

# Water Leak Detection at Temco

## Legacy Indicators and Secondary Techniques



# BHPB Water Leak Incidents

- Temco No2 Furnace – Ferromanganese
- Middleberg – Ferrochrome
- Olympic Dam - Copper

# Consequences of Water Leaks – No2 Furnace 1991



# Consequences of Water Leaks – No2 Furnace 1991



## Consequences of Water Leaks – No2 Furnace 1991



## Steam Explosion Mechanism

- When a molten material at high temperature comes into contact with a volatile liquid (water in our case) , the former fragments and its surface area increases by many orders of magnitude. As a result of this increase in surface area, thermal energy is rapidly transferred from the molten material to the volatile liquid. The liquid vaporises and expands explosively to thousands of times its original volume, resulting in the formation of a shock wave.
- Liquid To Steam expansion ratio 1700 : 1

# What furnace components failures can cause water leaks

- Contact clamp
- Pressure ring (diaphragm or cracks)
- Filler Section
- Mantle
- Heat shield
- Furnace Cover
- Feedchute (No5)
- Cooling ring pipes (No1&2)
- Cooling Water Hoses

# What types of water leaks can occur



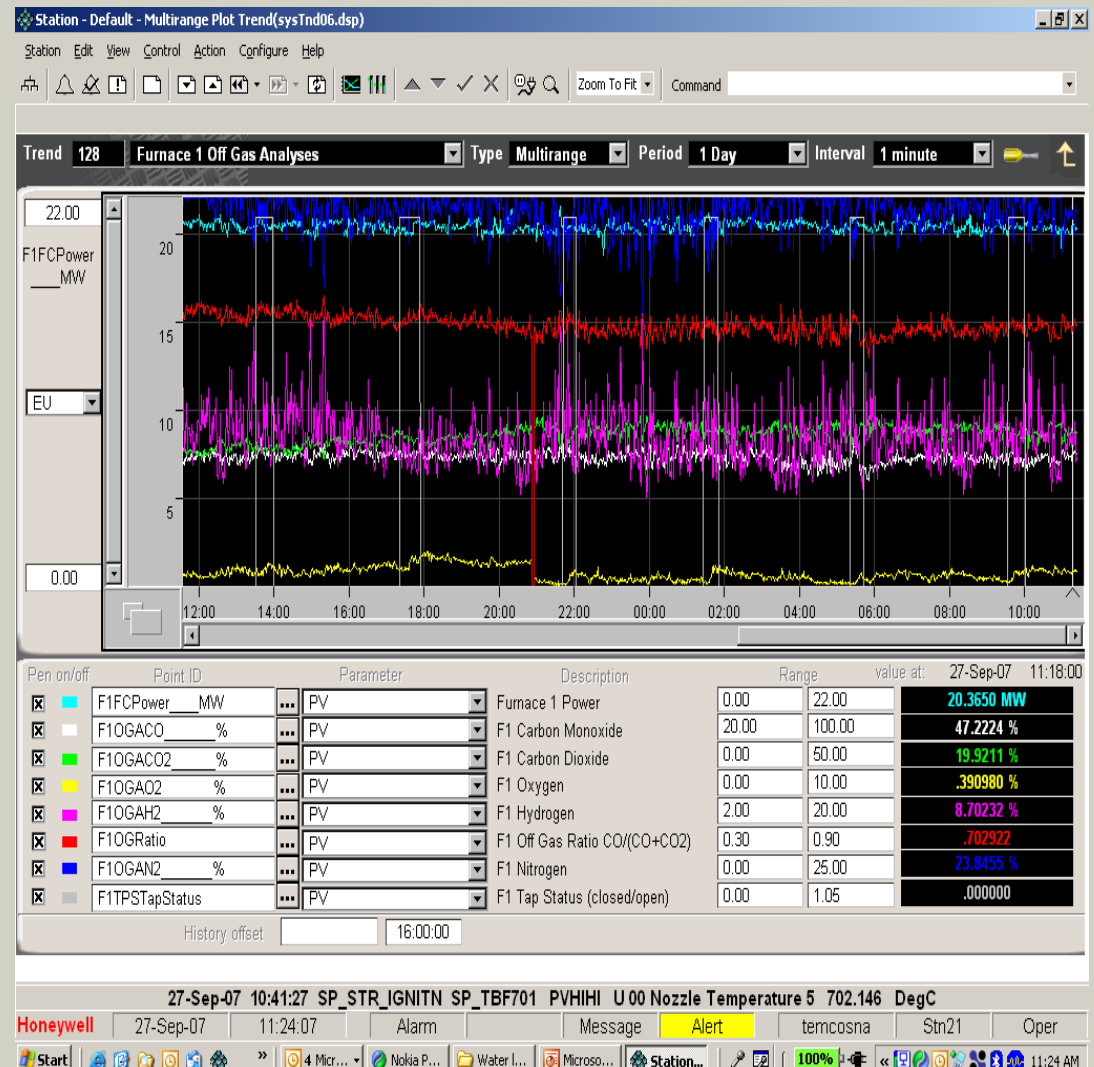
# Indicators and Actions for Water Leaks

## Hydrogen Analysers:

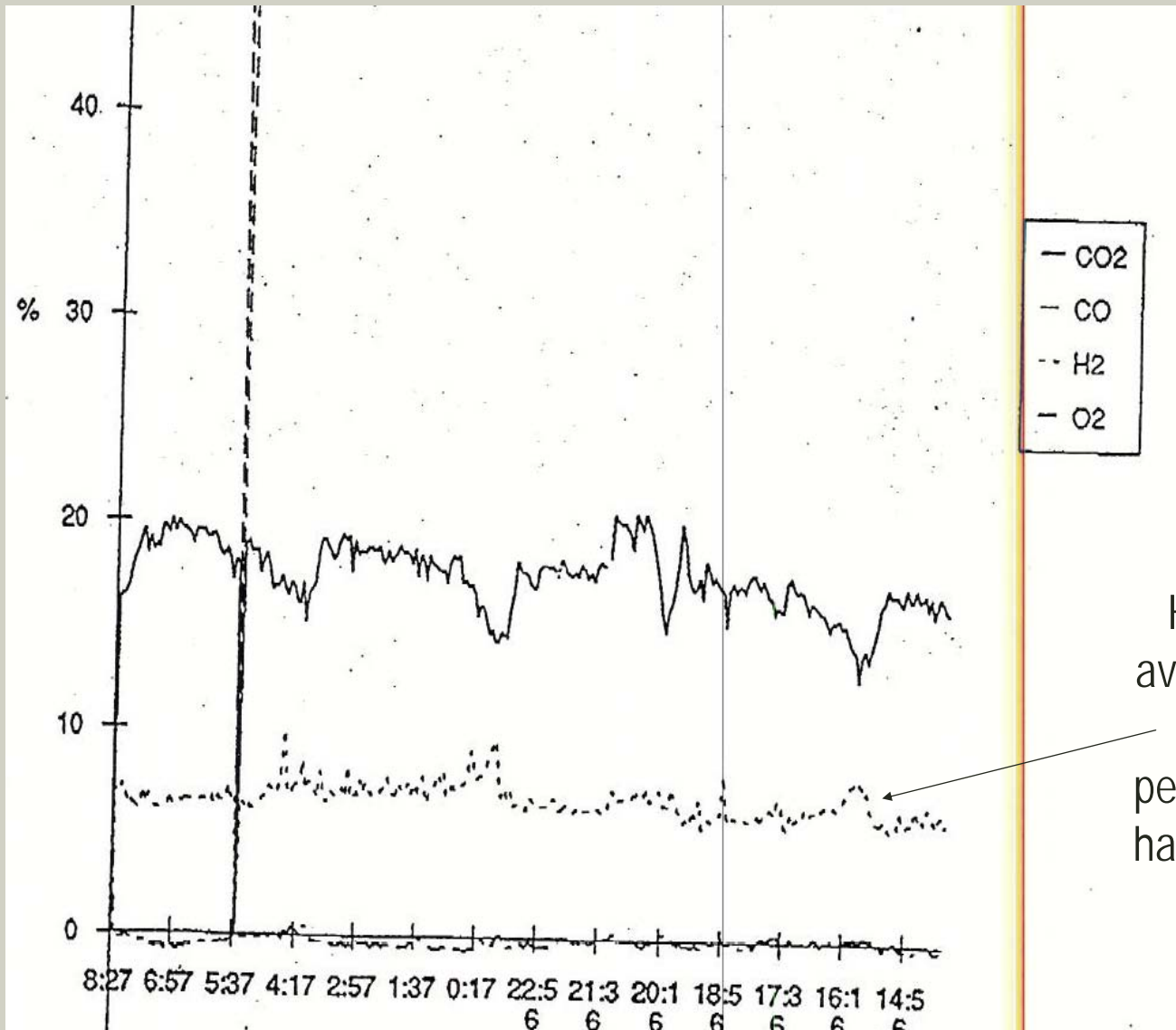
- Trends
- Alarms and Trips

## Actions:

- Tundish inspection to look for no/reduced flow or steam
- Furnace top inspection for hoses blown/leaking
- Internal furnace inspection for component failures, bridging or short electrodes



# Hydrogen before 1991 Furnace 2 Eruption



Hydrogen at average 8-10%.  
Electrode penetration may have been deep

# Hydrogen Alarms and trips

## F1&2 Hydrogen

- **Alarm** - high priority alarm at 12%
- **Trip** - urgent priority alarm at 20% (60 second filter time - must be above 20% for 60 seconds before it alarms)
- **Bad hydrogen trip** - urgent priority alarm if hydrogen is out of range (<- 2.9% or >25%)

## F3 Hydrogen

- **Alarm** - high priority alarm at 12% (10 second filter time)
- **Trip** - high priority alarm at 20% (60 second filter time - must be above 20% for 60 seconds before it alarms)
- **Bad hydrogen trip** - high priority alarm if hydrogen is out of range (<- 2.9% or >25%)

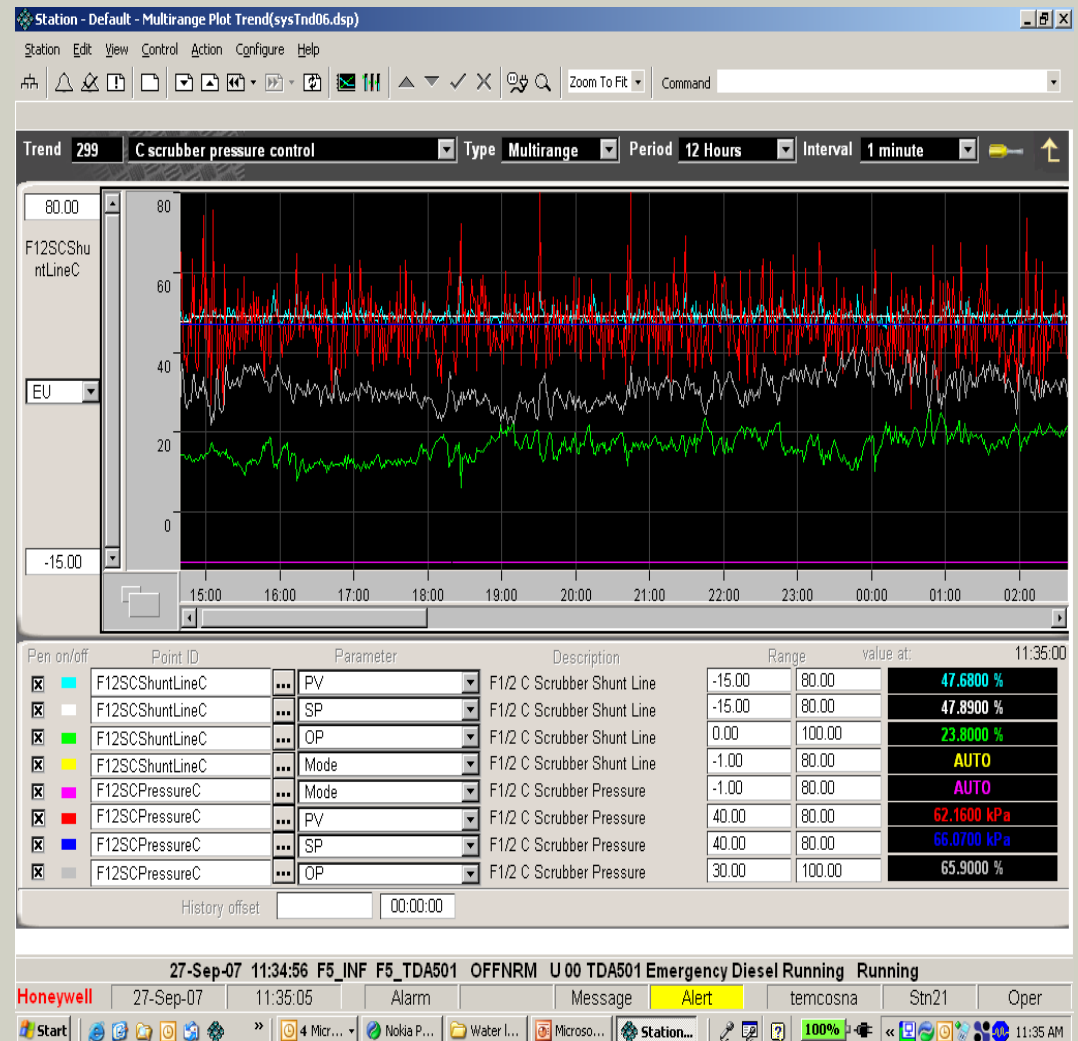
# Indicators and Actions for Water Leaks

## Furnace Pressure Analysers:

- Trends
- Pressure Trips
- Shunt line

## Actions:

- Tundish inspection to look for no/reduced flow or steam
- Furnace top inspection for hoses blown/leaking
- Internal furnace inspection for component failures
- Inspection of Furnace scrubber offtake blockages



# Pressure trips and alarms

## No1&2 Pressure

- **Trip** - 50 Pa for 15 Seconds for all scrubbers.

## No3 Pressure

- **Alarm** - urgent priority at 50 pa (5 second filter time)
- **F3 Pressure Trip** - urgent priority at 50 pa (10 second filter time)
- **F3 Pressure Trip - Fast** - urgent priority at 100 pa (2 second filter time)

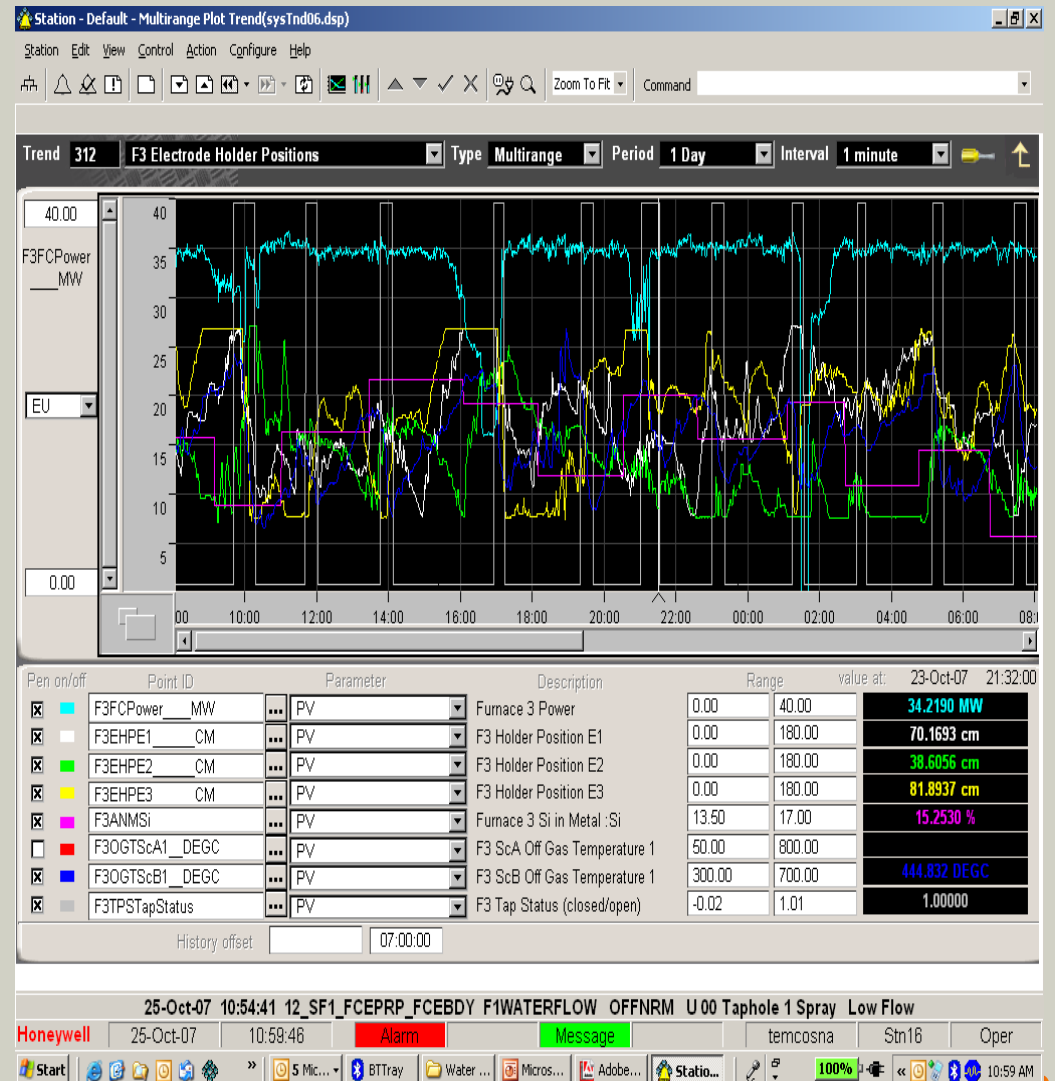
# Indicators and Actions for Water Leaks

## Unusual Electrode Movement:

- Trends (holder position bottom limit, KA's reduced on one electrode)

## Actions:

- Tundish inspection to look for no/reduced flow or steam
- Furnace top inspection for hoses blown/leaking
- Internal furnace inspection for component failures, bridging or short electrode



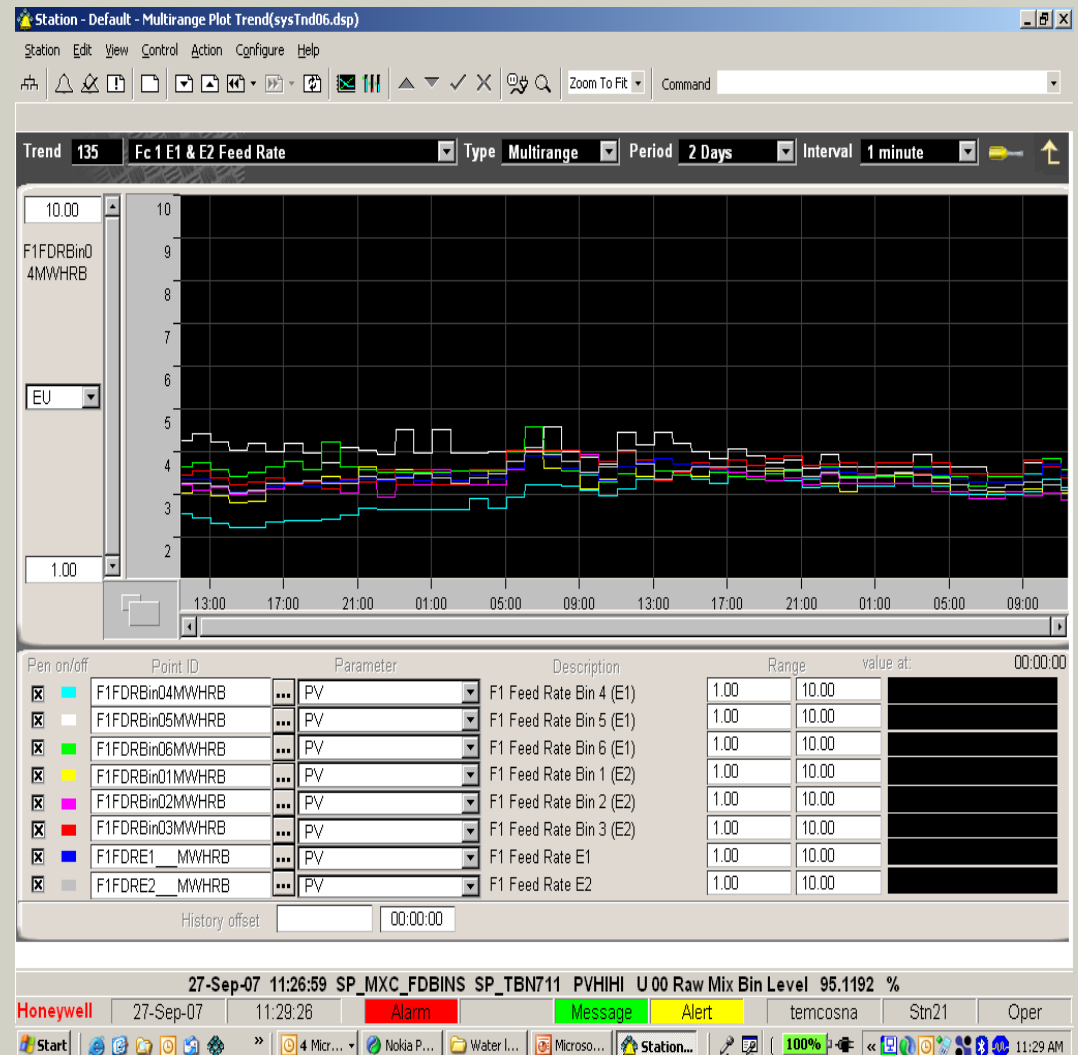
# Indicators and Actions for Water Leaks

## Feedrates:(MWHr/Feed Batch)

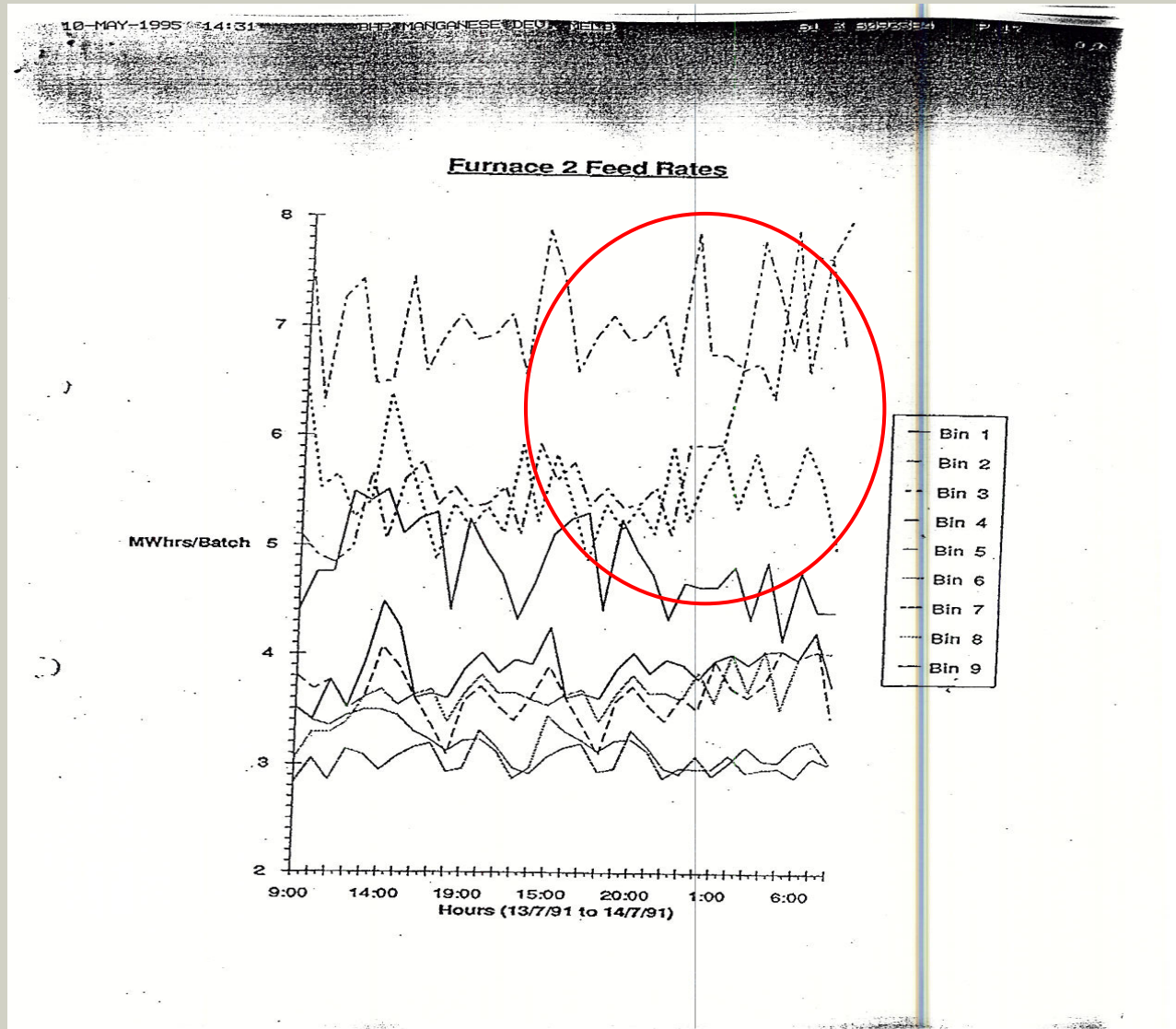
- Trends
- Alarms and Trips

## Actions:

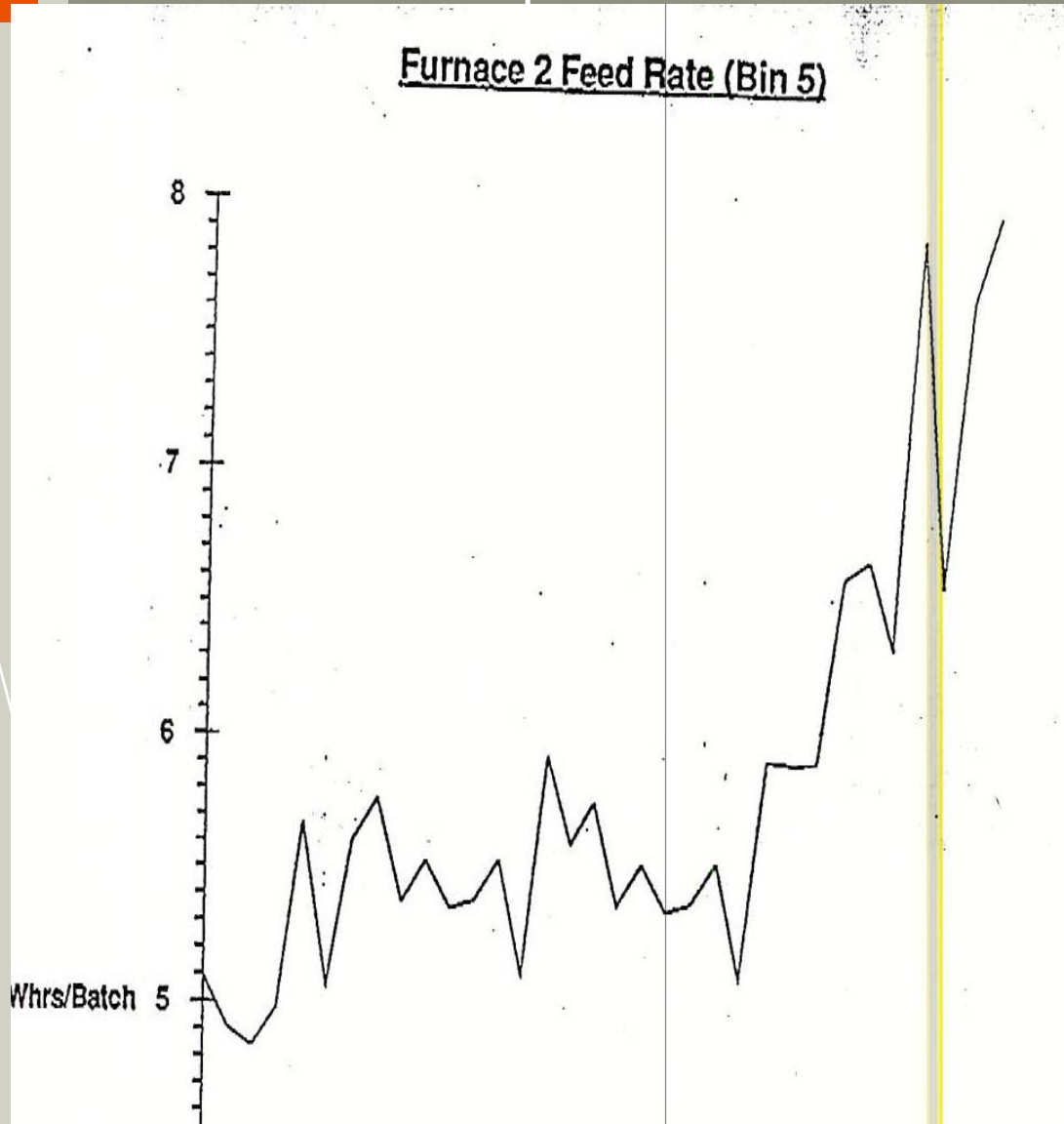
- Furnace Bin Inspection
- Tundish inspection to look for no/reduced flow or steam
- Furnace top inspection for hoses blown/leaking or empty feedchutes
- Internal furnace inspection for component failures or bridging



# No2 Furnace Explosion 1991



# No2 Furnace Explosion 1991



# Feed Rate Alarms and Trips

## **MWH/batch alarm on each furnace bin.**

- High priority alarm at 6.5 MWh/batch and trip

## **Electrode feed rate alarms**

- Urgent priority alarm at 27 MWhrs (eg Feed rate E1 MWhrs)
- 20 minutes furnace will trip

## **Furnace bin feed rate alarms**

- Urgent priority alarm at 27 MWhrs (Feed rate E1 Bin 1 MWhrs)
- 20 minutes furnace will trip

## Procedural Control

- SYSTEM INSPECTIONS
- REGULATE FLOW RATES - WATER LEAKS
- FURNACE PRESSURE CONTROL
- FURNACE INSPECTION – INTERIOR
- GAS ANALYSIS - HYDROGEN/OXYGEN
- RECIRCULATED WATER SYSTEM

## Summary of Controls (Legacy)

Hydrogen

Feed rate

Furnace Pressure

Electrode Holders

Operator Inspections

- If in doubt TURN FURNACE OFF AND INSPECT
- Know your indicators for water leaks
- Ensure we are vigilant with response to water leaks
- Operator Authority to turn off furnace

## Current Actions

- Centralized Control – Removal of People from furnace area



- Moisture Meter –  
Improved detection of water leaks

