

EMS Alarms at Puget Power Control Center

Typically

- Dispatchers Acknowledge Alarms in the Order Received
- 20-25 Alarms Awaiting Dispatcher Acknowledgment
- Burst of 100 Unacknowledged Alarms

Abnormal Conditions

- | | |
|------------------|---------------|
| • Wind Storm | 22,000 Alarms |
| January 20, 1993 | 13,000 Alarms |
| January 21, 1993 | 9,000 Alarms |

45
(50)

Potential for Massive Alarm Display

Estimates by Hydro-Québec Regional Control Centers

Transformer Fault

150 Alarms in 2 Seconds

Generation Substation Fault

2,000 Alarms

300 Alarms in the First 5 Seconds

Thunderstorms

20 Alarms Per Second

System Collapse

15,000 Alarms for the First 5 Seconds

Reference:

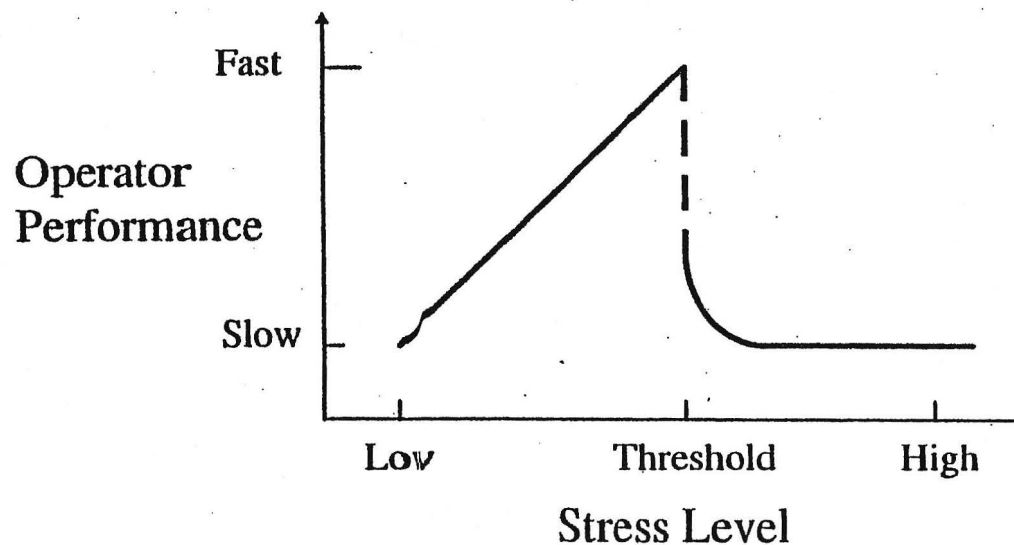
D. S. Kirchen and B. F. Wollenberg, "Intelligent Alarm Processing in Power Systems," *Proc. of IEEE*, May 1992.

51

Information Overload

Information Overload can Degrade Dispatcher Performance

- Time-Consuming to Determine Cause(s) of Problem(s)
- Potential for Error with High Stress and Overabundance of Data



Reference:

D. S. Kirchen and B. F. Wollenberg, "Intelligent Alarm Processing in Power Systems," *Proc. of IEEE*, May 1992.

Table I System set of alarms [3]

code	description
a_1	any circuit breaker position changes
a_2	any pair of circuit breaker position changes closing or opening
a_3	circuit breaker position changes to on-position
a_4	circuit breaker position changes to off-position
a_5	circuit breaker position leaving the off-position
a_6	any trip commands
a_7	trip commands of busbar protection devices
a_8	trip commands of transformer protection devices
a_9	any indications of starting relays (neutral or phase)
a_{10}	indications of starting relays (only phase)
a_{11}	any indication about blocking of automatic reclosing

$$c_1 \rightarrow A_1 = \{a_1, a_4, \bar{a}_5, a_6, a_7, \bar{a}_8\} \quad (6.a)$$

$$c_2 \rightarrow A_2 = \{a_1, a_4, \bar{a}_5, a_6, \bar{a}_7, a_8\} \quad (6.b)$$

$$c_3 \rightarrow A_3 = \{a_1, a_4, a_5, a_9, a_{10}\} \quad (6.c)$$

$$c_4 \rightarrow A_4 = \{a_1, \bar{a}_3, a_4, \bar{a}_5, \bar{a}_7, \bar{a}_8, a_9, a_{10}\} \quad (6.d)$$

$$c_5 \rightarrow A_5 = \{a_1, a_3, a_4, \bar{a}_5, \bar{a}_7, \bar{a}_8, a_9, a_{10}\} \quad (6.e)$$

$$c_6 \rightarrow A_6 = \{a_1, a_3, \bar{a}_4, \bar{a}_5, \bar{a}_7, \bar{a}_8, a_9\} \quad (6.f)$$

$$c_7 \rightarrow A_7 = \{\bar{a}_1, \bar{a}_6, a_9\} \quad (6.g)$$

$$c_8 \rightarrow A_8 = \{\bar{a}_1, \bar{a}_6, \bar{a}_9, a_{11}\} \quad (6.h)$$

$$c_9 \rightarrow A_9 = \{a_1, a_2, \bar{a}_6, \bar{a}_{10}\} \quad (6.i)$$

$$c_{10} \rightarrow A_{10} = \{a_1, \bar{a}_2, \bar{a}_6, \bar{a}_9\} \quad (6.j)$$

Table II System set of events [3]

code	description
c_1	fault on busbar
c_2	tripping of transformers
c_3	tripping after closing
c_4	tripping of lines
c_5	unsuccessful fast reclosing
c_6	successful fast reclosing
c_7	external incident
c_8	blocked reclosing
c_9	switching operation
c_{10}	maintenance activities

25