OLRT Constructors/Constructeurs
Confederation Line
Trailer Complex
535 Terminal Ave
Ottawa, Ontario
K1G 0Z2

Rideau Transit Maintenance
805 Belfast Road,
Ottawa, ON K1G 0Z4

9 November 2021

Our Ref.	OLR-RTM-00-0-LET-0483
RTM Ref.	NA
Project Agreement Ref.	

Attention: Mario Guerra
General Manager

Subject: Alarm Management; Reference Outstanding issues item P9

Dear Mr. Guerra,

As part of the OLRT-C outstanding issues list, item P9 related to Alarm Management was identified. It is OLRT-C's understanding the problem lies in the sheer quantity of alarms being generated and reported by the SCADA system and as such there are too many coming through to the TOCC for operations to effectively manage. With that being said, OLRT-C believes the SCADA system with respect to alarm management is a process that needs to be worked on and fine-tuned by RTM over the course of operations. Just like any new system put in place it is only through operations and management of that system that the operator will know what constitutes a more critical alarm (important alarm) versus say a more minor alarm. Part of this management of the alarm system may just mean increasing de-bounce times to avoid repeated alarms.

OLRTC has been made aware of two recent alarm studies that have taken place. One study was performed by Trenic Consulting through OC Transpo dated July 7, 2021. The other was perform by Willowglen Systems through RTM and is dated July 6, 2021. Copies of these studies have been included in this letter.

The Trenic Consulting report made 17 recommendations for next steps as follows;

Recap: Next Steps
• Further investigation of door wiring and programming
• Follow-up on TPSS-06 ground fault alarms
• Deeper investigation into Building Automation alarms
• Elevator Inspection muting
• Debounce and Root Cause assessment
• ETEL alarms status update and confirm functionality
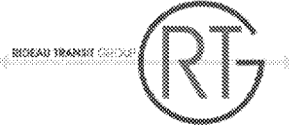
- Sump and Sanitary pumps functionality vs alarms
- Explore Escalator alarm source
- Further investigation of PA Rack Alarms
- Further investigation of Communication Alarms
- Consideration of GIDS muting
- Investigate Train Wash functionality vs alarms

- Follow-up on Substation Voltage alarms
- Discuss maintenance-related alarms (e.g. switch heaters)
- Investigate System alarms – video driver, etc.
- Review alarm naming and messages
- Include "Normal" in future log file captures

The Willowglen System Report analyzed a sample set of alarms and provided clarifications on their purpose as well as potential causes and resolutions to minimize them. This report is very detailed and also includes the frequency of these alarms so as to provide some form of prioritization in resolving them.

Both of these reports constitute a very good starting point to help plan a way forward towards improved alarm management. What OLRT-C does not understand is why is RTM not following through on these recommendations? As Willowglen Systems was the company who installed this system they should be tasked by RTM to help refine it and make it more manageable for OC Transpo now that the system has been in operation for 2 years.

There is no doubt that OLRT-C was responsible for the installation and testing of the system per the Project Agreement and those obligations were met, however there was no obligation to fine tune the system based on operational requirements. The PA Schedule 15-2 Part 4, Article 6.3 (h) (xii) does refer to "alarm management" as a generic requirement but there is no defined interpretation as to what that really means. The system does manage alarms however it appears that the frequency of the alarms being generated is what is in question.

PA Schedule 15-2 Part 4, Article 6.3 (h) (xii)

> (xii) High availability application servers shall perform real-time data acquisition and processing, generation of supervisor control commands, database queries, overview display, alarm management, executing of diagnostic, administrative and maintenance programs. The computer system shall produce, at a minimum, alarm and related logs, summaries, and other user defined reports.

Sincerely,

Ignacio Velasco
Project Director

Cc: Bill McCormick
   Tyler Miehe
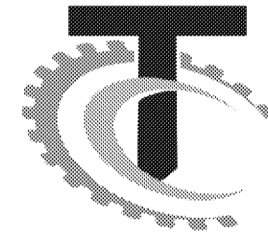   Hans Tenold
   Nicolas Truchon

Attachments: 2021 07 12 - OCT SCADA Alarm Analysis - Step 1 (3)
              WSI-P9433-R-001 - Alarm Analysis Report v1-0
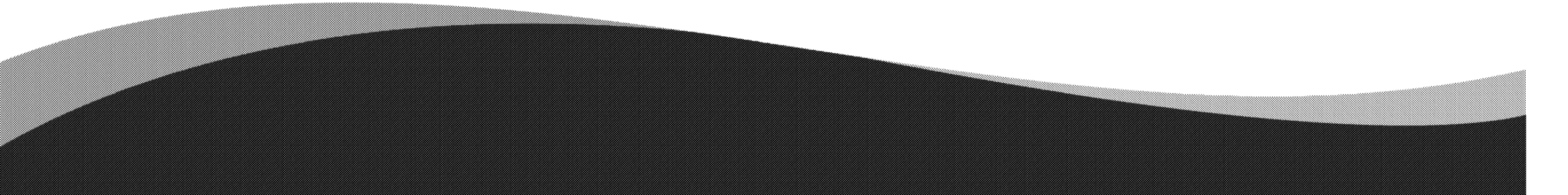
SCADA Alarm Analysis

OC Transpo Confederation Line
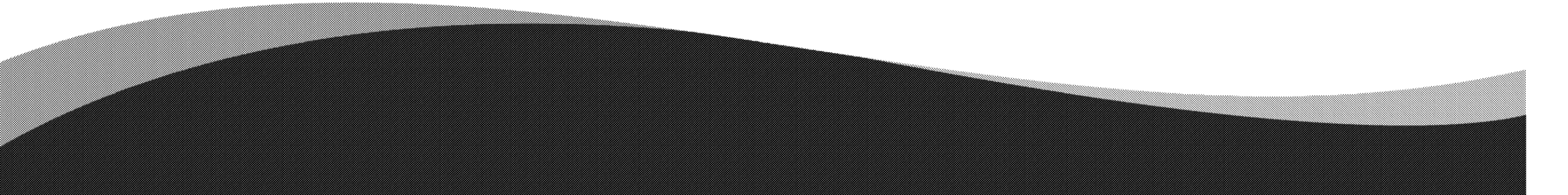
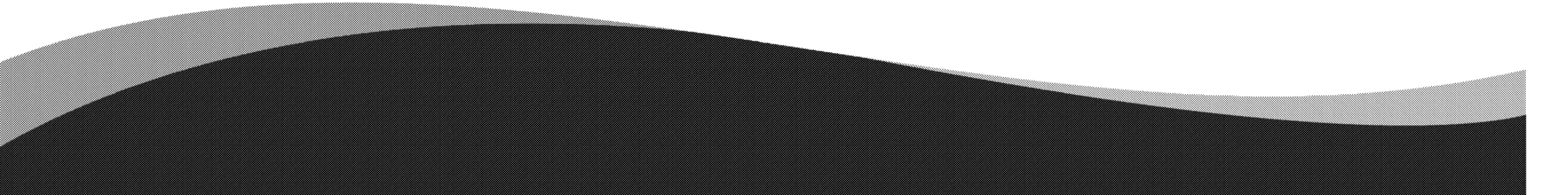Trevor Penner, P.Eng

trevor@trenic.ca

Agenda

- Purpose and Scope of Review
- High-level Statistics
- Categorization of Alarms
- Discussion of each Category
- Recommendations / Next Steps

Purpose and Scope of Review

- Understand the scale of the problem
- Review log files
- Find and assess "Bad Actors"
- Identify next steps towards resolution
- Alarm Strategy Report

What was assessed?

- Focused on log files from March 1 to April 22, 2021
  - Received information to April 25
  - April 23-25 – Communication Alarms

- Severity 0-3 and Event 1

Alarm Statistics

- 53 days – 132,146 total logged messages
  - Severity 0:   39,589
  - Severity 1:   31,056
  - Severity 2:   6,552
  - Severity 3:   8,914
  - Event 1:   46,035
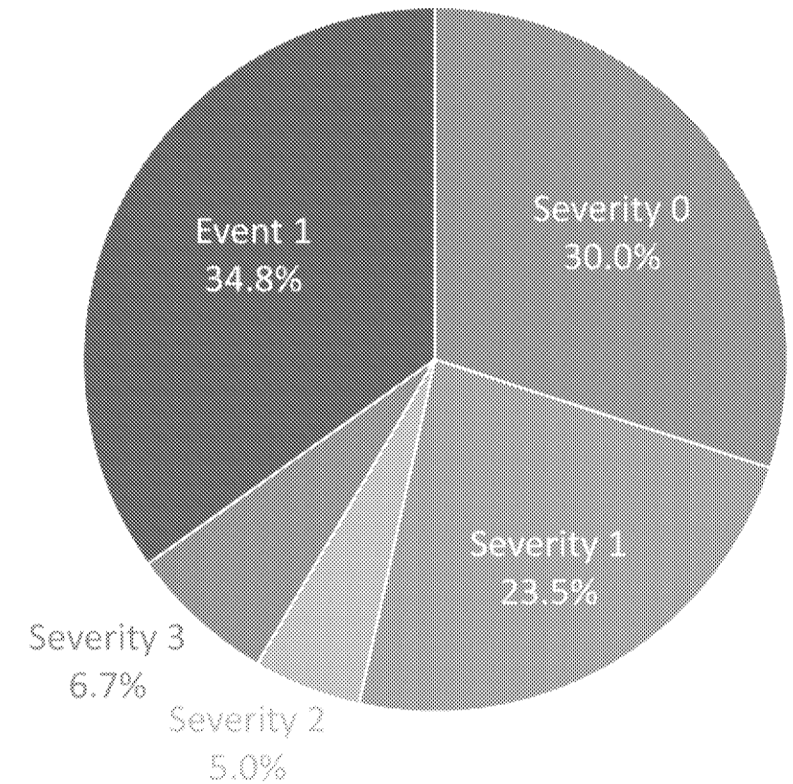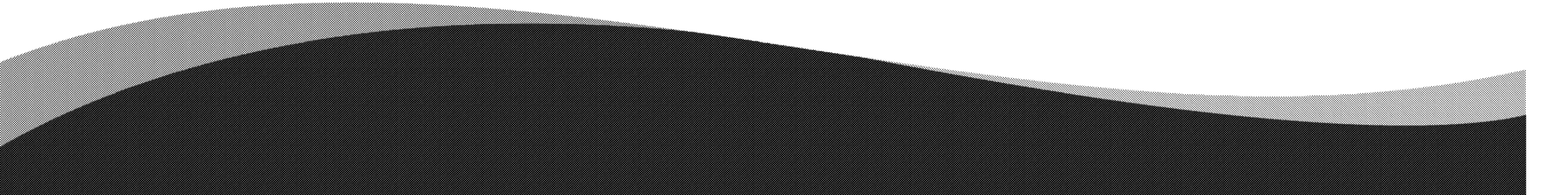
Alarm Statistics cont.

- 53 days – 86,111 total <u>alarm</u> messages
  - Severity 0:   39,589
  - Severity 1:   31,056
  - Severity 2:   6,552
  - Severity 3:   8,914

- Average 1,625 alarms per day

Severity 0
46.0%

Severity 3
10.4%

Severity 1
36.0%

Severity 2
7.6%
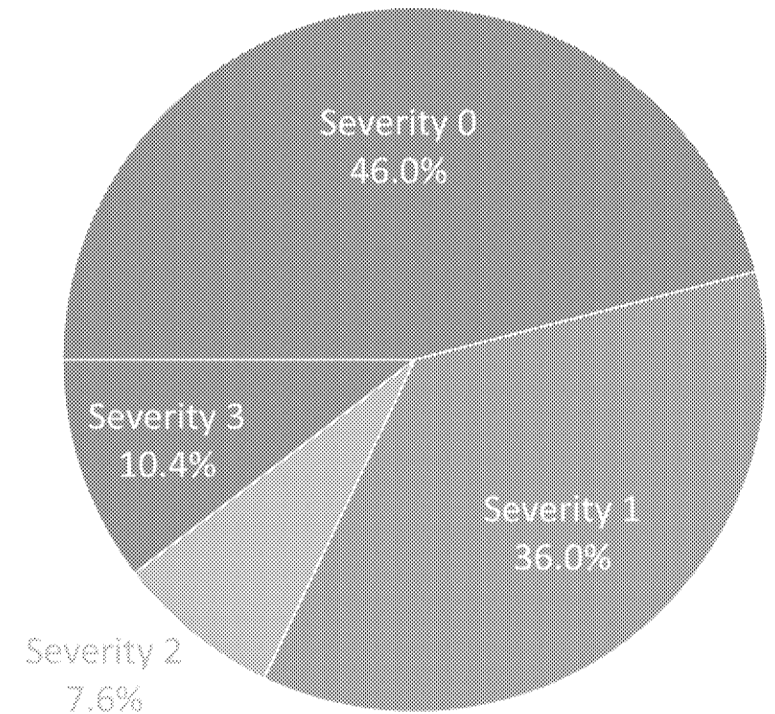
Alarm Count by Location (AOR)

- 18,521 - MSF
- 14,605 - TPSS-06
- 9,314 - Tunneys Pasture
- 8,829 - Rideau
- 5,679 - Parliament
- 5,373 - Hurdman

- 2,735 - Communication
- 2,722 - Bayview
- 2,572 - Blair
- 2,449 - Tremblay
- 2,343 - Lees
- 2,020 - Lyon
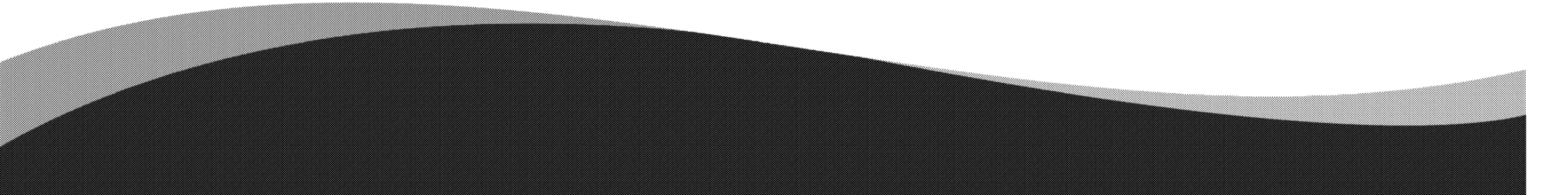
Alarm Count by Location (AOR) cont.

- 1,948 - uOttawa
- 1,909 - St-Laurent
- 1,820 - Pimisi
- 1,131 - Cyrville
- 327 - System
- 323 - TPSS-02
- 282 - TPSS-03

- 267 - TPSS-01
- 260 - TPSS-04
- 226 - TPSS-05
- 217 - TPSS-07
- 167 - TPSS-08
- 53 - TPSS-09
- 19 - TPSS-10

Alarm Count by Location (AOR)
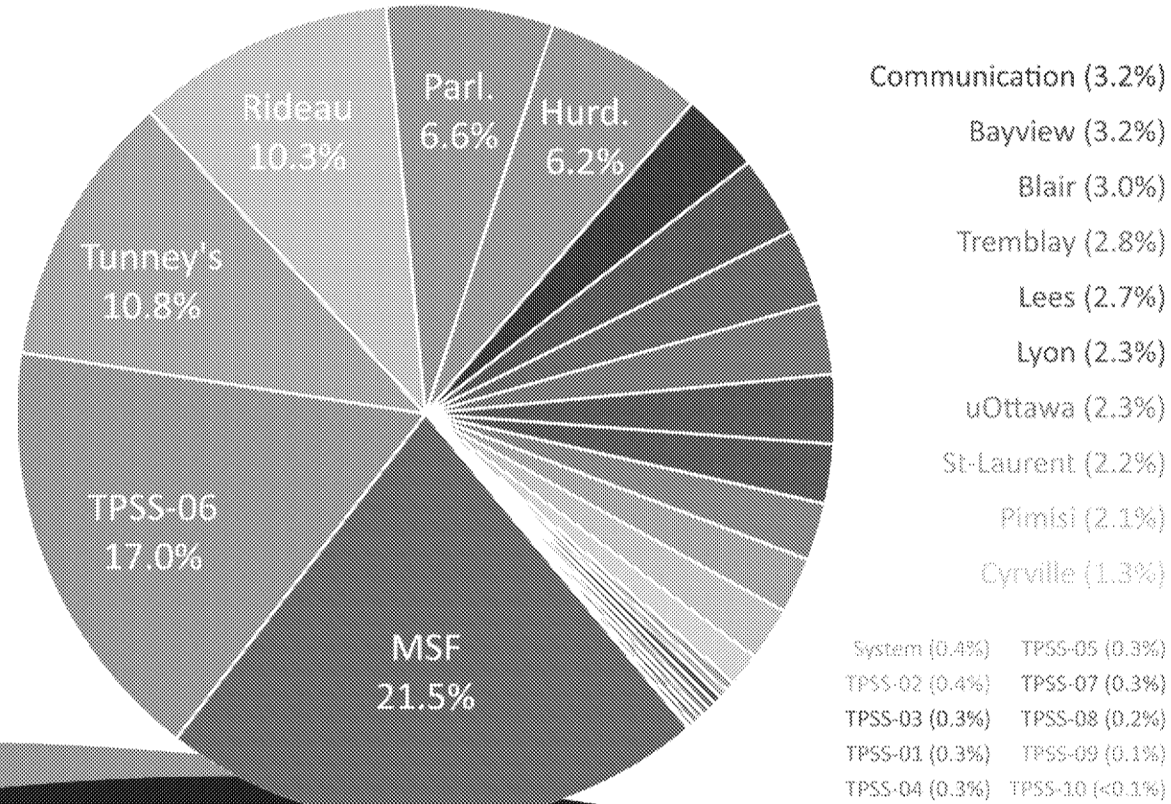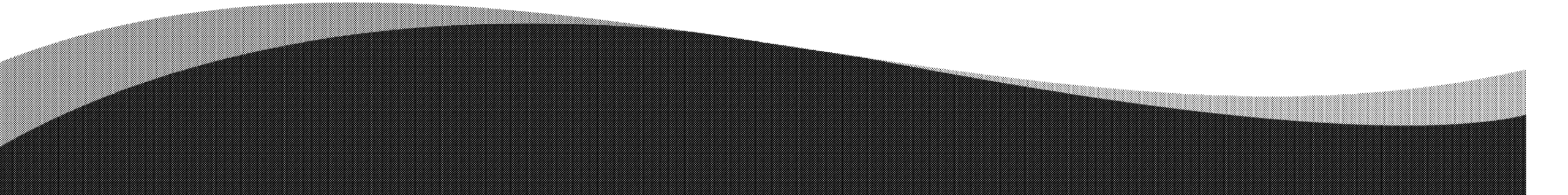
Top 20 "Bad Actors"

- 6,968 TP06 DC SG Ground / 64-1 Relay Fault
- 6,638 TP06 DC SG/Rect Enclosure Overvoltage
- 3,947 HUST ETEL-10 Off Hook
- 3,584 Tunney's Pasture BAS Critical
- 3,557 Tunney's Pasture BAS Information
- 2,849 MEAB Sump Well High-Level Alarm
- 1,944 MEAB DR01-401 Forced Open
- 1,768 RISU Station Sanitary Sump Fault
- 1,455 Bayview BAS Critical
- 1,410 MEAB Exp Door 01-005 B Forced Open

- 1,218 uOttawa BAS Critical
- 1,201 DESU 02-018A Corridor Door Forced Open
- 925 DESU ELEVATOR-03 (01-015) High Oil Temp
- 906 MEAB DR01-002 Door Forced Open
- 890 Lees BAS Critical
- 850 TRST 01-106A E Ancillary Door Forced Open
- 835 RISU 02-030A EMR Door Forced Open
- 784 MEAB Train Wash Off/Alarm
- 740 MEAB Exp Door 01-013 Held Open
- 709 MEAB Exp Door 01-013 Forced Open

Categories of Alarms

- Door Alarms
  - Forced Open
  - Held Open
- Switchgear
- Building Automation
- Elevator
- Escalator

- ETEL
- Pumps
- PA Rack
- Communications
- GIDS
- Train Wash
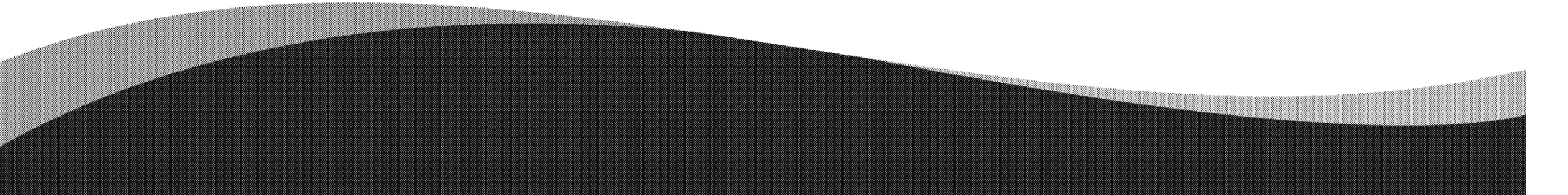
Categories of Alarms cont.

- Switch Heater
- End Gate
- System
- Tunnel Ventilation
- Hi Rail Access
- FACP
- Doors/Gates (Access)

- Train Sanding
- UPS
- Incident Panels
- Emergency Call Buttons
- HVAC
- Substation Communications
- Tunnel Incident Command Post

Categories of Alarms

Pie chart categories:
- Doors Held Open (9.2%)
- Elevator (8.4%)
- ETEL (5.8%)
- Pumps (5.4%)
- Escalator (5.1%)
- Building Automation (15.4%)
- Switchgear (17.8%)
- Doors Forced Open (20.3%)

PA Rack (3.2%)
Communication (3.2%)
GIDS (1.7%)
Train Wash (0.9%)
Voltage (0.7%)
Switch Heaters (0.5%)
End Gates (0.4%)
System (0.4%)
Other categories detailed later
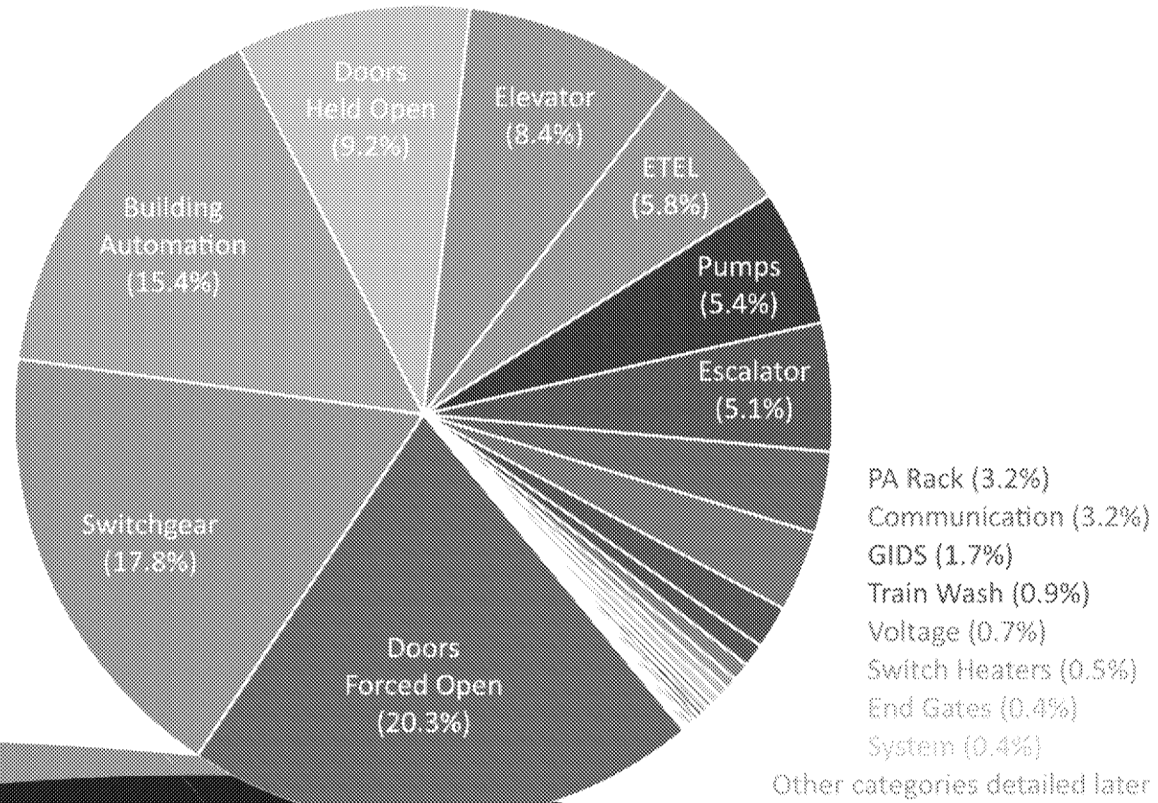
Door Alarms

- 25,437 Door-related Alarms
  - 29.5% of all alarms

- 17,472 "Forced Open" Alarms – Severity 0
  - 282 unique alarms

- 7,965 "Held Open" Alarms – Severity 1
  - 265 unique alarms

Door Forced Open – By Location

Pie chart segments:
- MSF 49.1% (8,587)
- Rideau 13.2% (2,304)
- Parliament 8.6% (1,508)

Legend:
- Tremblay 5.6% (979)
- Pimisi 3.9% (675)
- Bayview 3.4% (593)
- Blair 3.3% (582)
- Tunney's 3.0% (518)
- uOttawa 2.5% (439)
- Cyrville 1.6% (287)
- Lees 1.5% (254)
- Hurdman 1.3% (220)
- St-Laurent 1.0% (172)
- Lyon 0.9% (163)
- TPSS-06 0.4% (69)
- Other TPSSs 0.1% each (10-21 alarms each)
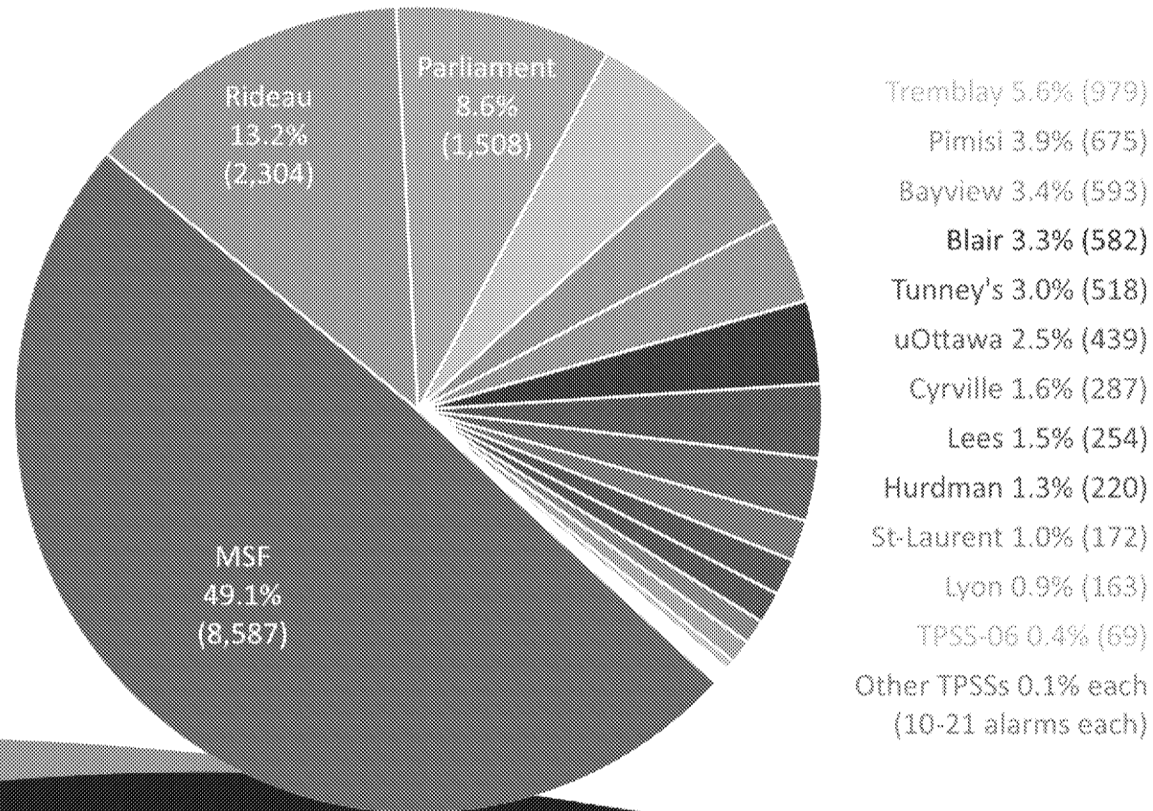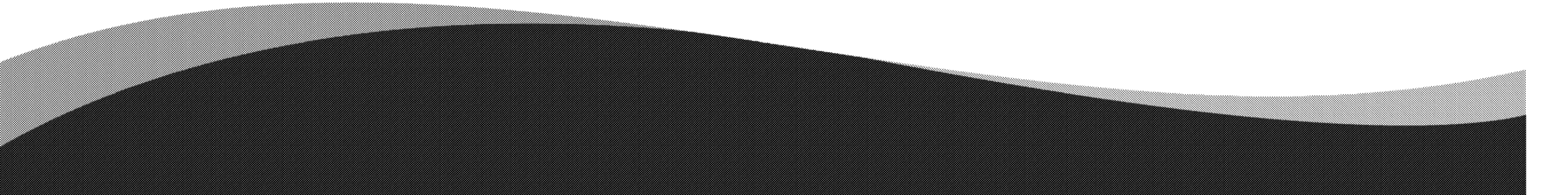
Door Forced Open – Top 20

- 1,944   MEAB DR01-401
- 1,410   MEAB Expansion Door 01-005 B
- 1,201   DESU 02-018A Corridor to E Ancillary
- 906   MEAB DR01-002
- 850   TRST 01-106A
- 835   RISU 02-030A Elevator Machine Room
- 709   MEAB Expansion Door 01-013
- 611   MEAB DR01-202A
- 438   RISU 02-029A HVAC Room
- 429   MEAB DR01-122

- 353   MEAB DR01-219B
- 307   TUST 01-122 Snow Removal Storage
- 283   RISU 02-028A Concourse to Equip Rm
- 277   MEAB DR01-227B
- 272   RISU 06-005C Grade Entrance East IN
- 267   BLST 01-103 Snow Removal Storage
- 249   CYST 01-106 Janitors Closet (Platform)
- 223   MEAB DR01-223A
- 200   MEAB DR01-123
- 195   LBST 02-107A Corridor to EMR
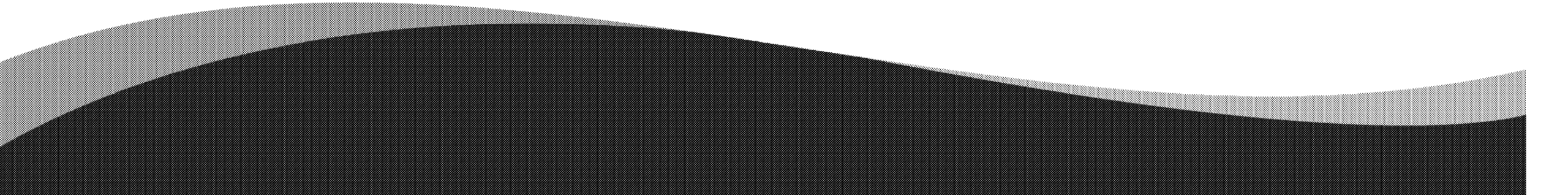
Door Held Open – By Location

MSF
74.3%
(5,915)

Parliament
8.1%
(643)

Rideau 4.8% (381)
Blair 2.9% (230)
Tunney's 2.6% (208)
Lyon 1.3% (103)
Pimisi 1.1% (90)
Lees 0.8% (67)
St-Laurent 0.8% (62)
Tremblay 0.8% (61)
Bayview 0.6% (49)
uOttawa 0.6% (44)
Hurdman 0.5% (43)
Cyrville 0.4% (34)
TPSS-06 0.3% (23)
Other TPSSs (1-4 each)
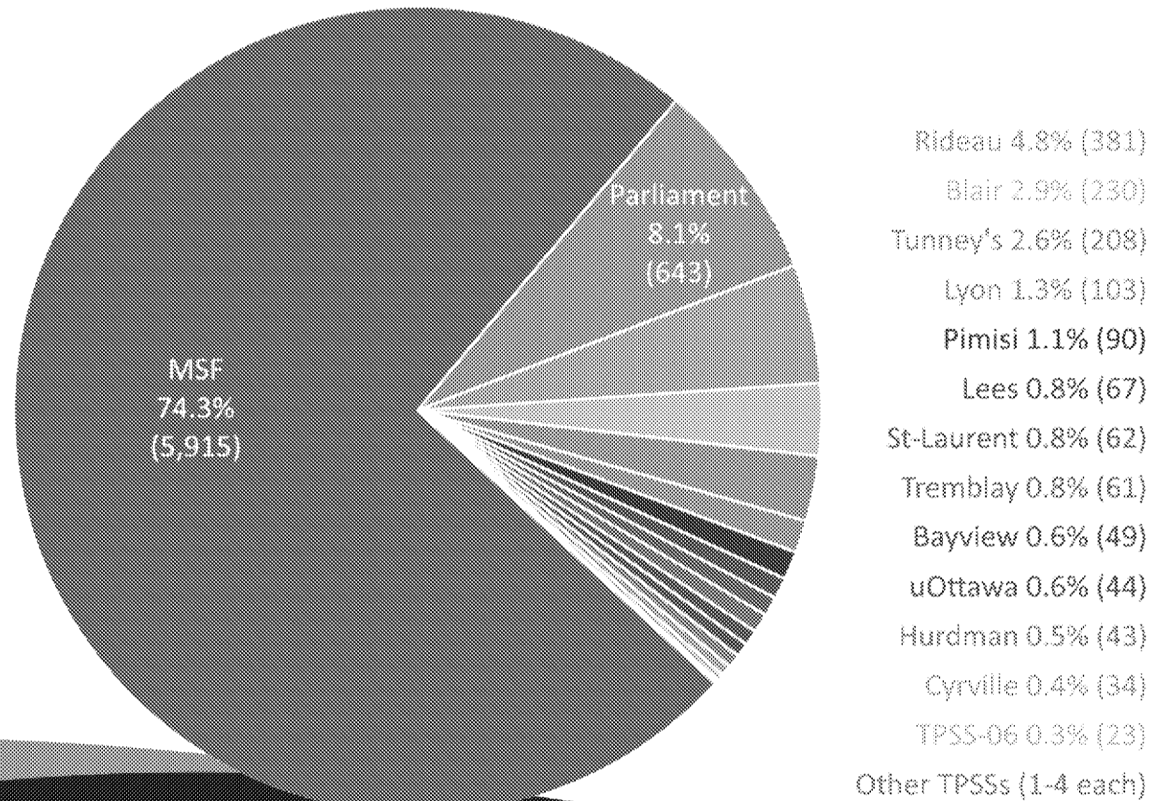
Door Held Open – Top 20

- 740   MEAB Expansion Door 01-013
- 704   MEAB DR01-219B
- 638   MEAB DR01-219A
- 590   MEAB Expansion Door 01-005 B
- 586   MEAB DR01-108 Radio Mag Lock Door
- 471   MEAB Pedestrian Gate 3
- 467   MEAB DR01-002
- 311   DESU 02-017A
- 168   MEAB DR01-121A
- 151   RISU 04-003A to Escalator Control

- 131   MEAB Expansion Door M-001
- 117   DESU 01-010A Refuse Room
- 117   MEAB DR01-202A
- 111   MEAB Expansion Door 01-006
- 97   TUST 01-122 Snow Removal Storage
- 94   MEAB DR01-231A
- 89   MEAB DR01-226
- 85   RISU 02-028A
- 84   BLST 01-108 Bus Supers Office
- 82   MEAB Expansion Door 01-012

Door Alarms Discussion

- MSF doors – 14,502 alarms
  - Site security
- Door unlock procedures
- Clarify access control components and configuration

Switchgear Alarms

- 15,368 alarms related to switchgear

- Two main culprits – together 13,606
  - TP06 DC Switchgear Ground / 64-1 Relay Fault State Fault
  - TP06 DC Switchgear/Rectifier Enclosure Overvoltage Detected Horn Strobe Alarm Command Activated by Calculation Service

- Breaker Open Alarms – combined 1,259

Switchgear Alarms Discussion
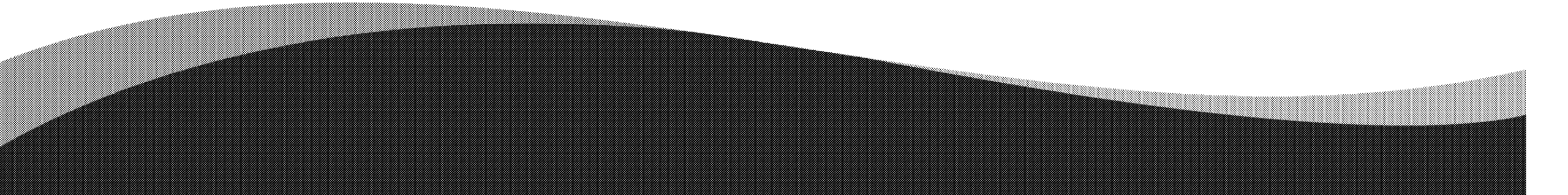
- TP06 Ground Fault Alarms
  - Legitimate ground fault?
  - Current status?

- Breaker Open Alarms
  - Primarily occur at evening shutdown.

Building Automation Alarms

- 13,265 alarms related to BAS

Bayview
11.6%
(1,533)

uOttawa
9.4%
(1,248)

Lees
8.0%
(1,061)

Tunney's Pasture
57.0%
(7,566)

Tremblay 4.3% (575)

Cyrville 3.3% (441)

Hurdman 3.0% (401)

Blair 2.8% (376)

Rideau 0.2% (30)

Parliament 0.1% (19)

Pimisi 0.1% (12)

Lyon <0.1% (2)

St-Laurent <0.1% (1)
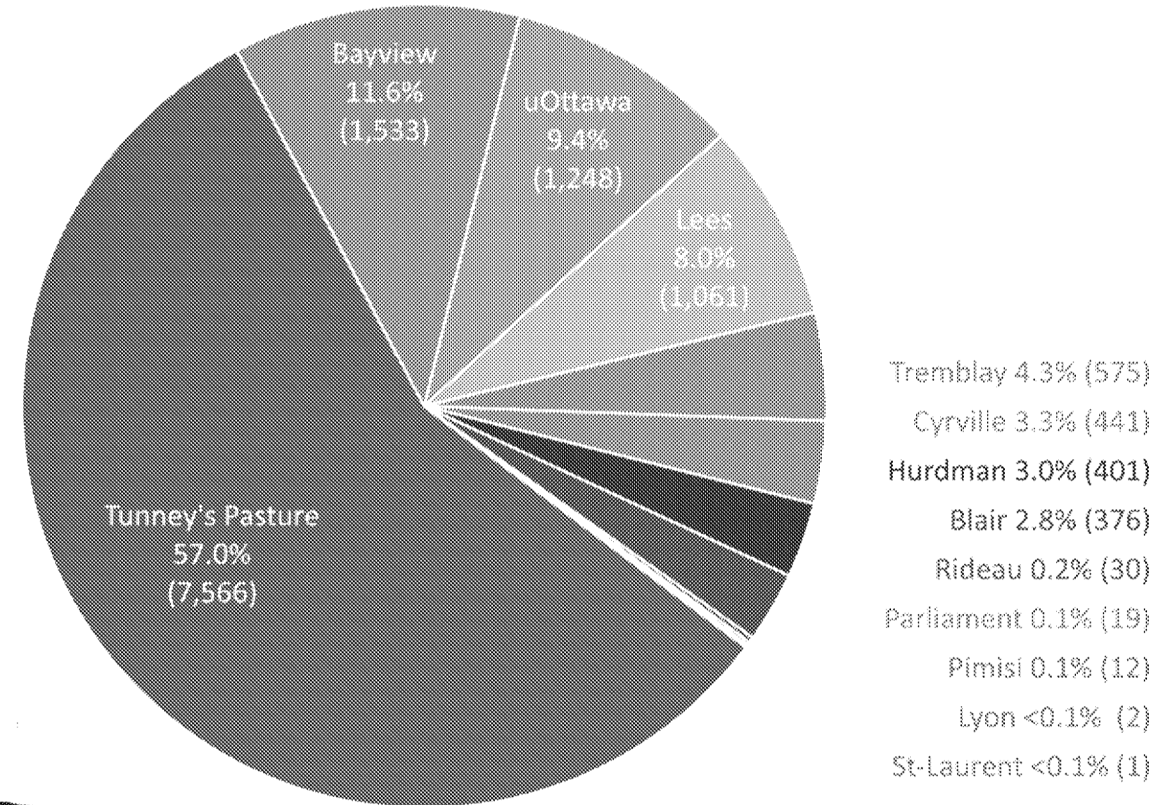
Building Automation – Top 20

- 3,584   Tunney's Pasture BAS Critical Device
- 3,557   Tunney's Pasture BAS Information
- 1,455   Bayview BAS Critical Device
- 1,218   uOttawa BAS Critical Device
- 890   Lees BAS Critical Device
- 433   Tremblay BAS Information
- 424   Tunney's Pasture BAS Critical Control
- 385   CYST BAS Critical Device
- 252   Hurdman BAS Critical Device
- 182   Blair BAS Critical Device

- 169   Lees BAS Warning
- 168   Blair BAS Information
- 147   Hurdman BAS Critical Control
- 141   Tremblay BAS Critical Device
- 52   CYST BAS Critical Control
- 43   Bayview BAS Information
- 30   Rideau BAS Critical Device
- 26   Blair BAS Critical Control
- 23   uOttawa BAS Warning
- 19   Bayview BAS Warning

BAS Alarms Discussion
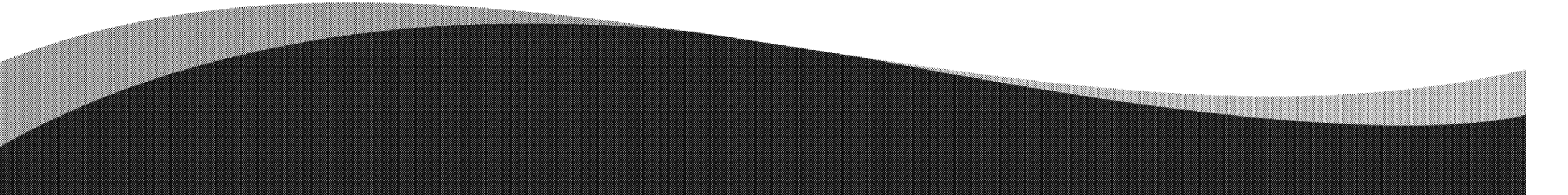
- Trending Down
- Alarm Message Clarity
- Tunney's Pasture correlation

Elevator Alarms

- 7,266 total alarms

Rideau 9.0% (656)
Tremblay 8.4% (608)
Lyon 9.2% (666)
Blair 9.6% (694)
Pimisi 10.2% (742)
Parliament 29.3% (2,128)
Hurdman 5.9% (426)
Tunney's 5.0% (364)
Cyrville 4.0% (291)
Bayview 3.6% (262)
Lees 2.3% (170)
St-Laurent 2.1% (154)
uOttawa 1.4% (105)
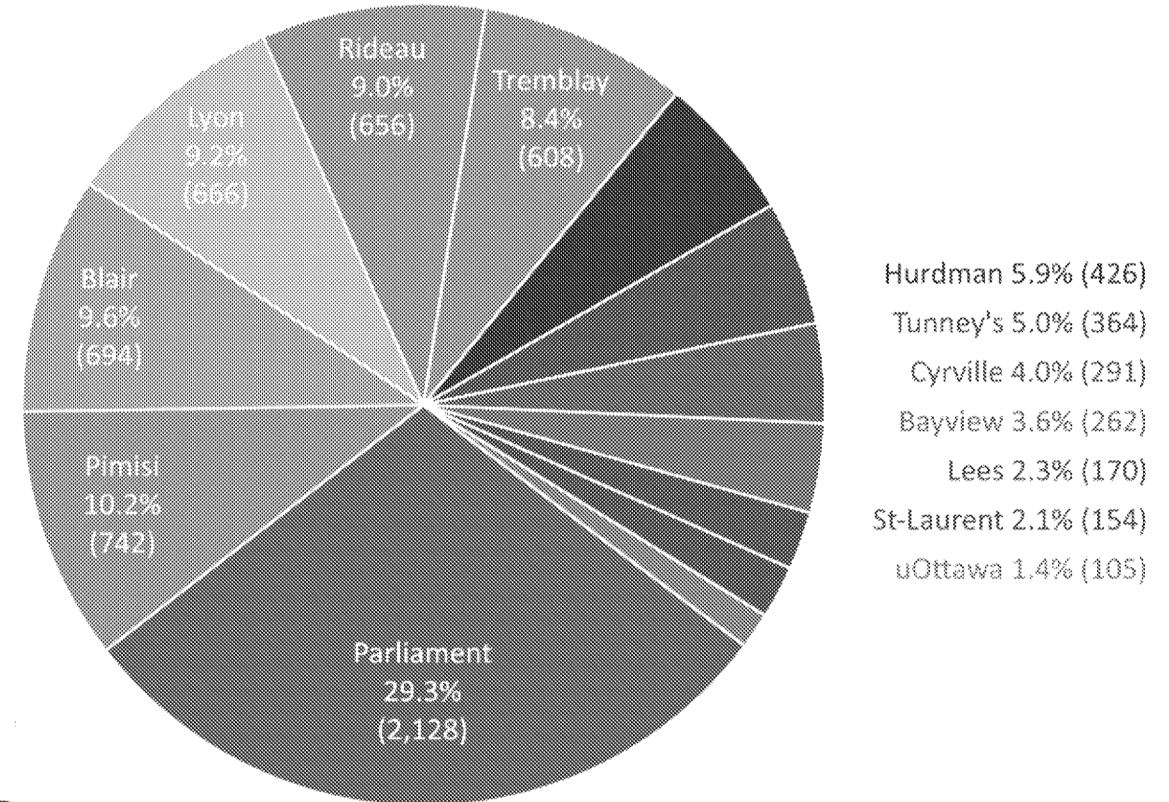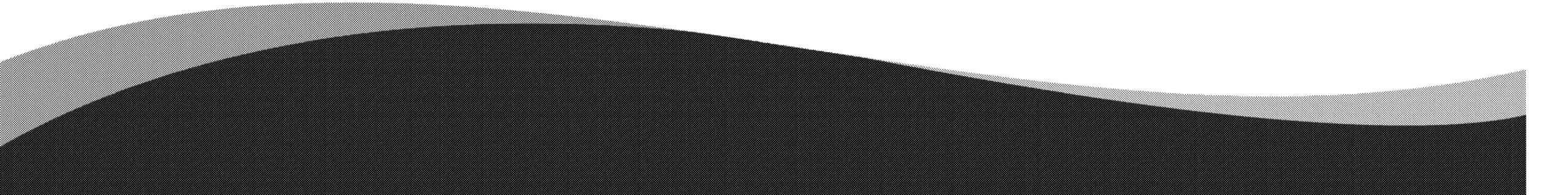
Elevator Alarms – Top 20

- 925   DESU Elevator-03 Oil Temp
- 166   BLST Elevator 2 Inspection
- 156   BLST Elevator 2 Not Normal
- 143   HUST Elevator 3 Not Normal
- 125   DESU Elevator 3 Not Normal
- 115   DESU Elevator 3 Out Of Service
- 90   DESU Elevator-06 Inspection
- 87   DESU Elevator 1 Not Normal
- 87   DESU Elevator 4 Not Normal
- 81   DESU Elevator 2 Not Normal

- 80   DESU Elevator 1 Out Of Service
- 78   DESU Elevator 4 Out Of Service
- 77   DESU Elevator 2 Out Of Service
- 73   RISU Elevator-01 Drive Failure
- 70   BLST Elevator 1 Inspection
- 69   TRST Elevator 4 Not Normal
- 67   CYST Elevator 1 Inspection
- 64   CYST Elevator 2 Inspection
- 63   HUST Elevator 3 Inspection
- 62   RISU Elevator 1 Not Normal

Elevator Alarms Discussion

- DESU High Oil Temp
- Inspection Muting
- Debouncing
- Root Cause Alarms

ETEL Alarms

- 4,964 total alarms
  - 111 different ETELs

- Top 8
  - 3,947 - HUST ETEL-10 Off Hook State Activated
  - 603 - LEST ETEL-07 Off Hook State Activated
  - 24 - LBST ETEL/ITEL-01 Off Hook State Activated
  - 15 - RISU ETEL-08 Off Hook State Activated
  - 11 - RISU ETEL/ITEL-02 Off Hook State Activated
  - 10 - TP03 ETEL-09 Off Hook State Activated
  - 10 - HUST ETEL-06 Off Hook State Activated
  - 10 - CYST ETEL/ITEL-02 Off Hook State Activated
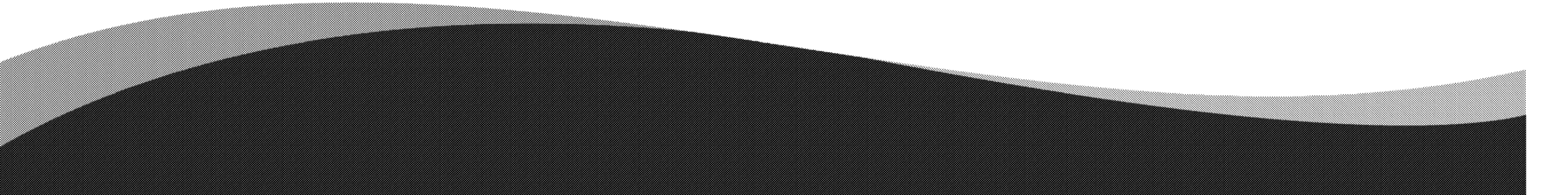
ETEL Alarms Discussion

- HUST ETEL-10, LEST ETEL-07 – Faulty Hardware?
- Answering ETEL calls
- Connectivity

Pump Alarms

- 4,625 pump-related alarms

- Two "Bad Actors"
  - 2,849 - MEAB Sump Well High Level Alarm
  - 1,768 - RISU Station Sanitary Sump Faults

Pump Alarms Discussion

- Sump correlation to weather
- Pump functionality vs alarms

Escalator Alarms

- 4,362 escalator-related alarms

- Consistent alarm activity – operational?

PA Rack Alarms

- 2,779 PA rack alarms
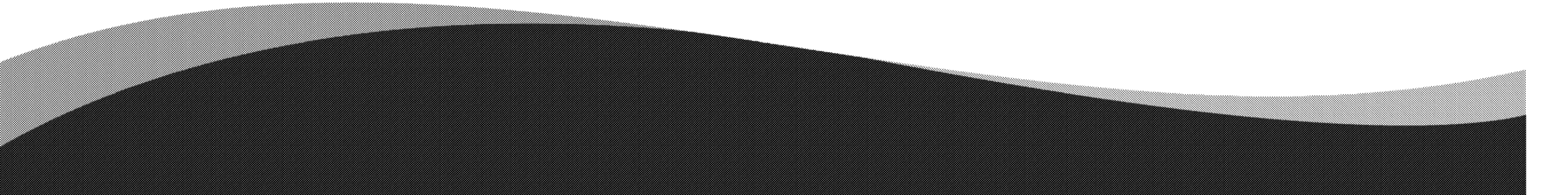
- All PA rack alarms:
  - 602 RISU PA Rack NAC-1 Fault State
  - 601 RISU PA Rack NAC-2 Fault State
  - 339 RISU PA Rack NAC-3 Fault State
  - 336 SLSU PA Rack NAC-1 Fault State
  - 331 DESU PA Rack NAC-2 Fault State
  - 322 SLSU PA Rack NAC-2 Fault State
  - 247 RISU PA Rack NAC-4 Fault State
  - 1 DESU PA Rack NAC-1Fault State

PA Rack Alarms Discussion

- Consistent alarms activity

- More information needed

Communication Alarms

- 2,748 communication-related alarms

- March 4, hour 20 oddity – 1,193 alarms in that hour

- Consistent low frequency, with bursts

Communication Alarms cont.
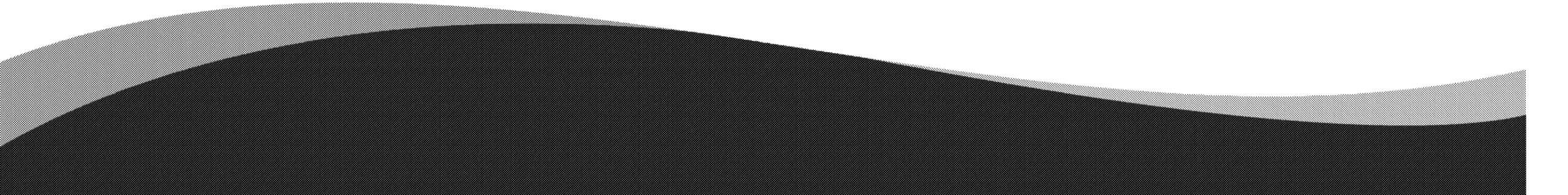
- Interesting hours:
  - Mar 13 - 11:00 - 71 alarms - 57 different BAS, RTU, PLC connection faults (some x 2)
  - Mar 13 - 13:00 - 57 alarms - 57 different BAS, RTU, PLC connection faults
  - Mar 14 - 03:00 - 55 alarms - 55 different BAS, RTU, PLC connection faults
  - Mar 20 - 12:00 - 58 alarms - 58 different BAS, RTU, PLC connection faults
  - Mar 30 - 22:00 - 114 alarms - 59 different BAS, RTU, PLC connection faults (most x 2)
  - Apr 4-6 - 4-5 alarms/hour - primarily IOS FTPConnection and APC Transfer/FTP
  - Apr 7 - 9:00-14:00 - 16-18 alarms/hour - primarily IOS FTPConnection and APC Transfer/FTP
  - Apr 10 - 18:00 - 184 alarms - 59 different BAS, RTU, PLC connection faults (most x 2, 3, 4)
  - Apr 16 - 14:00 - 25 alarms - primarily IOS FTPConnection and APC Transfer/FTP
  - Apr 17 - 20:00 - 96 alarms - 58 different BAS, RTU, PLC connection faults (many x 2)

Communication Alarms cont.

- Top Alarms
  - 309 IOS FTPConnection Retrieval Communication Timed Out - Severity 3
  - 126 APC Transfer CommunicationStatus Response Timed Out - Severity 3
  - 117 APC FTPConnection Retrieval Communication Timed Out - Severity 3
  - 97 Symmetry Controller Communication Failed - Severity 1
  - 93 St Laurent CIP Device FT: Fault tolerance now performed by None (Failed) - Severity 0
  - 84 APC Transfer Inactive Alarm - Severity 1
  - 77 Lyon CIP Device FT: Fault tolerance now performed by None (Failed) - Severity 0
  - 68 Parliament CIP Device FT: Fault tolerance now performed by None (Failed) - Severity 0
  - 67 Rideau CIP Device FT: Fault tolerance now performed by None (Failed) - Severity 0
  - 16 lines of scadasrv1/2 [Location] CommLine Communication Status Failed – Severity 1 and 2
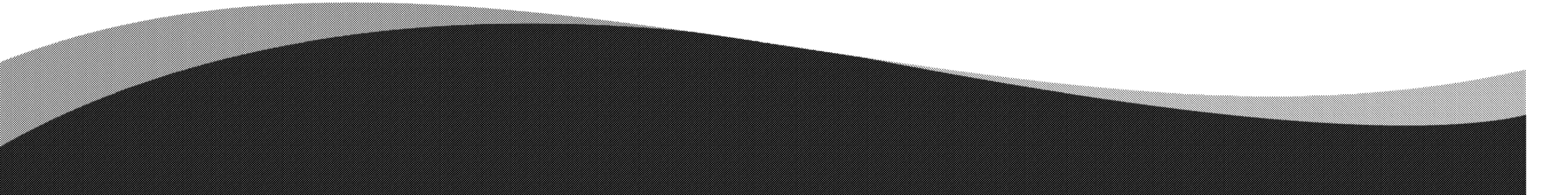
Communication Alarms Discussion

- March 4, 20:00 hour
- Operator action
- Meaning of alarms
- "Normal" state – duration of alarm
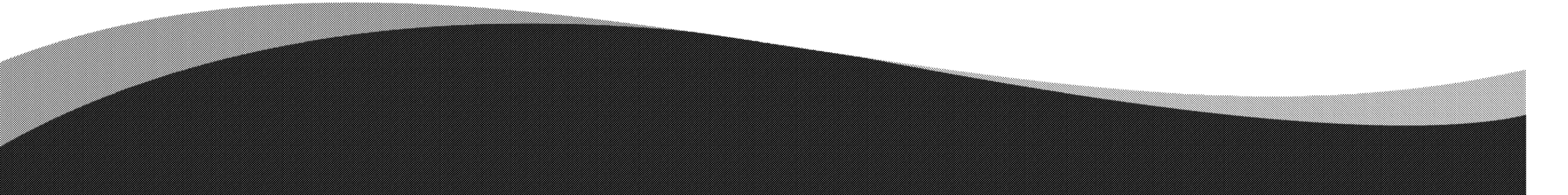
GIDS Alarms

- 1,465 alarms
- 88.5% of GIDS alarms are non-revenue
  - 141   00:00-01:00 on Mondays
  - 181   01:00-02:00 on Monday-Friday
  - 447   02:00-03:00 every day
  - 338   03:00-04:00 every day
  - 137   04:00-05:00 mostly Saturday and Sunday
  - 53   05:00-06:00 on Sunday
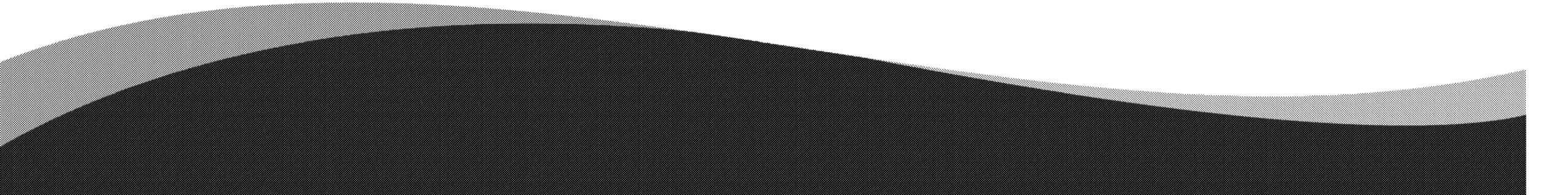
GIDS Alarms Discussion

- GIDS functionality
- Muting during non-revenue

Train Wash Alarms
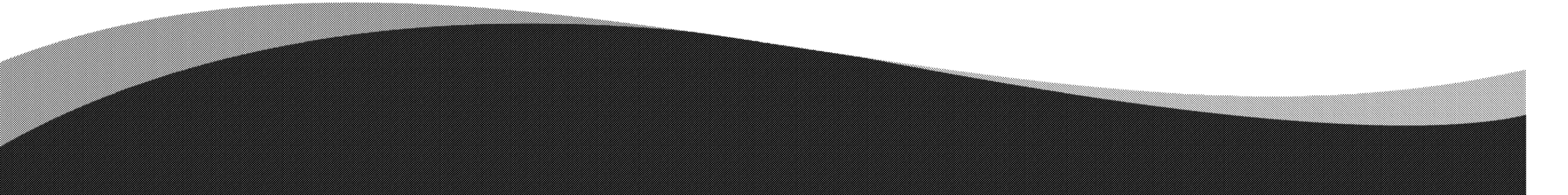
- 784 alarm trips by one single alarm point
- Functionality?

Substation Voltage Alarms

- 616 alarms
- Negative Bus Overvoltage
- March 2-4

Substation Voltage Alarms cont.
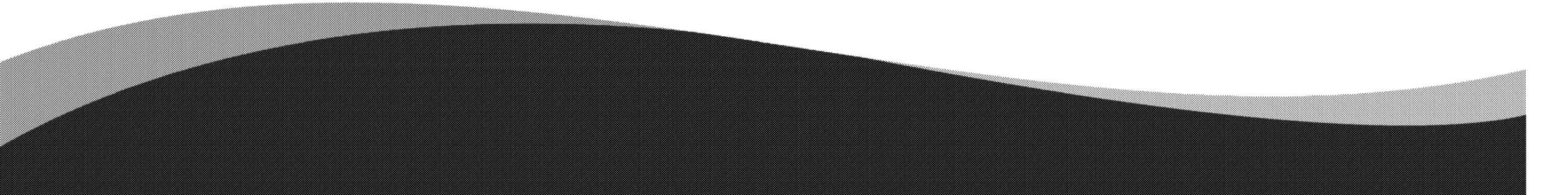
- Occurrences:
    - 516   TP06 NGD Negative Bus Overvoltage State Tripped
    - 51   TP08 NGD Negative Bus Overvoltage State Tripped
    - 13   TP09 NGD Negative Bus Overvoltage State Tripped
    - 13   TP05 NGD Negative Bus Overvoltage State Tripped
    - 11   TP07 NGD Negative Bus Overvoltage State Tripped
    - 6   TP02 NGD Negative Bus Overvoltage State Tripped
    - 4   TP04 NGD Negative Bus Overvoltage State Tripped
    - 2   TP03 NGD Negative Bus Overvoltage State Tripped

Substation Voltage Alarms Discussion
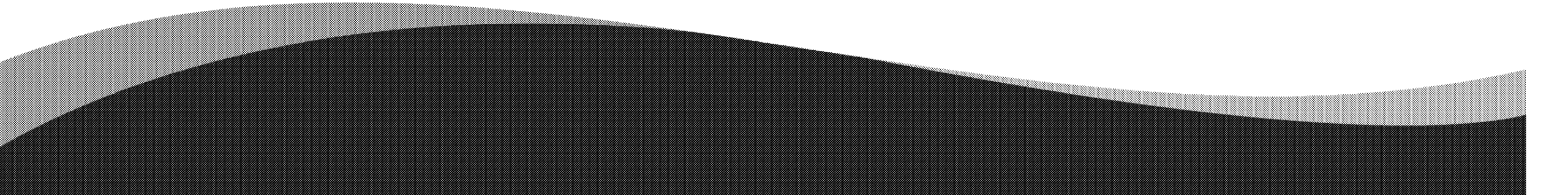
- March 2-4
- Infrastructure? Vehicles?

Switch Heater Alarms
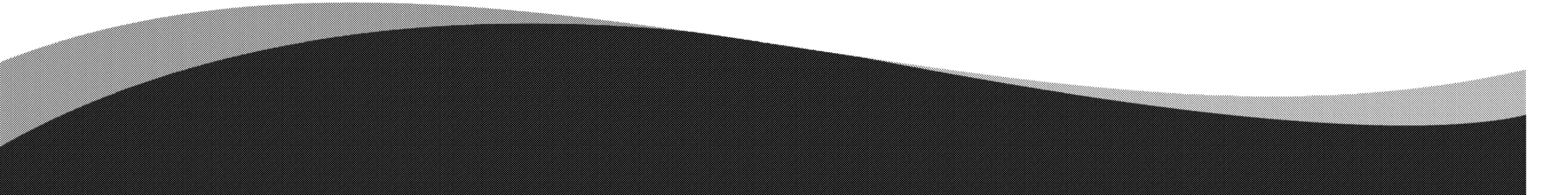
- 403 alarms related to switch heaters
  - Individual heater control failed alarms

- Maintenance activities or power outages
  - Mar 3, 10:00
  - Mar 7, 03:00
  - Mar 12, 16:00

Door / Gate / Access Alarms

- 375 alarms for end gates
- 220 alarms for Hi Rail Access
- 161 other door/gate messages

- Operational?

System Alarms

- 333 System alarms – primarily:
  - 229   Video driver module: Fault tolerance
  - 53   FTP Transfer: Fault tolerance
  - 44   Connection to the Symmetry Server: Fault tolerance

- Consistent

Tunnel Vent Alarms

- 230 TVS-related alarms
  - 193 during non-revenue
  - 31 – March 4, hour 20
  - Local Control

- TVS is a priority

FACP Alarms

- 178 alarms from FACPs
  - Status alarms

- No correlation
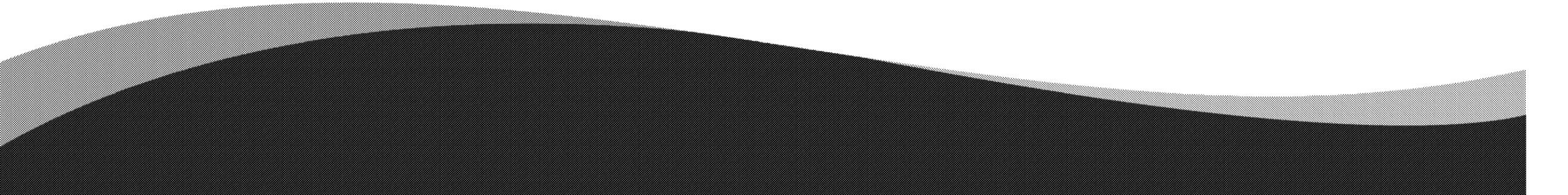
Substation Alarms

- 149 alarm messages related to substations
  - 26 TP06 Negative Grounding Device Closed
    - Correlated to earlier Switchgear faults at TPSS-06

  - Local Mode alarms related to Maintenance

  - Poor naming example: "Substation Not in Remote State Local"
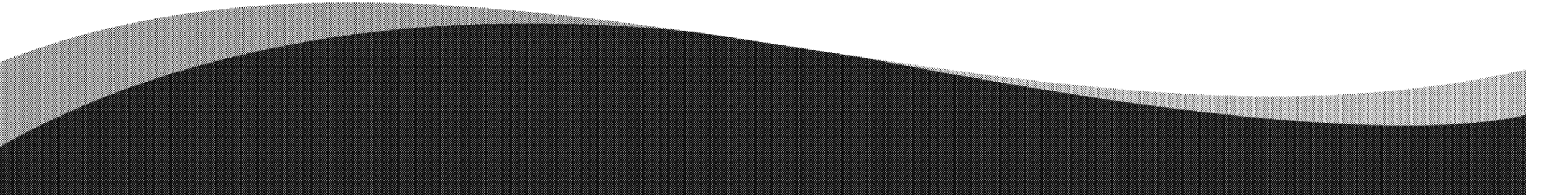
Train Sanding Alarms

- 134 trips of a single alarm point
- Functionality

UPS Alarms

- 112 alarms from UPS

- Duplication of alarms
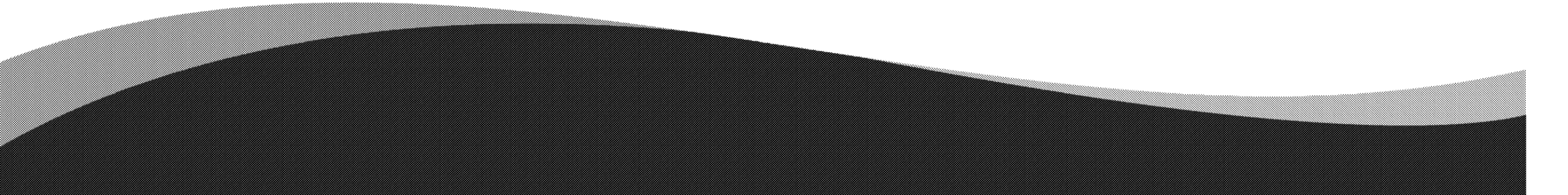
Last Categories

- 48 - Incident Panel Open
- 44 - Emergency Call Button
- 26 - HVAC
- 10 - Substation Comms
- 9 – Tunnel Incident Command Post
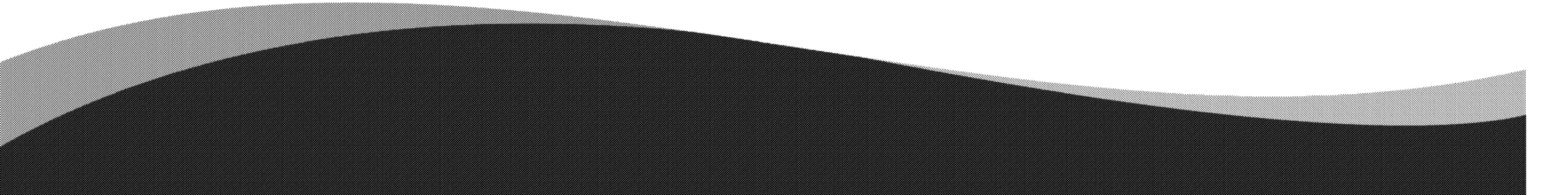
Additional Comments / Discussion?

Recap: Next Steps

- Further investigation of door wiring and programming
- Follow-up on TPSS-06 ground fault alarms
- Deeper investigation into Building Automation alarms
- Elevator Inspection muting
- Debounce and Root Cause assessment
- ETEL alarms status update and confirm functionality

Recap: Next Steps cont.

- Sump and Sanitary pumps functionality vs alarms
- Explore Escalator alarm source
- Further investigation of PA Rack Alarms
- Further investigation of Communication Alarms
- Consideration of GIDS muting
- Investigate Train Wash functionality vs alarms

Recap: Next Steps cont.

- Follow-up on Substation Voltage alarms
- Discuss maintenance-related alarms (e.g. switch heaters)
- Investigate System alarms – video driver, etc.
- Review alarm naming and messages
- Include "Normal" in future log file captures

Thank you!

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WILLOWGLEN SYSTEMS

WSI-P9433-R-001 - Alarm Analysis Report

v1.0

1   Executive Summary

Per the Ottawa Light Rail Transit (OLRT) project terms, a subset of performance metrics for Rideau Transit Maintenance (RTM) are triggered by specific types of alarms. Given how often they occur, the City of Ottawa is charging RTM with hefty fines. This document analyzes a sample set of alarms to clarify what they are, determine why they occur, suggest what can be done to prevent or minimize these alarms, and correctly associate (or disassociate) alarms with the performance metrics.

2   Background, Considerations, and Assumptions

- Per discussions with RTM, alarm management related issues remain the primary focus for this engagement

- Per request from RTM, WSI will provide some guidance on scope of responsibility

  o   The RACI assignments are based on WSI's understanding, and other parties may have different perspectives

- All configuration work requires time for all parties to coordinate expectations before work begins

- WSI views an alarm management expert employed by OC Transpo or RTM as a requirement to ensure the health of the alarm system

  o   WSI will assist this expert with understanding WSI's scope of alarms

  o   Others (signalling, CCTV, etc.) should assist this expert for their scope of alarms

  o   This is likely a full time position based on the responsibilities and volume of alarms

- Priorities shown are recommendations from WSI

  o   RTM may assign different priorities

- A 1-week sample of alarms from site is sufficient for initial analysis

  o   Willowglen may request additional data to complete some investigations

- Temporary failures (or failovers) with Kepware servers can generate a flood of alarms for points connected through Kepware

  o   A dynamic alarm (via a Program/Calculation) could be configured which detects the Kepware alarms and suppresses associated alarms

- Willowglen is aware of an issue where operators can ack alarms through the Alarm Journal (instead of the Current Alarms Display)

  o   This can lead to conditions where alarm acknowledgements appear without corresponding alarm records

  o   Willowglen plans to resolve this issue in a future release by disabling acks on the Alarm Journal

- Some alarms may functionally be events

- o   These alarms should be set to Event 1 severity
- o   Event 1 alarms do not require operator action, and they will still appear in the log files

3   Analytical Process

1. Start with the export from RTM for 1 week's alarms from the SCADACOM alarm management tool
2. Filter out Acknowledged = TRUE records as we are interested in how often alarms occur, rather than how often operators acknowledge these alarms
3. Sort one tab by Time only to view adjacent alarms
4. Sort one tab by Device to group each unique object in the database
   a. Sub-sort by Time to trend frequency and identify potential chattering or brief alarms
   b. Create a list of distinct Device entries (Excel: UNIQUE)
   c. Count the number of entries per device (Excel: COUNTIF)
   d. Sort by most records to iteratively focus on the most frequent alarms
5. Evaluate respective Severity, Device AOR, Alarm Text to clarify details on what the alarm is
6. Correlate the alarm to a potential penalty clause
7. For relevant alarms, evaluate frequency, alarm values, and time-adjacent alarms to identify potential causes and resolutions
8. Group alarms with similar causes and resolutions

4   Alarm Configuration Lists

A set of alarm configuration lists are included. The larger list is a full dump of the server's alarm configuration list. The smaller lists are organized by sub-systems, and are more human readable.

The lists were last generated in August 2019. FIDS (Fence Intrusion Detection System) points were added since that time. FIDS has not been commissioned yet.

5 Details for Relevant Alarms

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions

Device Failure - Individual
 	
• 656408576:TUST-BAS (2440)
• 656408582:CMST-BAS (503)
• 656408577:BAST-BAS (218)
• 656408585:TRST-BAS (160)
• 656408588:BLST-BAS (123)
• 656408587:CYST-BAS (103)
• 656408583:LEST-BAS (32)
• 656408580:DESU-BAS (27)
• 656408579:DWSU-BAS (6)
• 656408581:RISU-BAS (6)
• 656408578:LBST-BAS (5)
	• Building Automation System device status
	  o SCADA monitors and controls each station's sub-systems
	  o Device failure results in loss of visibility and control of that sub-system at that location
	• This alarm only indicates the device is unavailable
	  o It is not meant to clarify why the device is unavailable
	  o Communication failures may also be interpreted as device failures
	• When a device fails, it may trigger alarms for all related data points
		• Sub-system devices may fail due to a variety of issues
		  o Check error logs on respective sub-system for more details
		  o Monitor performance directly on the sub-systems rather than through SCADA
		• Network conditions may temporarily disrupt connectivity
		  o Run network analysis tools to measure bandwidth usage, packet loss, error rates, etc.
		  o Add OnDelays to wait longer for temporary communication issues to clear before declaring the device unavailable

Elevators
 	
• 571479994:DESU-ELEVATOR-03-01-015-HIGH-OIL-TEMP (2081)
• 571477902:DESU-ELEVATOR-03-01-015-ACT-BATTERY-PWR-DRIFTING-DEVICE (42)
• 571479990:DESU-ELEVATOR-03-01-015-LOW-OIL-LEVEL (27)
• 571479995:DESU-ELEVATOR-04-01-016-HIGH-OIL-TEMP (15)
	• Each elevator monitors a set of maintenance attributes
	  o Alarms trigger when maintenance is required
	• Most alarms chattered frequently and were shelved by operators one or more times
	• Some alarms were fleeting (in and out of alarm very briefly)
		• Frequent chattering indicates potential sensor issues, or bad wiring
		  o Shelve the alarm manually until the sensor is fixed, or wiring is corrected
		• Frequent chattering for analogs indicates potentially incorrect alarm setpoints
		  o Review the alarm setpoints, and adjust to operationally correct values
		  o Apply a deadband to filter out

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions

• 571478143:DWSU-ELEVATOR-03-02-014-HI-TEMP (9)
 	
• 571478002:LBST-ELEVATOR-03-01-113-ACT-BATTERY-PWR-DRIFTING-DEVICE (6)
 	
• 571479991:DESU-ELEVATOR-04-01-016-LOW-OIL-LEVEL (6)
 	
• 571477015:TRST-ELEVATOR-4-01-117-ACT-BATTERY-PWR-DRIFTING-DEVICE (5)
 	
• 571477982:LBST-ELEVATOR-01-01-104-ACT-BATTERY-PWR-DRIFTING-DEVICE (5)
 	
• 571477992:LBST-ELEVATOR-02-01-113-ACT-BATTERY-PWR-DRIFTING-DEVICE (5)
 	
• 571478012:LBST-ELEVATOR-04-02-108-ACT-BATTERY-PWR-DRIFTING-DEVICE (5)
 	
• 571478022:LBST-ELEVATOR-05-02-108-ACT-BATTERY-PWR-DRIFTING-DEVICE (5)
 	
• 571477117:LEST-ELEVATOR-1-01-108-ACT-BATTERY-PWR-DRIFTING-DEVICE (3)
 	
• 571477912:DESU-ELEVATOR-04-01-016-ACT-BATTERY-PWR-DRIFTING-DEVICE (3)
 	
• 571478032:BAST-ELEVATOR-01-01-114-ACT-BATTERY-PWR-DRIFTING-DEVICE (3)
 	
• 571478042:BAST-ELEVATOR-02-01-114-ACT-BATTERY-PWR-DRIFTING-DEVICE (3)
 	
• 571478119:DWSU-ELEVATOR-01-02-013-HI-TEMP (3)
 	
• 571479993:DESU-ELEVATOR-02-01-014-HIGH-OIL-TEMP (3)
		intermittent fluctuations near the alarm boundary
		
		    ○ Apply OnDelays and OffDelays if the point enters and leaves the alarm state too soon
		
		• Fleeting alarms indicate potential sensor issues
		
		    ○ Apply short OnDelays to wait long enough for a steady alarm

Elevators	• Each elevator monitors its operational	• Likely valid maintenance activity

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KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
• 571477977:DWSU-ELEVATOR-08-03-009-ACT-CAR-INSP-OPR (55) • 571477903:DESU-ELEVATOR-03-01-015-ACT-PH1-FIRE-EMRG-OPR (41) • 571477122:LEST-ELEVATOR-1-01-108-ACT-CAR-INSP-OPR (37) • 571477997:LBST-ELEVATOR-02-01-113-ACT-CAR-INSP-OPR (27) • 571477064:HUST-ELEVATOR-1-01-114-ACT-CAR-INSP-OPR (26) • 571477907:DESU-ELEVATOR-03-01-015-ACT-CAR-INSP-OPR (20) • 571477947:DWSU-ELEVATOR-05-04-005-ACT-CAR-INSP-OPR (20) • 571477913:DESU-ELEVATOR-04-01-016-ACT-PH1-FIRE-EMRG-OPR (16) • 571477115:LEST-ELEVATOR-1-01-108-CAR-ON-INDSRV-OPERATION (15) • 571478007:LBST-ELEVATOR-03-01-113-ACT-CAR-INSP-OPR (14) • 571477917:DESU-ELEVATOR-04-01-016-ACT-CAR-INSP-OPR (11) • 571477987:LBST-ELEVATOR-01-01-104-ACT-CAR-INSP-OPR (9) • 571478017:LBST-ELEVATOR-04-02-108-ACT-CAR-INSP-OPR (9) • 571478027:LBST-ELEVATOR-05-02-108-ACT-CAR-INSP-	mode ○ Alarms trigger when changing modes (inspection, normal, fire test, independent, out of service) • Most of these alarms occurred during 1 hour windows • Some days had multiple windows which could indicate repeat testing to confirm maintenance work done • Some alarms were shelved in advance which indicates awareness of confirmed maintenance activities • Some are passenger and intercom alarms	○ Operators can manually shelve the alarm during confirmed maintenance ○ If maintenance typically lasts for a known period of time, a long OffDelay acts like auto-shelving ○ Consult safety or security regulations before shelving or delaying • Possibly vandalism (with a lot of patience) ○ Use CCTV and/or intercom to confirm vandalism and coordinate response with security • Brief occurrence should be forwarded to maintenance and/or security for follow-up ○ They could be accidental toggles ○ They could be intentional vandalism ○ They could be related to maintenance issues • Multiple passenger/intercom alarms around the same time may indicate an issue for operations or security to investigate as many passengers may be reacting to the same situation • Individual passenger/intercom alarms may be accidental • Frequent and intermittent

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
OPR (9)		passenger/intercom alarms could indicate device-specific issues (sensor failure, overly sensitive/unprotected trigger)
• 571478047:BAST-ELEVATOR-02-01-114-ACT-CAR-INSP-OPR (8)		
• 571477904:DESU-ELEVATOR-03-01-015-ACT-PH2-IN-CAR-FIRE-SERVICE-OPR (7)		
• 571476990:TRST-ELEVATOR-1-01-107-ACT-CAR-INSP-OPR (6)		
• 571478037:BAST-ELEVATOR-01-01-114-ACT-CAR-INSP-OPR (6)		
• 571478067:BAST-ELEVATOR-04-01-115-ACT-CAR-INSP-OPR (6)		
• 571476783:BLST-ELEVATOR-2-01-110-ACT-CAR-INSP-OPR (5)		
• 571477983:LBST-ELEVATOR-01-01-104-ACT-PH1-FIRE-EMRG-OPR (5)		
• 571477990:LBST-ELEVATOR-02-01-113-CAR-ON-INDSRV-OPERATION (5)		
• 571477993:LBST-ELEVATOR-02-01-113-ACT-PH1-FIRE-EMRG-OPR (5)		
• 571478013:LBST-ELEVATOR-04-02-108-ACT-PH1-FIRE-EMRG-OPR (5)		
• 571478023:LBST-ELEVATOR-05-02-108-ACT-PH1-FIRE-EMRG-OPR (5)		
• 571478033:BAST-ELEVATOR-01-01-114-ACT-PH1-FIRE-EMRG-OPR (5)		
• 571478043:BAST-ELEVATOR-02-01-114-ACT-PH1-FIRE-EMRG-OPR (5)		

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
• 571477900:DESU-ELEVATOR-03-01-015-CAR-ON-INDSRV-OPERATION (4)		
• 571477074:HUST-ELEVATOR-2-01-114-ACT-CAR-INSP-OPR (3)		
• 571477118:LEST-ELEVATOR-1-01-108-ACT-PH1-FIRE-EMRG-OPR (3)		
• 571477152:LEST-ELEVATOR-4-01-108-ACT-CAR-INSP-OPR (3)		
• 571477193:CMST-ELEVATOR-2-01-106-ACT-CAR-INSP-OPR (3)		
• 571477807:RISU-ELEVATOR-01-01-013-ACT-CAR-INSP-OPR (3)		
• 571477914:DESU-ELEVATOR-04-01-016-ACT-PH2-IN-CAR-FIRE-SERVICE-OPR (3)		
• 571478057:BAST-ELEVATOR-03-01-115-ACT-CAR-INSP-OPR (3)		
• 571477899:DESU-ELEVATOR-03-01-015-CAR-IN-NORMAL-OPERATION (2)		
• 571477901:DESU-ELEVATOR-03-01-015-CAR-OUTSRV-OR-NOT-AVAILABLE (2)		
Elevator alarms with "ELE" tag		
• 581959715:DESU-ELE-03 (178)		
• 581959716:DESU-ELE-04 (112)		
• 581959683:BLST-ELE-02 (95)		
• 581959713:DESU-ELE-01 (75)		
• 581959714:DESU-ELE-02 (63)		

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
• 581959710:RISU-ELE-06 (55)		
• 581959736:DWSU-ELE-01 (51)		
• 581959738:DWSU-ELE-03 (51)		
• 581959693:TRST-ELE-04 (43)		
• 581959709:RISU-ELE-05 (39)		
• 581959737:DWSU-ELE-02 (39)		
• 581959739:DWSU-ELE-04 (39)		
• 581959687:SLSU-ELE-02 (38)		
• 581959724:LBST-ELE-02 (36)		
• 581959705:RISU-ELE-01 (33)		
• 581959719:DWSU-ELE-05 (33)		
• 581959703:CMST-ELE-02 (28)		
• 581959725:LBST-ELE-03 (27)		
• 581959712:RISU-ELE-08 (24)		
• 581959682:BLST-ELE-01 (23)		
• 581959711:RISU-ELE-07 (20)		
• 581959694:HUST-ELE-01 (18)		
• 581959698:LEST-ELE-01 (17)		
• 581959718:DESU-ELE-06 (15)		
• 581959735:TUST-ELE-04 (13)		
• 581959721:DWSU-ELE-07 (12)		
• 581959734:TUST-ELE-03 (12)		
• 581959695:HUST-ELE-02 (10)		

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
• 581959730:BAST-ELE-03 (10)		
• 581959697:HUST-ELE-04 (9)		
• 581959699:LEST-ELE-02 (9)		
• 581959701:LEST-ELE-04 (9)		
• 581959706:RISU-ELE-02 (9)		
• 581959690:TRST-ELE-01 (8)		
• 581959727:LBST-ELE-05 (7)		
• 581959689:SLSU-ELE-04 (6)		
• 581959696:HUST-ELE-03 (6)		
• 581959717:DESU-ELE-05 (6)		
• 581959722:DWSU-ELE-08 (6)		
• 581959728:BAST-ELE-01 (6)		
• 581959729:BAST-ELE-02 (6)		
• 581959688:SLSU-ELE-03 (4)		
• 581959723:LBST-ELE-01 (4)		
• 581959726:LBST-ELE-04 (4)		
• 581959731:BAST-ELE-04 (4)		
• 581959686:SLSU-ELE-01 (3)		
• 581959700:LEST-ELE-03 (3)		
• 581959704:CMST-ELE-03 (3)		
• 581959707:RISU-ELE-03 (3)		
• 581959720:DWSU-ELE-06 (3)		

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions

Elevators
 	
• 571477945:DWSU-ELEVATOR-05-04-005-ACT-DRIVE-FAILURE (28)
 	
• 571478005:LBST-ELEVATOR-03-01-113-ACT-DRIVE-FAILURE (26)
 	
• 571477975:DWSU-ELEVATOR-08-03-009-ACT-DRIVE-FAILURE (25)
 	
• 571477855:RISU-ELEVATOR-06-01-030-ACT-DRIVE-FAILURE (24)
 	
• 571477120:LEST-ELEVATOR-1-01-108-ACT-DRIVE-FAILURE (20)
 	
• 571477995:LBST-ELEVATOR-02-01-113-ACT-DRIVE-FAILURE (20)
 	
• 571477805:RISU-ELEVATOR-01-01-013-ACT-DRIVE-FAILURE (15)
 	
• 571476774:BLST-ELEVATOR-1-01-110-ACT-DRIVE-FAILURE (12)
 	
• 571476784:BLST-ELEVATOR-2-01-110-ACT-DRIVE-FAILURE (9)
 	
• 571477845:RISU-ELEVATOR-05-01-030-ACT-DRIVE-FAILURE (9)
 	
• 571478045:BAST-ELEVATOR-02-01-114-ACT-DRIVE-FAILURE (8)
 	
• 571477985:LBST-ELEVATOR-01-01-104-ACT-DRIVE-FAILURE (7)
 	
• 571478015:LBST-ELEVATOR-04-02-108-ACT-DRIVE-FAILURE (7)
	• Each elevator monitors a set of operational attributes
	
	    o Alarms trigger when expected operations fail
	
	• Some incidents occurred during a 1 hour window
	
	• Some incidents occurred briefly
		• May align with maintenance windows
		
		    o Authorized operators can temporarily disable communications with a device under confirmed maintenance or testing
		
		• Brief occurrences should be forwarded to maintenance for tracking and follow-up activities
		
		    o They could be temporary glitches at the device due to misuse or other conditions
		
		    o They could be precursors to more serious issues later

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
• 571478025:LBST-ELEVATOR-05-02-108-ACT-DRIVE-FAILURE (7) • 571476916:SLSU-ELEVATOR-2-01-105-ACT-DRIVE-FAILURE (6) • 571476988:TRST-ELEVATOR-1-01-107-ACT-DRIVE-FAILURE (6) • 571478035:BAST-ELEVATOR-01-01-114-ACT-DRIVE-FAILURE (6) • 571478065:BAST-ELEVATOR-04-01-115-ACT-DRIVE-FAILURE (6) • 571477018:TRST-ELEVATOR-4-01-117-ACT-DRIVE-FAILURE (5) • 571477150:LEST-ELEVATOR-4-01-108-ACT-DRIVE-FAILURE (5) • 571477815:RISU-ELEVATOR-02-01-014-ACT-DRIVE-FAILURE (3) • 571477935:DESU-ELEVATOR-06-02-014-ACT-DRIVE-FAILURE (3) • 571477965:DWSU-ELEVATOR-07-03-009-ACT-DRIVE-FAILURE (3) • 571478055:BAST-ELEVATOR-03-01-115-ACT-DRIVE-FAILURE (3)		

Pumps
 	
• 176686318:MEAB-SUMP-WELL-1-HIGH-LEVEL (1518)
 	
• 176686265:RISU-SUMP-FAULTS-ACTIVE-2 (743)
	• Each plumbing device monitors a set of operational attributes
	
	  ○ Alarms trigger when operations are at risk
	
	• Some incidents occurred throughout the
		• Frequent and consistent (but not obviously chattering) alarms may require alarm setpoint adjustments to better fit operational concerns
		
		  ○ Sensors should also be tested/replaced to confirm it's

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
	day for several days	not an occasional sensor issue
	• Some alarm conditions last for a minute or less	○ Some issues may temporarily spike due to environmental factors (e.g. excess rainfall)
		• OnDelays and OffDelays can smooth out temporary transitions that are not really operationally relevant

Doors
 	
• 633340357:MEAB-DR-01-401 (722)
 	
• 633340296:MEAB-DR-01-002 (432)
 	
• 633340413:RISU-DR-02-030-A (412)
 	
• 633340552:MEAB-EXP-DR-01-005-B (399)
 	
• 633340325:MEAB-DR-01-219-B (368)
 	
• 633340201:DESU-DR-02-018-A (347)
 	
• 633340324:MEAB-DR-01-219-A (338)
 	
• 633340571:MEAB-EXP-DR-01-013 (298)
 	
• 633340482:TUST-DR-02-106-C-IN (257)
 	
• 633340461:TRST-DR-01-106-A (224)
 	
• 633340306:MEAB-DR-01-108-MAG (205)
 	
• 633340480:TUST-DR-01-122 (201)
 	
• 633340411:RISU-DR-02-028-A (181)
 	
• 633340418:RISU-DR-04-003-A (167)
 	
• 633340320:MEAB-DR-01-202-A (163)
 	
• 633340200:DESU-DR-02-017-A (136)
	• Doors alarm on any unauthorized action
	
	  ○ Entered without correct procedure/credentials
	
	  ○ Held door open too long
	
	• Some alarms occur throughout the day
	
	• Some alarms occur more frequently during certain times of day
	
	• Some alarms occur during specific days
		• Frequent and consistent unauthorized entry may indicate possible failures with the security authorization device (card swipe) and/or door open/close sensors
		
		  ○ Repair or replace the device
		
		• People may be opening doors without following the proper security process
		
		  ○ Investigate how people are bypassing the process
		
		  ○ Update the process to prevent casual or unintentional bypassing
		
		  ○ Educate people on proper use of the doors
		
		• Doors may incorrectly be flagged as security sensitive
		
		  ○ If door don't need to be secured, remove the associated alarm or lower the alarm priority (make it an event)
		
		• Some times of day (such as shift change) may result in higher levels of traffic

WILLOWGLEN SYSTEMS

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions

• 633340130:BLST-DR-01-103 (126)
 	
• 633340277:LBST-DR-02-107-A (111)
 	
• 633340433:SLSU-DR-01-119 (105)
 	
• 633340336:MEAB-DR-01-227-B (98)
 	
• 633340412:RISU-DR-02-029-A (83)
 	
• 633340116:BAST-DR-01-100-IN (77)
 	
• 633340132:BLST-DR-01-108 (73)
 	
• 633340423:RISU-DR-06-005-C-IN (73)
 	
• 633340118:BAST-DR-01-110 (72)
 	
• 633340495:BLST-DR-01-102-C-IN (70)
 	
• 633340353:MEAB-DR-01-306-C (63)
 	
• 633340570:MEAB-EXP-DR-01-012 (63)
 	
• 633340270:LBST-DR-01-109 (62)
 	
• 633340297:MEAB-DR-01-005 (59)
 	
• 633340368:CMST-DR-01-104 (56)
 	
• 633340315:MEAB-DR-01-123 (54)
 	
• 633340540:HUST-DR-01-100-A-IN (54)
 	
• 633340171:DESU-DR-01-010-A (53)
 	
• 633340563:MEAB-EXP-DR-01-018A (52)
 	
• 633340572:CMST-DR-02-100-A-IN (52)
 	
• 633340313:MEAB-DR-01-121-A (51)
 	
• 633340331:MEAB-DR-01-223-A (51)
 	
• 633340558:MEAB-EXP-DR-01-006 (50)
		○ Dynamic alarms can temporarily lower the priority or shelve alarms during these periods as configured
		
		• Doors triggered many times on a specific day could indicate unusual activity
		
		   ○ Alarms can be shelved during known maintenance periods
		
		   ○ Security teams should investigate abnormal usage
		
		• Doors frequently held to long may be tuned too short due to traffic volume (one person may be holding doors for more people) or door open/close speed (motorized doors)
		
		   ○ Adjust the OnDelay to better reflect the typical time before doors close
		
		   ○ There may be other configuration values which set the "too long" period
		
		• Doors triggered very infrequently may indicate security risks
		
		   ○ Security teams should investigate abnormal triggers

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KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
• 633340307:MEAB-DR-01-110 (47)		
• 633340564:MEAB-EXP-DR-01-019 (47)		
• 633340350:MEAB-DR-01-300-C (44)		
• 633340117:BAST-DR-01-106 (43)		
• 633340334:MEAB-DR-01-225-B (42)		
• 633340120:BAST-DR-01-114 (41)		
• 633340468:TRST-DR-02-100-IN (39)		
• 633340346:MEAB-DR-01-238 (38)		
• 633340574:CMST-DR-02-102-C-IN (37)		
• 633340126:BAST-DR-02-100-A (36)		
• 633340397:RISU-DR-01-041-A (36)		
• 633340561:MEAB-EXP-DR-01-016 (36)		
• 633340275:LBST-DR-01-114 (35)		
• 633340351:MEAB-DR-01-305-B (35)		
• 633340143:BLST-DR-01-126 (34)		
• 633340283:LBST-DR-03-101-IN (33)		
• 633340338:MEAB-DR-01-231-A (33)		
• 633340193:DESU-DR-02-006-B (32)		
• 633340430:SLSU-DR-01-109 (32)		
• 633340566:MEAB-EXP-DR-M-001 (31)		
• 633340266:LBST-DR-01-103 (30)		
• 633340267:LBST-DR-01-104 (30)		
• 633340290:LEST-DR-01-113 (30)		

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
• 633340335:MEAB-DR-01-226 (27)		
• 633340210:DESU-DR-03-011-C-IN (26)		
• 633340366:CMST-DR-01-100-A-IN (25)		
• 633340170:DESU-DR-01-009-A (24)		
• 633340310:MEAB-DR-01-116 (24)		
• 633340337:MEAB-DR-01-229 (24)		
• 633340452:TP09-DR-01 (24)		
• 633340342:MEAB-DR-01-234-D (23)		
• 633340593:TP02-DR-01-BACK (23)		
• 633340299:MEAB-DR-01-014 (21)		
• 633340301:MEAB-DR-01-018 (21)		
• 633340305:MEAB-DR-01-108 (21)		
• 633340333:MEAB-DR-01-225-A (21)		
• 633340361:MEAB-DR-02-227 (21)		
• 633340548:LEST-DR-01-103-C-IN (21)		
• 633340196:DESU-DR-02-011-A (20)		
• 633340362:MEAB-DR-02-228 (19)		
• 633340550:MEAB-EXP-DR-01-001 (19)		
• 633340237:DWSU-DR-02-027-A (18)		
• 633340300:MEAB-DR-01-017 (18)		
• 633340316:MEAB-DR-01-124 (18)		
• 633340347:MEAB-DR-01-242-C (18)		
• 633340419:RISU-DR-04-004-A (18)		

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KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
• 633340481:TUST-DR-02-100-A-IN (18)		
• 633340356:MEAB-DR-01-316 (17)		
• 633340254:HUST-DR-01-101 (16)		
• 633340236:DWSU-DR-02-023-A (15)		
• 633340250:DWSU-DR-05-001-E-IN (15)		
• 633340259:HUST-DR-01-113 (15)		
• 633340261:HUST-DR-01-115 (15)		
• 633340298:MEAB-DR-01-012 (15)		
• 633340360:MEAB-DR-02-226 (15)		
• 633340371:CMST-DR-01-109 (15)		
• 633340385:RISU-DR-01-022-A (15)		
• 633340568:MEAB-EXP-DR-01-007 (15)		
• 633340129:BLST-DR-01-100 (14)		
• 633340285:LEST-DR-01-106 (13)		
• 633340465:TRST-DR-01-112 (13)		
• 633340551:MEAB-EXP-DR-01-002 (13)		
• 633340328:MEAB-DR-01-221-B (12)		
• 633340329:MEAB-DR-01-222-B (12)		
• 633340512:CYST-DR-01-103-IN (12)		
• 633340537:DWSU-DR-05-002-D-IN (12)		
• 633340185:DESU-DR-01-028-A (11)		
• 633340288:LEST-DR-01-111 (11)		
• 633340352:MEAB-DR-01-306-A (11)		

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
• 633340559:MEAB-EXP-DR-01-014 (11)		
• 633340127:BAST-DR-02-103-B-IN (10)		
• 633340144:BLST-DR-02-105 (10)		
• 633340263:HUST-DR-01-117 (10)		
• 633340075:RISU-DR-02-002-B (9)		
• 633340131:BLST-DR-01-104 (9)		
• 633340174:DESU-DR-01-015-A (9)		
• 633340198:DESU-DR-02-014-A (9)		
• 633340211:DESU-DR-04-001-C-IN (9)		
• 633340242:DWSU-DR-03-009-A (9)		
• 633340265:LBST-DR-01-100-A-IN (9)		
• 633340271:LBST-DR-01-110 (9)		
• 633340282:LBST-DR-03-100-IN (9)		
• 633340354:MEAB-DR-01-308-B (9)		
• 633340382:RISU-DR-01-013-A (9)		
• 633340359:MEAB-DR-02-016-A (8)		
• 633340560:MEAB-EXP-DR-01-015 (8)		
• 633340562:MEAB-EXP-DR-01-018 (8)		
• 633340567:MEAB-EXP-DR-01-006-B (8)		
• 633340569:MEAB-EXP-DR-01-008 (8)		
• 633340079:RISU-DR-02-023-B (7)		
• 633340175:DESU-DR-01-016-A (7)		
• 633340247:DWSU-DR-03-017-A (7)		

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
• 633340327:MEAB-DR-01-221-A (7)		
• 633340454:TP04-DR-01-MAIN (7)		
• 633340608:SLSU-DR-02-101-A-IN (7)		
• 633340194:DESU-DR-02-008-A (6)		
• 633340208:DESU-DR-03-004-A (6)		
• 633340220:DWSU-DR-02-001-A (6)		
• 633340228:DWSU-DR-02-011-A (6)		
• 633340280:LBST-DR-02-109 (6)		
• 633340375:CMST-DR-02-102-A-IN (6)		
• 633340384:RISU-DR-01-021-A (6)		
• 633340404:RISU-DR-02-006-A (6)		
• 633340457:TP06-DR-01-MAIN (6)		
• 633340597:TP05-DR-01-BACK (6)		
• 633340602:SLSU-DR-01-111-B-IN (6)		
• 633340369:CMST-DR-01-105 (5)		
• 633340601:TP08-DR-01-BACK (5)		
• 633340050:DESU-DR-03-011-A (4)		
• 633340151:CYST-DR-01-106 (4)		
• 633340264:HUST-DR-01-124-A-IN (4)		
• 633340491:DESU-DR-04-002-A (4)		
• 633340140:BLST-DR-01-119-A (3)		
• 633340146:BLST-DR-03-101-C-IN (3)		
• 633340148:BLST-DR-03-104 (3)		

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KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
• 633340172:DESU-DR-01-013-A (3)		
• 633340209:DESU-DR-03-007-A (3)		
• 633340243:DWSU-DR-03-010-A (3)		
• 633340245:DWSU-DR-03-011-A (3)		
• 633340253:DWSU-DR-05-005-A (3)		
• 633340255:HUST-DR-01-104 (3)		
• 633340268:LBST-DR-01-106-A (3)		
• 633340273:LBST-DR-01-112 (3)		
• 633340276:LBST-DR-01-115 (3)		
• 633340287:LEST-DR-01-108 (3)		
• 633340295:LEST-DR-02-101-A-IN (3)		
• 633340303:MEAB-DR-01-102 (3)		
• 633340343:MEAB-DR-01-235 (3)		
• 633340389:RISU-DR-01-030-B (3)		
• 633340390:RISU-DR-01-031-A (3)		
• 633340400:RISU-DR-02-001-A (3)		
• 633340407:RISU-DR-02-010-A (3)		
• 633340435:SLSU-DR-01-125 (3)		
• 633340451:TP05-DR-01-MAIN (3)		
• 633340455:TP02-DR-01-MAIN (3)		
• 633340469:TUST-DR-01-103 (3)		
• 633340472:TUST-DR-01-109 (3)		
• 633340473:TUST-DR-01-110 (3)		

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
• 633340474:TUST-DR-01-111 (3)		
• 633340475:TUST-DR-01-112 (3)		
• 633340476:TUST-DR-01-116 (3)		
• 633340477:TUST-DR-01-119 (3)		
• 633340478:TUST-DR-01-120 (3)		
• 633340479:TUST-DR-01-121 (3)		
• 633340535:DESU-DR-01-026-B (3)		
• 633340599:TP06-DR-01-BACK (3)		
• 633340600:TP07-DR-01-BACK (3)		
• 633340616:SLSU-DR-02-135-B (3)		
• 633340621:TP09-DR-04 (3)		
• 633339931:SLSU-DR-02-100-E (2)		
• 633339933:SLSU-DR-02-100-G (2)		
• 633339935:SLSU-DR-02-100-H (2)		
• 633340044:DESU-DR-03-001-B (2)		
• 633340047:DESU-DR-04-001-A (2)		
• 633340052:DWSU-DR-04-008-A (2)		
• 633340053:DWSU-DR-05-001-A (2)		
• 633340062:DWSU-DR-04-007-A (2)		
• 633340066:DWSU-DR-05-002-E (2)		
• 633340212:DESU-DR-04-003-C-IN (2)		
• 633339934:SLSU-DR-02-100-J (2)		
• 633339993:MEAB-DR-01-310-G (1)		

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
• 633340003:MEAB-DR-01-403 (1) • 633340004:MEAB-DR-00-001E (1) • 633340012:MEAB-DR-01-234-C (1) • 633340019:MEAB-DR-01-310-B (1) • 633340035:RISU-DR-05-006-A (1) • 633340036:RISU-DR-05-006-B (1) • 633340038:RISU-DR-06-005-A (1) • 633340042:DESU-DR-03-001-D (1) • 633340049:DESU-DR-04-003-A (1) • 633340054:DWSU-DR-05-001-B (1) • 633340055:DWSU-DR-05-001-C (1) • 633340057:DWSU-DR-05-002-F (1) • 633340302:MEAB-DR-01-101 (1) • 633340466:TRST-DR-01-113-A (1)		

Device Failure - Individual
 • 18350136:wg_video_driver (537)
 • 18350160:wg_ftp_transfer_application (33)
 • 18350139:wg_iac_client (21)
	• SCADACOM server processes trigger alarms when they fail
	     o Backup processes take over immediately
	     o The process restarts itself, usually within 10 seconds
		• Server process failures can indicate various issues with the process
		     o Contact Willowglen technical support for analysis
		     o If possible, save error logs when the issues occur, before they get overwritten
		 • Processes may also fail due to general issues with a server, VM, or network (memory shortage, disk shortage, network errors, third party service error)

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
		o IT should review device logs when the application logs don't indicate any issues o Third party system may need to check their logs for more details

Device Failure - Individual
 	
• 571477285:RISU-PA-RACK-NAC-2-FAULT (237)
 	
• 571477284:RISU-PA-RACK-NAC-1-FAULT (204)
 	
• 571476602:SLSU-PA-RACK-NAC-1-FAULT (172)
 	
• 571477286:RISU-PA-RACK-NAC-3-FAULT (156)
 	
• 571476603:SLSU-PA-RACK-NAC-2-FAULT (143)
 	
• 571477312:DESU-PA-RACK-NAC-2-FAULT (137)
 	
• 571477287:RISU-PA-RACK-NAC-4-FAULT (95)
	• Network Audio Controller device status
	
	   o SCADA monitors and controls each station's sub-systems
	
	   o Device failure results in loss of visibility and control of that sub-system at that location
	
	• This alarm only indicates the device is unavailable
	
	   o It is not meant to clarify why the device is unavailable
	
	   o Communication failures may also be interpreted as device failures
	
	• When a device fails, it may trigger alarms for all related data points
		• Sub-system devices may fail due to a variety of issues
		
		   o Check error logs on respective sub-system for more details
		
		   o Monitor performance directly on the sub-systems rather than through SCADA
		
		• Network conditions may temporarily disrupt connectivity
		
		   o Run network analysis tools to measure bandwidth usage, packet loss, error rates, etc.
		
		   o Add OnDelays to wait longer for temporary communication issues to clear before declaring the device unavailable

Emergency Telephone
 	
• 571476103:HUST-ETEL-10-OFF-HOOK (118)
 	
• 571477365:DWSU-ETEL-14-OFF-HOOK (20)
 	
• 571477273:RISU-ETEL-11-OFF-HOOK (10)
 	
• 571477268:RISU-ETEL-01-OFF-HOOK (9)
	• Each emergency telephone triggers when it is off hook or back in place
	
	• High frequency alarms occurred during 1 hour windows
	
	• Some days had multiple windows which could indicate repeat testing to confirm
		• Frequent or repeated occurrences are likely valid maintenance activity
		
		   o Operators can manually shelve the alarm during confirmed maintenance
		
		   o If maintenance typically lasts for a known period of time, a long

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions

• 571476096:HUST-ETEL-03-OFF-HOOK (8)
 	
• 571477313:DESU-ETEL-01-OFF-HOOK (6)
 	
• 571475942:CYST-ETEL-01-OFF-HOOK (5)
 	
• 571476099:HUST-ETEL-06-OFF-HOOK (5)
 	
• 571476617:SLSU-ETEL-10-OFF-HOOK (5)
 	
• 571477405:BAST-ETEL-06-OFF-HOOK (5)
 	
• 571477317:DESU-ETEL-10-OFF-HOOK (5)
 	
• 571477400:BAST-ETEL-01-OFF-HOOK (4)
 	
• 571475944:CYST-ETEL-ITEL-03-OFF-HOOK (4)
 	
• 571476255:LEST-ETEL-06-OFF-HOOK (3)
 	
• 571476321:CMST-ETEL-02-OFF-HOOK (3)
 	
• 571477290:RISU-ETEL-04-OFF-HOOK (3)
 	
• 571477295:RISU-ETEL-ITEL-02-OFF-HOOK (3)
 	
• 571477316:DESU-ETEL-08-OFF-HOOK (3)
 	
• 571477327:DESU-ETEL-09-OFF-HOOK (3)
 	
• 571477360:DWSU-ETEL-08-OFF-HOOK (3)
 	
• 571477403:BAST-ETEL-04-OFF-HOOK (3)
 	
• 571477432:TUST-ETEL-ITEL-03-OFF-HOOK (3)
 	
Call Button
 	
• 571475817:BLST-EMERGENCY-CALL-BUTTON-01-107-ALARM-TRIP (3)
 	
• 571475819:BLST-EMERGENCY-CALL-BUTTON-01-125-ALARM-TRIP (3)
 	
• 571476088:HUST-EMERGENCY-CALL-BUTTON-01-128-
	maintenance work done
	
	• Some only lasted for a few seconds
	
	• Some lasted several minutes
		OffDelay acts like auto-shelving
		
		  o Consult safety or security regulations before shelving or delaying
		
		• Brief occurrence should be forwarded to maintenance and/or security for follow-up
		
		  o Use CCTV and/or intercom to confirm situation
		
		  o They could be accidental toggles
		
		  o They could be intentional vandalism
		
		  o They could be related to maintenance issues
		
		• Short duration alarms were likely accidental or have sensors that are too sensitive
		
		  o OnDelays with at least 2-10 seconds may help
		
		  o Consult security teams for how long it is safe to wait before triggering the alarm
		
		• Longer and infrequent occurrences are likely valid calls

WILLOWGLEN SYSTEMS

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
ALARM-TRIP (3) • 571476289:CMST-EMERGENCY-CALL-BUTTON-01-107-ALARM-TRIP (3) • 571477339:DWSU-EMERGENCY-CALL-BUTTON-03-004-ALARM-TRIP (3) • 571477446:TUST-EMERGENCY-CALL-BUTTON-117-ALARM-TRIP (3)		

GIDS
 	
 • 628097026:BLST-GIDS-WEST (93)
 • 628097025:BLST-GIDS-EAST (36)
 • 628097029:SLSU-GIDS-EAST (30)
 • 628097046:DESU-GIDS-EAST (25)
 • 628097044:RISU-GIDS-EAST (19)
 • 628097048:DWSU-GIDS-PORTAL (15)
 • 628097055:TUST-GIDS-EAST (15)
 • 628097043:CMST-GIDS-WEST (13)
 • 628097047:DESU-GIDS-WEST (13)
 • 628097051:LBST-GIDS-EAST (12)
 • 628097049:DWSU-GIDS-EAST (11)
 • 628097050:DWSU-GIDS-WEST (9)
 • 628097045:RISU-GIDS-WEST (7)
 • 571475849:BLST-GIDS-ALARM-CABINET-TAMPER-ALARM-STATION-PAU-30 (6)
 • 628097033:TRST-GIDS-EAST (6)
	• Guideway intrusion alarms trip when lasers are obstructed
	    o Objects must be large enough (people, larger birds, large debris)
	    o Most alarms occur within 1 minute
	
	 • Alarms also trigger when cabinet tampering is detected, or bypasses are activated
	
	 • Alarms also trigger on health status changes
	    o Most of these alarms are fleeting or occur very briefly
	
	 • Some of the alarms trigger very closely together within a 1 hour window
		• Alarms that occur for brief periods may be due to large objects (birds, boxes/bags, debris) drifting in and out of trigger zones
		    o Use CCTV to confirm the situation
		    o Check if physical barriers to prevent obstructions are positioned correctly
		
		 • Alarms that occur during a longer window may be due to maintenance
		    o Alarms can be shelved during maintenance
		    o Shelving can be programmed to turn on automatically during a bypass
		
		 • Fleeting health status changes may indicate sensor failures or loose connections
		    o Repair/replace the sensors and connections
		    o OnDelays for 2-5 seconds may help

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
• 628097042:CMST-GIDS-EAST (4) • 628097031:SLSU-GIDS-PORTAL-EAST (3) • 628097052:LBST-GIDS-WEST (3) • 628097056:TUST-GIDS-WEST (3)		

Tunnel Ventilation (Fan On)
• 642777089:SVZ-4 (67)
• 642777088:TVZ-5 (66)
• 642777095:SVZ-3 (3)
• 642777096:TVZ-4 (3)
	• Tunnel ventilation equipment alarms on fan activation
	    o TVS alarms are more safety-critical
	• Changes are paired (ActiveModeType, ActiveModeState) and trigger a set of alarms
	• Some incidents occurred over a 3 hour window involving multiple devices in the same area
	• Some incidents occurred within 1 minute
		• Safety alarms require extra caution before making any changes
		• Longer periods involving multiple devices are likely serious incidents which require investigation from safety and operational teams
		• Longer periods may also indicate maintenance activities
		    o Shelving safety alarms is not recommended as forgetting to unshelve them in time can cause serious safety issues
		• Brief incidents could be due to temporary environmental issues (smokers, unexpected pollutants)
		    o Due to the safety-critical nature, OnDelays should be avoided as every second may count
		    o Use CCTV to confirm situation

Pedestrian Gates • 633340553:MEAB-GATE-P3 (58) • 633340555:MEAB-GATE-P5 (11) • 630194189:MEAB-GATE-V5 (10)	• Pedestrian gates trip on various security states • Most alarms were for being held too long • Most alarms occurred multiple times	• Doors frequently held to long may be tuned too short due to traffic volume (one person may be holding doors for more people) or door open/close speed (motorized doors) o Adjust the OnDelay to better

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
630194181:MEAB-GATE-P9 (9) 630194187:MEAB-GATE-V3 (2) 630194185:MEAB-GATE-V1 (1) 630194186:MEAB-GATE-V2 (1) 630194188:MEAB-GATE-V4 (1) 630194193:MEAB-GATE-V12 (1)	throughout the same day	reflect the typical time before doors close ○ There may be other configuration values which set the "too long" period • Doors triggered many times on a specific day could indicate unusual activity ○ Alarms can be shelved during known maintenance periods ○ Security teams should investigate abnormal usage • Isolated unauthorized entry alarms could indicate security issues
Escalators 585105427:RISU-ESC-12 (52) 585105428:RISU-ESC-13 (52) 585105436:DESU-ESC-08 (49) 585105443:DWSU-ESC-07 (49) 585105448:BAST-ESC-02 (49) 585105446:LBST-ESC-02 (46) 585105433:DESU-ESC-04 (45) 585105447:BAST-ESC-01 (44) 585105451:DESU-ESC-09 (44) 585105429:RISU-ESC-14 (43) 585105445:LBST-ESC-01 (43)	• Escalators trip on emergency stop button status changes • Most alarms occur within 1 minute • Most alarms occur around the same time of day every day	• Brief alarms could indicate sensor/trigger malfunctions or electro-mechanical flaws with the device ○ Repair or replace the sensor/trigger ○ This is unlikely given how the alarms are spread out across multiple devices at multiple stations ○ If it is an issue, it's a manufacturing level issue • Some times of day (such as rush hour, both ways) may result in higher levels of traffic ○ Dynamic alarms can temporarily lower the priority or shelve alarms during these periods as

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
585105441:DWSU-ESC-05 (42) 585105449:TUST-ESC-01 (41) 585105410:SLSU-ESC-01 (41) 585105437:DWSU-ESC-01 (41) 585105442:DWSU-ESC-06 (41) 585105444:DWSU-ESC-08 (41) 585105450:TUST-ESC-02 (41) 585105424:RISU-ESC-09 (39) 585105435:DESU-ESC-07 (39) 585105439:DWSU-ESC-03 (39) 585105426:RISU-ESC-11 (38) 585105409:BLST-ESC-01 (37) 585105418:RISU-ESC-03 (37) 585105420:RISU-ESC-05 (37) 585105414:HUST-ESC-01 (36) 585105415:HUST-ESC-02 (36) 585105430:DESU-ESC-01 (36) 585105440:DWSU-ESC-04 (36) 585105413:SLSU-ESC-04 (35) 585105416:RISU-ESC-01 (35) 585105417:RISU-ESC-02 (35) 585105421:RISU-ESC-06 (35) 585105422:RISU-ESC-07 (35)		configured - These could be regular safety checks to ensure the emergency protocols work - Records of these alarms are then useful as-is for positive confirmation - People may be accidentally hitting the buttons - Ensure protective measures (flip-guards) are in place and instructions are clear - Some people may be intentionally hitting the buttons (turn the escalator into fixed stairs, run down quickly, turn it back on) - Use CCTV or security to confirm the situation - Educate people about where the actual fixed stairs are so they don't disrupt motion for others - Vandalism may be involved - This is unlikely as the disruptions are so common and predictable - This could be possible for isolated scenarios with rapid toggles

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
• 585105425:RISU-ESC-10 (35) • 585105431:DESU-ESC-02 (35) • 585105432:DESU-ESC-03 (35) • 585105434:DESU-ESC-05 (35) • 585105438:DWSU-ESC-02 (35) • 585105411:SLSU-ESC-02 (33) • 585105412:SLSU-ESC-03 (26) • 585105419:RISU-ESC-04 (26) • 585105423:RISU-ESC-08 (26) • 585105453:RISU-ESC-16 (2)		

Communication Failure - Single
 	
 • 636485632:SymmetryController (35)
 	
 Intrusion Access Control
 	
 • 632291328:scadasrv1 IAC CommLine (15)
 	
 • 632291329:scadasrv2 IAC CommLine (6)
 	
 Door Controllers
 	
 • 634388523:MSF-DC-63 (14)
 	
 • 634388500:MSF-DC-05 (3)
 	
 RTU/PLC
 	
 • 571475640:Lyon RTU Communication Status (3)
 	
 • 571475684:TPSS-02 PLC Communication Status (3)
 	
 • 571475685:TPSS-02 PLC Communication Mode (3)
 	
 Building Automation System
	• Alarms trigger when communications are lost with sub-system devices/servers
	
	 • Some alarms are triggering as duplicates
	
	 • Most alarms occur within 10 seconds
	
	     o Connections are set to automatically reconnect
		• Duplicate alarms may be misconfigured
		
		     o Contact WSI to review and correct possible misconfiguration
		
		 • Network conditions may temporarily disrupt connectivity
		
		     o Run network analysis tools to measure bandwidth usage, packet loss, error rates, etc.
		
		     o Add OnDelays to wait longer for temporary communication issues to clear before declaring the connection failed
		
		 • Sub-system devices can cause comm failures and may fail due to a variety of issues
		
		     o Check error logs on respective

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
• 571480370:Rideau BAS Communication Status (3)		sub-system for more details o Monitor performance directly on the sub-systems rather than through SCADA

TPSS Feeder Breaker
 	
• 579862570:TP05-FB-3 (30)
• 579862579:TP07-FB-2 (29)
• 579862560:TP03-FB-1 (28)
• 579862561:TP03-FB-2 (28)
• 579862562:TP03-FB-3 (28)
• 579862563:TP03-FB-4 (28)
• 579862564:TP04-FB-1 (28)
• 579862565:TP04-FB-2 (28)
• 579862566:TP04-FB-3 (28)
• 579862567:TP04-FB-4 (28)
• 579862568:TP05-FB-1 (28)
• 579862569:TP05-FB-2 (28)
• 579862571:TP05-FB-4 (28)
• 579862572:TP06-FB-1 (28)
• 579862573:TP06-FB-2 (28)
• 579862574:TP06-FB-3 (28)
• 579862575:TP06-FB-4 (28)
• 579862578:TP07-FB-1 (28)
	• It is unclear whether this KPM triggers penalties
	
	• Breakers toggle between open (alarm, de-energized) and closed (normal, energized) states
	
	    o For a brief second, some breakers can be seen in travel states (switching between open/closed)
	
	• Most breakers trip around the same time of day almost every day
	
	• Most breakers trip at the same time as other breakers
	
	• Most breakers stay open for about 2 hours
	
	• Racking status alarms indicate whether the breakers are racked (Connected) or not racked (Not Connected)
		• Repeated periodic trips could be regular maintenance, bypass, downtime, or load balancing activities
		
		    o If these are expected events, the alarm records serve as positive confirmation and should not trigger any penalties
		
		    o If the time ranges are predictable, programmatic logic can be used to reduce severity to events during this time, or to update the text to indicate these are scheduled events
		
		• Unwanted repeated behaviour such as this could indicate major flaws with the power system with long outages
		
		• Isolated and unexpected incidents outside the scheduled time range could indicate actual maintenance and operational issues

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
• 579862580:TP07-FB-3 (28)		
• 579862581:TP07-FB-4 (28)		
• 579862582:TP08-FB-1 (28)		
• 579862583:TP08-FB-2 (28)		
• 579862555:TP01-FB-1 (27)		
• 579862556:TP01-FB-2 (27)		
• 579862559:TP02-FB-3 (24)		
• 579862593:TP02-FB-4 (24)		
• 579862557:TP02-FB-1 (23)		
• 579862558:TP02-FB-2 (23)		
• 579862540:TP09-FB-6 (9)		
Breaker Racking Status		
• 571474581:TP02-DC-FEEDER-BRK-3-NOT-IN-CONNECT (8)		
• 571475302:TP02-DC-FEEDER-BRK-4-NOT-IN-CONNECT (4)		
• 571474587:TP03-DC-FEEDER-BRK-1-NOT-IN-CONNECT (3)		
• 571474593:TP03-DC-FEEDER-BRK-2-NOT-IN-CONNECT (3)		

Fire Alarm Control Panel
• 571477296:DESU-FIRE-ALARM-CONTROL-PANEL-STATUS (28)
• 571476478:SLSU-FIRE-ALARM-CONTROL-PANEL-STATUS (17)
	• These alarms indicate the overall health and availability of the fire alarm control panel
	   o They do not indicate door open/closed alarms or fire
		• Brief alarms could indicate sensor failures or sensors that are too sensitive
		   o Repair, replace, or tune sensors
		   o OnDelays and OffDelays can help mute some sensor issues

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
• 571475956:TRST-FIRE-ALARM-CONTROL-PANEL-STATUS (9) • 571476267:CMST-FIRE-ALARM-CONTROL-PANEL-STATUS (9) • 571475796:BLST-FIRE-ALARM-CONTROL-PANEL-STATUS (8) • 571477256:MEAB-FIRE-ALARM-CONTROL-PANEL-STATUS (8) • 571475892:CYST-FIRE-ALARM-CONTROL-PANEL-STATUS (5) • 571476182:LEST-FIRE-ALARM-CONTROL-PANEL-STATUS (5) • 571475535:TP01-FIRE-ALARM-CONTROL-PANEL-STATUS (3) • 571475584:TP02-FIRE-ALARM-CONTROL-PANEL-STATUS (3) • 571475596:TP04-FIRE-ALARM-CONTROL-PANEL-STATUS (3) • 571475602:TP05-FIRE-ALARM-CONTROL-PANEL-STATUS (3) • 571475608:TP06-FIRE-ALARM-CONTROL-PANEL-STATUS (3) • 571475614:TP07-FIRE-ALARM-CONTROL-PANEL-STATUS (3) • 571476069:HUST-FIRE-ALARM-CONTROL-PANEL-STATUS (3)	alarms going off • Some alarms change state within 10 seconds • Some alarms occurred multiple times within 1 hour	o Consult safety regulations before adding delays • Repeated alarms during a single period could indicate maintenance activities, temporary environmental issues, or vandalism o Alarms can be shelved during maintenance windows if safety regulations allow o Security and operations should investigate unexpected events • The panel suppliers (Vanguard) should be notified about recurring issues so they can validate the devices are working correctly and wired correctly
End Gates	• These are the gates at the end of each platform to prevent the public from	• Since these do not appear to trigger "held too long" alarms, there is no need to adjust

WILLOWGLEN
SYSTEMS

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions

• 633340114:TUST-EG-01-101-C (17)
• 633340081:RISU-EG-01-030-A (11)
• 633340088:DESU-EG-01-012-B (8)
• 633340111:TUST-EG-01-100-B (8)
• 633340087:DESU-EG-01-011-B (7)
• 633339919:BLST-EG-02-100-C (6)
• 633340048:DESU-EG-01-011-A (6)
• 633340086:DESU-EG-01-012-A (5)
• 633340102:LBST-EG-02-100-A (4)
• 633339946:SLSU-EG-01-100-B (3)
• 633339956:TRST-EG-01-100-D (3)
• 633339957:TRST-EG-01-101-C (3)
• 633339958:TRST-EG-01-100-C (3)
• 633339959:TRST-EG-01-101-B (3)
• 633339962:HUST-EG-02-100-B (3)
• 633339963:HUST-EG-02-101-B (3)
• 633339964:HUST-EG-02-100-A (3)
• 633339965:HUST-EG-02-101-A (3)
• 633340095:DWSU-EG-02-009-A (3)
• 633340103:LBST-EG-02-100-B (3)
• 633340112:TUST-EG-01-100-C (3)
• 633340113:TUST-EG-01-101-B (3)
	walking off the edge of the platform
	
	    o The gates are normally locked and require a maintenance key to open
	
	    o The gates are considered part of IAC scope
	
	• Gates toggle between open (alarm) and closed (normal) states
	
	    o Open is considered the highest alarm condition (Priority 0)
	
	• Most gates are closed within 10 seconds
	
	• Some alarms occur multiple times within a few minutes
		OnDelays
		
		• Check if these events occurred during scheduled maintenance windows as it may be maintenance workers using the gates to access areas they need to work in

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions

Breakers: Station, Rectifier, Transformer, Cathode
 	
• 578814005:TP02-STATR-1 (15)
 	
• 578813998:TP10-ACRECT-1 (12)
 	
• 578813991:TP02-ACRECT-1 (10)
 	
• 571474874:TP02-AC-STATION-TRANS-BRK-1-PROTECT-RELAY-FAILURE-OR-COM-ALRM (3)
 	
• 571474875:TP02-AC-STATION-TRANS-BRK-1-NOT-IN-CONNECT (3)
 	
• 579862545:TP10-CATH-1 (6)
 	
• 579862548:TP02-CATH-1 (2)
	• Breakers alarm on states (open, closed) and modes (remote, local)
	
	• Some alarms occurred within 10 minute windows
		• Remote control typically indicates maintenance activities
		    o Alarms can be temporarily shelved during known maintenance
		• Unexpected remote control could indicate security issues at the field
		    o Security and maintenance should investigate

HVAC • 571475091:TP04-BUILDING-HVAC-POWER-LOSS (10) • 571475259:TP09-BUILDING-HVAC-POWER-LOSS (5) • 571475031:TP02-BUILDING-HVAC-POWER-LOSS (3) • 571475121:TP05-BUILDING-HVAC-POWER-LOSS (3) • 571475212:TP08-BUILDING-HVAC-POWER-LOSS (3)	• HVAC sub-system monitors power loss • Some alarms last for 1-10 seconds • Some alarms last for several minutes	• For electrical systems, even a brief power outage can indicate electrical issues o OnDelays should not be used if these systems are considered safety-critical • Outages can occur for various reasons at the field

UPS
 	
• 571476105:HUST-UNINTERRUPTIBLE-POWER-SUPPLY-COMMON-ALARM (9)
 	
• 571476107:HUST-UNINTERRUPTIBLE-POWER-SUPPLY-BACK-UPMODE (9)
 	
• 571477408:BAST-UNINTERRUPTIBLE-POWER-SUPPLY-COMMON-ALARM (7)
 	
• 571477410:BAST-UNINTERRUPTIBLE-POWER-SUPPLY-
	• UPS monitors activation of backup power units
	
	• "Common Alarm" and "Backup Mode" alarms are paired together; both will trigger at the same time
	
	• Most alarms last for 1-10 seconds
	
	• Some alarms last for 30+ minutes
		• UPS kicks in immediately due to loss of power, insufficient power, or badly formed power
		    o This can happen even for brief brownouts as well as longer blackouts
		    o Apply short (1-2 seconds) OnDelays if there is no need to be notified about quick brownouts

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
BACK-UPMODE (7) • 571475902:CYST-UNINTERRUPTIBLE-POWER-SUPPLY-COMMON-ALARM (3) • 571475904:CYST-UNINTERRUPTIBLE-POWER-SUPPLY-BACK-UPMODE (3) • 571476004:TRST-UNINTERRUPTIBLE-POWER-SUPPLY-COMMON-ALARM (3) • 571476006:TRST-UNINTERRUPTIBLE-POWER-SUPPLY-BACK-UPMODE (3) • 571477382:LBST-UNINTERRUPTIBLE-POWER-SUPPLY-COMMON-ALARM (3) • 571477384:LBST-UNINTERRUPTIBLE-POWER-SUPPLY-BACK-UPMODE (3)		o Maintenance should investigate longer blackouts

Tunnel Ventilation (Misc.)
 	
• 571478269:SL_TVS_CTS.A4_LOCAL_DO (4)
 	
• 571478271:SL_TVS_CTS.SLWF2_FAULT_DO (4)
 	
• 571478295:SL_TVS_CTS.SLWF2_ALARM_DO (4)
 	
• 571478301:SL_TVS_CTS.A1_LOCAL_DO (4)
 	
• 571478329:SL_TVS_CTS.A2_LOCAL_DO (4)
 	
• 571478418:SL_TVS_CTS.SLWF3_FAULT_DO (4)
 	
• 571478462:SL_TVS_CTS.SLWF3_ALARM_DO (4)
 	
• 571478467:SL_TVS_CTS.SLWF1_FAULT_DO (4)
 	
• 571478511:SL_TVS_CTS.A3_LOCAL_DO (4)
 	
• 571478585:SL_TVS_CTS.SLWF1_ALARM_DO (4)
 	
• 571479277:RI_TVS_CTS.A5.SW1_LOCAL_DO (4)
	• TVS devices monitor various modes (local, remote), conditions (fault, alarm), and security states (door open)
	
	• Some alarms appear to be paired and trigger at the same time
	
	• Local control typically lasts for about 2 hours
	
	• Most alarms occurred within a 2 hour period on the same day
	
	• Door open alarms last less than 10 minutes
		• Safety alarms require extra caution before making any changes
		
		• Alarms that occur while a device is in local mode typically indicates field maintenance activities
		
		   o For safety-critical devices, shelving is not recommended unless extra care is taken to ensure alarms are unshelved as soon as maintenance is complete
		
		   o The alarms as-is can serve as positive confirmation the system is working as expected end-to-end

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
571479349:RI_TVS_CTS.A5.SW2_LOCAL_DO (4) 571478466:SL_TVS_CTS.TICP6_DOOR_OPEN_DO (3) 571478492:SL_TVS_CTS.TICP7_DOOR_OPEN_DO (3) 571479244:RI_TVS_CTS.RIEF3.ALARM_DO (3) 571479298:RI_TVS_CTS.TICP4.DOOR_OPEN_DO (3) 571478967:DW_TVS_CTS.HHDR05_001D.OPENED_DO (1)		
Escalators 571477626:RISU-ESCALATOR-11-04-007-IN-SERVICE (2) 571477630:RISU-ESCALATOR-11-04-007-MAINTENANCE-OPERATION (2) 571476789:BLST-ESCALATOR-1-01-118-IN-SERVICE (1) 571476881:SLSU-ESCALATOR-2-01-110-UNIT-IN-SERVICE (1) 571477605:RISU-ESCALATOR-08-04-007-IN-SERVICE (1) 571477633:RISU-ESCALATOR-12-04-007-IN-SERVICE (1) 571477637:RISU-ESCALATOR-12-04-007-MAINTENANCE-OPERATION (1) 571477647:RISU-ESCALATOR-14-05-007-IN-SERVICE (1) 571477651:RISU-ESCALATOR-14-05-007-MAINTENANCE-OPERATION (1) 571477696:DESU-ESCALATOR-08-02-014-IN-SERVICE (1) 571477780:BAST-ESCALATOR-2-01-115-IN-SERVICE (1) 571480021:RISU-ESCALATOR-16-IN-SERVICE (1) 571480025:RISU-ESCALATOR-16-MAINTENANCE-	- Each escalator monitors operational states (in service, maintenance) - These were all ack records, which indicate the actual status changes likely occurred before the alarm period	Long duration (days) state changes typically indicate extended maintenance

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
OPERATION (1)		
Fire Control Panels - Underground Tunnels • 633339949:SLSU-TFCP-6 (3) • 633340026:TP03-TFCP-4 (3) • 633340490:SLSU-TFCP-7 (3)	• Underground tunnel fire control panels alarm when access doors are opened or closed • Most alarms occurred within 1 minute windows	• Check if these alarms occurred during scheduled maintenance windows
Coiling Grille • 629145609:TRST-CG-02-101 (4)	• These are really events (not alarms) tracking commands executed by operators • Batches of commands were acknowledged quickly together	• These alarms do not show up on the alarm displays 　　○ The alarms can be acked from the faceplate for the device
Maintenance of Way Gates • 633339911:BLST-SR-MOW-BL (36) • 633340034:TUST-SR-MOW-MT (31) • 633339968:LEST-SR-MOW-EL (21)	• These gates are used by maintenance vehicles to get on or off the tracks at some stations • Most alarms occurred during maintenance hours	• Check if these alarms occurred during scheduled maintenance windows
IOS (Interactive Operational State) • 654311427:IOS FTPConnection Retrieval (57) • 655360565:IOS056 (1) • 655360572:IOS063 (1) • 655360573:IOS064 (1) • 655360574:IOS065 (1) • 655362098:IOS059 (1) • 655362778:IOS059 (1)	• IOS alarms are train alarms from Alstom sent as a XML file via FTP to the ICS 　　○ Blank file = no alarms 　　○ ID number = ID of alarms • IOS alarms are currently treated as events (not alarms) • Alstom provided a spreadsheet which maps the IDs to the devices on the train	• Requirements from Alstom and the customer are required to convert these codes into meaningful alarms • FTP retrieval errors can indicate issues connecting to the FTP server or a lack of files on the server 　　○ Check with the IOS provider if files are missing 　　○ Files may also be missing when the trains are not running
APC (Advanced People Counting)	• APC alarms are sent as XML files via FTP to	• FTP retrieval errors can indicate issues connecting to the FTP server or a lack of files

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions

• 653262848:APC Transfer (74)
 	
• 654311424:APC FTPConnection Retrieval (12)
	the ICS
	
	• These alarms are important as they impact payments for Alstom
	    ○ The ICS does not process the file in any way
	    ○ The ICS simply forwards the file to ATIS
	
	• Inactive alarms indicate no files were found for several hours
	
	• All files since the last transfer are transferred
		on the server
		
		    ○ Check with the APC provider if files are missing
		
		    ○ Files can also be corrupted at the source, for example when a train exits the wireless range before finishing writing the files

Elevators • 571480347:BLST-ELEVATOR-3-03-106-ACT-HANDS-FREEIN-TERCOM (3) • 571477908:DESU-ELEVATOR-03-01-015-ACT-HANDS-FREEIN-TERCOM (2)	• Intercoms on elevators alarm when a person activates the intercom • Some alarms occurred within 1 minute • Some alarms were shelved	• Brief and shelved alarms could indicate maintenance activities
Elevators • 571477906:DESU-ELEVATOR-03-01-015-ACT-PASSENGER-ALARM (2)	• Pressing the alarm button on an elevator sends an alarm to the ICS • The alarms occurred around the same time as the intercom alarm • Some alarms were shelved	• Shelved alarms could indicate maintenance activities

Incident Control Panel
 	
• 633340027:TP03-ICP (8)
 	
• 633339967:LEST-ICP (6)
 	
• 633339950:TRST-ICP (3)
	• Alarms trigger when doors for the incident control panels are opened or closed
	
	• Most alarms occur within 1 minute
		• These doors are intended for use by authorized users
		
		    ○ Brief occurrences may indicate someone testing if their keys work
		
		    ○ Check if these occurred during

KPM, Alarms (Frequency)	Purpose and Clarifications	Potential Causes and Resolutions
• 633339961:HUST-ICP (3) • 633339975:CMST-ICP (3)		scheduled maintenance periods • Given these are located outside, strong winds pushing against the door might also trigger the sensors

6   Out of Scope Issues

The following items are out-of-scope per the RTM KPM spreadsheet. At RTM's request, we can analyze any or all of these issues.

- Switchgear per Device Failure - Group or Individual
    - 571475133:TP06-DC-SWITCH-GEAR-GROUND-64-1-RELAY-FAULT (1360)
    - 572524344:TP06-DC-SWITCHGEAR-RECTIFIER-ENCLOSURE-OVERVOLTAGE-DETECTED-HORN-STROBE-ALARM-COMMAND (1306)
- Train maintenance
    - 571477241:MEAB-TRAIN-WASH-OFF-ALARM (248)
    - 571477253:MEAB-TRAIN-SANDING-FAULT (44)
- Switch heaters
    - 584056859:MEAB-SM-01 (14)
    - 584056862:MEAB-SM-04 (14)
    - 584056866:MEAB-SM-08 (14)
    - 584056871:MEAB-SM-13 (14)
    - 584056865:MEAB-SM-07 (11)
    - 584056870:MEAB-SM-12 (10)
    - 584056860:MEAB-SM-02 (9)
    - 584056861:MEAB-SM-03 (9)
    - 584056863:MEAB-SM-05 (9)
    - 584056864:MEAB-SM-06 (9)

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- o 584056867:MEAB-SM-09 (9)

- o 584056869:MEAB-SM-11 (7)

- o 584056872:MEAB-SM-14 (7)

- o 584056873:MEAB-SM-15 (7)

- o 584056875:MEAB-SM-17 (7)

- o 584056880:MEAB-SM-22 (3)

- o 584056881:MEAB-SM-23 (3)

- o 584056883:MEAB-SM-25 (3)

- o 584056884:MEAB-SM-26 (3)

- o 584056882:MEAB-SM-24 (2)

- More switch heaters

- o 584056840:CMST-TSH-08 (13)

- o 584056850:SLSU-TSH-18 (11)

- o 584056843:TRST-TSH-11 (7)

- o 584056847:TRST-TSH-15 (7)

- o 584056858:BLST-TSH-26 (6)

- o 584056836:TUST-TSH-04 (4)

- o 584056835:TUST-TSH-03 (3)

- o 584056837:CMST-TSH-05 (3)

- o 584056838:CMST-TSH-06 (3)

- o 584056842:HUST-TSH-10 (3)

- o 584056845:TRST-TSH-13 (3)

- o 584056846:TRST-TSH-14 (3)

- o 584056851:SLSU-TSH-19 (3)

- o 584056853:SLSU-TSH-21 (3)

- o 584056856:BLST-TSH-24 (3)
  - o 584056857:BLST-TSH-25 (3)
- TPSS Substation
  - o 571475286:TP10-SUBSTATION-NOT-IN-REMOTE (8)
  - o 571475027:TP02-SUBSTATION-NOT-IN-REMOTE (4)
  - o 571475255:TP09-SUBSTATION-NOT-IN-REMOTE (3)
- TPSS Transfer Trip
  - o 571474989:TP01-TRANSFER-TRIP-FAILURE (3)
  - o 571475049:TP03-TRANSFER-TRIP-FAILURE (3)
- TPSS DC Line Disconnect
  - o 577765390:TP02-DCL-1 (2)
  - o 577765391:TP02-DCL-3 (2)
  - o 577765392:TP02-DCL-2 (2)
  - o 577765393:TP02-DCL-4 (2)
- TPSS Bypass Switch
  - o 577765394:TP02-BYP-WB (2)
  - o 577765395:TP02-BYP-EB (2)
- User logout
  - o 27262979:LAN 1 Session 1 (TSCC WkStn 1) (1)
  - o 27262980:LAN 1 Session 2 (TSCC WkStn 2) (1)
- Lighting
  - o 572523155:CYST-STATION-LIGHTING-LIGHTING-ON-COMMAND (1)