

An Analysis Of Combustion System Concerns

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Introduction

- Current research effort
- Recent related work
 - 2001 CIBO Boiler Survey
 - 2001 AFB operating benchmarks
 - 2001 Boiler Survey relationship to current research effort
 - 2001 forced outage causes
 - 2001 boiler O/M concerns

Current Research Effort

- Research justification
- Survey forms
 - Nine separate populations surveyed to determine amount of consistency between combustion system owners and operators and vendors of the systems
 - Three combustion technologies analyzed (fluidized bed [FBC], pulverized coal [PC], and stoker fired)

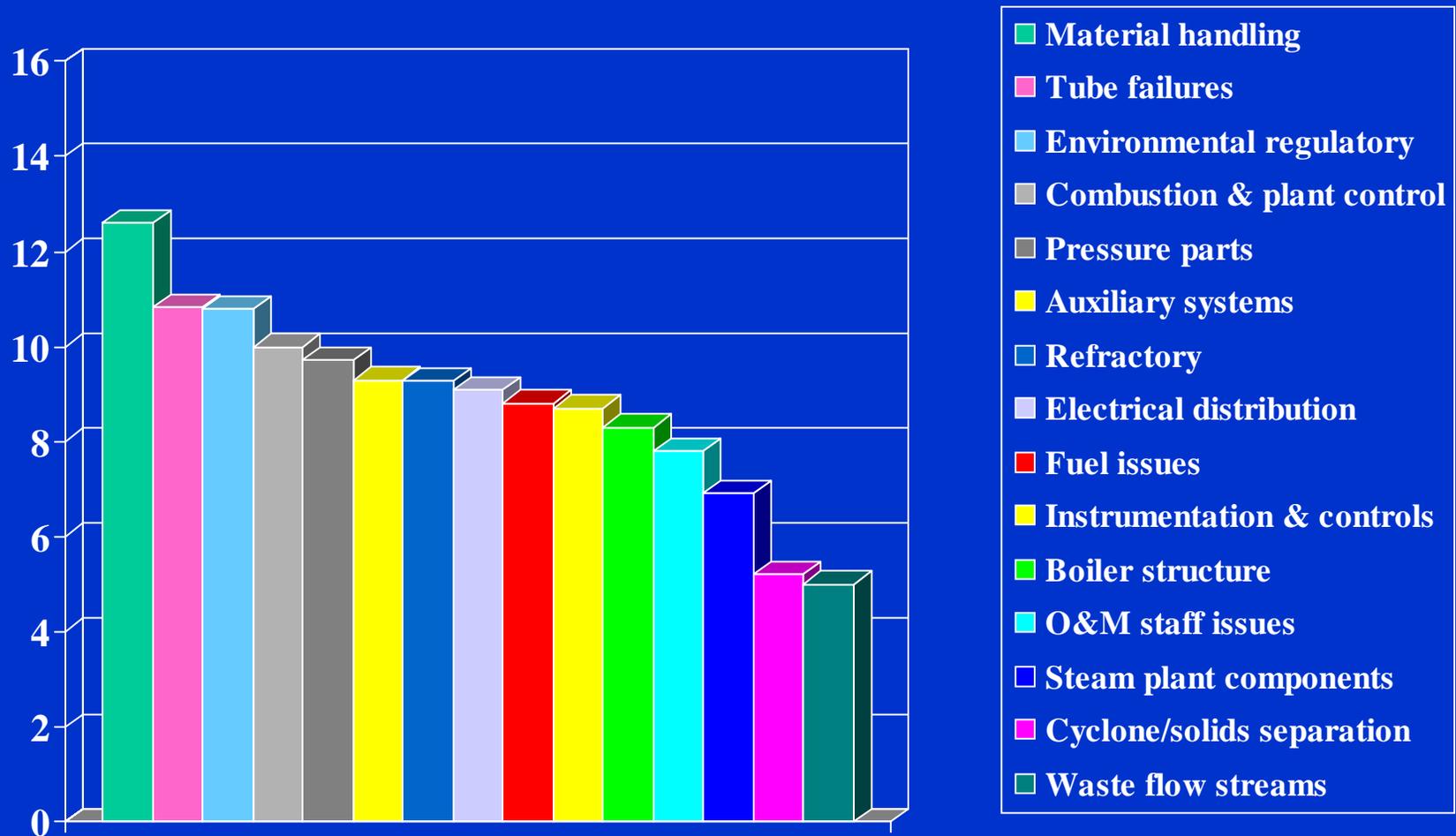
Populations Surveyed

- FBC plant owners and operators (responses received representing 11 plants and 15 boilers)
 - Industrial PC plant owners and operators (responses received representing 9 plants and 24 boilers)
 - Industrial Stoker Fired plant owners and operators (responses received representing 12 plants and 33 boilers)
 - FBC utility owners and operators *
- * Note: Not enough responses were received to perform reliable data analysis

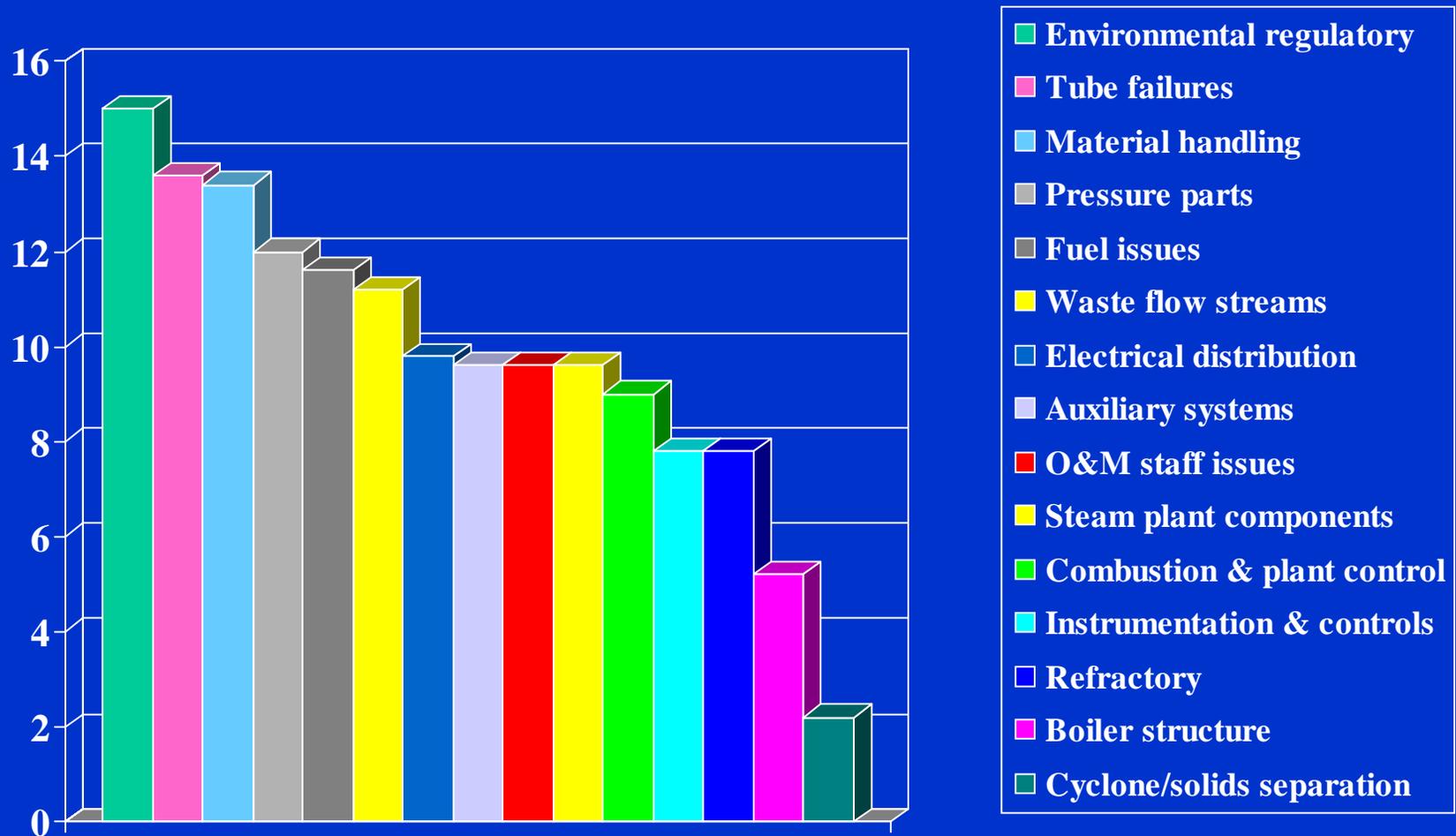
Populations Surveyed (continued)

- PC utility owners and operators (responses received representing 101 plants and 228 boilers)
- Stoker Fired utility owners and operators *
- FBC technology vendors (4 responses received)
- PC technology vendors (3 responses received) **
- Stoker Fired technology vendors **
 - * Note: Not enough responses were received to perform reliable data analysis
 - ** Note: Combined results since responses were so similar

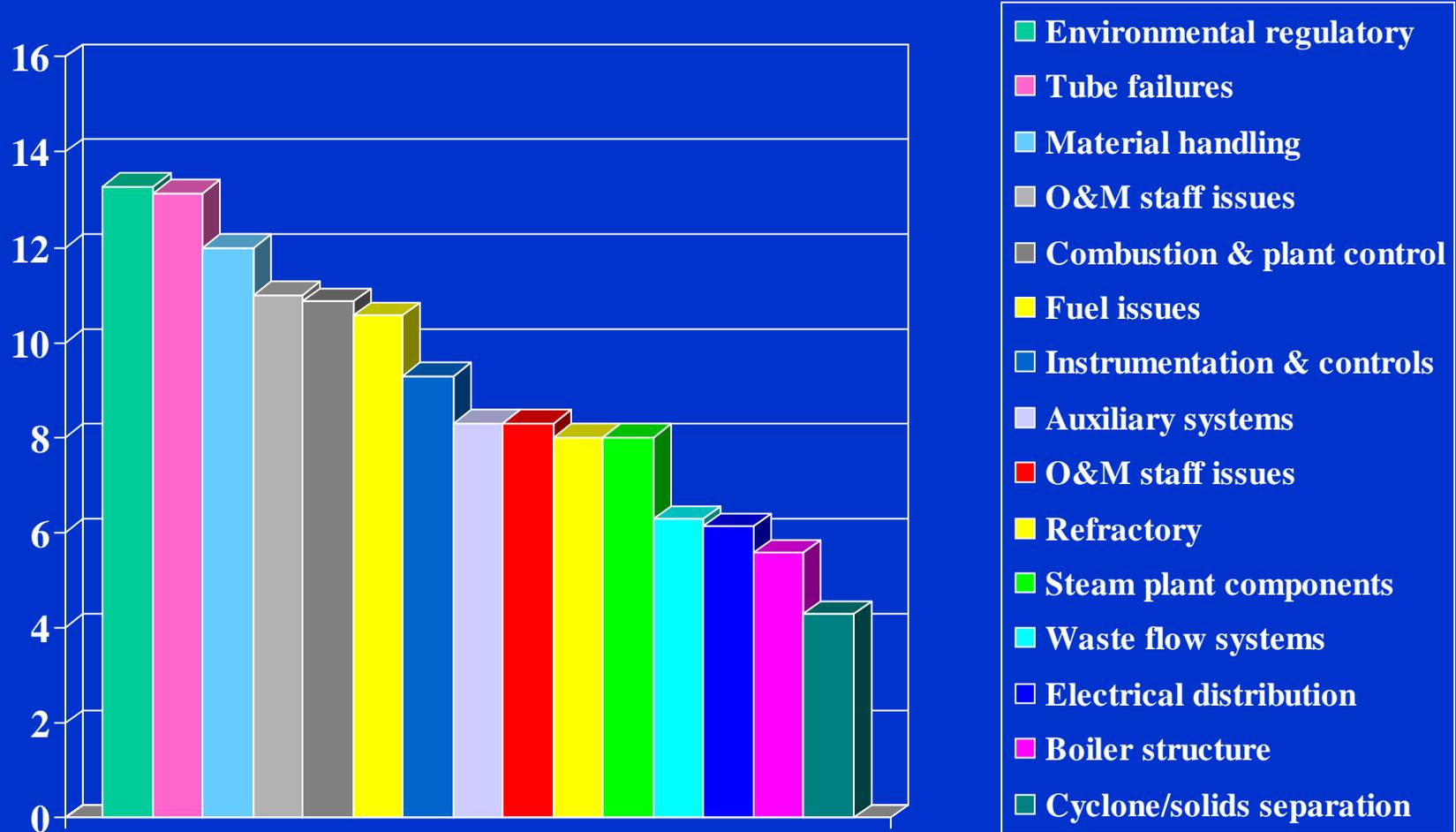
Boiler O/M Concerns (FBC Owners and Operators)



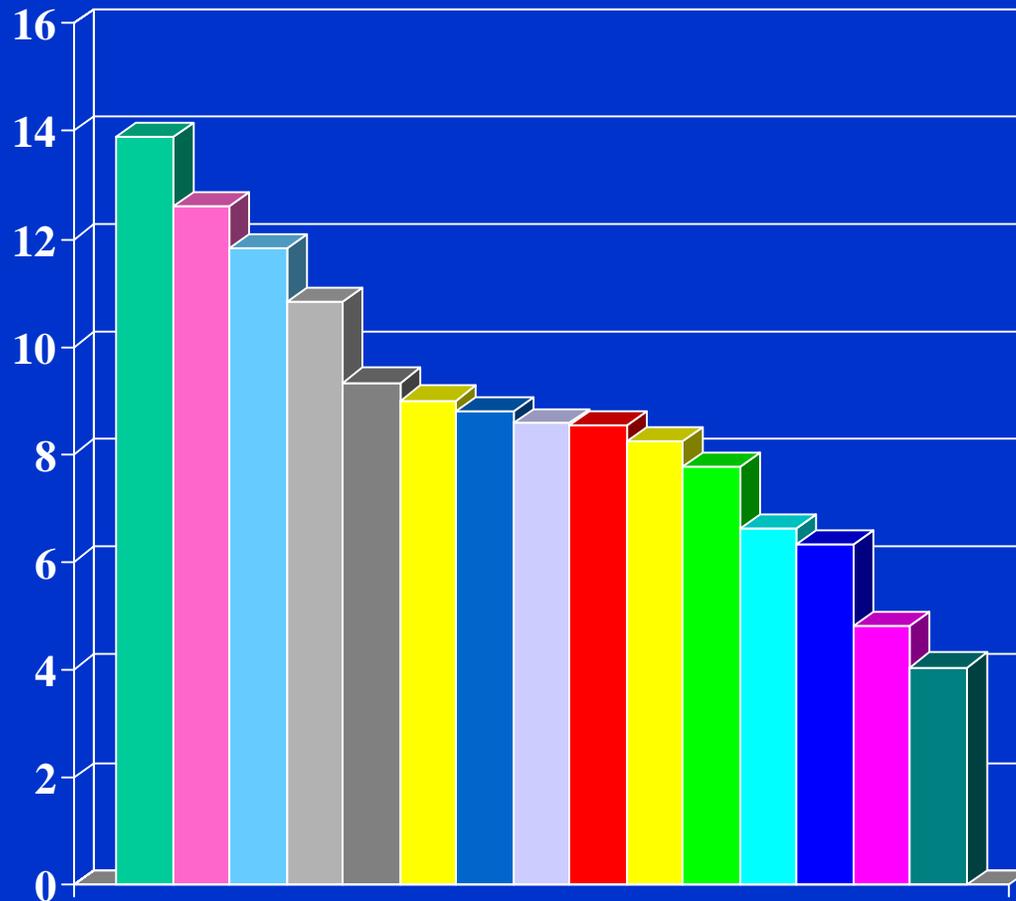
Boiler O/M Concerns (Industrial PC Owners and Operators)



Boiler O/M Concerns (Industrial Stoker Fired Owners and Operators)

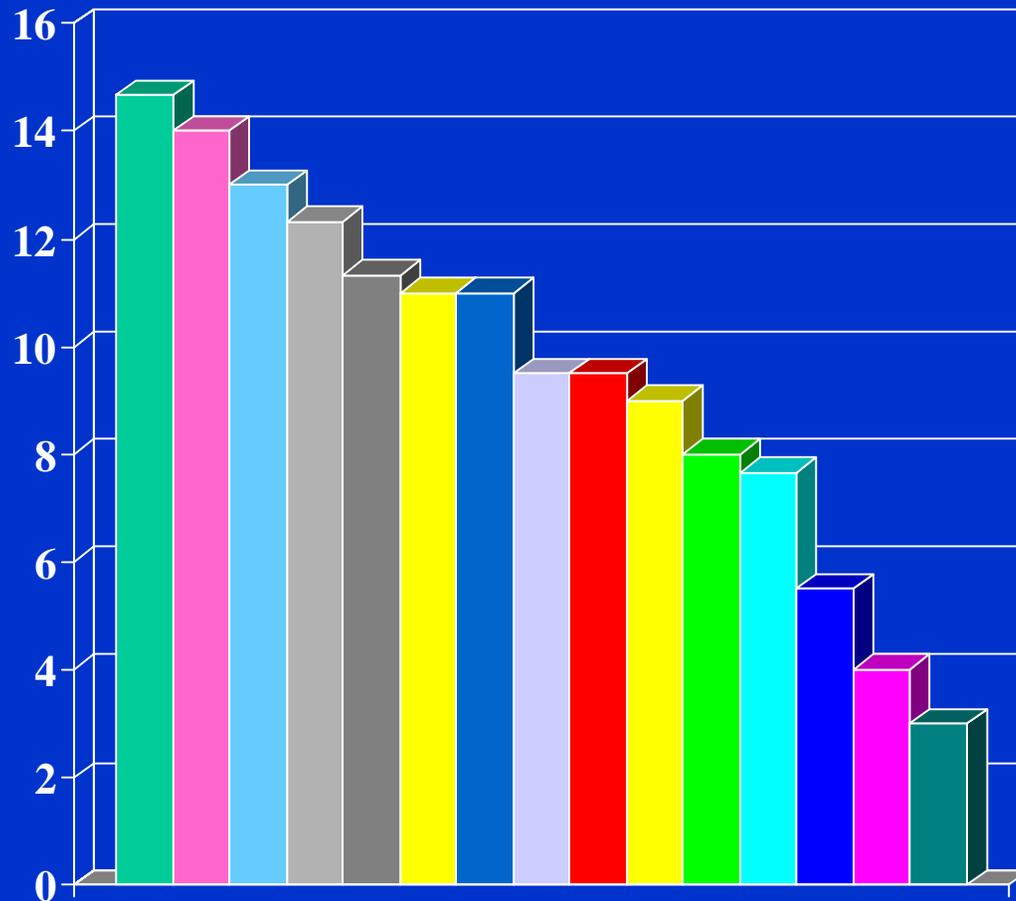


Boiler O/M Concerns (PC Utility Owners and Operators)



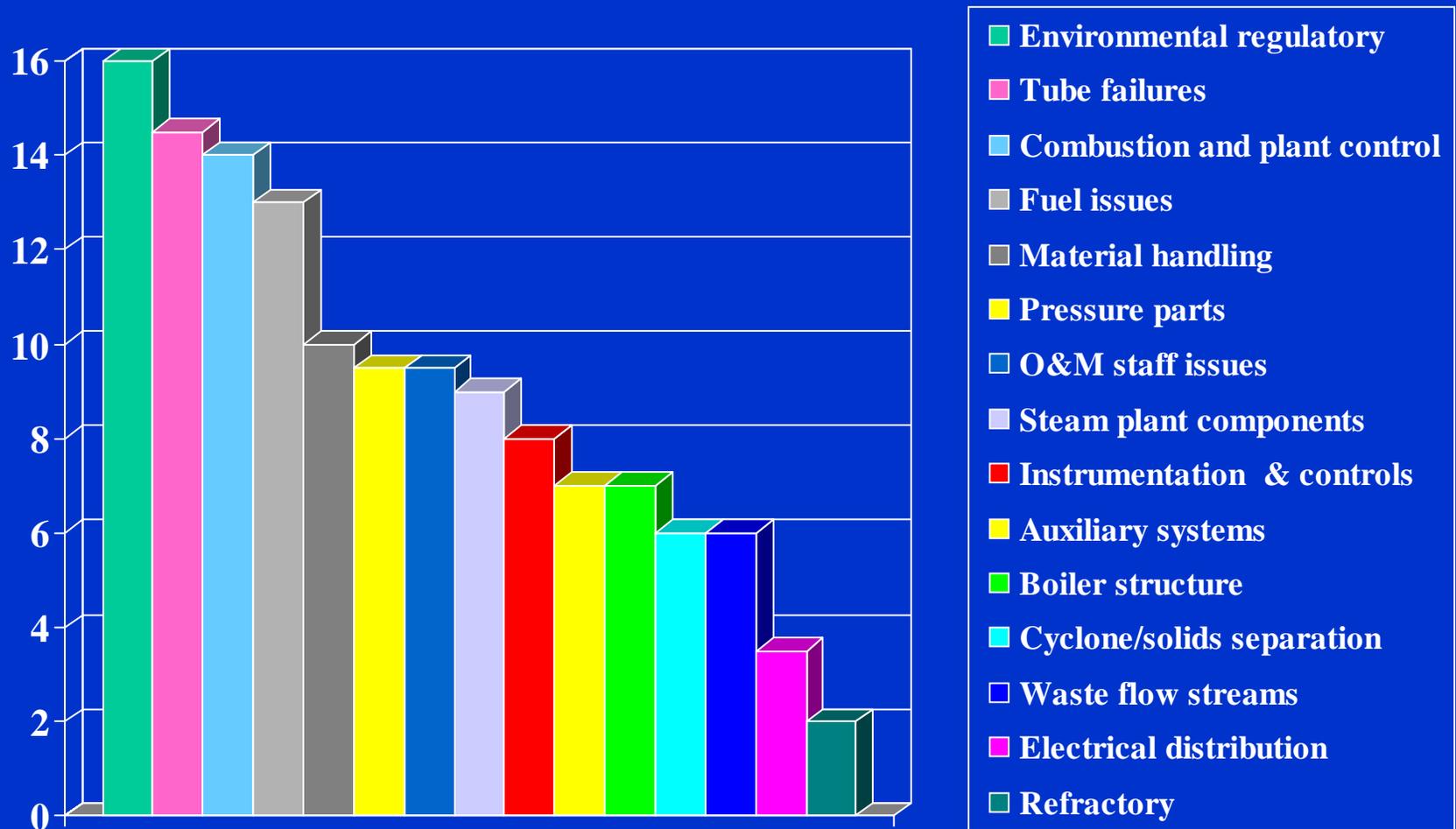
- Tube failures
- Pressure parts
- Environmental regulatory
- Steam plant components
- Combustion & plant control
- Fuel issues
- Auxiliary systems
- Material handling
- Boiler structure
- Instrumentation & controls
- O&M staff issues
- Electrical distribution
- Waste flow streams
- Refractory
- Cyclone/solids separation

Boiler O/M Concerns (FBC Technology Vendors)



- Tube failures
- Material handling
- Environmental regulatory
- Refractory
- Cyclone/solids separation
- Combustion & plant control
- Waste flow streams
- Fuel issues
- Instrumentation & controls
- Pressure parts
- Boiler structure
- Auxiliary systems
- O&M staff issues
- Steam plant components
- Electrical distribution

Boiler O/M Concerns (PC And Stoker Fired Technology Vendors)



Comparison of Boiler O/M Concerns By Responding Group

<u>Group</u>	<u>Top five</u>	<u>Middle five</u>	<u>Lowest five</u>
1	9,14,7,3,10	1,12,5,6,8	2,11,13,4,15
2	7,14,9,10,6	15,5,1,11,13	3,8,12,2,4
3	7,14,9,10,3	6,8,1,11,12	13,15,5,2,4
4	14,10,7,13,3	6,1,9,2,8	11,5,15,12,4
5	14,9,7,12,4	3,15,6,8,10	2,1,11,13,5
6	7,14,3,6,9	10,11,13,8,1	2,4,15,5,12

Note: Group 1 is FBC owners and operators.

Group 2 is industrial PC owners and operators.

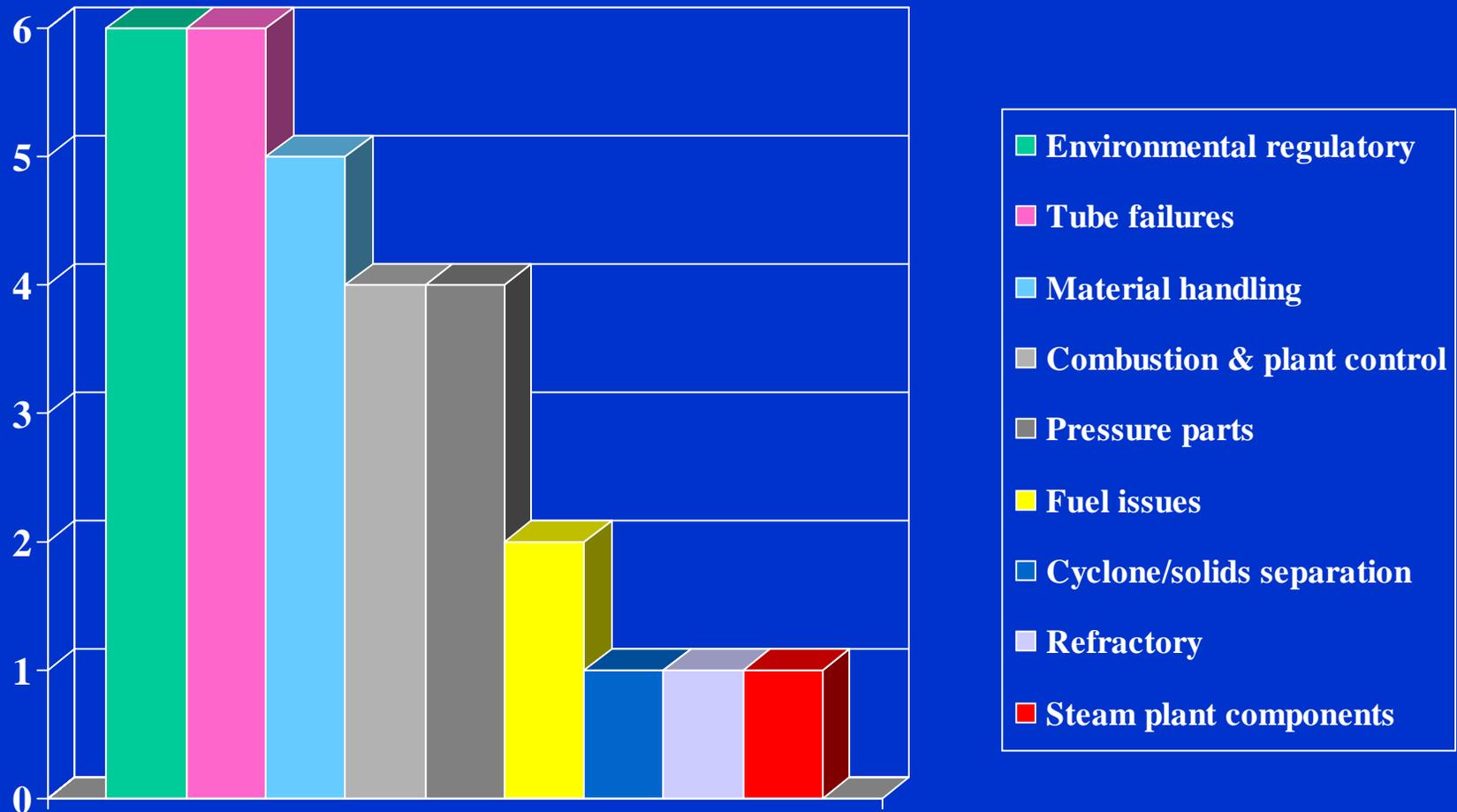
Group 3 is industrial stoker fired owners and operators.

Group 4 is PC utility owners and operators.

Group 5 is FBC technology vendors.

Group 6 is PC & stoker fired technology vendors.

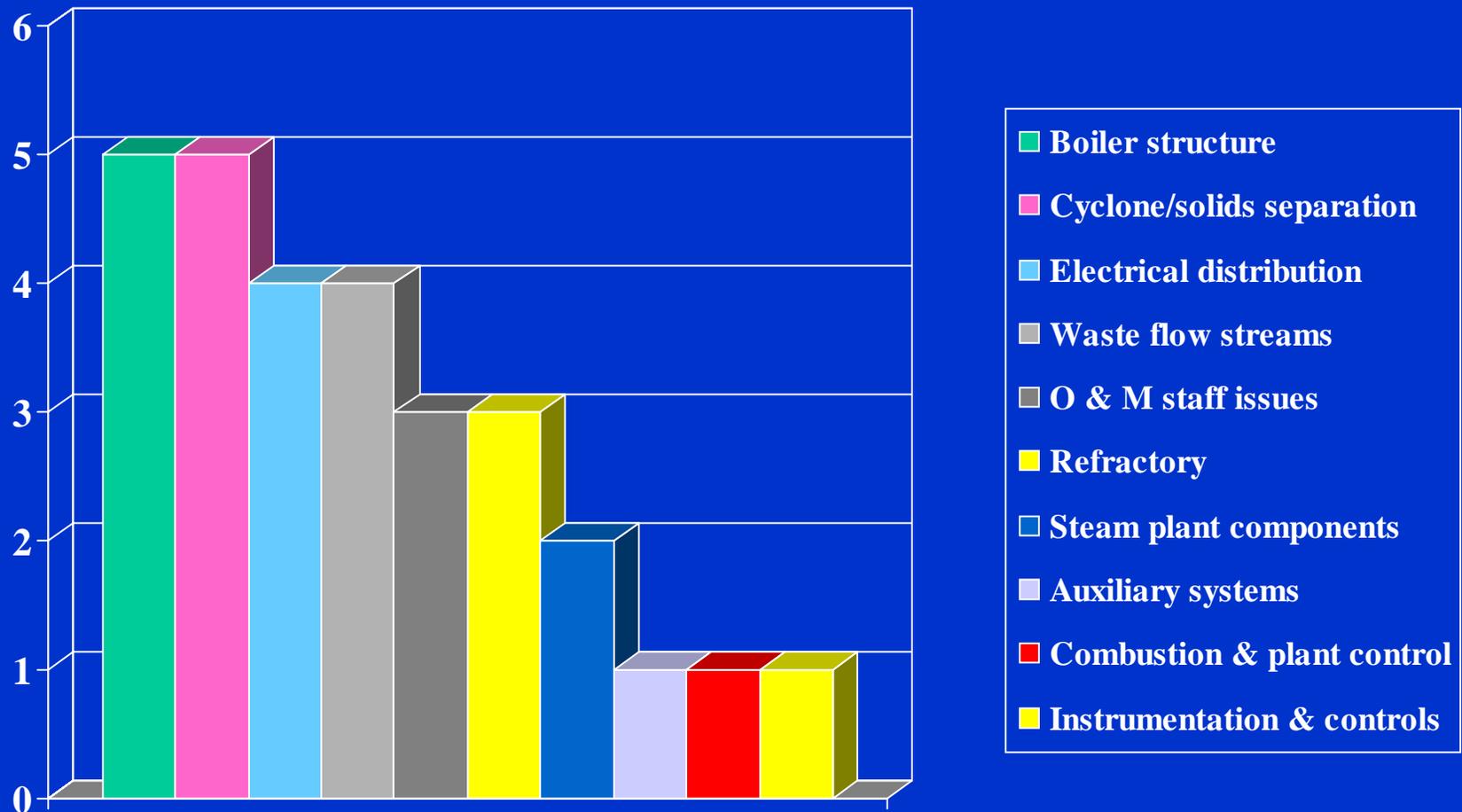
Number Of Groups Out Of Six That Ranked This Item As One Of Their Top Five Concerns



Observations

- Items 7 (Impact of environmental regulatory activity) and 14 (Tube failures [corrosion and erosion]) were among the top five concern issues for all six groups.
- Item 9 (Material handling, preparation, transport, and injection or removal [fuel, ash, sorbant]) was among the top five concern issues for five of the six groups.
- Items 3 (Combustion and plant control systems) and 10 (Mechanical failure of pressure parts [drum superheater, economizer, air heaters, and generating tubes]) were among the top five concern issues for four of the six groups.

Number Of Groups Out Of Six That Ranked This Item As One Of Their Lowest Five Concerns



Observations

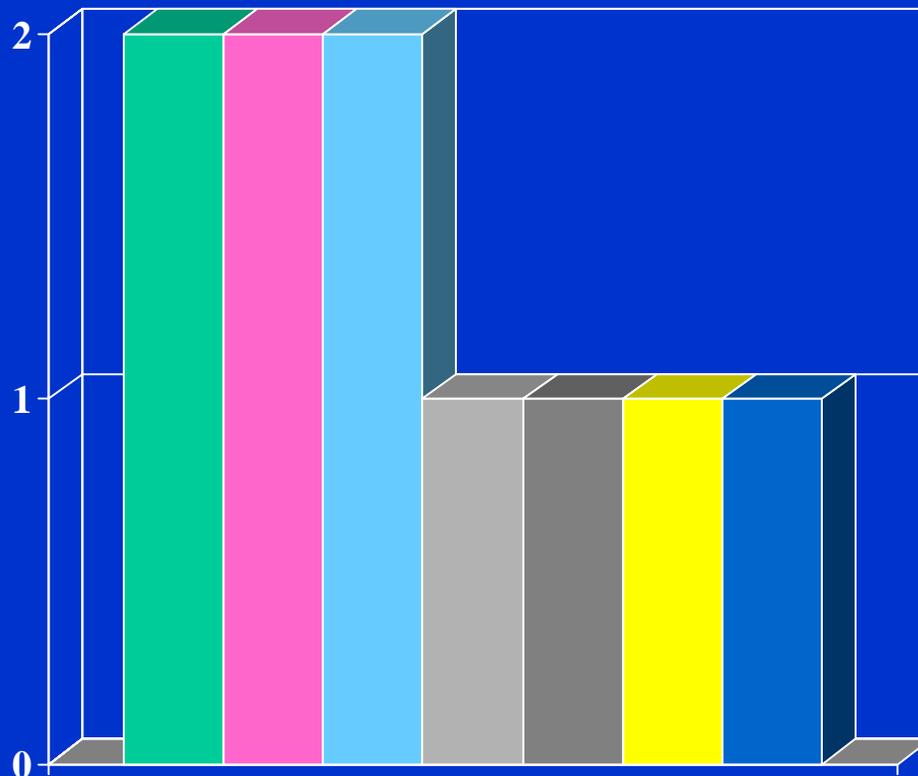
- Items 2 (Boiler structure, expansion joints, casing, and air ducting) and 4 (Cyclone / solids separation) were among the lowest five concern areas for five of the six groups.
- Items 5 (Electrical distribution and controls) and 15 (Waste flow streams [water, solid, gaseous]) were among the lowest five concern areas for four of the six groups.

Comparison of Boiler O/M Concerns By FBC Responding Group

<u>Group</u>	<u>Top five</u>	<u>Middle five</u>	<u>Lowest five</u>
1	9,14,7,3,10	1,12,5,6,8	2,11,13,4,15
2	14,9,7,12,4	3,15,6,8,10	2,1,11,13,5

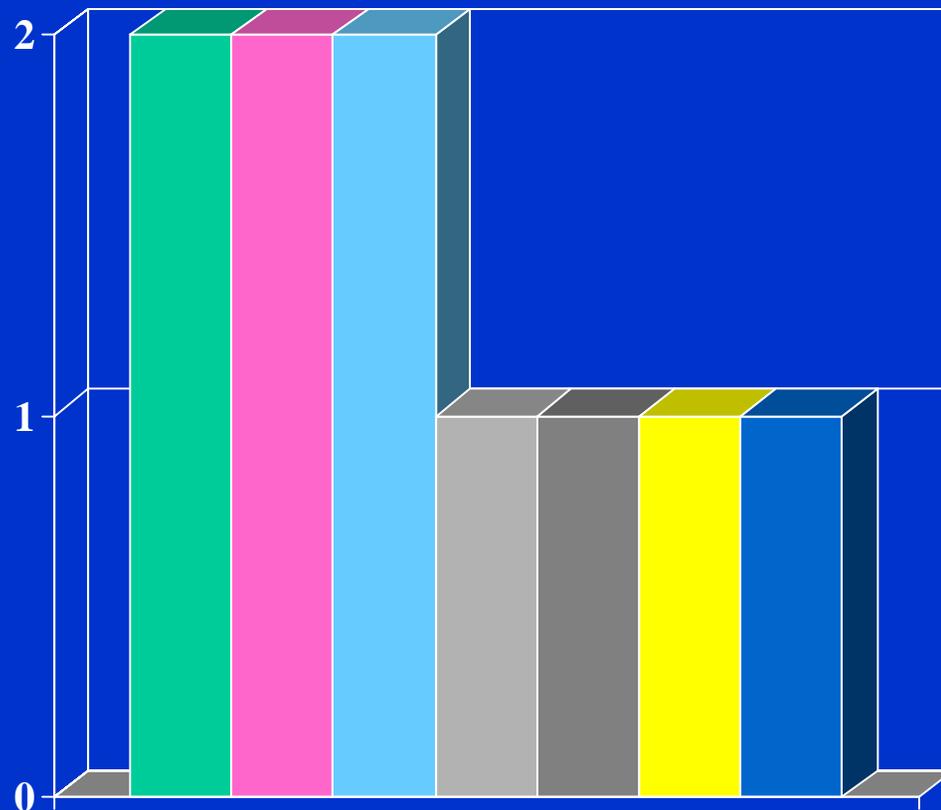
Note: Group 1 is FBC owners and operators.
Group 2 is FBC technology vendors.

Number Of Groups Out Of Two That Ranked This Item As One Of Their Top Five Concerns



- Environmental regulatory
- Material handling
- Tube failures
- Combustion & plant control
- Cyclone/solids separation
- Pressure parts
- Refractory

Number Of Groups Out Of Two That Ranked This Item As One Of Their Lowest Five Concerns



- Boiler structure
- O & M staff issues
- Steam plant components
- Auxiliary systems
- Cyclone/solids separation
- Electrical distribution
- Waste flow streams

Observations

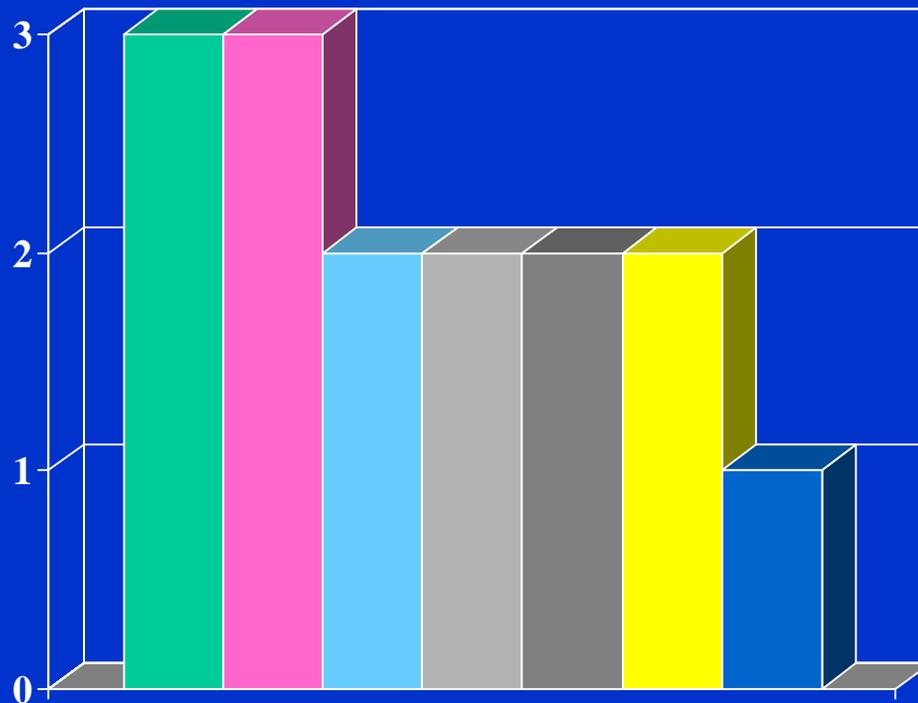
- Items 7 (Impact of environmental regulatory activity), 9 (Material handling, preparation, transport, and injection or removal [fuel, ash, sorbant]), and 14 (Tube failures [corrosion and erosion]) were among the highest five concerns for both groups.
- Items 2 (Boiler structure, expansion joints, casing, and air ducting), 11 (O&M staff training and qualifications), and 13 (Steam plant components [condensers, feedheaters, aerators, pumps]) were among the lowest five concerns for both groups.

Comparison of Boiler O/M Concerns By PC Responding Group

<u>Group</u>	<u>Top five</u>	<u>Middle five</u>	<u>Lowest five</u>
1	7,14,9,10,6	15,5,1,11,13	3,8,12,2,4
2	14,10,7,13,3	6,1,9,2,8	11,5,15,12,4
3	7,14,3,6,9	10,11,13,8,1	2,4,15,5,12

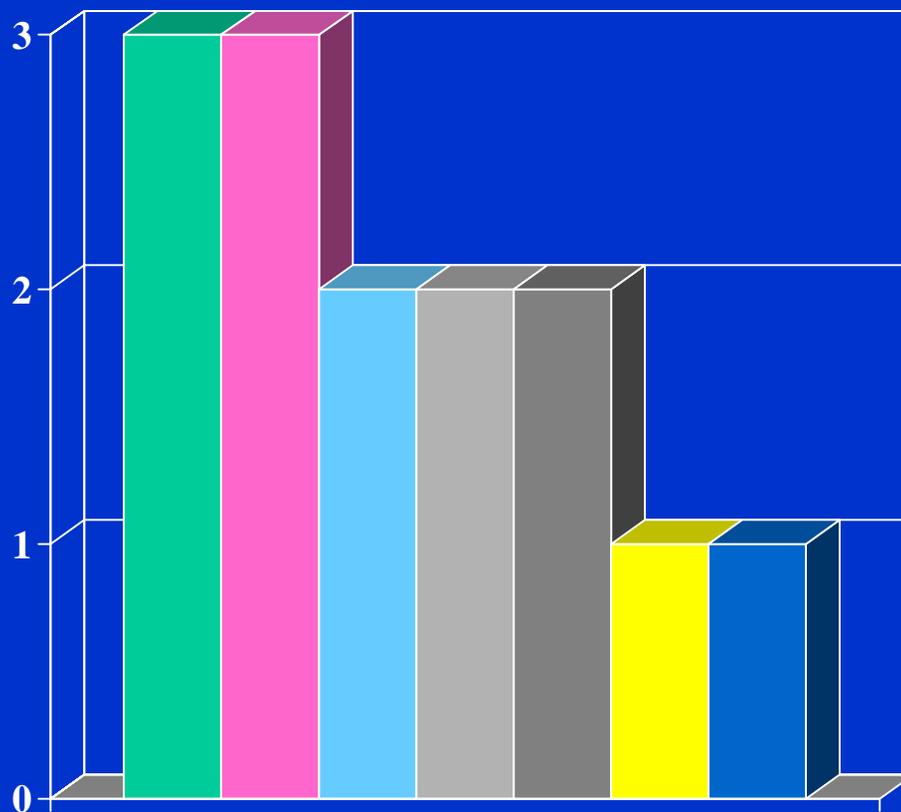
Note: Group 1 is industrial PC owners and operators.
Group 2 is PC utility owners and operators.
Group 3 is PC and stoker fired technology vendors.

Number Of Groups Out Of Three That Ranked This Item As One Of Their Top Five Concerns



- Environmental regulatory
- Tube failures
- Combustion & plant control
- Fuel issues
- Material handling
- Pressure parts
- Steam plant components

Number Of Groups Out Of Three That Ranked This Item As One Of Their Lowest Five Concerns



- Cyclone solids separation
- Refractory
- Boiler structure
- Electrical distribution
- Waste flow streams
- Combustion & plant control
- Instrumentation & controls

Observations

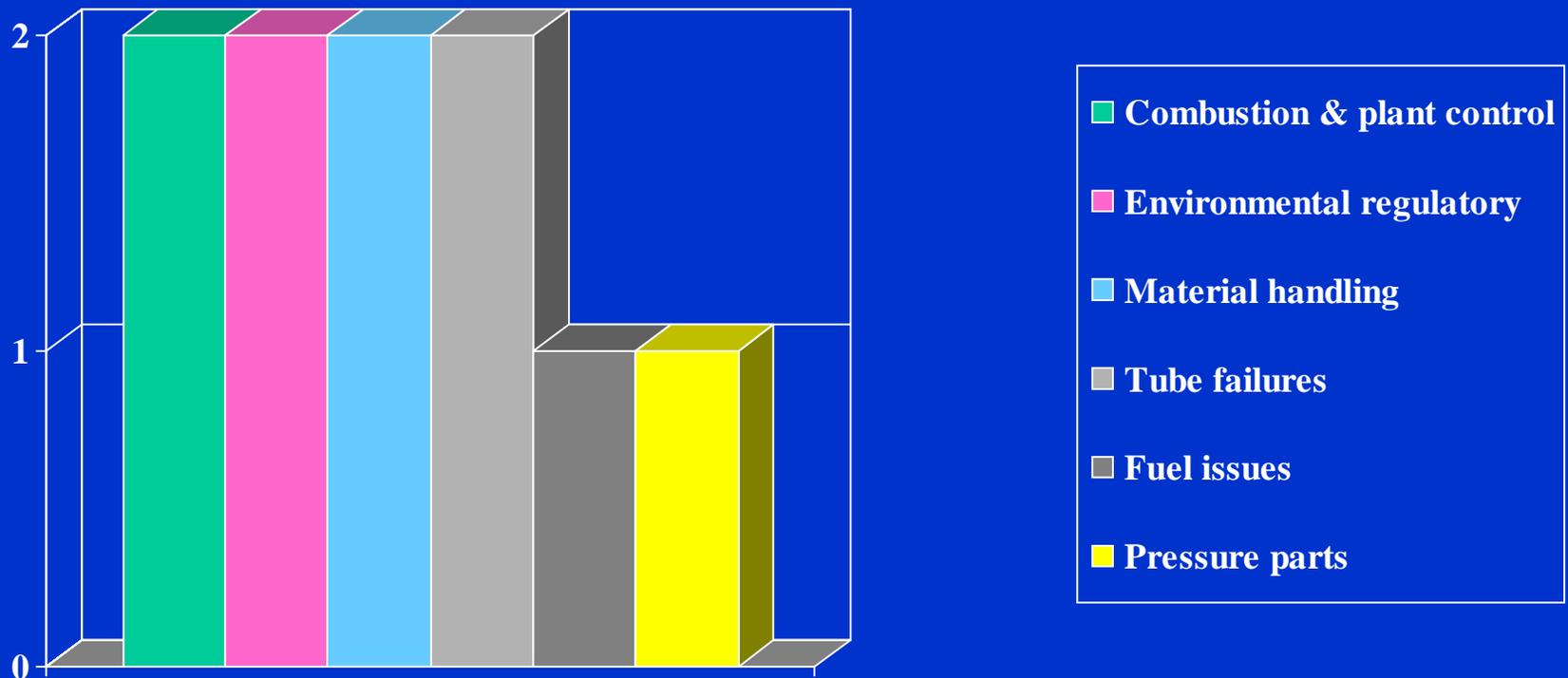
- Items 7 (Impact of environmental regulatory activity) and 14 (Tube failures [corrosion and erosion]) were among the highest five concerns for all three groups.
- Items 4 (Cyclone / solids separation) and 12 (Refractory) were among the lowest five concerns for all three groups.

Comparison of Boiler O/M Concerns By Stoker Fired Responding Group

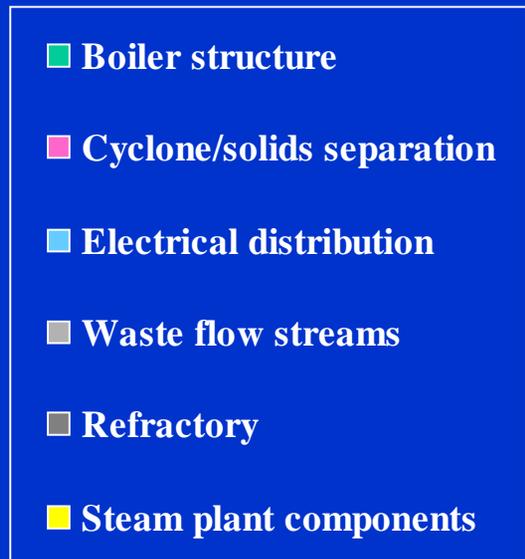
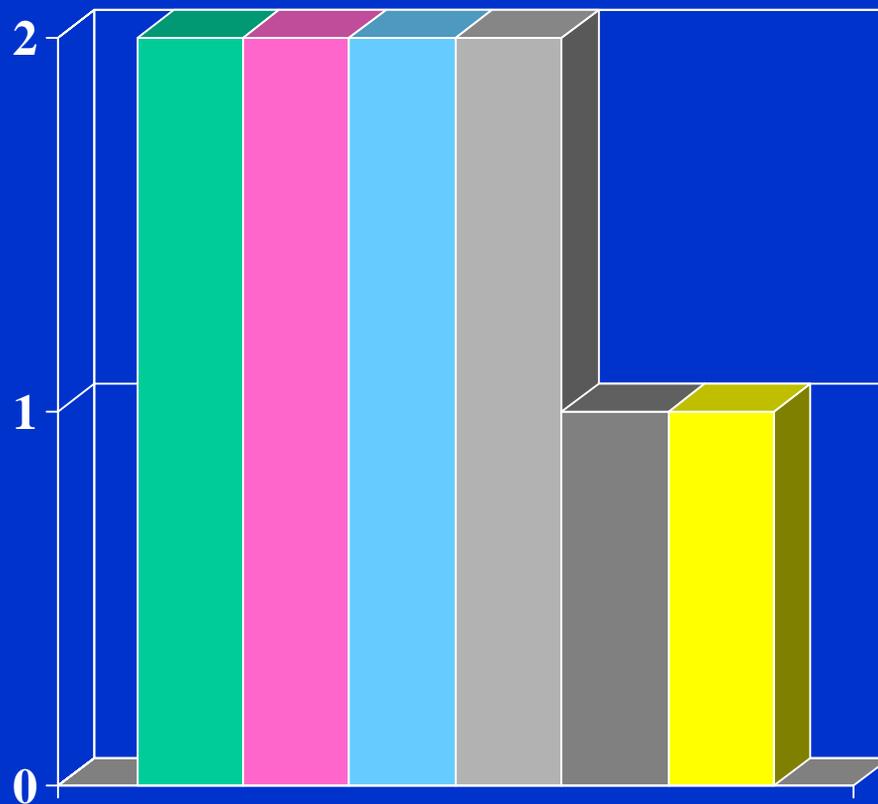
<u>Group</u>	<u>Top five</u>	<u>Middle five</u>	<u>Lowest five</u>
1	7,14,9,10,3	6,8,1,11,12	13,15,5,2,4
2	7,14,3,6,9	10,11,13,8,1	2,4,15,5,12

Note: Group 1 is industrial stoker fired owners and operators.
Group 2 is PC and stoker fired technology vendors.

Number Of Groups Out Of Two That Ranked This Item As One Of Their Top Five Concerns



Number Of Groups Out Of Two That Ranked This Item As One Of Their Lowest Five Concerns



Observations

- Items 3 (Combustion and plant control systems), 7 (Impact of environmental regulatory activity), 9 (Material handling, preparation, transport, and injection or removal [fuel, ash, sorbant]), and 14 (Tube failures [corrosion and erosion]) were among the top five concern areas for both groups.
- Items 2 (Boiler structure, expansion joints, casing, and air ducting), 4 (Cyclone / solids separation), 5 (Electrical distribution and controls), and 15 (Waste flow streams [water, solid, gaseous]) were among the lowest five concern areas for both groups.

Boiler O/M Concerns (Additional Responder Comments)

- FBC owners and operators:
 - Industry financial issues
 - Turbine generator and associated controls
 - Air heater tube failures
 - Fuel quality
 - Economizer tube leaks (perhaps can be addressed with shielding)
 - Supplier performance (can not monitor everything with efficient staffing levels)

Boiler O/M Concerns (Additional Responder Comments)

- PC utility owners and operators:
 - Age of the work force
 - Load following / regulation
 - Condensate / feedwater chemistry issues (water chemistry is a major cause of tube failures)
 - NOX reduction technologies
 - Turbines / generator
 - Deslagging and soot blowing
 - Environmental controls (precipitator and SCR)
 - Ash systems (bottom ash and fly ash)

Boiler O/M Concerns (Additional Responder Comments)

- PC utility owners and operators (continued):
 - As the regulatory side forces us to meet and maintain tighter environmental standards, we are exposing our boiler to higher corrosive environments. As we make recommendations to meet these standards, our fuel department tries to “help” us by buying cheaper and more corrosive fuels. Then our plant operations decreases the O₂ in our boiler to help meet the standards. The end result is that the O&M and capital cost increases. Usually it takes about two to six years to experience these problems and by that time it is too late.

Boiler O/M Concerns (Additional Responder Comments)

- FBC technology vendors:
 - Impact of deregulation on existing power purchase agreements

Boiler O/M Concerns (Additional Responder Comments)

- Vendor comments without regard to type of technology:
 - We believe there are a growing number of cases where plant owners are foregoing efficiency improvements through control improvement to avoid the current regulatory climate of PSD / New Source Review triggered by control improvement. For example, if you improve efficiency, you have the ability to increase pollution. We are concerned that plant owners are being pushed to do things that are politically correct, and not defensible scientifically.

Boiler O/M Concerns (Additional Responder Comments)

- Additional vendor comments without regard to type of technology:
 - Many plants have combustion controls and instruments which are aging and / or obsolete. The modernization of these plants is an item of concern. PSD / NSR also impacts on this as well.