Operator performance as a function of alarm rate and interface design

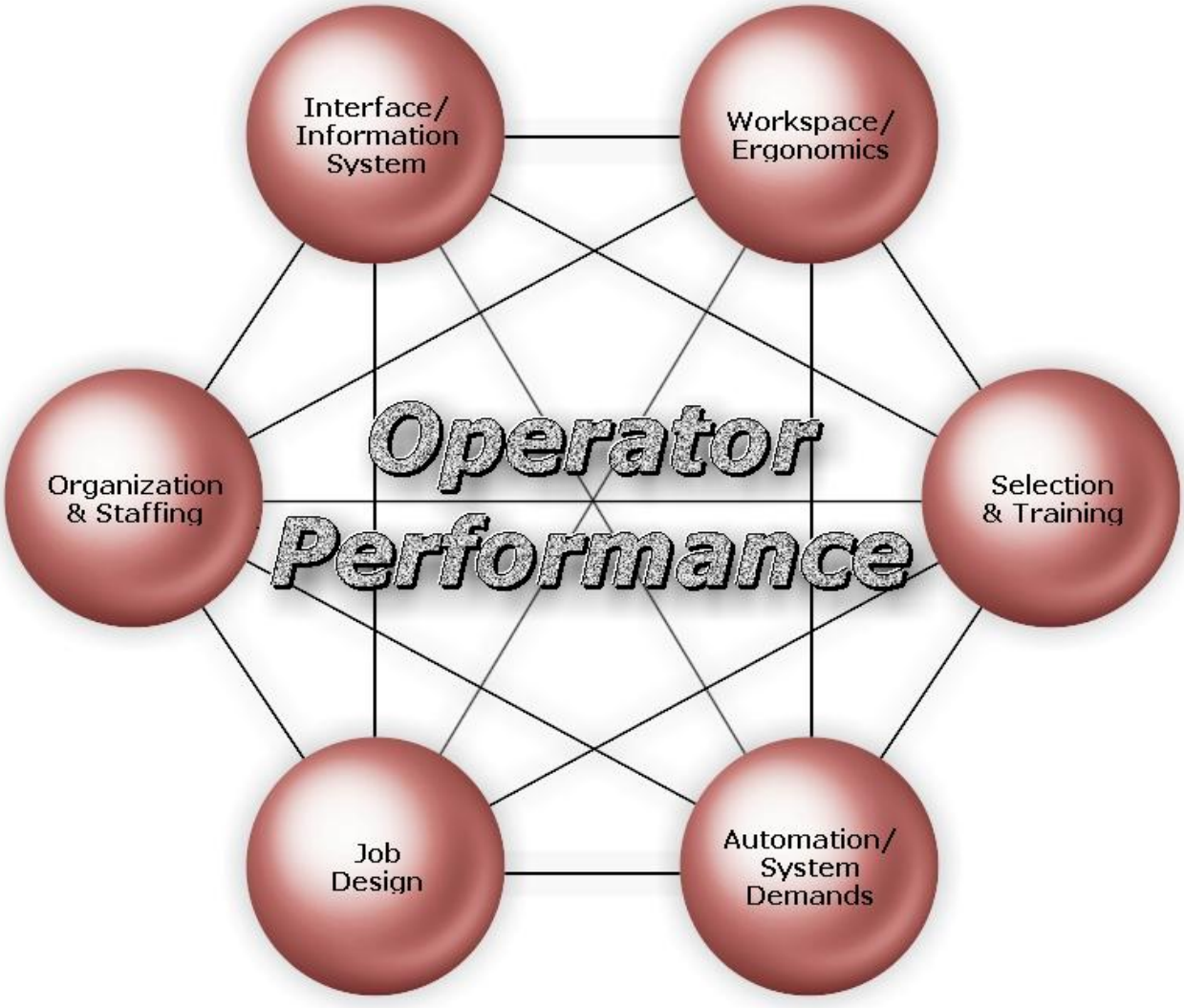
David Strobhar, PE - Beville Engineering
Glenn Uhack - Louisiana State University
Craig Harvey, Ph.D., PE –Louisiana State University

CENTER FOR OPERATOR PERFORMANCE
An Industry/University Center for Excellence

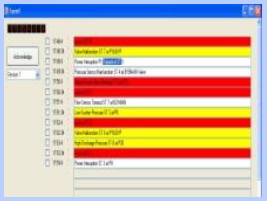
Center for Operator Performance

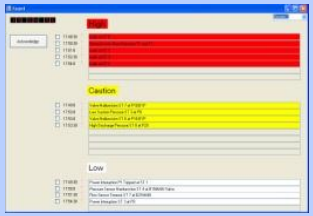
An Industry-Academia Collaboration

Performance Shaping Factors



Experiment Overview

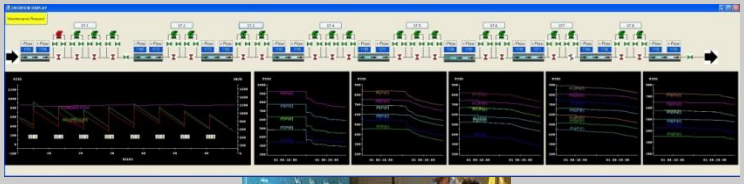




Alarm Displays
- Categorical
- Chronological

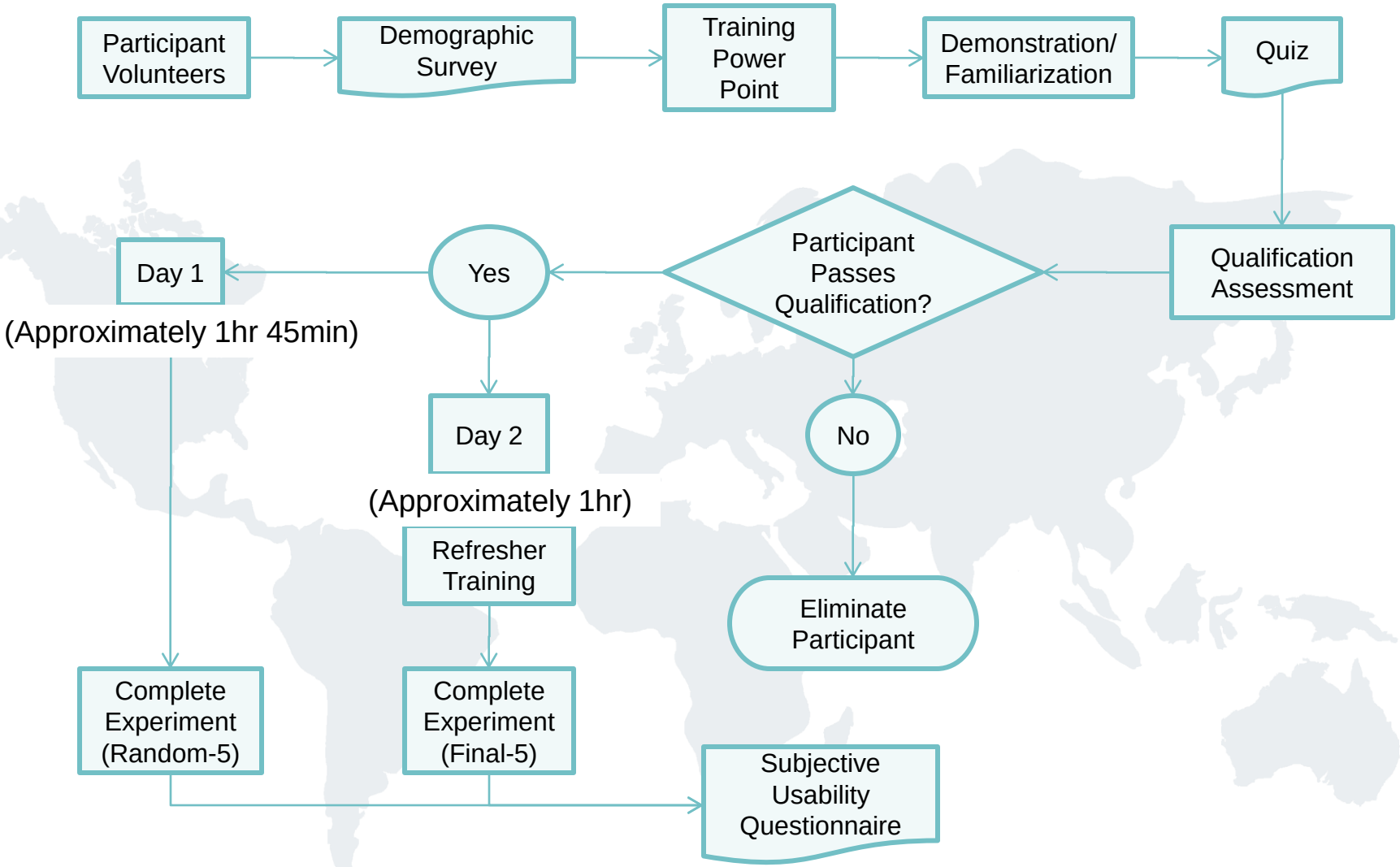
20 in First 10 Minutes	Chronological and Categorized Alarm display
10 in First 10 Minutes	Chronological and Categorized Alarm display
5 in First 10 Minutes	Chronological and Categorized Alarm display
2 in First 10 Minutes	Chronological and Categorized Alarm display
1 in First 10 Minutes	Chronological and Categorized Alarm display

Alarm Rates
- 1 per 10 min
- 2 per 10 min
- 5 per 10 min
- 10 per 10 min
- 20 per 10 min

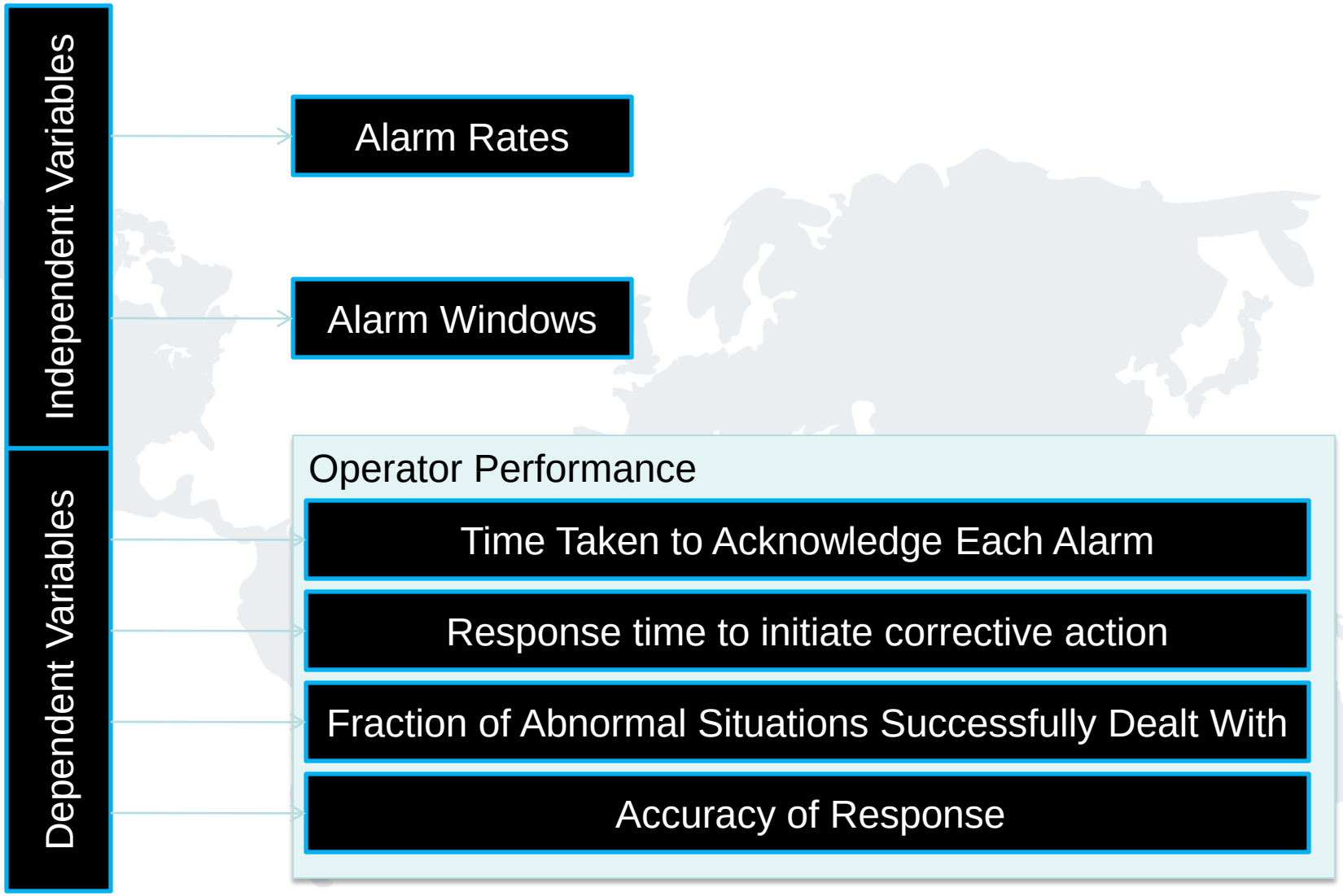


Operator Performance

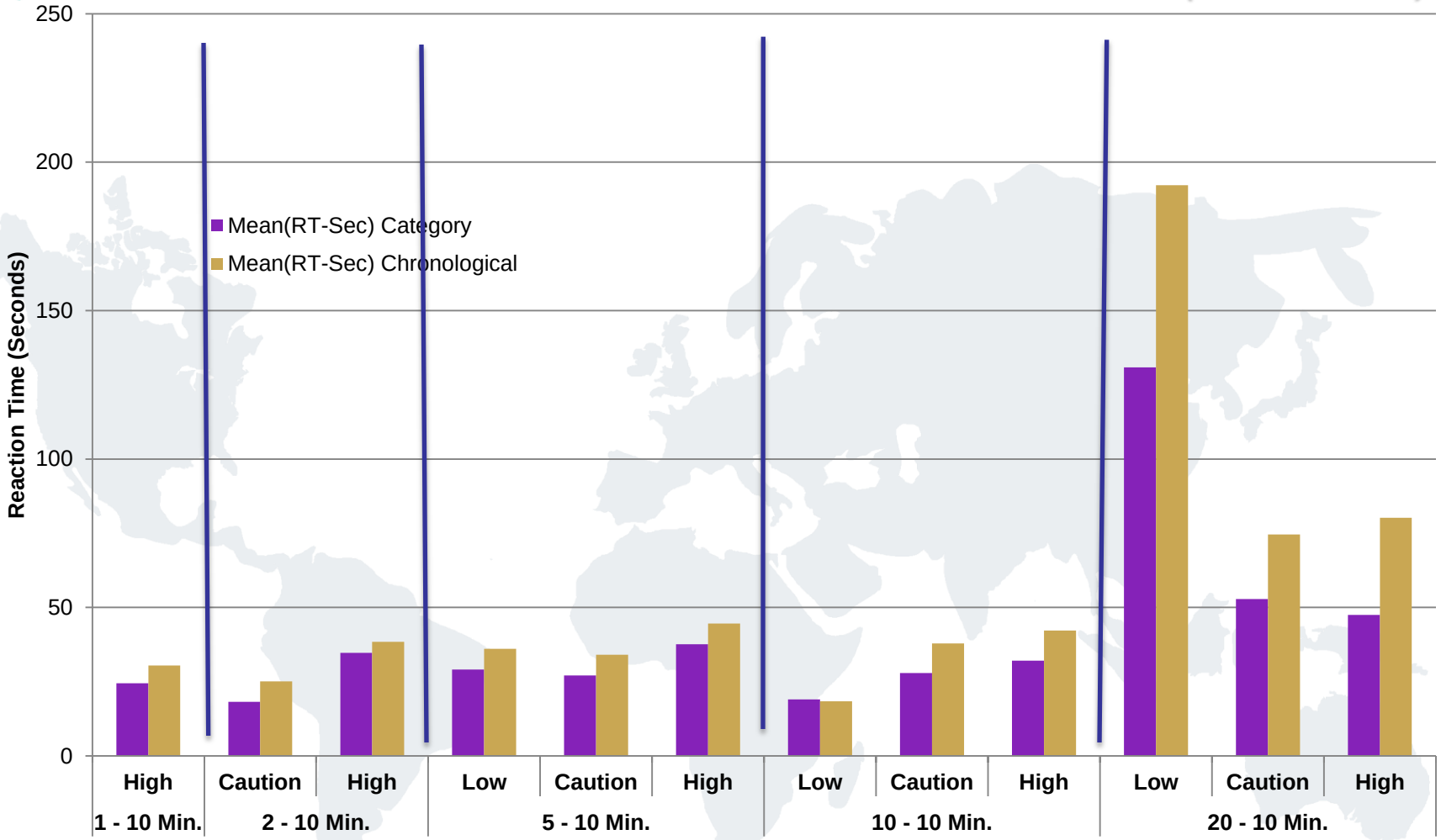
Experimental Flow Chart



Experimental Measures



Descriptive Statistics - Mean Reaction Time *(Seconds)*



Reaction Time *(All Alarms)*

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	9	2590480	287831	25.8014
Error	2311	25780633	11156	**Prob > F**
C. Total	2320	28371113		**<.0001**

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Alarm Rate	4	4	2137765.9	47.9078	**<.0001**
Cat.(2)/Chron(1)	1	1	34194.5	3.0652	0.0801
Alarm Rate*Cat.(2)/Chron(1)	4	4	137439.4	3.0800	**0.0153**

Reaction Time *(All Alarms)*

Level			Least Sq Mean
2010,1	A		111.83361
2010,2		B	73.85974
510,1		C	38.67097
1010,1		C	35.64821
210,1		C	31.77419
510,2		C	31.71333
110,1		C	30.41935
1010,2		C	27.85161
210,2		C	26.46774
110,2		C	24.48387

***Levels not connected by same letter are significantly different

- **20 alarms in 10 minutes using a chronological display is statistically different than 20 alarms in 10 minutes using a categorical display.**
- **20 alarms in 10 minutes for either display is statistically different than any other alarm rate using either display.**
- **20 alarms in 10 minutes doubles or triples their response time.**

Note
1-Chronological
2-Categorical

CONCLUSIONS

- **Current alarm metrics may be too conservative**
- **Presentation method has a significant impact**
- **Operator performance impact can be measured**
- **However –**
  - Students?
  - 10 minutes?

Alarm Rate II – In Process

Repeat initial experiment

- With refinery operators and pipeline controllers

	Treatment Condition	
Alarms per 10 minutes	Chronological	Categorical
10	10 min	10 min
20	10 min	10 min

Longer time duration

- Expose to alarms for 60 minutes
- Refinery operators and pipeline controllers

	Treatment Condition	
Alarms per 10 minutes	Chronological	Categorical
15	1 hour	
20	1 hour	1 hour
25	1 hour	1 hour
30		1 hour

Questions?