Managing Reliability Across the Corporation

by

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Prior to implementing a standardized infrared thermography management program at twelve beverage plants in 2006, one of the corporate reliability champion says that they were spending several hundred thousand $$ annually with eleven different IR contractors, yet corporate managers were still not certain that critical electrical equipment was being monitored according to well defined corporate guidelines. For example, the guidelines called for every critical MCC to be scanned under load at least annually, but the reliability champion says "we just didn't know for sure" if this was being accomplished.

For more than 5 years a major food producer has used a single contractor to provide condition monitoring services with several technologies at more than 100 of its plant sites. A corporate reliability leader says in the early days of this effort he had plenty of condition monitoring data but not a good view of equipment health across his division. With the large quantity of reports coming from several technologies, each with non standard fault and severity descriptions, he says the information was most often used "to help plants do post-mortems after their train wrecks" instead of to driving pro-active maintenance work.

Over the last decade equipment reliability has become an important component in the competitive strategy of many industrial corporations. Condition monitoring is a cornerstone of that strategy, using technologies such as vibration analysis, infrared thermography, and oil analysis. Unfortunately, even when corporate standards for defining critical equipment, selecting appropriate monitoring technologies, and reporting metrics are well defined at the corporate level and communicated to plants, many independent choices remain. When independent databases are set up for different monitoring technologies, employees or service companies often make changes in equipment definitions, monitoring schedules, and fault descriptions. Reports come in diverse formats and at different times from various technology groups. At the corporate level, such a confusing flow of information makes it difficult to know the status and value of reliability at individual plants.

This paper discusses how two major food and beverage corporations now use internet-based communications to manage condition monitoring activities and results across many plant sites, even when outside contractors are providing monitoring services. Topics will include:

- Enforcing use of corporate procedures in condition monitoring
- Managing frequency & completion of monitoring tasks
- Standardizing metrics & reporting of reliability progress from many plant sites across the corporation
- Role of internet-based communications in creating consistent corporate accountability for reliability improvement

By 2005, the beverage corporation had developed a corporate expectation that "equipment reliability will be optimized" at each of its twelve plants across the USA. Work had been done to define and rank standard operating procedures for condition monitoring, including items such as:

- Critical equipment definition & identification
- Technology selections for critical equipment
- Standard fault & severity definitions

One of the most important concerns was coverage of electrical systems, due to the high historical cost of electrical outage. IR Thermography was the primary condition monitoring technology selected for this area and eleven different service contractors had been selected to monitor the different plants based on geographic locations. The corporate guideline was that each MCC cabinet would be scanned at least annually while under load. This did not seem to be a particularly difficult procedure to comply with, and corporate managers were initially confident that their people were 'doing the right things' to assure electrical reliability. However, during one plant visit the corporate reliability champion found that only 60% of the plant's panels were sufficiently loaded while the service contractor conducted his scans. That created significant concern about consistent compliance with the electrical monitoring SOP at each plant. Corporate managers decided they needed to do something more "to be sure that reliability work is being done consistently and on time per the SOP's".

They looked at their existing EAM system first to see if it could provide a solution for improving visibility of reliability activity & status, but decided that customizing their implementation for reliability information would be expensive and impractical. The corporate reliability champion described it as 'not very visual, more of a spreadsheet look with numbers & boxes, typically what you expect from accounting software.' It also wasn't able to manage documents such as the IR images very well, and there would also be the issue of allowing outside contractors direct access to the system for entering their information. They decided an internet-based communication system designed specifically to handle equipment life-cycle and reliability information would be a better fit for these needs.

In this system each plant has a web-hosted database on a secure internet server that is outside the corporate IT system. This allows corporate, plant, and contractor personnel to access the database without having to contend with corporate firewalls. The corporate champion supervised the set-up of the equipment location hierarchy, monitoring tasks, fault descriptions, and severity levels in each plant's database to ensure that the corporate standards were followed (fig 1).

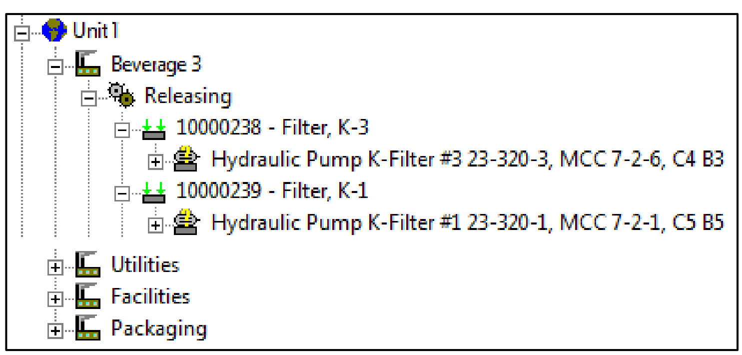

Fig 1: Web-hosted database enforces use of corporate standards for defining MCC locations

For the IR thermography work, each contractor uses their desired brand of camera and software, but the scheduling of surveys and reporting of results is done in the internet-based system. Condition assessment tasks are set up to define what locations are to be scanned, when the scans are due, and who is assigned to do the work (fig 2). Authorized users at both the corporate level and at each plant can see the status of pending and completed thermography tasks through their web-browser.

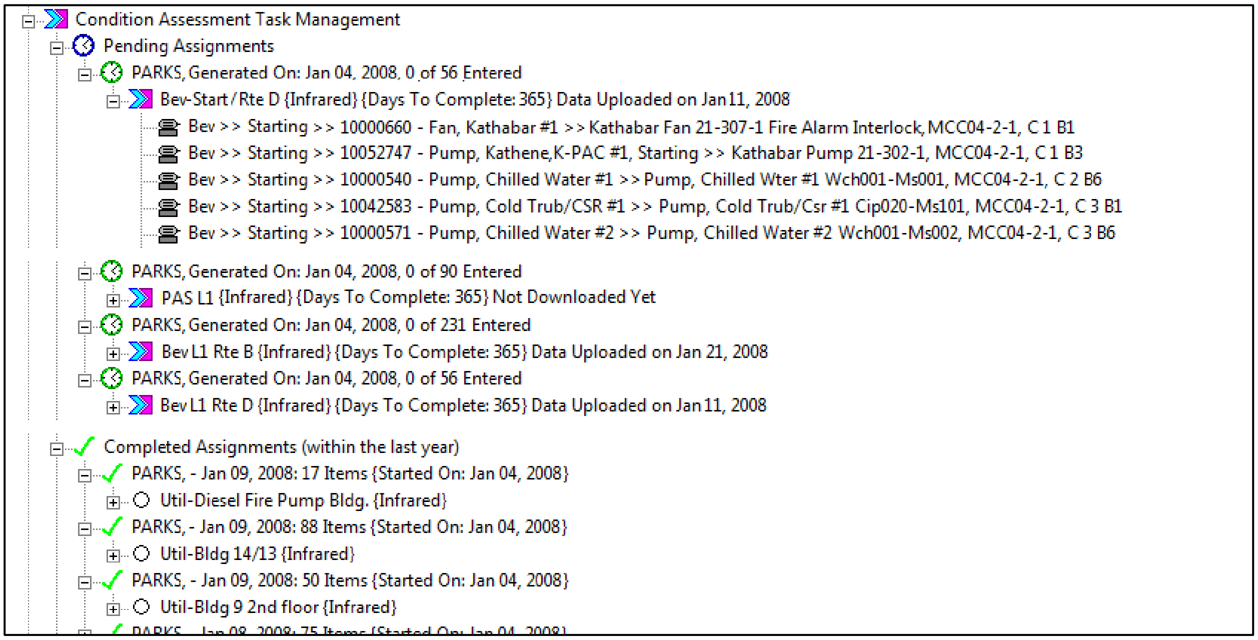

Fig 2: Condition monitoring tasks are defined, scheduled, and assigned through the internet-based system, allowing authorized corporate and plant users know the status of monitoring work

Contractors load a handheld PDA with the task details from the web-hosted database, and the IR contractor follows the list of MCC and bucket locations to be scanned. First he scans a bar code inside the panel door with the PDA; the PDA displays the location for confirmation and the contractor sees then documents the situation – no problems are detected, problems exist (fig 3), or the component can't be scanned at this time (fig 4). When a problem is found, the contractor initiates a 'condition entry' and references the infrared and visible image files along with comments about the problem (fig 5).

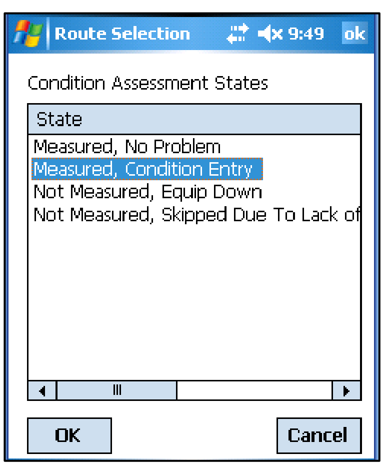

Fig 3: Selection list for noting status of the scan

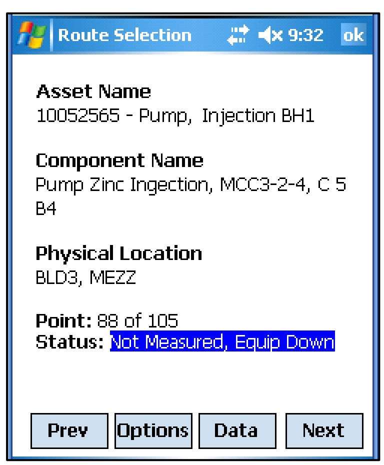

Fig 4: Entry for a component that is cold due to no load

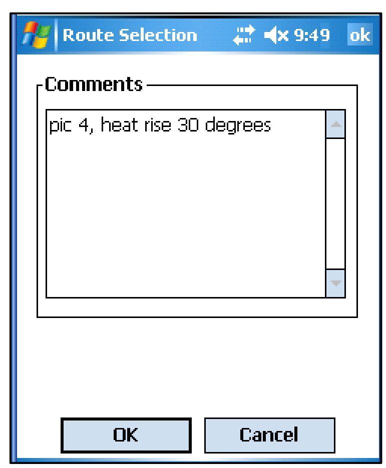

Fig 5: Documenting images and notes about a problem

Once the survey task has been completed, the contractor transfers information from the PDA to the web-hosted database and the component locations that were not measured or did not have any problems are automatically updated. A list is also produced showing the locations with problems, and the thermographer completes the condition entry with the information from his analysis software and the PDA. Descriptions for faults and severity are picked from pull down lists that comply with the corporate SOP, and the infrared and visible image files are linked to the condition entry.

The contractor does not assemble a report manually. An e-mail about high severity problems on critical components is sent to specified contacts. They can then log into the database with their web-browser, and the web-based system dynamically assembles a report that includes the most current condition status information for the user's area of interest (fig 6). This integrated condition status report includes:

- Overview of how many components are currently reported with problems at various levels of severity
- Detail section with high severity level problems at the top of the list
- A list of work orders related to the condition problem report
- Information about how long the condition entry has been open, or if work orders have been completed to resolve the problem.

Integrated Condition Status Report

User: TF7. Date: 01/20/2008. Time: 13:40:53

Color	Level	Entries	Description
	Red	14 {31%}	Emergency - Requires Immediate Reaction
	Magenta	28 {62%}	Alarm - Reaction Level
	Yellow	2 {4%}	Alert - Begin Investigation
	Grey	1 {2%}	Non Pdm Issue

Open Condition Entries

	Severity	Asset	Component	Technologies	Days Awaiting TECO	Work Order Status	Work Order Numbers	Case Closure
	Red	10018367 - Compressor	CP30PS1 I PBL30-3 Bucket C1 B1	Infrared	11	2 of 3	• 57107271 • 57113332	Close Entry
	Red	10000846 - Compressor, 70# CO2 #2	Bucket MCC09-9-2-1 C5 B3	Infrared	12	2 of 3	• 57115846 • 48109835-CO2	Close Entry
	Red	10000712 - Pump, Evap Condens Water #1	Bucket MCC09-2-10 C2 B3	Infrared	TECOed	1 of 1	• 57115847	Close Entry
	Red	10000714 - Pump, Evap Condens Water #2	Bucket MCC09-2-12 C3 B2	Infrared	TECOed	1 of 1	• 57115848	Close Entry
	Red	10001046 - Pump, Condens Water Supply PSM	Bucket MCC 14-1-1 C1 B3	Infrared	11	1 of 1	• 57115849	Close Entry
	Red	10042003 - HVAC, Building 13	Bucket MCC13-1-2 C5 B4	Infrared	12	1 of 1	• 57115850	Close Entry
	Red	10000880 - L6 Full Case Delivery Conveyor D-2	EEP61E-1	Infrared	11	2 of 3	• 57113117 • 57109694	Close Entry
	Red	10000882 - EEP62E1 , EEP62E2 Empty Can System	EEP62E1 , EEP62E2, MCC PP-PSCL62PS-2/3	Infrared	11	1 of 2	• 57113331	Close Entry
	Magenta	10042008 - Fire Alarms, Building 13	Bucket MCC13-1-2 C4 B5	Infrared	12	3 of 3	• 57115853 • Investigating Scope	Close Entry
	Magenta	10001304 - L61 Depalletizer Empty Can	CP61 W1	Infrared	11	2 of 3	• 57113116 • 57109695	Close Entry

Fig 6: Condition status report available via web-browser

Users can drill into any item on the report to see the thermographer's name, date of the scan, fault description, recommendations, and in-depth comments (fig 7). A detailed report can be opened to show the associated linked images, and for easy printing.

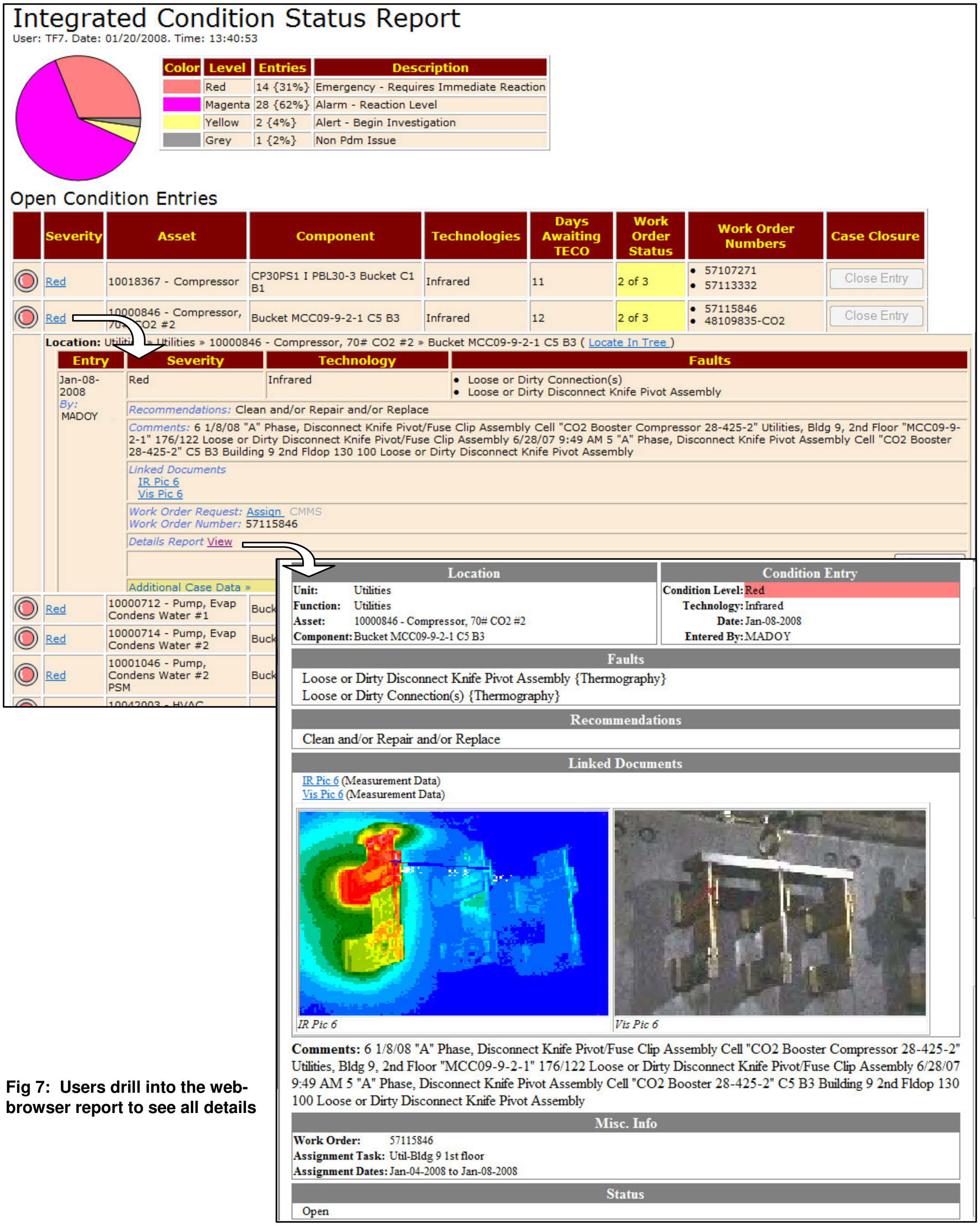

Fig 7: Users drill into the web-browser report to see all details

Following the pilot implementation in 2007, the corporate reliability champion says that the web-based system 'makes it easy to see the status of condition monitoring activities & results'. Personnel can now see the status of scheduled IR surveys at their plant, and use the details about reported problems to drive maintenance planning. Corporate managers can use their web-browser to spot check the status of scheduled IR tasks and the quality of the problem reporting at any of their plants.

That did create a 'big brother is watching' attitude at some of the plants and contractors during the pilot program. That issue faded once those people realized that web-browser reports could also improve communications between IR contractors and plant maintenance about the current status of electrical problems, without additional work by the contractors.

More importantly for the corporate reliability champion managers, they now have a practical means for checking compliance with electrical monitoring SOP's and to know the reliability status of electrical equipment at the plants. 2008 will be the first year that each plant manager's goals include a requirement that all MCC's have been monitored under load at least once annually to ensure reliable operation, in compliance with the corporate SOP (Fig 8).

Task Items Not Measured in Date Range

Date From	Jan-01-2007
Date To	Dec-31-2007

Entire Plant Percentage of Points Assessed in Time Period: 81.15%
Selected Filter Percentage of Points Assessed in Time Period: 98.91%
Filtered by Unit: Plant 1 Packaging

Items Not Assessed					
Unit	**Function**	**Asset**	**Component**	**Date Last Measured**	**State When Last Assessed**
Packaging	Line 2	148715 - Conveyor, Full Case	P20D1A	Never Measured	Never Measured
Packaging	Line 3	118408 - Multipacker	Enclosure B, Partition Nozzle Drive	Never Measured	Never Measured
Packaging	Line 3	118411 - Hot Glue Multipacker	CPBL0MP Glue Unit PBL30-3 C1 B2	Never Measured	Never Measured
Packaging	Line 3	150518 - RAJ AML	Aenc1, AML	Never Measured	Never Measured
Packaging	Line 3	150518 - RAJ AML	BL30-1 Bucket C1-B6	Never Measured	Never Measured

Fig 8: Annual report auditing electrical locations that have not been monitored with IR thermography as required by the corporate SOP

Now the plant managers are as interested as the corporate managers in using web-browser reports so they will "know that what they think is being done, really is being done". In fact, the corporate reliability champion says oil analysis is already scheduled to be their next condition monitoring activity using handheld PDAs and internet-based communications - "to make sure they know" the plants are complying with the corporate SOP for sample collection, and to increase the use of integrated condition results in maintenance planning.

At the food producer's plants, Allied Reliability is the reliability service contractor who shared the corporate reliability leader's desire to use condition monitoring information more proactively. Over the last five years the food producer and Allied Reliability have worked together to evolve their process, from using condition information to manage a 'run to failure' maintenance strategy to now achieving 'early detection AND elimination of defects'. (Details about their process for cataloging critical equipment, selecting appropriate monitoring technologies, and creating standards for execution can be found in the March 2007 Uptime Magazine article 'Nourishing Reliability Through Healthy Assets).

In 2003 Allied adapted an internet-based communication service for delivering reliability results by developing several customized reports to support the reliability management capabilities they needed. Allied's analysts enter information about scheduled monitoring activities and results for all technologies into a single web-hosted database for each plant site, without crossing any of the food producer's firewalls. The database structure and user interface helps enforce the use of corporate standards, so that both plant and corporate users can retrieve current and comparable information about asset health instantly through their web-browser.

The corporate reliability leader says he uses the information frequently, spot checking compliance to the asset health process and the quality of Allied's monitoring services. For example, with his web-browser he can pull up the list of pending condition monitoring assignments for a plant (Fig 9), and quickly see what's scheduled in the near future or if any are overdue.

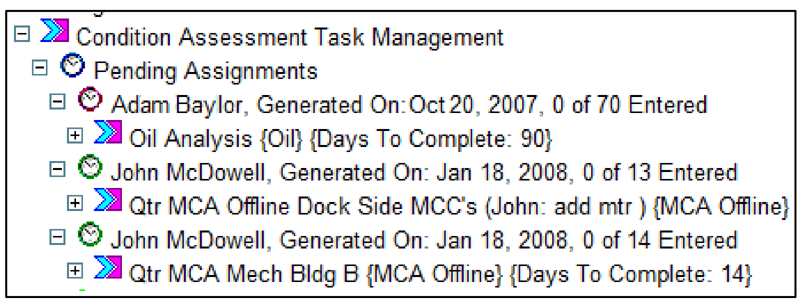

Fig 9: Monitoring assignments due in the near future show a green icon; any that are overdue show a red icon

Allied's analysts use their normal hardware and software system for collecting and analyzing the data. Rather than assembling a report manually, they now enter their findings and recommendations into the web-hosted database through the internet, typically during their analysis session. The interface enforces entry of the information under a standard name for the asset, and fault descriptions and severity levels have to be selected from a standards-compliant pull down list. Analysts don't spend any time preparing or distributing a report document; authorized users retrieve web-browser reports that are created dynamically from the latest information that's been put into the database. The web-browser can produce a traditional report that covers a specific monitoring assignment, or an integrated Asset Health Report that pulls together condition status information from all the technologies being used (Fig 10).

Asset Health Report

Current Status (on Jan-23-2008)

Sorted by: Criticality

Crit	Alias	Location	Vibration	Oil	MCA Offline	Infrared-Mechanical	Infrared-Electrical	MCA-Online	UE-Mechanical	UE-Electrical	UE-Stationary	Overall
		Allied Inspired Reliability	All Functional Groups									
		Percent of Plant Locations in GREEN condition	70.57%		96.56%	98.38%	95.9%	96.05%				80.49%
		Percent of Plant Locations in YELLOW condition	1.2%									0.66%
		Percent of Plant Locations in RED condition	28.23%		3.44%	1.62%	4.1%	3.95%				18.85%
		Total Locations Assessed	333	0	262	557	195	329	0	0	0	610
475	8331	REFINERY >> Refinery Outside >> 8331 VESSEL, STAINLESS, AMMONIA PUMP SEPERATOR (HPS-481				Jul-16-2007						Jul-16-2007
470	8336	REFINERY >> Refinery Outside >> 8336 AMMONIA COMPRESSOR, 2014	Dec-20-2007			Jul-16-2007	Jul-16-2007	Jan-14-2008				Jan-14-2008
455	8321	REFINERY >> Refinery1stthruTop >> 8321 CONDENSER, DEODORIZER B DRY CONDENSING UNIT A (HX-				Jul-16-2007						Jul-16-2007
455	8322	REFINERY >> Refinery1stthruTop >> 8322 CONDENSER, DEODORIZER B DRY CONDENSING UNIT B (HX-				Jul-16-2007						Jul-16-2007
430	8299	REFINERY >> Refinery Outside >> 8299 REACTOR, REFORMER, 135				Jul-16-2007						Jul-16-2007
420	7999	CRUSH >> Extraction >> 7999 WET FLAKE COLLECTING BULK FLOW, C5	Dec-27-2007		Oct-02-2006	Aug-15-2007	Aug-31-2007	Dec-18-2007				Dec-27-2007
420	8282	REFINERY >> RefinerySteelTanks >> 8282 TANK, STAINLESS, DEODORIZER A TOCOPHEROL STRIPPER				Jul-16-2007						Jul-16-2007
420	8466	REFINERY >> RefinerySteelTanks >> 8466 TANK, STEEL, CAUSTIC STORAGE TANK, 82				Jul-16-2007						Jul-16-2007
415	8242	REFINERY >> Refinery1stthruTop >> 8242 PRIMARY PX-100 CENTRIFUGE (	Dec-20-2007		Oct-02-2007	Jul-16-2007	Jul-16-2007	Jan-14-2008				Jan-14-2008
400	7913	CRUSH >> Extraction >> 7913 ROTOCELL EXTRACTOR, C145	Dec-27-2007		Oct-02-2006	Aug-15-2007	Aug-31-2007	Dec-18-2007				Dec-27-2007
400	8300	REFINERY >> Refinery1stthruTop >> 8300 REACTOR, HIGH TEMPERATURE SHIFT (HTS) CONVERTER, 1				Jul-16-2007						Jul-16-2007
400	8266	REFINERY >> RefinerySteelTanks >> 8266 TANK, STEEL, CATALYST FILTER FEED TANK A (T-036A)				Jul-16-2007						Jul-16-2007
400	8267	REFINERY >> RefinerySteelTanks >> 8267 TANK, STEEL, CATALYST FILTER FEED TANK B (T-036B)				Jul-16-2007						Jul-16-2007
400	8272	REFINERY >> RefinerySteelTanks >> 8272 TANK, STEEL, POLISH FILTER FEED TANK A (T-039A)				Jul-16-2007						Jul-16-2007
400	8273	REFINERY >> RefinerySteelTanks >> 8273 TANK, STEEL, POLISH FILTER FEED TANK B (T-039B)				Jul-16-2007						Jul-16-2007
385	8317	REFINERY >> Refinery Outside >> 8317 BOILER, YORK-SHIPLEY BOILER, 151	Jul-18-2006			Jan-26-2006						Jul-18-2006
380	9030	REFINERY >> Refinery1stthruTop >> 9030 HEATER, STEAM, DEODORIZER B HIGH PRESSURE LOOP (V-				Jul-16-2007						Jul-16-2007
380	8262	REFINERY >> RefinerySteelTanks >> 8262 TANK, STEEL, CONVERTER A (R-001A)				Jul-16-2007						Jul-16-2007
380	8263	REFINERY >> RefinerySteelTanks >> 8263 TANK, STEEL, CONVERTER B (R-001B)				Jul-16-2007						Jul-16-2007
370	7916	CRUSH >> Extraction >> 7916 DESOLVENTIZER TOASTER, C147	Dec-27-2007		Oct-10-2007	Aug-15-2007	Aug-31-2007	Dec-18-2007				Dec-27-2007
370	8333	REFINERY >> Refinery Outside >> 8333 VESSEL, STAINLESS, AMMONIA SYSTEM SEPERATOR OIL DR				Jul-16-2007						Jul-16-2007
365	8291	REFINERY >> RefinerySteelTanks >> 8291 TANK, STAINLESS, DEODORIZER B (T-101)				Jul-16-2007						Jul-16-2007
360	8301	REFINERY >> Refinery1stthruTop >> 8301 ABSORBER, HYDROGEN PURIFICATION UNIT (PSA) #1, 137				Jul-16-2007						Jul-16-2007
360	8302	REFINERY >> Refinery1stthruTop >> 8302 ABSORBER, HYDROGEN PURIFICATION UNIT (PSA) #2, 137				Jul-16-2007						Jul-16-2007
360	8303	REFINERY >> Refinery1stthruTop >> 8303 ABSORBER, HYDROGEN PURIFICATION UNIT (PSA) #3, 137				Jul-16-2007						Jul-16-2007
360	8304	REFINERY >> Refinery1stthruTop >> 8304 ABSORBER, HYDROGEN PURIFICATION UNIT (PSA) #4, 137				Jul-16-2007						Jul-16-2007
355	8037	CRUSH >> Extraction >> 8037 HEXANE TRANSFER PUMP, C600	Oct-30-2007		Oct-10-2007	Aug-15-2007	Aug-31-2007	Mar-13-2007				Oct-30-2007
355	8281	REFINERY >> RefinerySteelTanks >> 8281 TANK, STAINLESS, DEODORIZER A HIGH PRESSURE BOILER				Jul-16-2007						Jul-16-2007
350	7917	CRUSH >> Prep >> 7917 DRYER COOLER, C148	Dec-28-2007		Dec-17-2007	Aug-15-2007	Aug-31-2007	Jul-02-2007				Dec-28-2007
350	9132	REFINERY >> RefinerySteelTanks >> 9132 TANK, STEEL, SULFURIC ACID TANK (T-210)				Jul-16-2007						Jul-16-2007
345	8315	REFINERY >> Refinery Boiler >> 8315 HIGH PRESSURE BOILER A, 150	Dec-20-2007			Jul-16-2007		Mar-28-2007				Dec-20-2007
345	8316	REFINERY >> Refinery Boiler >> 8316 HIGH PRESSURE BOILER B, 150	Dec-20-2007			Jul-16-2007		Jan-14-2008				Jan-14-2008
335	7998	CRUSH >> Extraction >> 7998 RAW FLAKE COLLECTING BULK FLOW, C5	Dec-27-2007		Oct-02-2006	Aug-15-2007	Aug-31-2007	Dec-18-2007				Dec-27-2007
335	8126	CRUSH >> Prep >> 8126 SOLVENT WATER SEPARATOR TANK; C816				Aug-15-2007						Aug-15-2007
335	9710	CRUSH >> Prep >> 9710 SOLVENT WATER SEPARATOR TANK; C813				Aug-15-2007						Aug-15-2007
330	8153	CRUSH >> Prep >> 8153 FLAME ARESTORS; C859				Nov-12-2006						Nov-12-2006

Fig 10: Integrated Asset Health Report gives graphic overview of asset status from all monitoring technologies, along with coverage dates and the ratio of assets at different severity levels

Since the results from all plants and all across technologies are reported in standard terms, the corporate reliability leader says he can quickly understand the overall health at each of his facilities and get a relative comparison for any gross abnormality from facility to facility (too many or too few problems). Trending the percentages of assets in the green, yellow, and red condition status categories also helps measure each facility's reliability progress. The web reports make it easy for him to spot check the technical quality of findings and recommendations, and keep him updated on the top ten most critical assets with current health problems at each facility. That helps him identify critical equipment that might need special analysis to achieve the 'elimination of defects' goal. According to the corporate reliability champion, the internet-based communication systems has helped replace his old discomfort that "the next phone call could be about an unexpected train wreck" with "the confidence that all his sites are using the same corporate standards for equipment criticality, condition monitoring coverage, and asset health metrics".

In summary, internet-based communication and management of reliability information is proving to be a significant enabling technology for:

- Communicating corporate reliability expectations and procedures to plant and contractor personnel

- Managing the frequency and completion of monitoring tasks in compliance with corporate expectations

- Replacing the confusing flow of non-standard reporting from separate technologies and contractors, with versatile, standardized web-browser reports

- Enforcing the use of corporately-defined standards in reporting reliability status and progress across many different plants

- Providing timely, broad-based distribution of current and historical reliability information to enhance the teamwork between plant and corporation reliability professionals