

Points Condition Monitoring

CHKPQ has developed a system that monitors the health of Pneumatic and Electric Points for railways. The system comprises hardware that monitors key mechanical and electrical metrics of Pneumatic and Electric Points, transmits data to a CHKPQ proprietary database and reporting tool called AsMoSys (Asset Monitoring System) that monitors operations, identifies maloperation and impending Point failures, and alerts railway network operators. Remedial actions can then be scheduled before a potentially catastrophic failure occurs. Refer to figure 1.

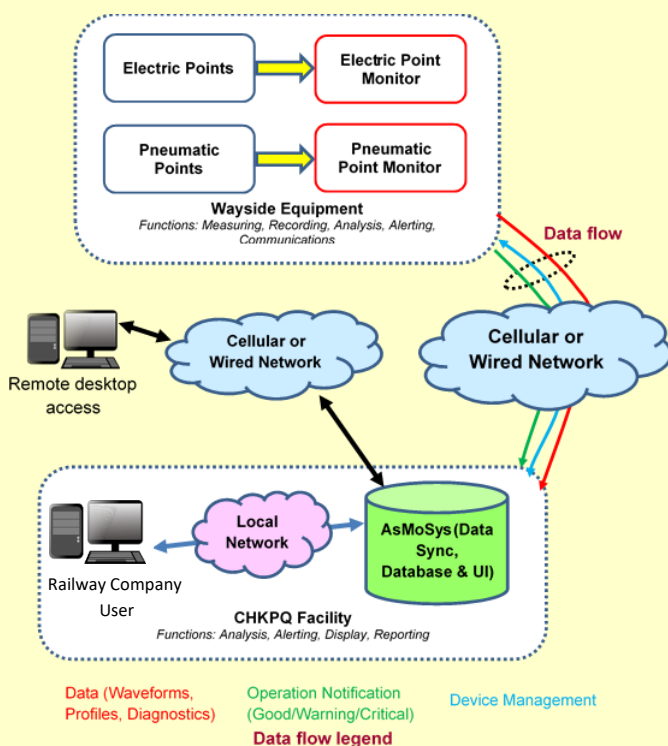


Figure 1: Points Condition monitoring system

AsMoSys

The AsMoSys solution serves to:

- Communicate with the Point Condition Monitor (PCM), and display the views and reports.
- Set up the PCM training, approval and putting the PCM into operation.
- View, acknowledge and resolve alarms and alerts.
- View PCM operation graphs and save them to a catalogue. Users can create reports by selecting measurements to be displayed, time period etc.

Citrus:

Citrus is the proprietary software that is used to communicate directly with the Miro PCM to download and view data, configure the PCMs, and upload firmware.

Benefits

The PCM allows railway operators to track point operation trends and optimise maintenance intervals. Trends include point operation duration, load current and flow rate changes between maintenance periods.

The benefits of PCMs and the data it provides include:

- Improved operational statistics, thereby optimising maintenance intervals (thereby minimising costs).
- Transition from periodic maintenance to a condition-based maintenance regime (thereby minimising costs).
- Reduced train delays (minimise or eliminate downtime and costs).
- Increased intangible benefits, e.g. customer goodwill.
- Enhanced key performance indicators, e.g. high train service availability.

Commissioning (training)

Once installed, every PCM is trained (monitors and characterises the normal operation of the Point). Once trained, the PCM then monitors every Point operation and determines if the operation is within allowable limits, i.e. 'normal'.

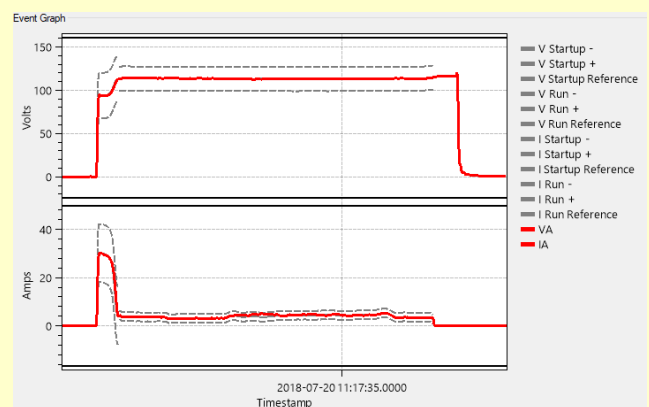


Figure 2: Typical Electric Point operation showing 'normal operation'

Figure 2 shows:

- limit envelopes (dashed lines) from the training data;
- voltage and current curves for each Points Operation.

Detection and classification of Points operation

Point operations are segmented into three phases:

- Start-up (green region);
- Transition (yellow region); and
- Run (blue region).

Key metrics are calculated including Start-up duration, Run-duration, and Peak-values. Two classifications of operations exist 'Critical' (defined by Run-duration) and 'Possible' (other) by testing metrics against limits.

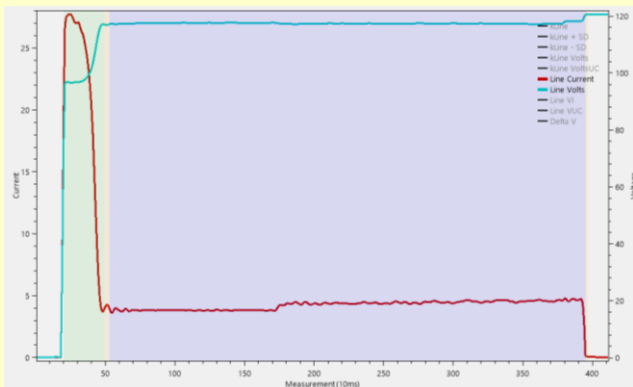


Figure 3: Point operation showing three characteristic regions

Alarms

If thresholds are exceeded, alarms are raised and notifications sent to relevant staff. Email notifications include a graphic representation of the operation and staff can quickly identify specific abnormalities, deploying field staff with necessary spares to quickly rectify the problem.

Hardware models

Two PCM models are currently available:

- **1ARL-Elect:** PCM for electrically driven Point machines. Inputs for this version include points operating voltages and currents.
- **1ARL-Pneu:** PCM for pneumatically driven point machines is shown in Figure 4. Inputs for this version include pressure and flow rates.

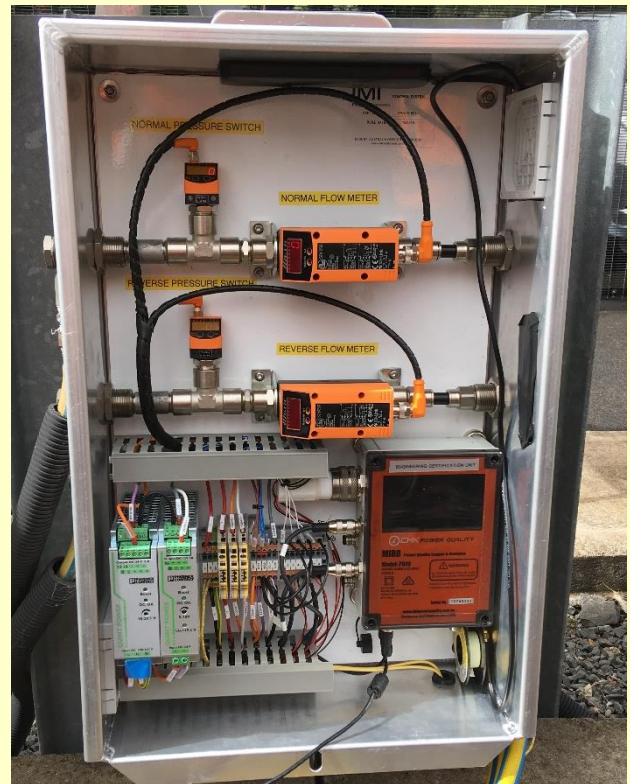


Figure 4: Shows 1ARL-Pneu in a Pneumatic control cabinet

The 1ARL-Elect is normally installed in a Rail Location Cabinet (LOC) and not necessarily located close to the Electric Point whilst the control cabinet containing the 1ARL-Pneu is installed on a metallic frame located close to the Pneumatic Point.

Key features of the Miro instrument

Electric

- Support for multiple point machine types/setups
 - Single ended machine.
 - Double-ended machine.
 - Two independent single machines ("dual single").
- Detection of non-operational failures
 - Voltage still present after end of operation.
 - Lack of operation despite presence of voltage.
 - Ends operating out of sync.
 - Multiple operations in the same direction.

Pneumatic

- Pressure and Flow measurements
 - 4-20mA inputs.
 - 20ms measurements for points operation detection and classification.

Get more Work from your Power

- 200ms measurements aggregated to 10-min (configurable) periodic logged min/avg/max for diagnostic purposes.
- Support for 'single machine' setup.
- Detection of non-operational failure
 - Multiple operations in the same direction.

Common features

- PCM training process
 - Sets 'normal' operation trace.
 - Provides suggested values for metric limits.
- Maintenance mode
 - Operations and non-operational failures are flagged as 'maintenance' and are excluded from trend data.
- LCD
 - Real time display of voltage/current or pressure/flow.
 - Displays graph of most recent operation.
 - User interface for initiating training and maintenance modes.
- Local communication by USB
 - Device configuration and firmware upgrade using Citrus software.
 - Live monitoring of captured events and other data.
 - On site data download in case of loss of remote communications.
- Remote communications
 - 3G/4G cellular option.
 - 10/100 Ethernet option.
 - Secure Socket Shell (SSH) for authenticated and encrypted communications.
 - Device configuration and firmware upgrade using Citrus.
 - 'Real time' data update.
 - Network Time Protocol (NTP) time synchronisation.

Key features of AsMoSys

General features

- Retrieval of data from Miro devices in real time.
- Storage of all data in the database.
- Associating of Miro devices with a hierarchy, e.g. 'Asset', 'Location', 'Region' etc.
- Alert/Alarm generation based on event data
 - Alert/Alarm listing, filtered according to network, location or individual asset.
 - Acknowledgement and actioning of alerts/alarms.
- Asset and Location alarms/alerts shown in order of most-severe to least severe Alert/Alarm status.
- Event listing for an Asset or Miro device
 - Event view based on Citrus software.
 - Filtering by event type.

- Pop-out graphs and tables for Points metrics.
- Exporting of graphs.
- Metric trends for points operations
 - Average flow/current.
 - Run duration.
- Different level User accounts
 - 'Engineer' level that can action alerts/alarms.
 - 'Analyst' level for viewing only.
 - Secure username/password login.

The AsMoSys dashboard

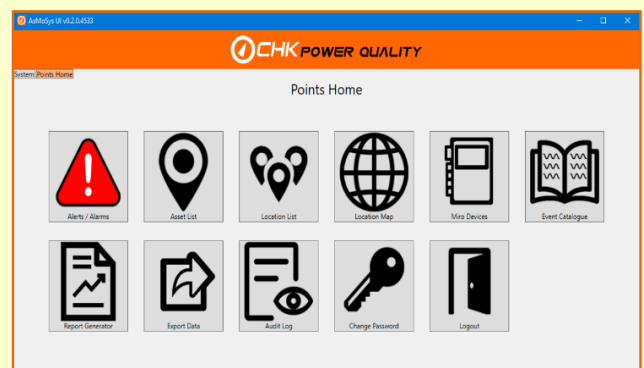


Figure 5: AsMoSys dashboard

The AsMoSys dashboard has multiple functions, including:

- Setting up and maintaining user logins and access levels.
- Setting up, training and commissioning new points.
- Viewing the overall railway network, point locations and state of the points (Normal, Alarm, Alert).
- Drilling down to individual points to see how a point is performing and view operation trends.
- Creating and maintaining event catalogues that users can refer to when trying to identify and understand point operation behaviour, faults and peculiarities.
- Creating multilevel reports (e.g. individual point, group of points or network wide), including operation trends and maintenance intervals.

The AsMoSys Point Status window

The AsMoSys Point Status window utilises the 'traffic light' system to show the status of each Point installed in the network:

- Red blinking dot - Unacknowledged alarm.
- Red dot - Acknowledged alarm.
- Yellow blinking dot - Unacknowledged alert.
- Yellow dot - Acknowledged alert.
- Green dot - Resolved Alert/Alarm.



Figure 6: AsMoSys Point Status window

The above system allows users to very quickly ascertain the status of the Points, e.g. are there any unresolved alarms and alerts.

Reports

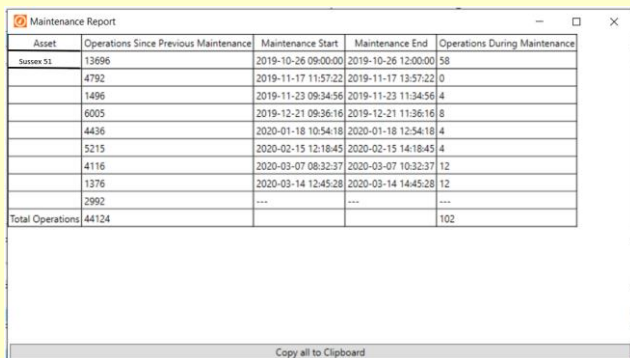


Figure 7: AsMoSys Maintenance report

Table in Figure 7 shows operations between Point maintenance and during point maintenance. This allows rail operators:

- to optimise maintenance programs by determining the number of operations that the point can undergo, before maintenance is required.
- determine the number of operations that was carried out during the maintenance period. These operations can be ignored when generating reports and therefore reflect accurate data.

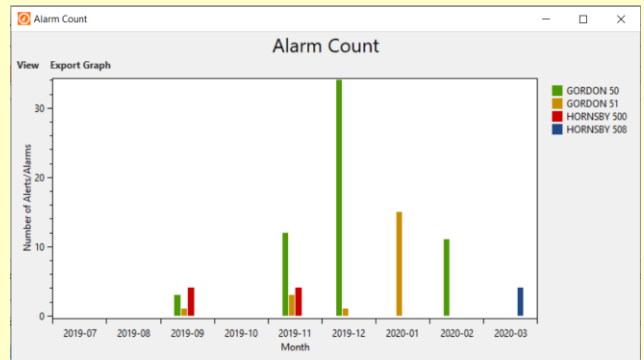


Figure 8: AsMoSys Alarm Count

Figure 8 shows the Alarm and Alert counts for various Point machines. This allows users to:

- quickly determine which Points are prone to failure, identify the causes and take remedial action.
- drill down to correlate alarms and alerts and identify failure trends e.g. insufficient lubrication during maintenance.

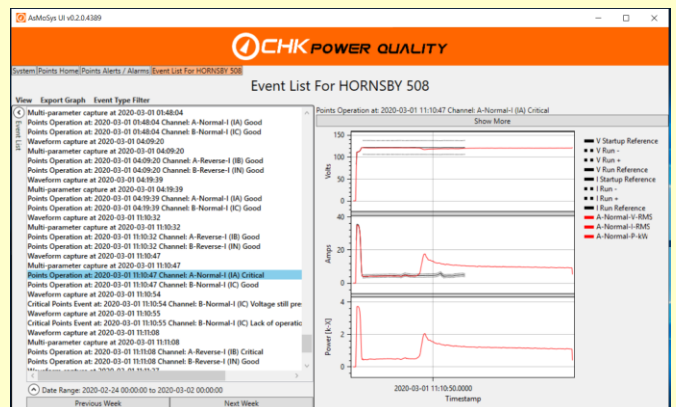


Figure 9: AsMoSys Event List

The Event List shows traces for a critical alarm. This allows users to:

- recognise and identify probable cause of failure and advise field staff and thereby minimise downtime.
- Use the traces as a learning tool where information can be added to the trace and saved to the event catalogue and made available to other users.