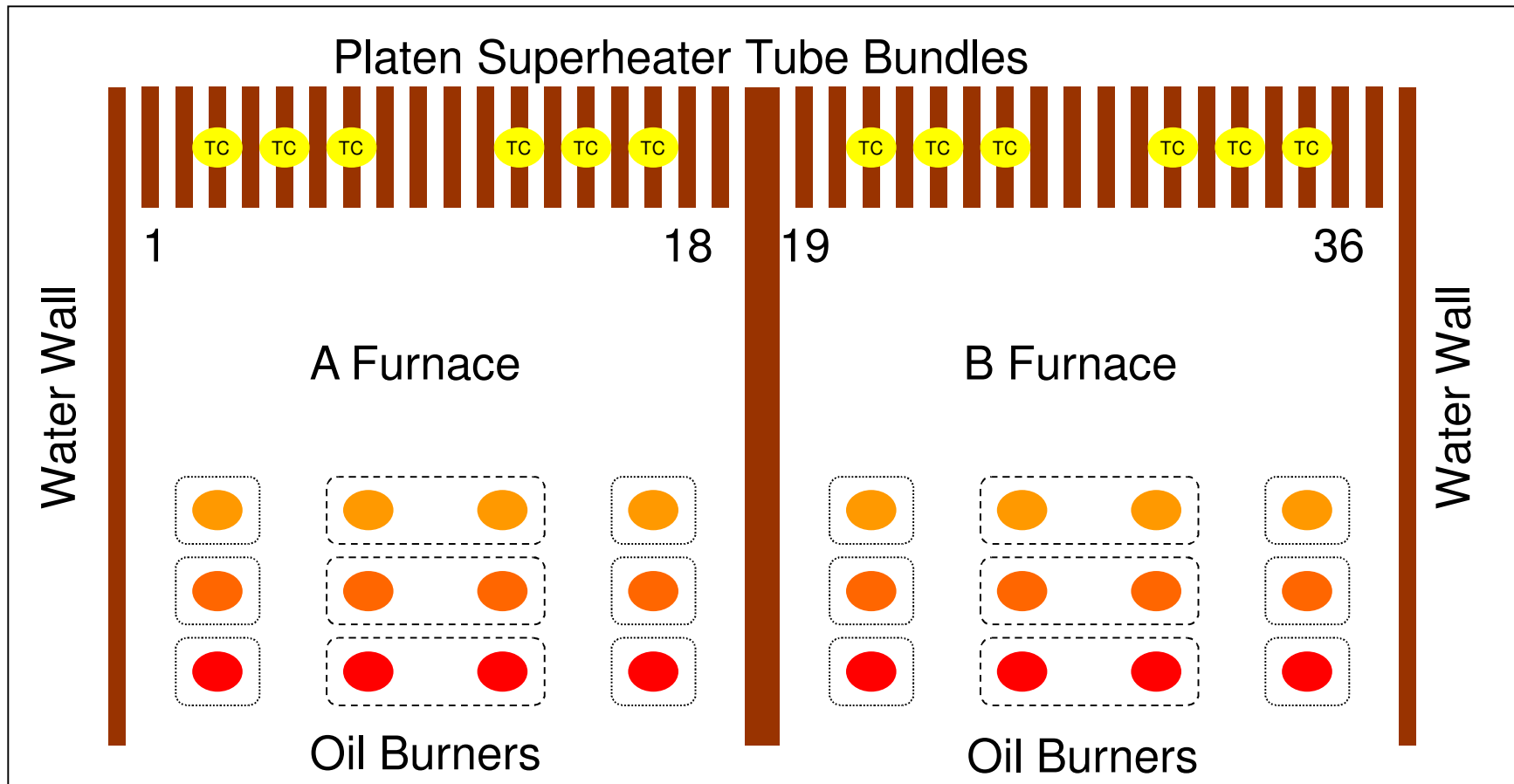


Main steam temperature during an automated start-up



RTP

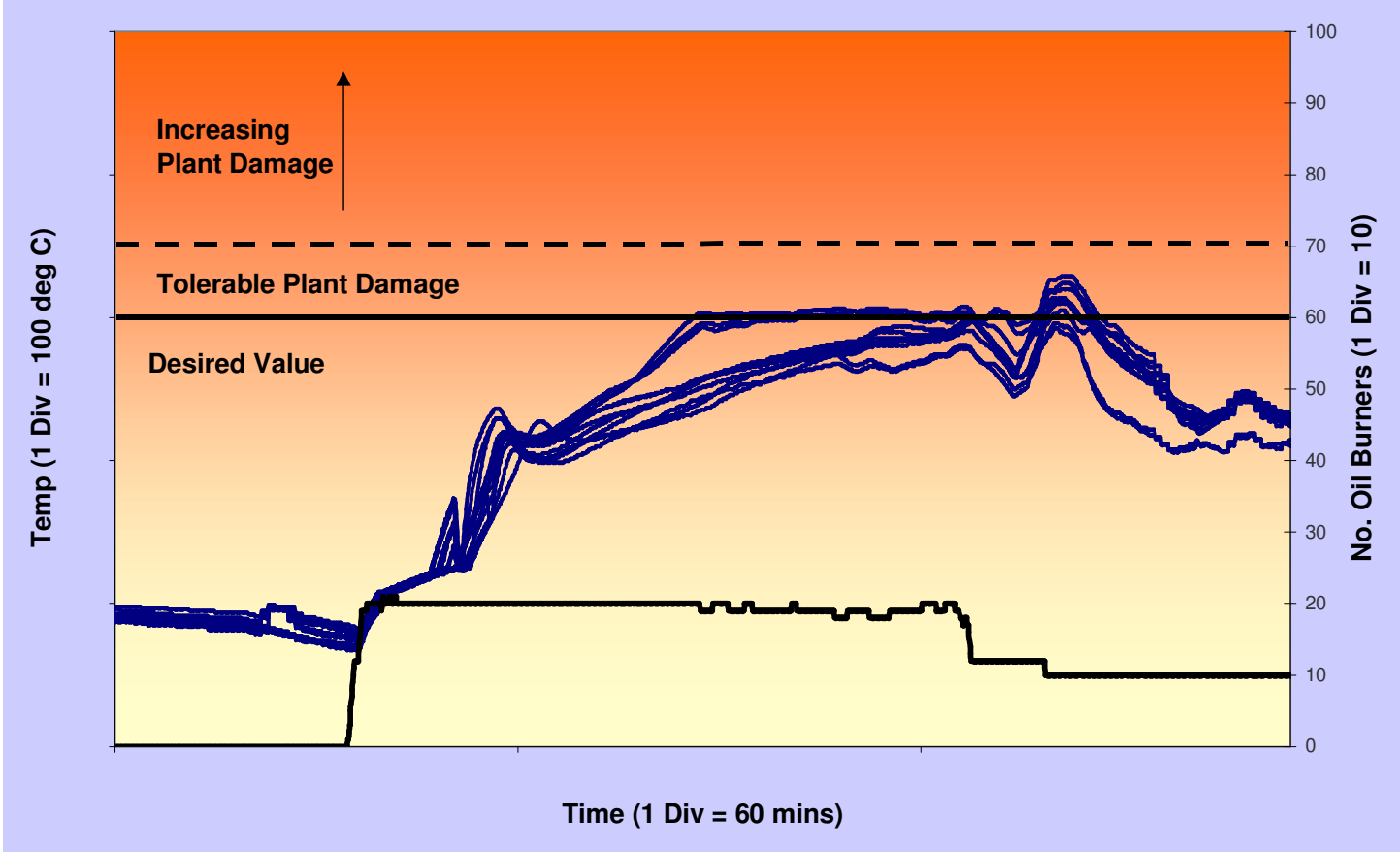
Oil Burner Controller for Wall-Fired Units



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TC Thermocouple Location

Intelligent Oil Burner Control

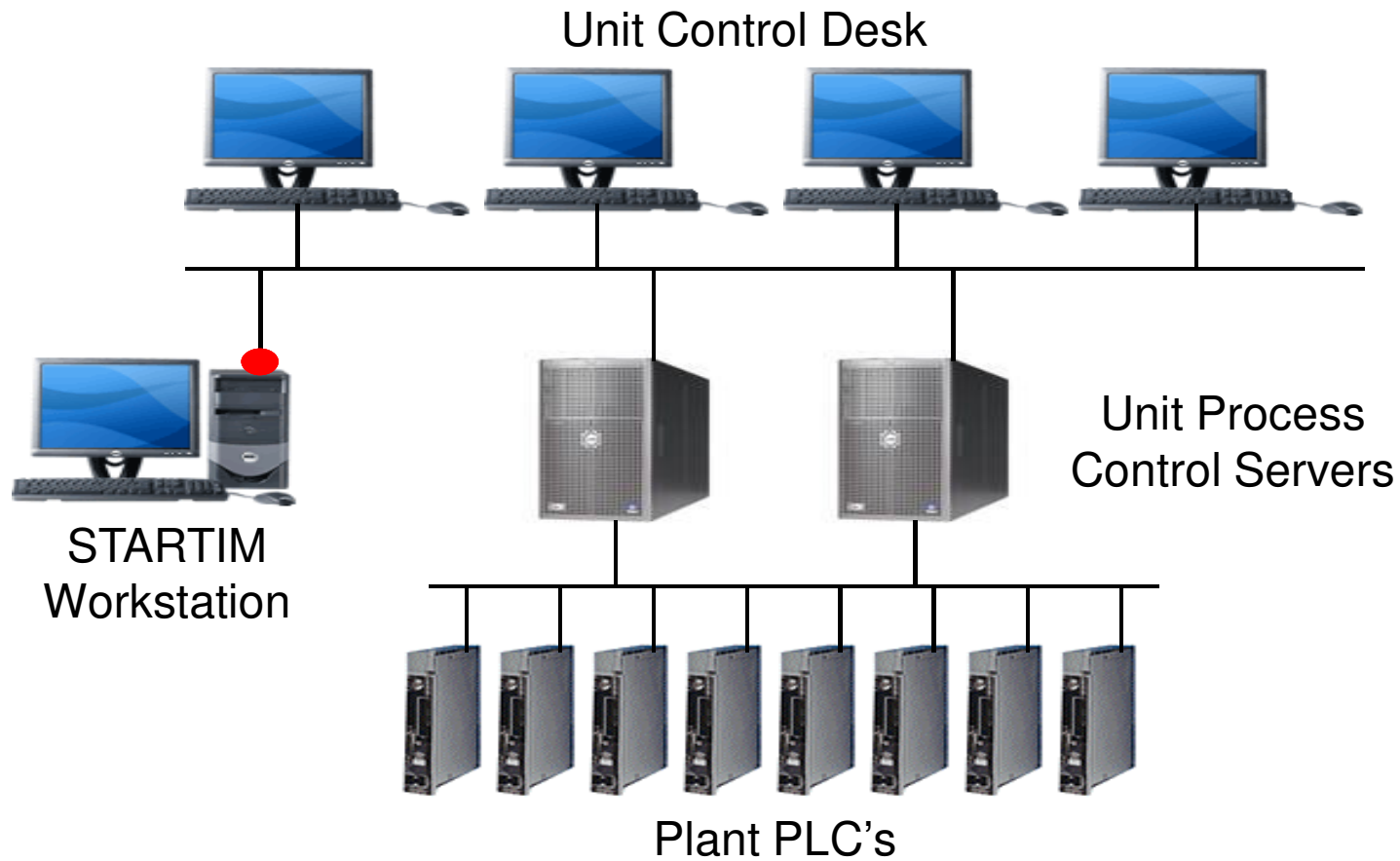


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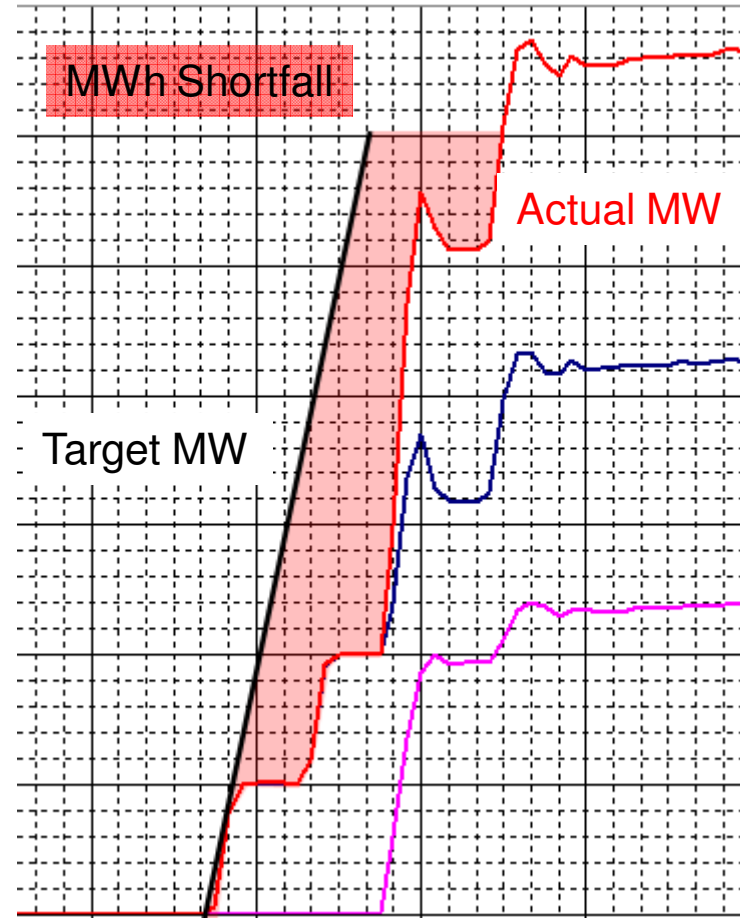
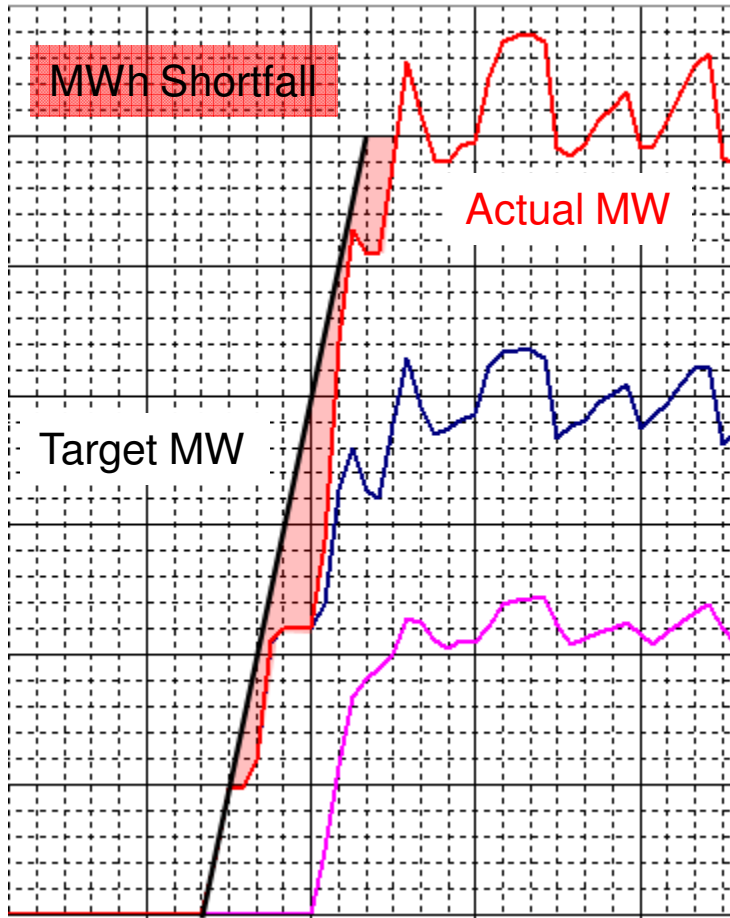
Scope of Automation

- All automatable tasks from topping up drum all the way through to minimum load, including:
 - preparing & purging the gas passes
 - inserting & managing oil burners
 - inserting & managing coal mills
 - actively controlling pressure & temperatures
 - establishing cooling water systems
 - pulling vacuum
 - running up the turbine
 - engaging desuperheater sprays

Implementation Details



Commercial implications of inconsistent start-ups



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The case for automating complex manual procedures

BBC NEWS UK EDITION

Last Updated: Tuesday, 17 May, 2005, 20:37 GMT 21:37 UK

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Errors led to BP refinery blast

BP has accepted responsibility for a "series of failures" by staff which it said led to the fatal explosion at its largest US refinery in March.

The blast and subsequent fire at the Texas City refinery near Houston claimed 15 lives and injured 170.



Proper procedures were not followed before the explosion

"The mistakes made during the start-up of this unit were surprising and deeply disturbing," said Ross Pillari, president of BP Products North America.

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In Summary

- Consistent, low damage start-ups have been successfully achieved through:
 - An appropriate technical approach
 - The design of best practice start-up procedures
 - The precise and reliable automated execution of these procedures
- Achieving consistency allows further optimization benefits to be realized

Power Plant Unit 1 Hot Start Help

File View Tools Fri 04 Mar 2005 15:29:13

Unit Status: **Shutdown** Sync Time: Fri 04 Mar 2005 15:54:16 Time To Sync: 25 m

Unit Condition: **Warm Start** Estim Sync Time: Fri 04 Mar 2005 15:54:16 Progress: On time

A Drains Manager	15:23	15:55
A Fans Manager	15:24	15:58
A Firing Manager	15:28	15:59
A Vacuum Manager		15:44 - 15:49

A Prepare Boiler	15:23	15:52
+ A Prepare Boiler Checks	15:23	15:24
+ A Prepare Gas Passes	15:24	15:24
+ A Purge Gas Passes	15:24	15:27
- A Establish Oil Burners	15:28	15:30
A Reduce Precipitators	15:28	15:28
A Check Drum Level (Oil)	15:28	15:28
A Check Furn Press (Oil)	15:28	15:28
A Confirm Propane Valve Open	15:28	15:28
A Snapshot SDW OL Hdr Temps	15:28	15:28
A Insert 12 Oil Burners	15:28	15:29
A Insert Extra Oil Burners	15:29	15:30
- A Warm Steam Side	15:29	15:43
- A Warm Steam Div Walls	15:29	15:38
A Match 1st SDW	15:29	15:36
A Match Both SDW's		15:36 - 15:37
A Open Desup Drains		15:36 - 15:37
A Open Platen IL Drains		15:37 - 15:38
- A Warm Platen SH	15:29	15:38
A Match 1st Platen	15:29	15:36
A Open Platen OL Drains		15:38 - 15:38

Furnace Press

Oil Burner Mimic

C1	F1	F2	C2	C3	F3	F4	C4
○	○	○	○	○	○	○	○
D1	A1	A2	D2	D3	A3	A4	D4
●	○	○	◐	◐	○	○	●
B1	E1	E2	B2	B3	E3	E4	B4
◐	○	○	○	○	○	○	○

Information Hold Overrunning Tasks Hold

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15:29:09 All Tasks automated
15:29:10 D2 Oil Burner Insert
15:29:11 D3 Oil Burner Insert
15:29:12 B1 Oil Burner Insert
15:29:13 B4 Oil Burner Insert
  
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