

Longwall Visual Analysis

Information Sheet



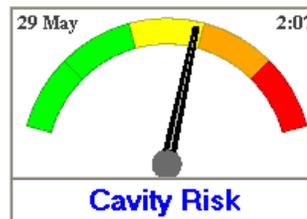
Using the Cavity Risk Index (CRI) and Weight Developing Index (WDI)

Revision 1, 21/6/2011

1. Introduction

A “Cavity Risk Index” (CRI) feature has been introduced into LVA. It is important to note that this is a prototype, and that further development may be needed to fine-tune the algorithms. The CRI is based on specific patterns of roof shields that have relatively high loading rates combined with significant yielding. A high CRI indicates that the risk of a roof cavity forming within the next few hours is higher than normal, and that it is worth considering taking extra steps to maintain roof integrity.

Associated with the CRI is a “Weight Developing Index” (WDI), for which a high value indicates that a weighting event is in progress on the face. The indexes are based on visual gauges that look like this..



2. How the CRI and WDI are calculated

Every few minutes each roof shield is analysed to see whether it had

- a high loading rate when last set to the roof, and
- significant yielding during the previous set-to-roof cycle.

Roof shields with both high loading and yielding are said to be in a “trigger” state for the purposes of CRI and WDI calculations. The user can configure the loading rate and yield values that would activate this trigger state.

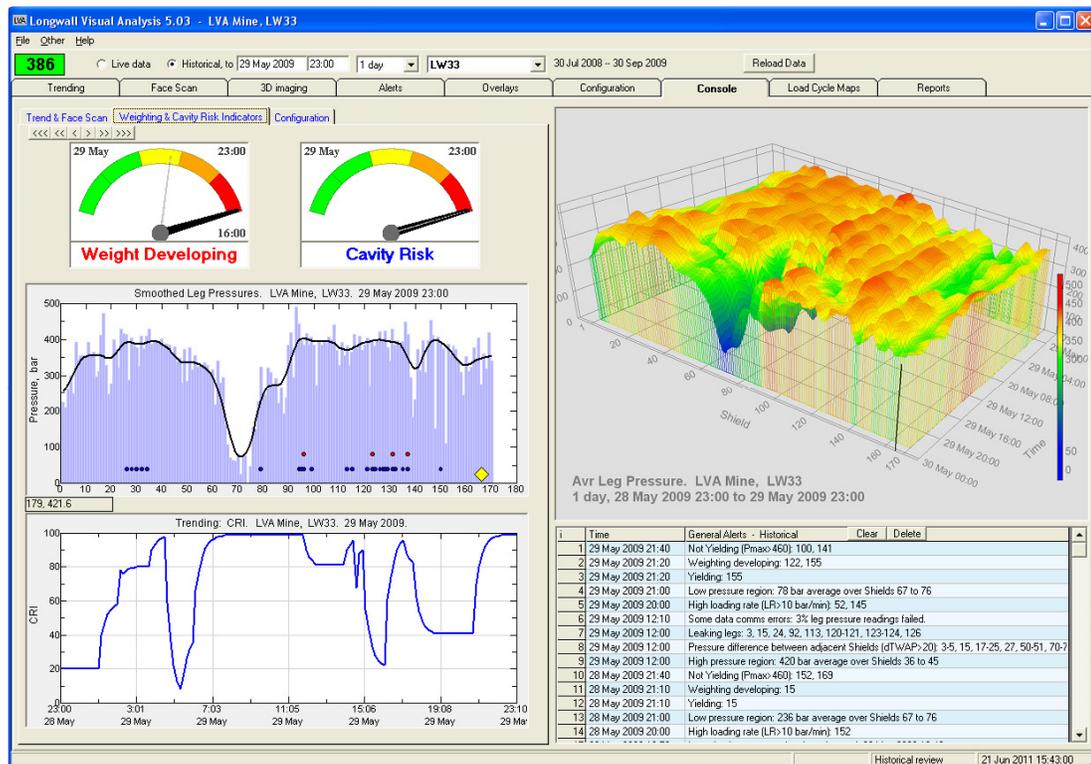
The WDI is calculated from the proportion of adjacent shields that are in a trigger state. For example WDI may be set to display 80% (start of red zone) when there is an area somewhere across the longwall where at least 10 out of 20 adjacent shields are in a trigger state. In this case, if there had been a maximum of only 5 shields in a trigger state out of any 20 adjacent shields then the WDI would be 40%.

The CRI calculations also use shields in a “trigger” state, but the pattern of triggered shields now needs to look like two separate areas straddling a trough of non-triggered shields. In other words we are looking for two separated areas of high loading and yielding on the face, bridging across an area of low loading.

The various configuration values can be tuned for specific longwall sites. The default values used and shown in this info sheet have been found to be quite good starting values across multiple sites and cavity events.

3. Viewing CRI and WDI in LVA

Access the CRI and WDI gauge displays from the Console | Weighting & Cavity Risk Indicators tabs. Depending on how it is configured, the display may look like this:

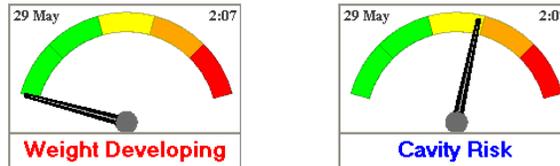


Note that in earlier versions of LVA the left half showed trending for one selected shield, and a face scan view. These are still available by clicking the “Trend and Face Scan” tab.

The left half of the screen shows up to three sections (top, middle, bottom)..

a. Top – the CRI and WDI gauges

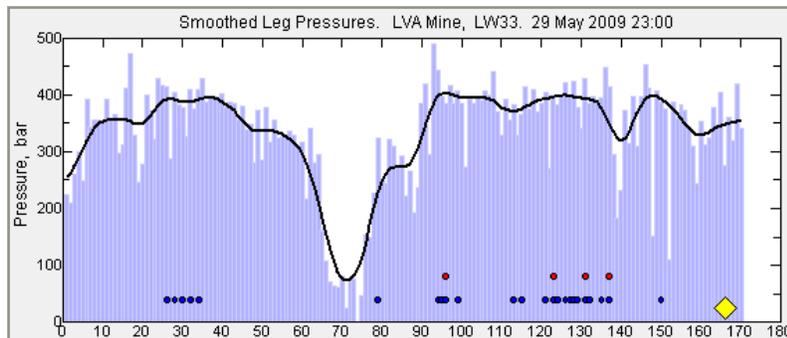
Each gauge shows a thick black line and thin light grey line. The grey line is the current value. The black line is the peak value over the previous several hours as set in the configuration (see below). The reason is that the instantaneous CRI and WDI values may swing up and down, but the operator needs to be aware that the value may have been high recently to indicate an on-going risk situation.



b. Middle – smoothed profile of the longwall leg pressures

The longwall profile graph shows the current face profile with a thick black line representing the smoothed profile. Depending on the Configuration settings, it may also show the following:

- i. Blue dots – show each shield that is in a CRI trigger state
- ii. Red dots – show each shield that is in a WDI trigger state
- iii. Green dots – yield count (*10) for each shield
- iv. Yellow dots – Loading rate, bar/min *10 for each shield
- v. Yellow diamond or triangle – shearer position

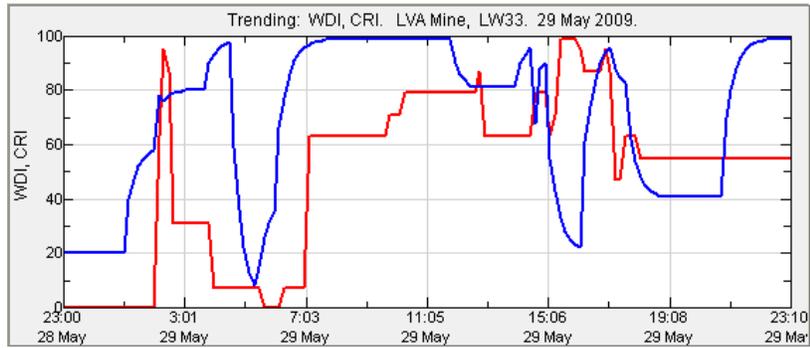


This graph may not be visible if all relevant options are switched off in Configuration.

c. Bottom – Trend of the WDI and/or CRI

The Trending graph shows the values of CRI and WDI over the previous time period as selected at the top of the LVA screen. Depending on the Configuration settings, it may show the following:

- i. Thick blue line – WDI
- ii. Thick red line – CRI
- iii. Thin blue line – represents the apparent size of any cavity across the face
- iv. Thin red line – represents the highest apparent local weighting on the face



4. Configuring parameters for WDI and CR

The Console | Configuration tab shows the configuration details. This is where you can change the parameters used to calculate CRI and WDI, and also adjust what values are displayed in the graphs. The default values are shown in the screenshot below; these have worked for many situations checked by LVA during the development of the CRI and WDI.

WDI & CRI Configuration

Indicator Gauges... Major line shows peak value during past 8 hours (max)
(minor line shows latest value)

Weighting..... Red zone starts at 10 triggers out of 20 shields
Triggers: at least 3 yields, loading rate > 4 bar/min

Cavity Risk... Yielding bridge 10 to 50 shields wide, 1 max triggers on bridge
Red zone starts at 4 triggers out of 12 each side of bridge
Triggers: at least 2 yields, loading rate > 3 bar/min

Weighting..... Peak of smoothed face weights, % of Yield P

Cavity Depth..... Trough (max-min) on smoothed face weights, % of Yield P

Face scan (smoothed profile).....
 WDI trigger (red) Yields (*10, green)
 CRI trigger (blue) Loading rate (*10, yellow)
 Shearer

Trending graph.....
 WDI (red, thick) Weight on face (red, thin)
 CRI (blue, thick) Cavity (blue, thin)

i	Time	General Alerts - Histo
1	29 May 2009 21:40	Not Yielding (Pmax>4E
2	29 May 2009 21:20	Weighting developing
3	29 May 2009 21:20	Yielding: 155
4	29 May 2009 21:00	Low pressure region: 7
5	29 May 2009 20:00	High loading rate (R

5. Alerts based on WDI and CR

Two additional Alert rules have been added to LVA, as shown in the screenshot below.

The screenshot displays the 'Alerts' configuration window in the Longwall Visual Analysis 5.03 software. The window title is 'LVA Longwall Visual Analysis 5.03 - LVA Mine, LW33'. The interface includes a menu bar (File, Other, Help), a status bar (386), and a toolbar with buttons for Trending, Face Scan, 3D imaging, Alerts, Overlays, Configuration, and Console. The 'Alerts' button is highlighted with a red box. Below the toolbar, the 'Alert Rules - General' tab is selected and highlighted with a red box. The main area shows the 'Configuration of General Alerts' with two sections: 'Latest readings..' and 'Most recent roof setting cycle..'. The 'Latest readings..' section includes rules for data communication errors, no change in incoming data, high/low pressure on individual legs, and high/low pressure regions. The 'Most recent roof setting cycle..' section includes rules for cycle duration, loading rate, TWAP difference, yielding, and pressure-related conditions. At the bottom of the list, two rules are highlighted with red boxes: 'WDI (Weight Developing Index)..... exceeds 80 %' and 'CRI (Cavity Risk Index)..... exceeds 80 %'. Both rules have their checkboxes checked.

Section	Rule	Value	Unit
Latest readings..	<input checked="" type="checkbox"/> Longwall data communication errors have occurred		
	<input checked="" type="checkbox"/> No change in incoming data for	60	minutes
	<input type="checkbox"/> High Pressure on individual legs	450	bar
	<input type="checkbox"/> Low Pressure on individual legs	250	bar
	<input checked="" type="checkbox"/> High Pressure Region	400	bar across 10 supports
	<input checked="" type="checkbox"/> Low Pressure Region	250	bar across " "
Most recent roof setting cycle..	<input checked="" type="checkbox"/> Ignore cycles shorter than 5 minutes or longer than 120 minutes	5	minutes
	<input checked="" type="checkbox"/> High loading rate	10	bar/min
	<input checked="" type="checkbox"/> TWAP difference between adjacent Supports	20	bar
	<input checked="" type="checkbox"/> Yielding	2	cycles with apparent YP > 380 bar
	<input checked="" type="checkbox"/> Not Yielding	460	bar
	<input type="checkbox"/> Set Pressure too High	400	bar, stabilising below 350 bar
	<input type="checkbox"/> Set Pressure too Low	1	bar/min, cycle longer than 5 min, pressure < 400
	<input type="checkbox"/> Low pressure within a cycle	300	bar
	<input type="checkbox"/> Pressure difference between Legs	20	bar
	<input checked="" type="checkbox"/> Diverging pressures (possible leaking legs)..	0.5	bar/min
	<input checked="" type="checkbox"/> Weighting development	1	shields, Loading rate > 1 bar/min, TWAP > 380
	<input checked="" type="checkbox"/> WDI (Weight Developing Index).....	80	%
	<input checked="" type="checkbox"/> CRI (Cavity Risk Index).....	80	%