1. **EFFICIENCY REPORTS:** Daily plant performance in terms of efficiency reports calculated by PADO systems are sent to operation, efficiency and maintenance groups on a daily basis.

2. **DISSOLVED OXYGEN (DO2) REPORT:** Dissolved oxygen in the feed water of a power plant can deteriorate the metallic parts of the pipeline. This reduces the life of the plant, therefore the oxygen levels are monitored via an online measuring system. Daily reports are containing per minute values and graph of DO2 values. These are monitored in a daily management meeting.

3. **GENERATION REPORT:** Power plant generation report is also sent via email to the commercial department. This has helped in reduction of time taken to manually record the values for compliance.

4. **CONTROL SYSTEM MODIFICATION REPORT:** Any modification done in the control system is recorded by the control systems logs. But it contains any process parameter changes and other information. These logs are automatically filtered daily for control system editing and a daily report is sent to all control system maintenance engineers for review. Any unwanted changes can be reverted back in time leading to increased reliability of control system. A sample report is shown in Figure 7. Here the tag's state changes are recorded with time. Also, it can be noted that the tags state was normalized, hence no action needs to be taken. Also, there is workstation taking start hence it needs to be ascertained about the reasons for the workstation stating.

C&I DAILY LOG REPORT

Report Date = 25-03-2019

Activities done in Centum System

User	Date/Time	Controller	TAG	Description	Mode
Unit 1					
USER@HIS0159	2019/03/25 02:40:09.000 +05:30	FCS0913	1BFPAFLOW	1BFPAFLOW BFP-A SUC FLOW	CAL
USER@HIS0159	2019/03/25 06:18:47.000 +05:30	FCS0913	1BFPAFLOW	1BFPAFLOW BFP-A SUC FLOW	NCL
	2019/03/25 09:36:25.031 +05:30	SIOS0955		SIOS0955 Start	
Unit 3					
Unit 4					

Figure 7

5. **ANTIVIRUS HEALTH REPORT:** Antivirus software is installed for protecting the control system from any malware, virus, Trojan, etc. This antivirus software is updated on a daily basis without any human intervention. Many times the auto update of antivirus in some of the systems fails. Monitoring these kinds of system is a cumbersome process. To improve the process email alerts are configured for any system that fails to update. This has reduced time to monitor the system. As seen in Figure 8 the antivirus health is showing 7 clients out of date. It also shows last time the information is updated. Also, details of the user and IP address are shown (masked for security). This helps in only checking the problematic clients. Saving lots of time.

7 computers found with virus definitions older than 7 days.

Symantec Endpoint Protection

Out-of-Date Clients Triggering Notification on 03/25/2019 09:44:25

Updated since 03/25/2019 05:30:00

Computer Current User IP Address	Virus Definition	Last Download	Last time status changed	Domain Name Server Name Group Name	Product Version
[illegible]	03/10/2019 r17	Never	03/25/2019 06:22:28	DomainName 3LINK2 My Company\Unit #3	12.1.3001.165
[illegible]	03/05/2019 r6	Never	03/25/2019 06:21:48	DomainName 3LINK2 My Company\Unit #3	12.1.3001.165
[illegible]	03/05/2019 r6	Never	03/25/2019 06:22:19	DomainName 3LINK2 My Company\Unit #3	12.1.3001.165
[illegible]	03/05/2019 r6	Never	03/25/2019 06:18:39	DomainName 3LINK2 My Company\Unit #3	12.1.3001.165
[illegible]	03/05/2019 r6	Never	03/25/2019 08:01:54	DomainName 1LINK2 My Company\Unit #1	12.1.3001.165
[illegible]	03/05/2019 r6	Never	03/25/2019 08:00:54	DomainName 1LINK2 My Company\Unit #1	12.1.3001.165
[illegible]	03/05/2019 r6	Never	03/25/2019 08:13:51	DomainName 2LINK2 My Company\Unit #2	12.1.3001.165

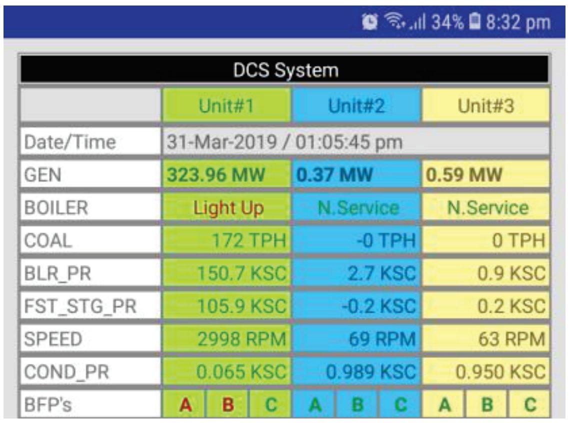
Figure 8

EMAIL FACILITY:

An email facility is designed to send emails to predefined users of the system. Through this email facility, any reports or data can now be sent via email form the control system workstations. Without this email facility, the user has to either take printouts of the data or can take data via writing to CD/DVDs. Writing to CD/DVD is a very cumbersome process and time taking. Also it is painful to maintain CD/DVD drives of more than 300 PCs. Also, it's not practical to always carry a portable CD/DVD drive.

STATUS SNAPSHOTS:

Various key parameters snapshot is sent every 5 min to every user for their updates. These snapshots help in getting a picture of what is running in the plant. These parameters help to keep track of plants running status on the go. Figure 9 shows the running snapshot of all units. It shows critical running parameters and drives' status.


34% 8:32 pm

DCS System

	Unit#1			Unit#2			Unit#3		
Date/Time	31-Mar-2019 / 01:05:45 pm								
GEN	323.96 MW			0.37 MW			0.59 MW		
BOILER	Light Up			N.Service			N.Service		
COAL	172 TPH			-0 TPH			0 TPH		
BLR_PR	150.7 KSC			2.7 KSC			0.9 KSC		
FST_STG_PR	105.9 KSC			-0.2 KSC			0.2 KSC		
SPEED	2998 RPM			69 RPM			63 RPM		
COND_PR	0.065 KSC			0.989 KSC			0.950 KSC		
BFP's	A	B	C	A	B	C	A	B	C

Figure 9

CHALLENGES

The key challenges faced were regarding:

1. **INTERFACING WITH CONTROL SYSTEM:** The control system doesn't have any feature to send emails, or SMS, or for any mobile application interface. These facilities were developed in-house using third-party apps and other features as follows:

   i) SMS: SMS are sent via SMS modem via an OPC client.

   ii) Email: Emails are sent using scripts and Gmail as SMTP server.

   iii) Mobile app: Mobile app is developed for displaying alarms and status snapshots. The data is sent via Google's cloud server.

2. **SECURITY ISSUES:** The major issue while connecting to the internet is of any attacks from outsiders. This risk is nullified by using multiple firewalls and blocking any incoming requests at the internet gateway. Also, internet access is restricted to only 2 servers. So other internal servers in the system send data to these internet servers. From this data is sent to the internet. No permanent connection is kept open. An auto-updated antivirus and OS also helps is keeping systems safe from zero-day attack. A third-party audit was also conducted for accessing the security level of the system.

3. **NETWORK DELAYS/CONNECTIVITY LOSS:** Every public network is never full proof. There can be delays or momentarily failure in the connectivity. To avoid any loss of information due to network connectivity, buffers in the system are provided. The buffer saves the outgoing messages and delivers them as soon as the connectivity is restored. This helps in the complete delivery of messages without fail.

BENEFITS ACHIEVED

The various benefits achieved by implementation of these systems are:

1. **USER FRIENDLINESS:** With the size of a large power plant or a process industry its very difficult to manage multiple locations and

system. With multiple systems in service to report, it always helps to increase productivity.

2. **GOING ENVIRONMENT-FRIENDLY:** by using emails instead of taking print out or using CD/DVDs, it's better to use modern state of the art facilities like emails and going paperless. By going digital we put less strain on our physical resources and also better manage the workflow. By avoiding cumbersome methods of doing things we also increase our efficiency to work.
3. **REDUCE DOWNTIME:** There will always be a time gap between event occurrence and its detection and reporting time. When systems are in place for monitoring any failure they can help in reducing downtime by alerting the concerned person immediately. Thus avoiding any risk associated with the failure.

4. **TARGETED INFORMATION:** When information is provided to only the concerned group, the response time gets better. In the alarm systems deployed the alarms are given only to the concerned group. This help is the faster response and better understanding by the concerned person.

5. **LOW COST:** The return on investment on the kind of implementation at IGSTPP is very high. The benefits achieved are multiple at a very low initial or running cost.

CONCLUSION

The future of the industry is where we can leave machines to work for themselves. But before this can be achieved a lot of work has is to be done.

The secure integration of internet to the DCS environment has helped in early detection of any failure. The maintenance team response time to any abnormality in the DCS system has effectively decreased and thus the reliability of systems has been improved. The self-reporting features introduced have made the analysis part easy and have also helped in the reduction of paper usage as desired data is taken from DCS using email facility provided. As it is a low cost solution and do not require any major configuration changes, it can be easily implemented at other process industries.

AUTHORS:

Sh. Hemant Panday is Manager (Control and Instrumentation) in NTPC Ltd. He has worked in the control system maintenance for 10 years. During that time he was responsible for 3x500 MW power plant field instruments, control systems and network security. He has special interest in the field of mobile app development and system integration. He has degree in electronics and communication from GGSIP university in Delhi.

Sh. Prem Prakash Rai is Manager (Control and Instrumentation) in APCPL (NTPC, HPGCL and IPGCL Joint Venture). He has worked in the control system maintenance for 10 years. During that period he was responsible for commissioning & maintenance of FSSS systems, boiler instrumentations and DCS system. He has special interest in the field of networking and Control systems. He has degree in Electronics and Communication engineering from Uttar Pradesh Technical University.

Reliable and Safe Operation with Surge Protective Devices for Telecommunication and Signalling Networks

Gernot Finis, Steffen Pförtner, Jens Willmann

Phoenix Contact GmbH & Co. KG, Flachsmarktstraße 8, D-32825 Blomberg, Germany

Keywords

Surge protective device (SPD), measurement and control, signaling systems (MCR), overload, metal oxide varistor (MOV), transient voltage suppressor diodes (TVSD), thermal disconnect device (TDD), component displacement disconnection (CDD)

Abstract

Surge protective devices (SPDs) for the protection of the sensitive electronic equipment of measurement, control and regulation systems (MCR systems) are qualified according to IEC 61643-21. Usually, these applications have low operation voltages and low short circuit currents. Therefore, an SPD failure normally does not lead to a critical condition like an impermissible rise in temperature. But in some cases measurement and control applications with increased operation voltages and increased short circuit energies exist. In these cases, additional safety aspects and the requirements of the standard IEC 61643-21 should be considered. With regard to this aspect, overload protection mechanisms for SPDs used in MCR systems have been developed. The focus is set on the handling of overloaded metal oxide varistors (MOV) and transient voltage suppressor diodes (TVSD) which are used in the protection circuit of these kinds of SPDs. The results presented, provide practical information for the design of innovative SPDs for the protection of MCR systems with increased operation voltages and increased short circuit currents.

1. INTRODUCTION

1.1 REASONS FOR THE USE OF SURGE PROTECTIVE DEVICES FOR THE PROTECTION OF MEASUREMENT AND CONTROL SYSTEMS

The availability of applications is at risk, if surge voltages occur to telecommunication, signaling lines or devices. Surge voltages are mainly caused by lightning, by switching actions and – for some special applications – by electrostatics. Whenever a source of disturbance is located near to cabling systems or electronic devices, surge voltages are always expected to couple into them. If the electrical stress level, due to the inducted voltages, exceeds the dielectric strength of a cabling system or the connected devices, damages and system failures can occur.

It has to be considered that not only lightning strikes to the structure itself, but also lightning strikes nearby can cause huge transient voltage rises. Due to the electromagnetic field, transients in electric lines can be caused due to capacitive and/or inductive coupling.

This specifically applies to the sensitive electronic equipment of measurement, control and regulation systems (MCR systems).

The use of surge protective devices (SPDs) can provide effective protection against this kind of electrical stress and ensure high operational availability of these systems, if a high grade technology is used and the installation is done correctly. The SPD has to protect between active lines (differential mode protection) and also very important between active lines and ground (common mode protection). The insolation withstand capability of a 24 V DC field device, like a measurement transducer, or a barrier which is used for galvanic isolation or other electronic devices is usually in the range of up 1.5 kV (see figure 1). Surge protective devices are specially designed to limit transient overvoltages to a level which will be no risk for the insulation of such electronic devices.

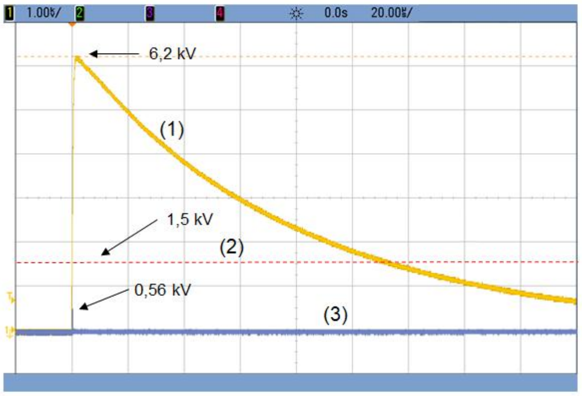


Fig. 1: 1,2 / 50 µs impulse (1), insulation capability of a typical electronic device (2) and limiting voltage of a typical SPD between active lines and ground (3)

To meet the requirements regarding the protection effect for the various types of MCR applications, SPDs with application-specific protection circuits featuring low impulse-limiting voltage and high surge current "let-through" capability have been developed.

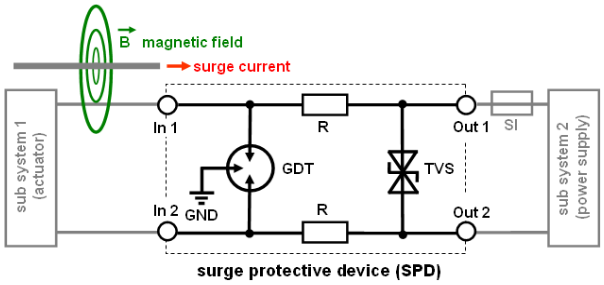


Fig. 2: Inductive coupling of surge voltages in the cabling system of a MCR system protected by a SPD with a 2-stage protective circuit

Figure 2 shows the circuit diagram of a surge protective device, which is e.g suitable for the protection of a 4-20 mA analog signal. SPDs for the use in MCR systems are designed and tested according to IEC 61643-21 [1]. Usually, these applications have low operation voltages and low short circuit energies, like the before mentioned 4-20 mA current loop. Therefore, an SPD failure e.g. in case of overload or due to ageing does not lead to a critical condition like an impermissible rise in temperature. But in some cases MCR applications with higher operation voltages, higher operating currents and therewith a certain probability of a critical temperature rise in the case of a short-circuit exist. This e.g. could be applications with solenoid valves or other kind of actuators. In such a case, the occurrence of over-currents through the protective components of an overloaded or aged SPD should not lead to dangerous operation conditions and therefore, the SPD has to reach a safe state in a controlled manner without getting overheated. The application has to stay in a reliable and safe state of operation.

1.2 SURGE PROTECTIVE COMPONENTS USED IN MCR SPDS

In surge protective devices for instrumentation, telecommunications and signaling the following components are mostly used:

- Gas-discharge tubes (GDTs)
- Metal-oxide varistors (MOVs)
- Transient voltage suppressor diodes (TVSDs)

TVSDs are frequently used in applications with Extra Low Voltage. Due to their low capacitance they are also often used in applications where high transmission rates or high frequencies are needed. The discharge capability of TVSDs is lower than the discharge capacity of comparable MOVs or GDTs.

MOVs are frequently used in many applications where a protective component with a higher discharge capability, in comparison to TVSDs is needed and if the use of GDTs is not possible due to increased system voltages paired with prospective short-circuit currents which could cause challenges to the extinguishing capability of the component.

1.3 METHODS OF FAILURE HANDLING

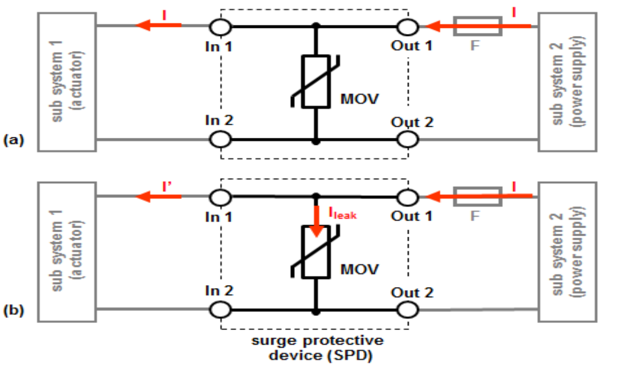


Fig. 3: MOV-based single stage SPD for the protection of measurement and control systems – (a) undisturbed operation, (b) occurrence of leakage currents in case of a MOV ageing or overload.

Figure 3 shows a MCR application protected by a single stage SPD based on a MOV as an example. Electrical overloading can lead to an ageing of the varistor which is linked to the occurrence of leakage currents. Especially in use in applications with an increased operation voltage, increased operating currents and therewith the capability of increased buildup of heat at the location of a short-circuit, the leakage currents can lead to the overheating of the MOV. Under certain conditions, this scenario can lead to fire hazard. Therefore, an effective method of failure handling is mandatory. Regarding the use of backup fuses as an example, an effective protection against this failure scenario is subjected to certain boundary conditions e.g. is not possible in any case:

To cut-off short-circuit currents with backup fuses requires a coordination of the fuse with the power supply unit. To achieve a fast response of the fuse, the prospective short-circuit current of the power supply unit has to be considerably higher than the minimum cut-off current of the backup fuse.

Failure currents below the cut-off current of the fuse cannot be switched off by the fuse. This has relevance for applications with high operation currents like electrical actuators (e.g. 120 V/2 A) and therewith higher rated backup fuses. In such a case, failure currents slightly above the rated current of the fuse can be in a current range where a fuse might not blow or might need a long time to blow. See Fig. 4.

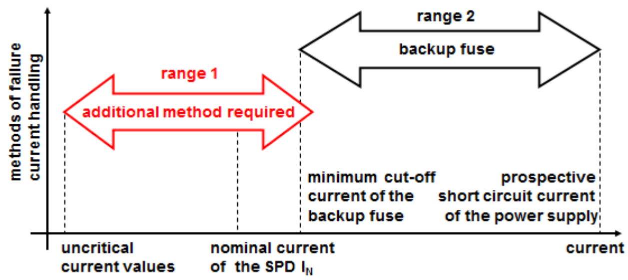


Fig. 4: Methods of failure current handling over the different failure current ranges.

These aspects show clearly that for the handling of failure currents with values below the minimum cut-off current of the selected backup fuse an additional method of failure current handling is required. This includes also applications without backup fuses, but with operation currents which have to be considered under safety aspects.

2. TECHNICAL SOLUTIONS FOR A RELIABLE AND SAFE OPERATION IF SPD COMPONENTS FAIL

With regard to these aspects, new solutions for the overload protection of SPDs used for the protection of MCR systems are required. New technologies to be developed have to ensure a maximum level of product safety and should provide the function of status indication and remote signaling. Additionally the protected application has to stay in safe operation.

Therefore, the focus is to develop a mechanism to realize a safe failure handling of MOVs and TVSDs. This is because of the fact, that these two components are the most common elements in protection circuits of SPDs for the protection of MCR systems. Regarding the technical data of these components, circular MOV types (diameter of 20 mm, nominal voltage up to 150 V) and TVSD designed as SMD components (5 kW peak pulse power capability (10/1000 µs), voltage up to 55 V) should be considered.

The target is to equip MOVs and TVSDs with thermally activated disconnect devices which disconnect the respective element from the MCR system in case of thermal overload. Compared to standard thermal fuses (TF), the thermal disconnect device to be developed has to provide a significant higher discharge capability for surge currents and an equal or better disconnection performance. Especially for SPDs used in applications with high operation voltages and the capability of high short circuit energies, highest safety performance requirements, which goes beyond the requirements of the standard IEC 61643-21 [1], should be considered. Regarding this, safety tests described in IEC 61643-11 [2] should provide guidance.

Above that, the realization of a mechanical status indicator to display the status of the thermal disconnect device and a system for the remote signaling of this status has to be developed.

2.1 TECHNICAL SOLUTIONS FOR MOV BASED MCR SPDS

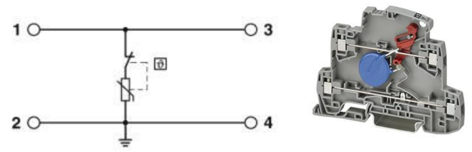


Fig. 5: MOV based single stage SPD, with a mechanical disconnect mechanism and a status indication in case of overload

The basic idea was to develop a new SPD technology for the protection of energetic powerful MCR applications which provides the feature of thermal overload protection comparable to disconnection mechanisms in surge protective devices for power supply systems. Figure 5 shows the circuit diagram and the design drawing of the newly developed MOV-based single stage SPD. This SPD contains a thermal disconnection device (TDD) and a connected status indicator. The TDD is designed as a break contact which is fixed by a solder material. The solder connection is located close to the MOV as the heat source. This is mandatory to achieve an optimized heat transfer into the soldering point which ensures a fast reaction on a possible heating of the varistor. In this construction, the thermal disconnect mechanism consists of a spring steel element which is soldered directly on the connection wire of the MOV. This cost efficient construction provides also a good thermal coupling of the solder material to the varistor ceramic. In case of a rising leakage current the ceramic heats up and causes the solder material to melt. The spring provides the mechanical force to open the soldering point. Linked to the movement of the unsoldered spring steel element the indicator element (red plastic part) moves into a defined position. To achieve a proper function of this mechanism, the melting temperature of the solder material has to be matched to the thermal properties of the construction. The solder connection has to withstand the mechanical stress generated by the spring steel element during the declared product life-time. With regard to this, particularly environmental influences such as vibrations have to be included.

2.2 OVERLOAD BEHAVIOR OF TVS DIODES AND TEST METHODS

Electrical overloading, e.g. through high-energy transients, can lead to a destruction of transient voltage suppressor diodes (TVSDs). Exemplary studies carried out to determine the ageing and failure behavior of such diodes show that an overloading by surge-current impulses leads to an irreversible degradation, which results in significant decrease of the 1-mA-point-voltage of the TVSD. Tests performed have confirmed that a correlation exists between the wave-shape as well as the amplitude of the surge-current impulse, and the decrease of the 1 mA-point-voltage of the TVSD (impedance drop).

2.3 TECHNICAL SOLUTION FOR TVSD BASED MCR SPDS

On the basis of the determined thermal behaviour of damaged TVSDs connected to powerful MCR applications, the target was to develop a thermal disconnect device (TDD) for the protection of overloaded TVSDs. To ensure a maximum level of product safety this device has to operate before a critical surface temperature of the TVSD is exceeded.

Figure 6 shows the circuit diagram and the design drawing of the developed SPD with the integrated TDD for a TVSD. The TVSD is electrically connected to the signal path to be protected. The fundamental operational principle is to disconnect the TVSD in case of overload via shifting it away from its position on the printed circuit board (PCB). To achieve this, TVSDs in SMD technology are used (fig. 6, (1)). The respective TVSD is soldered on the PCB using a low temperature solder alloy. A steel spring (fig. 6, (2)) is in contact with the TVSD. This arrangement operates as a heat-triggered breaking contact. The soldering connection of the TVSD is designed in a way that it can permanently withstand the mechanical force of the steel spring under normal operation conditions and if it is exposed to highest shock and vibration loads.

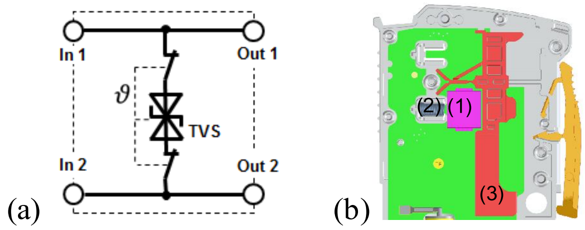


Fig. 6: Component displacement disconnection (CDD) – thermal disconnect device for a TVSD with two separating points, (a) circuit diagram; (b) design drawing.

In case of an overload of the TVSD, leakage currents occur and the TVSD heats up. This causes a heat transfer into the soldering points between the TVSD and the PCB. If a pre-defined temperature is reached the solder material melts and the spring moves the TVSD away from its electric contact points along the PCB into a defined position. In this position the TVSD is disconnected and insulated from the electric circuit. This disconnection technology is called Component Displacement Disconnection (CDD). The movement of the TVSD additionally moves a slider (fig. 5, (3)) made of non-conductive plastic material which indicates the disconnected status on top of the SPD housing.

2.4 PERFORMANCE OF NEWLY DEVELOPED COMPONENT DISPLACEMENT DISCONNECTION

A performance test based on the thermal stability test acc. to IEC 61643-11 [2] can be applied advantageously for this test purpose.

The high performance and the advantage of the CDD designed for TVSDs is seen if a comparison with thermal fuses takes place. Figure 7 shows the switching characteristic of the CDD (green curve) compared with a thermal fuse (type X29 [7]) with a trigger temperature of 108°C (red curve). The temperature measurement in this test is carried out directly on the surface of the components.

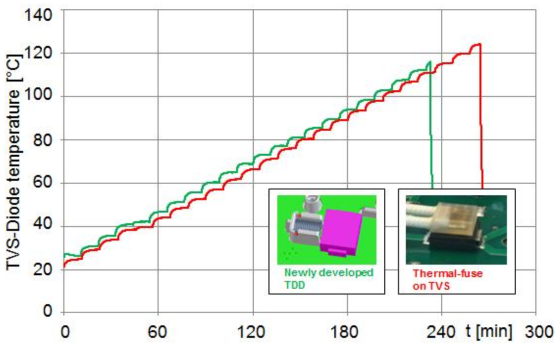


Fig 07: Switching characteristic of the component displacement disconnector (CDD) for TVSDs (green) compared with a thermal fuse (TF) with a trigger temperature of 108 °C (red) as a function of impressed current.

The comparison of the determined switching characteristics shows the advantages of the developed CDD for TVSD. The CDD acts before the surface temperature of the TVS diode exceeds 115 °C. This thermal short-term stress does not lead to a significant degrading of standard insulation materials and circuit boards. Under the same test conditions the thermal fuse – which is standard technology – reaches temperatures above 120 °C and needs approximately 30 min reaction time. This means more thermal stress for the surrounding insulation materials and the SPD housing. Regarding the performance of the developed CDD for TVSD in total, the following properties with practical relevance have been observed:

- In case of a temperature raise, the CDD for TVSD acts faster than a standard thermal fuse. Due to the faster disconnection, the thermal stress to insulation materials, the circuit boards and housing of the SPD is reduced.
- Above this, the principle of the CDD for TVSD which is based on a movement of the TVSD, allows a robust and cost efficient design of a mechanical status indicator. A proper solution can be realized with a slider which is triggered by the movement of the TVSD (comp. fig. 8 (3)). In addition to this, indicate the tripping of a thermal fuse is technically much more demanding and therefore less economic.
- With regard to the discharge capability for surge- and lightning-currents a comparison between the TDD and TF get less priority at this point. This is related to their use in multistage protective circuits or in applications where high discharge currents cannot occur.
- An additional feature of the component displacement disconnection (CDD) is the high breaking capability for AC and DC currents which is founded in the two existing separating points.

3. CONCLUSION

Surge protective devices are more and more used to protect measurement, control and regulation systems against transients or lightning strikes.

Metal oxide varistors (MOV) and transient voltage suppressor diodes (TVSD) used as protective elements in SPDs for the protection of measurement and control applications can heat up in case of overload or ageing. By the use of these elements in applications with high operation voltages and the capability of high short circuit energies safety aspects should be considered.

Therefore it is important to use the right SPD technology for the application to have a reliable and safe operation. Thermal Disconnection Devices (TDD) for MOVs and TVSDs have been developed. In case of an overload these components will be disconnected from the circuit, so that there is no influence to the application.

Additionally the principle of both TDDs based on a mechanical movement allows a robust and cost efficient design of a status indicator and a remote signaling, which is useful in such applications. The status of the SPDs can be easily monitored from the control room.

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BIOGRAPHIES

Gernot Finis was born in Germany on November 6, 1970. His industrial career started at Bosch Telecom in Frankfurt/Germany, were he attended an industrial training on telecommunication systems. He received his diploma in electrical engineering from the University of Kassel/Germany in 2000. After that he started working at the Chair for Power Systems and High Voltage Engineering of the University of Kassel. His area of work includes the research on new insulation materials for MV- and HV-insulation applications. For his work in the field of the insulation properties of silicone gels he earned a doctorate in electrical engineering in 2005. Now he is Senior Director of Product Marketing and R&D of the Business Unit TRABTECH - Surge Protection of Phoenix Contact GmbH & Co. KG in Blomberg/Germany. Above that, he is lecturer at the University Kassel and member of standardizing committees in the field of surge protection.

Steffen Pförtner was born in Hannover, Germany in 1982. After an initial training in the field of electrical installation he graduated in electrical engineering at University of Applied Science in Hannover. He joined Phoenix Contact GmbH & Co. KG in 2007. At present he is Manager of R&D Signal Protection of the Business Unit TRABTECH - Surge Protection.

Jens Willmann was born in Germany on March 18, 1979. He graduated in electrical engineering at the University of Applied Science in Bielefeld. He joined Phoenix Contact GmbH & Co. KG in 2004. At present he is working as Director Product Marketing Surge Protection of the Business Unit TRABTECH. He is a member of member of standardizing committees in the field of surge protection.

Latest Innovations in Video wall technology and trends from DLP rear projection to Seamless Fine pitch LED video wall

Kuldeep Singh Rathore, India

ABSTRACT

Drastic emerging trends has been seen in last one decade, drifting Control room Video wall technology from DLP Lamp Based rear projection to Fine Pitch Direct View LED video wall technology.

INTRODUCTION

The fine pitch LED display industry has risen rapidly in the last five years, and the adoption rate seems to be accelerating as prices drop and high quality installations grow more commonplace in retail, corporate and public venues. The dominant technology used for fine pitch displays – surface mounted

Diodes (SMDs) – is being manufactured in progressively smaller form factors. Prototype displays have pitches as narrow as 0.7mm, which is roughly the same pitch as a 1080P HD LCD.

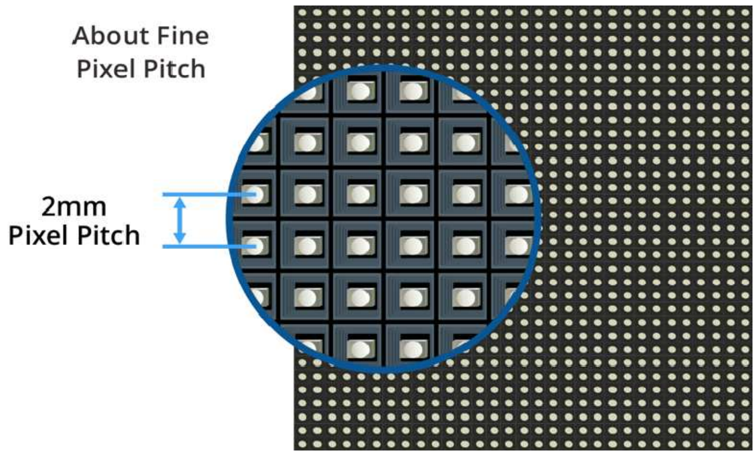
We will likely see fine or narrow pitch LED displays taking the place of printed material, draping and topping buildings and even replacing some traditional architectural finishes like tile and stone.

BASICS OF LED

ABOUT PIXEL PITCH

The distance from the center of that LED package to the center of the packages surrounding it is measured in millimeters, and reported as the pixel pitch.

The narrower or finer, the pixel pitch, the more LED packages get fixed on one back plate. To realize super-fine pixel pitches, manufacturers use smaller LED packages.



ABOUT LED PACKAGES

The colored light you see on an LED display comes from three Light Emitting Diode (LED) chips.

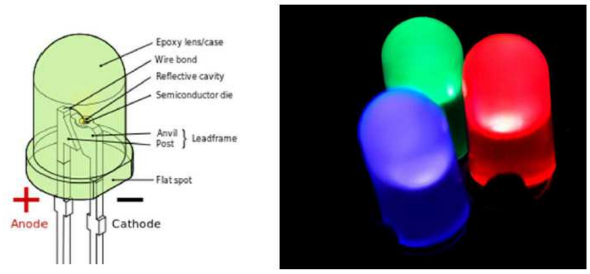
The chips used for displays are the same or similar to ones used in things like commercial and automotive lighting. The older, generally lower resolution version of LED displays tends to use Through-Hole Diodes (THDs) that look like tiny light tubes with wire legs on the end. The majority of the LED displays being used for indoor video walls – called fine pixel pitch displays or Narrow Pixel Pitch (NPP) – use Surface Mounted Diodes (SMDs).

The LED chips – red, green and blue – are packaged by high-speed robotics machines into a housing that has a reflector cup to amplify the light. The packages are wired to pass electricity, and then encapsulated with an epoxy, creating a lens for the lights.

ABOUT LED

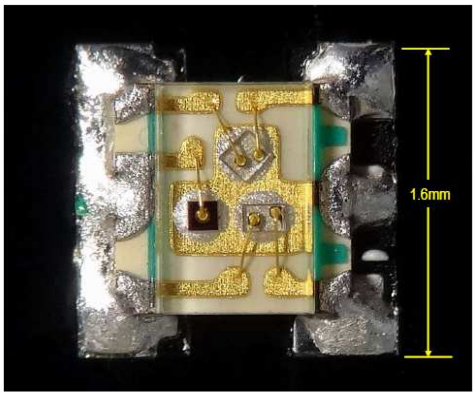
Light emitting diodes were first developed in the 1950's. By using semiconductor technology, LED's proved an efficient way to convert electrical energy into photons. Over the years, LED's continued to improve advancements in microprocessors; Haitz's law tracked the similar progress in LED development.

Light Emitting Diode



This configuration is called a Surface Mount Device – or SMD. The three diodes are affixed to a mount, gold conductive leads are attached and a plastic frame and epoxy seal are added. This example of an SMD pixel is 1.6mm square, so would be ideal for a display with a 2 mm pixel pitch. Each LED is driven independently by specialize chips called drivers

LED Surface Mount Device (SMD)



There are numerous companies – the majority in Japan, Taiwan and China – that are fully or partially in the business of developing and manufacturing LED chips. Different LED makers have different reputations for the light and color output, lifespan and overall quality of their LED chips, also known as die. The LED chips are grown as silicon wafers and then diced into individual, tiny light sources. A lot of the cost of LED displays owes to the precise manufacturing process of growing layers of semiconductor crystals from a chemical vapor.

ABOUT MODULE AND CABINETS

The output from the packaging and related processes is a module, a square or rectangle with an array of SMD packages on the front and electronics on the back. These modules are attached to composite or

Metal frame cabinets that then hold all the circuitry needed to drive and manage the LED lights, and communicate with the controlling hardware and software. The modules and cabinets tile together, and connect by cabling or docking systems. The cabinet engineering varies for such things as servicing, with some modules requiring rear access for servicing, while others offer front access, or both. Some of the cabinets are connected by wiring harnesses while others effectively dock and interconnect with their neighboring modules.

ABOUT MEDIA SIGNAL

An LED display gets its signal from a computer and runs that through a display controller, or from a specialty display control device. It manages the media signal and does the work to map it to the pixels on the screen.

HOW LED ARE BEING USED

Fine pitch LED is starting to transition from a premium, niche product to a more mainstreamed display – that shift is driven by steadily lowering costs and broader awareness and acceptance of the technology.

The early adopters for fine pitch were:

Broadcast – Using tiled modules as seamless backdrops on live sets for news and talk formats;

Corporate – Used as architectural/art statements in the lobbies of major companies, notably deep-pocketed sectors like finance and tech;

Control rooms – Utilities and other large companies, particularly in China, have installed fine pitch LED walls, replacing LCD or older rear projection display cube technology.

LOCATION AND ENVIRONMENTAL CONDITIONS

LED is an optimal solution for locations like retailers, airports and office tower lobbies that gets a lot of natural sunlight through big street-side windows and atrium glass. LED does a very good job of fighting brightness and glare.

LED does not do well in those kinds of locations, and others, if the displays are within easy reach of the general public – because the tiny surface-mounted light packages on video walls are easily bumped and damaged, notably at the perimeters of the display clusters.

Generally, the SMD packages on modules can be field-repaired, but maintenance costs can add up if the walls are steadily exposed to accidental or purposeful abuse. Unlike LCD displays that have hard glass faces, LEDs don't have protective glass. They need to be glass-free to allow the LED lights to vent off the heat they generate. There are some touches LEDs out there that have a permeable film layer over the LEDs that enable touch, provide protection and allow her to dissipate. Still, it's best to position fine pitch SMD-based walls so that they are not within reach of curious hands or be at steady risk of bumping by equipment like carts.

DISTANCE MATTERS

Establishing some distance from viewers is necessary, anyway, with even the finest pitch LED display walls.

The premium 0.9mm pixel pitch displays now being sold are still best viewed from several feet back – probably five at a minimum and optimally 8-10 feet back. Seen from any closer, people will start to visually pick up the individual light pixels of the display, degrading the viewing experience.

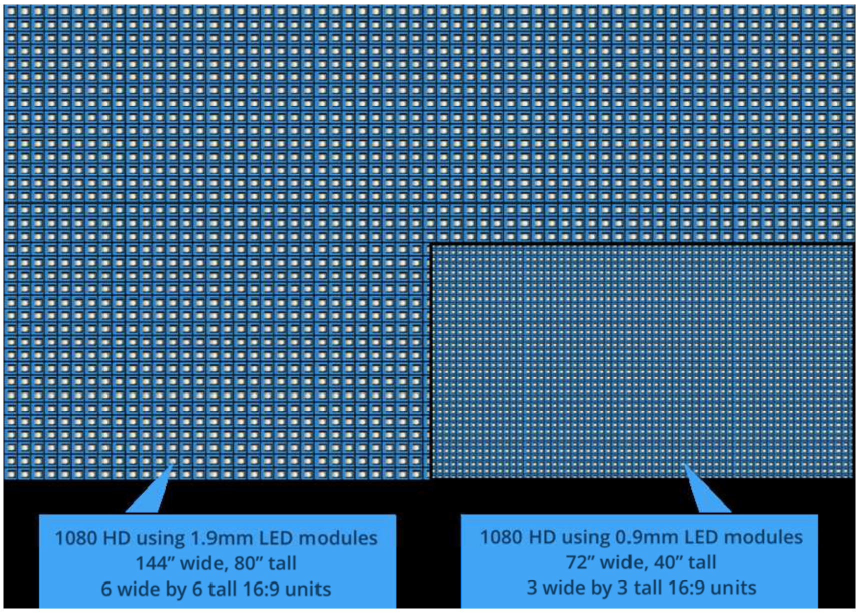
The conventional rule of thumb is that 1mm of pitch equates to about 8 feet of viewing distance. That means a 1.5mm pitch display is best seen from 12 feet away or more, 2mm at 16 feet, and so on.

DETERMINING RESOLUTION

LED display makers, and particularly systems integrators and AV designers, approach projects with specific questions about the intended resolution for the display. They don't lead with pixel pitch. That's because the desired resolution has a direct impact on the physical footprint of the video wall.

With LED, the finer the pixels pitch of display modules, the more pixels are packed into each of those modules.

This graphic shows how the footprint of a 1080 HD LED display can be dramatically different based on the pitch and pixel count.

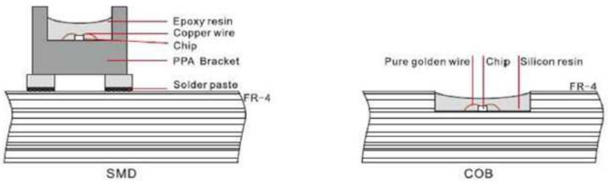


UPCOMING LED CUTURE TECHNOLOGY

There are two other LED display technologies that are seen in some (but not all) circles as big parts of the future for fine pitch LED technology

CHIP ON BOARD

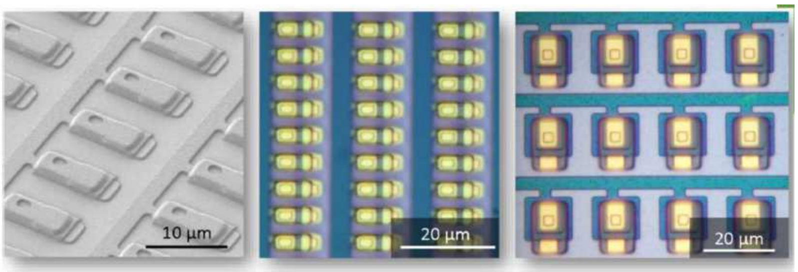
New technology already being used by at least a pair of companies involves a newer process called Chip On board (COB).



With COB, batches of the bare LED chips are directly bonded to the printed circuit board substrates, removing the interim step of that SMD packaging and mounting. The main selling propositions for this tech are cost reductions and how COB makes modules more durable, and produces better visuals. COB also results in much higher densities of LEDs being packed into the same physical area.

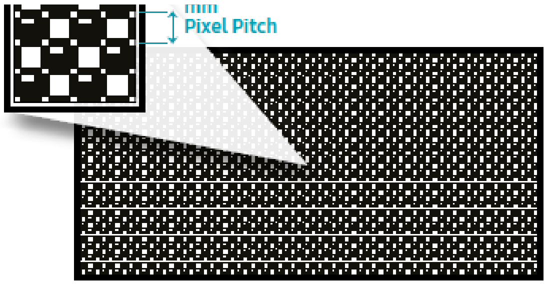
MICRO LED

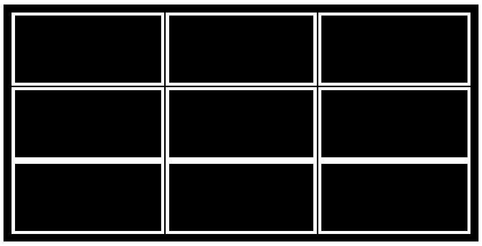
Micro LED is seen in some circles as the future for fine pitch display, but it may be a very distant future because of the relative infancy of the technology, severe manufacturing limitations and, as a result, extraordinary costs.



Micro LEDs emit light just like mainstream SMD LED technology. Instead of the LEDs being packaged for surface mounting, the LED chips are not packaged but directly picked and placed on large back plates or substrate

COMPARISION BETWEEN LCD & LED TECHNOLOGIES





DIRECT VIEW LED

- Millions of light dots on rectangular or square black tiles, no bezel.
- The closer the distance between light dots, or pixel pitch, the better they look up close
- No visible seams between LED tiles
- Best for large, spectacular canvases and in bright ambient lighting scenarios

LCD

- Same display as most consumer televisions
- Joining multiple displays to make video walls creates visible seams, but those seams are getting smaller with slimmer bezels.
- Much more budget-friendly
- LCDs produce super high-resolution visuals not possible on LED
- LCDs support up close viewing and touch interaction

DETERMEINANT FACTOR FOR VIDEO WALL

BUDGET

LCD video display walls , with ultra narrow bezels, generally cost anywhere from half to a 10th the cost of a fine pixel pitch display of the same dimension.

SHAPE

LCD displays are somewhat constrained by their shape, though there are limited numbers of square and wide-stretched displays on the market. LED modules, on the other hand, are like tiles. The tiles tend to be smaller than LCD displays, and can more readily fit into spaces with odd and varied dimensions.

LIGHTING

Ambient lighting conditions, such as a sun-filled atrium in a building, or a storefront window, can overpower conventional LCD displays that don't have sufficient light power to make visuals cut through glare. Now the LED displays, generally, have designed-in brightness to win those battles against direct sunlight.

DISTANCE

In the finest pitch LED. However, if viewers will be 25 feet away, a relatively low cost 2.5mm pixel pitch LED wall will deliver big, rich and seam-free visuals, with no discernible difference in clarity from an LCD wall.

PHYSICAL CONSTRAINTS

A big video wall fills an area like a building lobby or feature wall in a store, but it also removes space if the technical design is not carefully considered. The issue is installation and servicing. In the LED displays that have thin side profiles and can be installed and serviced from the front.\

CONCLUSION

Large LED "Video Wall" displays have been around for many years. The concept is quite simple: LED pixels with red, green and blue light sources are built into modules, and these modules are stacked into a frame to create the desired image size. These displays have been used for outdoor signage, and indoor applications such as retail, restaurant menus, control rooms, corporate lobbies, trade shows, broadcast stage sets and many other uses.

fine pitch LED has been mainstreamed – with even the major LCD display manufacturers showing their own lines of LED video wall product.

Most commercial display expect much of the business now seen in LCD-based video walls will shift to LED as manufacturing volumes increase, competition and buyer awareness grows, and, more than anything, prices continue to drop.

The world is going to get lit up by LED.

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BIOGRAPHIES

- Kuldeep Singh Rathore has got total working experience of 25 years in IT and display solution.
- He is having an experience in the display solution for more than 10 years.
- Had provided video wall solution into power generation transmission distribution / Oil and gas / City surveillance / and smart city projects control room.

MERCURY MONITORING AT STACK

Anant Ghadigaonkar
Regional Sales Manager
ThermoFisher Scientific India Private Limited, Mumbai

ABSTRACT

Thermo Scientific Mercury Freedom System is Uniquely simple through successfully adapting known measurement methods to meet a complex application, the measurement of low levels of a transitory and reactive pollutant:

- Wet-basis Dilution Extractive method, widely used in the industry.
- Direct measurement using Cold Vapor Atomic Fluorescence, similar in concept to the SO2 Analyzer.
- Dry conversion of oxidized mercury in the probe, similar in principle to the NOx converter

KEYWORDS

Mercury, Hg, CVAF, Fluorescence, Elemental, Ionic, Dilution, Total, Speciate, Coal

INTRODUCTION

The Thermo Scientific Mercury Freedom System was Originally design to meet the requirement of the Clean Air Mercury Rule (CAMR). Several Hundred of Mercury Freedom System were Installed in Coal Fired Power Plants across the United States and Cement Plant and passing stringent Relative Accuracy Test Audits (RATAs) under varying plant conditions.

With respect to India, Ministry of Environment and Forest (MoEF) Notification and Climate Change Notification, New Delhi the 7th December 2015 (S.O. 3305 (E) – In exercise of the powers conferred by sections 6 and 25 of Environment (Protection) Act 1986 (29 of 1986), the need to select and install a Mercury Monitoring Solution / System is becoming increasingly important / Urgent.

BACKGROUND - EXPOSURE Fig.1

- Mercury is a transition metal with 3 common states (Hg^0, Hg^{2+}, Hg^p).
- Elemental Mercury (Hg^0) – Dominant species in atmosphere, most pollution sources.
- Ionic or oxidized mercury (Hg^{2+}) – In air, reactive gaseous mercury (RGM), primarily HgCl2. Dominant species in rainfall, water, sediments, soil, and some pollution sources (notably incinerators).
- Particulate-bound mercury (Hg^p)
- Total Mercury (Hg^t) – The sum of $Hg^0 + Hg^{2+} = Hg^t$.
- Unit of measure - Micro-grams per cubic meter (µg/m³).

- MDL: 1 ng/m³ ~ 0.1 ppt
- Inorganic mercury settles to the sediments of the water body where microbiological activity converts it to Methylmercury (MeHg).
- MeHg is easily passed up to animals at the top of the food chain (bioaccumulated).

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Exposure Limits

- Recommended Exposure Limits of Mercury vapor is 50 µg/m³ on a Time Weighted Average concentration for up to a 10-hour work day during a 40-hour workweek. Potential for dermal absorption; skin exposure should be prevented.
- The recommended ceiling value of 0.1 mg/m³ should not be exceeded at any time. OSHA ceiling value = 0.1 mg/m³.
- Immediately Dangerous to Life or Health (IDLH) =10 mg/m³ (as Hg).

MAIN APPLICATION FOR MERCURY MONITORING

POWER GENERATION

•Solid combustible (coal, wood, simple biomass)
•Liquid combustible (fuel, oil)
•Gaseous combustible (natural gas, biogas)

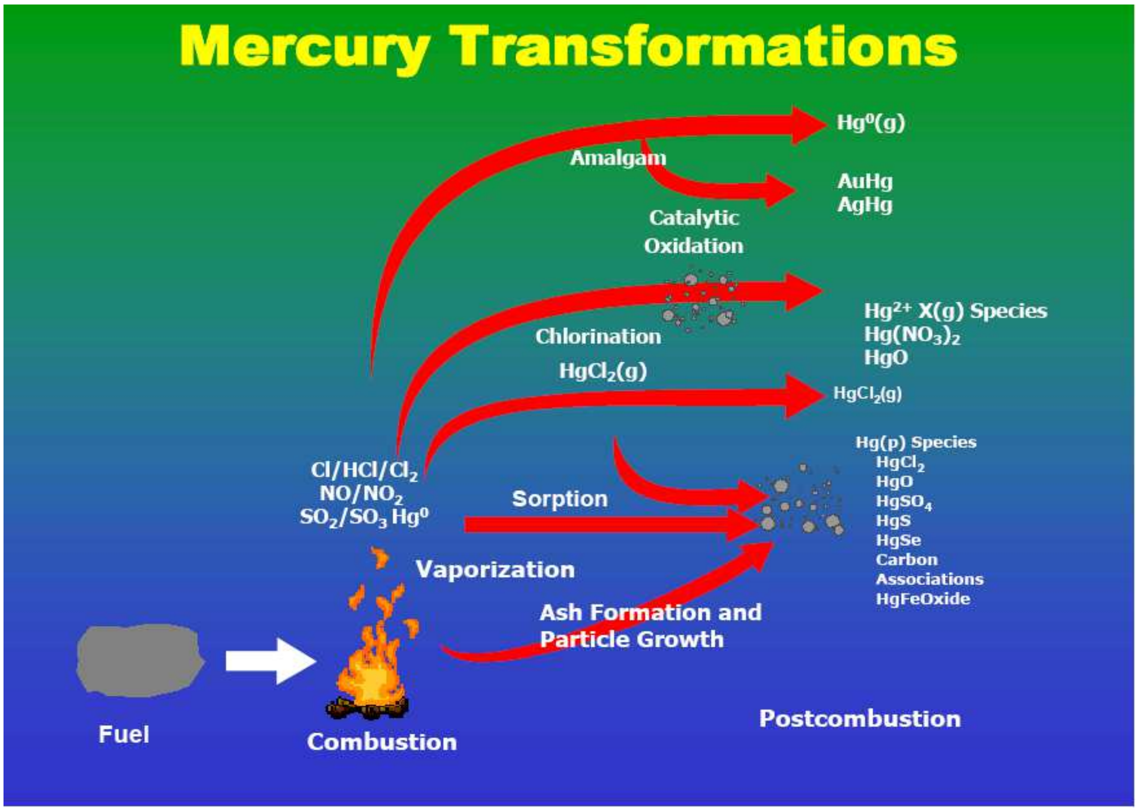
INCINERATION

•Domestic waste
•Special waste (sludge, hospital, industrial)
•Biomass (complex, mixture)

OTHER APPLICATIONS

•Cement, Glass, Fertilizer

Figure 1



THE THERMO SCIENTIFIC MERCURY FREEDOM SYSTEM

WORKING PRINCIPLE: COLD VAPOUR ATOMIC FLUORESCENCE (CVAF)

The Thermo Scientific Mercury Freedom System is comprised of a Hg analyser (Model 80*i*), a Hg calibrator (Model 81*i*), a Hg probe controller (Model 82*i*), and a Hg probe along with additional peripheral components, such as a zero air supply, umbilical, and instrument rack.

However, the Model 80*i* is also available as a stand-alone instrument. The Model 80*i* Analyzer is based on the principle that Hg atoms absorb ultraviolet (UV) light at 253.7 nm, become excited, then decay back to the ground energy state, emitting (fluorescing) UV light at the same wavelength. Specifically,
Hg + *h*v (253.7*nm*) → *Hg* *-→ *Hg* +*h*v (253.7*nm*)

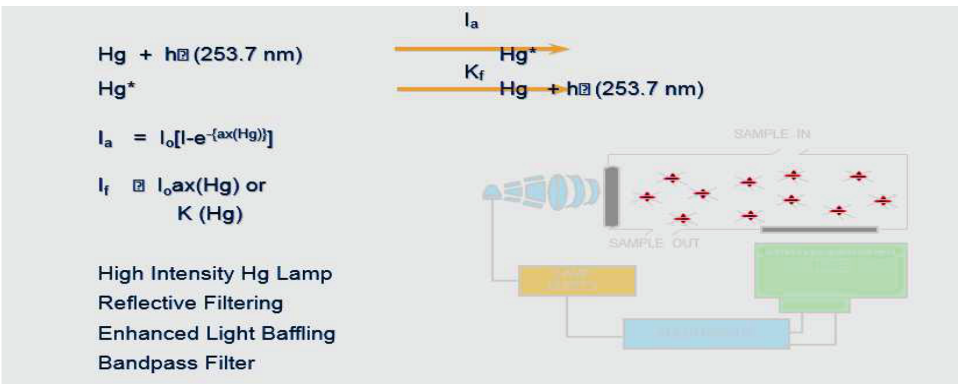
CONCEPT OF OPERATION – HG COLD VAPOR ATOMIC FLUORESCENCE (Figure 2)

FEATURES OF MERCURY FREEDOM SYSTEM

•Direct Measurement and Continuous using CVAF
•No additional gases required
oUses Diluted Sample
•Lower moisture, less reactive
•Capable of Speciation
•Measures both HgT or Hg0
•Analyzer Detection Limit: ~1 ng/m3 (~0.1 ppt)
•No cross interference with SO2

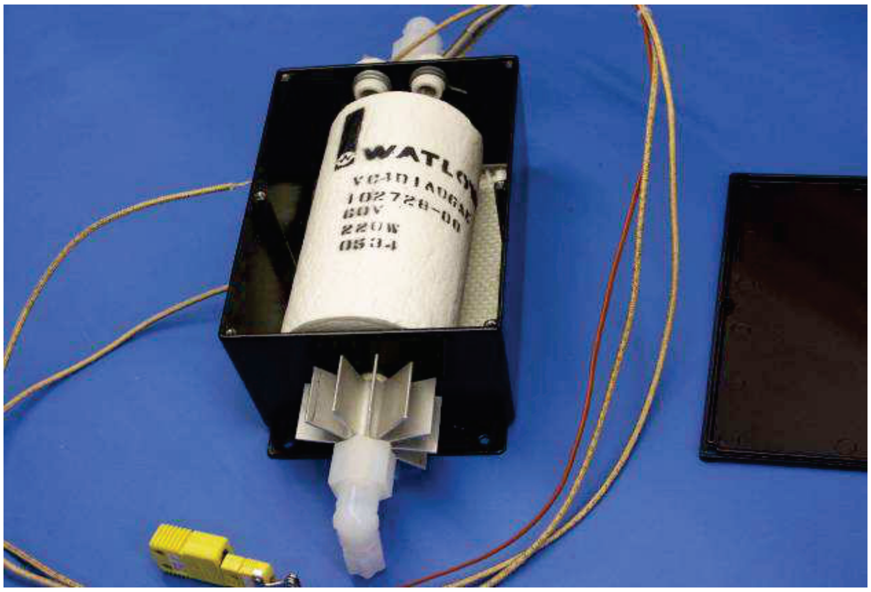
The Mercury Freedom System offers high measurement sensitivity, fast response times and robust operation in harsh environments through a simple design that closely resembles a traditional wet-basis dilution extractive CEMS. The system is capable of measuring elemental, ionic and total mercury in exhaust stacks through the use of Cold Vapor Atomic Fluorescence technology. This design also eliminates the need for an SO2 scrubber, commonly used with atomic absorption systems, or an expensive carrier gas (e.g Argon). The system provides true continuous measurement as opposed to batch collection by pre-concentration of mercury on a gold amalgamation trap

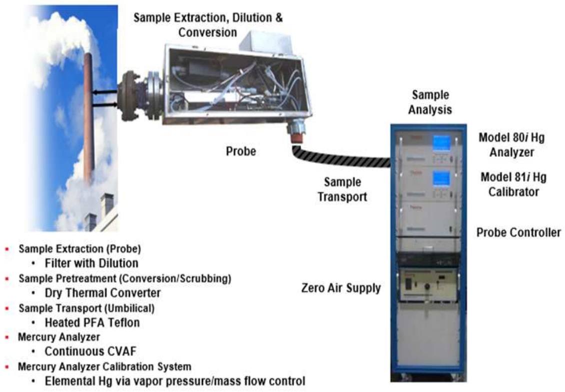
The Mercury Freedom System consists of a sampling probe at the stack, a heated umbilical line for sample transport, and a rack of instruments that include the analyzer, calibrator and probe controller. The rack, which is placed in an accessible temperature controlled location, also contains a zero-air generator and a sample pump. A working diagram of the Mercury Freedom System is shown in Figure 4. The system extracts the sample using a probe. The probe contains filter that prevents particulate clogging and requires less frequent maintenance. The sample is



diluted with instrument-generated zero air or nitrogen before it is transported to the Thermo Scientific Model 80i analyzer, which detects elemental mercury (Hg0), not oxidized mercury (Hg2+). In order to detect all (total) mercury, oxidized mercury needs to be converted into elemental mercury. The probe splits the sample into two flow paths. One uses a dry converter to convert the oxidized mercury into elemental mercury. This way, one of the sample tubes carries elemental mercury and the other tube carries total mercury, which includes the converted oxidized mercury. Converting the oxidized mercury at the stack minimizes the loss of mercury in the sample line, and consequently removes the need for high temperature in the umbilical line. The Model 80i analyser, Model 81i calibrator and Model 82i probe controller all reside in the rack. The diluted sample from the probe is transported through the optical chamber, where it is subjected to a high intensity UV light source. Mercury in the sample is excited by 253.7 nm wavelength light, which causes it to fluorescence; the fluorescent intensity is directly proportional to the amount of mercury in the sample. The fluorescence is measured by a photomultiplier tube (PMT). Because only mercury is excited by the chosen wavelength, interference from other pollutants is eliminated. The Model 82i probe controller controls probe parameters such as pressure and temperature, and also controls automated blowback and secondary valve functions.

High Temperature Thermal Converter: Ionic Mercury to Elemental Mercury (Figure 3)





MERCURY CEMS OVERVIEW

Figure 4

When used with the Thermo Scientific Zero Air Supply, the Model 82i delivers clean dilution gas to both the Model 81i calibrator and the probe Model EPM.302). The Model 81i calibrator generates mercury vapor used to calibrate the Model 80i Analyzer and the CEMS. It uses a Peltier Cooler and mass flow controllers to generate precise amounts of elemental mercury. Mercury span gas is transported through the sample line to the probe. During a calibration cycle, the calibration gas floods the probe and is drawn through the filter back into
the analyzer for measurement.
The Model 80i analyzer displays Elemental Hg, Oxidized Hg, and Total Hg concentrations. The analyzer is totally self-contained, linear through all ranges and uses atomic fluorescence detection technology for fast response time and high sensitivity. The Model 81i Mercury Calibrator generate a specific and consistent concentration of mercury. The generated mercury concentration, as measured by the model 80i analyzer, is
used to confirm the reliability of the model 81i calibrator output in accordance with
U.S. EPA Interim Elemental Mercury Traceability Protocol requirements

At the stack

1. Mercury Extraction Probe (Figure 5)
   a. Eductor Extraction
   b. Filter
   c. Dilution
   d. Dry Thermal Converter
   e. Oxidizer

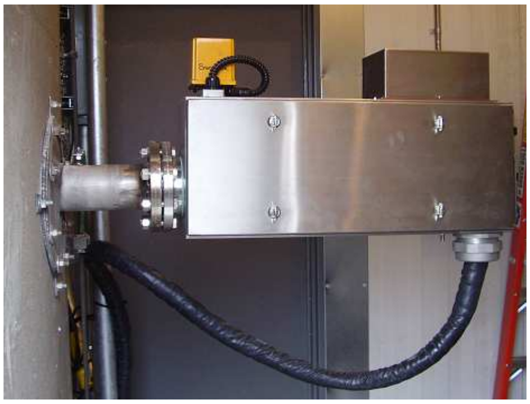


Figure 5
Model EPM.302 Probe Assembly Along with Converter installed at Stack (Figure 5)

- Conversion at Stack of IONIC mercury to ELEMENTAL Mercury, Reduces re-oxidation of Hg especially in the presence of SO3 or other acid gases
- Stainless steel system housing meets NEMA 4X specifications.
- 4 inch Mounting Flange bolts to the Mantel special Flange.
- Extraction – Eductor Venturi
- Ionic Hg Conversion - Dry Chemical / Thermal Conversion (Hg (+2) -> Hg (0))
- Mercuric Chloride Generator $HgCl_2$
- The Dilution Module pulls a small volume of Stack gas through the Filter and an Orifice, and dilute the concentration with Conditioned Air.
- Small volumes of this “Diluted Sample” are drawn through an 250

mL/min critical orifice to mix with the dilution air or nitrogen.

- An Orifice and a Hg(2+)   Hg(0) Converter (Total Channel)
- An Orifice (Elemental Channel)

PERIODIC QUALITY ASSURANCE REQUIREMENTS

For Hg CEMS:

- Daily calibrations---with elemental Hg or $HgCl_2$
- Weekly system integrity check (1 span point)
- Quarterly linearity check with elemental Hg or system integrity check with $HgCl_2$
- Annual RATA and bias test.

SUPERIOR MEASUREMENT:

The Mercury Freedom System offers high sensitivity and a true real-time measurement:

- **High Sensitivity**: The specially designed CVAF bench operates under a superior vacuum that allows
- the direct measurement of elemental mercury. The sample bench has high sensitivity
- **No interferences**: The CVAF method guards against interferences with acidic gases like SO2, an issue with Atomic Absorption Spectroscopy, because only mercury fluoresces at the chosen wavelength of light source, ~253.7 nm.
- **Real-time response**: Because the sample can be directly transported to the analyzer for measurement, the Mercury Freedom System is able to
-
  generate a true continuous real-time response.

However, it must be recognized that the Mercury Freedom System requires more *support* than a generic CEMS. Our studies reveal that, by rule of thumb, that the Mercury Freedom System would require anywhere from 1.5 to 2 times the service resources needed for a conventional CEMS, a factor that is dependent on the application, familiarity with the system and regularity of service.

CONCLUSION

The Mercury Freedom System has been successfully tested and installed in multiple Power Plants and cement plants.
In summary, our field tests have proven that the current design of the Mercury Freedom System is fully capable of meeting the regulatory monitoring requirements of the Power and Cement industry. We will continue to focus on enhancing the range and sensitivity of the instruments to meet more stringent needs.

ACRONYM

CVAF – cold Vapour Atomic Fluorescence
MDL – Minimum Detectable Limit
CEMS – Continuous Emission Monitoring System
OSHA – Occupational Safety and Health Administration

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BIOGRAPHICS

- Sh. Anant Ghadigaonkar was Born in Mumbai , India in the year 1967. He graduated in Instrumentation from Mumbai University having B.Sc Physics, B. Sc Tech (Instrumentation) and MMS in Marketing Degree. He is Ex- BARC employee. He is Result oriented professional with over 21 years of experience in the Environmental Monitoring and presently associated with ThermoFisher Scientific India Pvt. Ltd. Mumbai, India (Wholly Owned subsidiary of ThermoFisher Scientific Inc. USA) as Regional Sales Manager for Central Part of India
- He is Skilled at efficiently imparting necessary training to the colleague and Engineers of the customer about the Thermo EPM Product Line and then precautions, running, maintenance and sterilizing information for the product supplied.
- An effective communicator with excellent relationship, management skills and strong analytical, problem solving abilities.

Efficient Plant Asset Management

Ulrich H. Hempen, Head of Market Management, WAGO Kontakttechnik GmbH, Germany

KEY WORDS

Asset Management, Preventive Maintenance, Predictive Maintenance, Plant Efficiency, Production Efficiency, Digitalization of Production Plants

ABSTRACT

The availability of industrial production facilities is an essential success factor for a high-quality production facility. For optimum availability, it must be possible to calculate wear in advance and to plan maintenance procedures so that the operator can plan downtimes due to maintenance and repair work. For this optimum availability, all operating resources of a plant must be digitally recorded, including those parts that are not connected in classic process automation. Projects have shown that it makes sense to separate the local process automation from production plant spreading asset management at distributed production plants. Process automation is local, asset management is comprehensive and even across production sites.

Introduction

Machines, plants and production processes are typically controlled by decentralized controllers and control systems. Rising labour costs and energy costs, the need for higher availability and planning reliability, however, make it necessary to coordinate the entire plantwith additional asset management monitoring solutions. In particular, the foresighted view of production processes including necessary maintenance processes, raw material logistics, production capacities and accompanying production processes makes it necessary to digitally record the entire production plant in addition to the core automation and make it available as a virtual image. Only when the entire production process, including all surrounding dynamic processes and stationary and moving components, has been digitally captured is it possible to plan in advance. Thus an optimally conceived asset management of a production focuses on the complete digital recording of all Asstes and passive components involved in the production, such as non-automated pipelines, up to hazard monitoring, control of traffic and logistics routes, hazard alarms, access alarms and buildings and grounds.

Topology

A complete virtual image of the production plant initially creates a transparent view of all plant components involved in production and links the previously separate plant components such as logistics, production/process plant, warehousing and distribution in a data view. This enables permanent, complete monitoring of the plant. One of the biggest cost factors with regard to energy and maintenance within the plants are the pumps. Vibration monitoring systems are necessary for consistent preventive maintenance, as are additional acoustic and visual monitoring and possibly paired with analysis of the supplied energy. In process engineering plants, intelligent field devices for pressure, temperature, level, flow rate and analysis and actuators such as positioners and valves offer further diagnosis and status data in addition to the primary measured value and control value. However, these can only be read out via the integrated HART communication or PROFIBUS PA or

Fieldbus Foundation. This diagnostic data, however, provides important information about the status of the running process as well as historical data up to manufacturing data and factory settings. Previously, data had to be read out from these field devices using local hand-held communicators or via the distributed control system (DCS). Further utilization of this data in superimposed analysis tools in cloud architectures was not previously planned or in the company's own software tools associated with the control system. Further use beyond the control system was not planned until now, but is increasingly required in order to use the data, for example, in cloud applications across multiple sites. Another aspect has not yet been considered in large production plants: The analysis of the electric current at pumps and aggregates. Electricity is replacing pneumatics more and more, so that electric current becomes the primary energy source in production and process plants. Anaomalies can be detected on the basis of consumption and even damage to rotating machines can be detected with higher analysis of the current. The analysis of the current is a future area for the preventive maintenance of pumps and aggregates. In combination with vibration and temperature sensors, more precise conditions can be predicted.

IT Security

The great obvious advantages of the digitalization of production and process plants and the remote access they allow are countered by the danger of cybercrime. Hacker attacks become possible as soon as a free Internet address is available on the Web. However, there is no danger with pure monitoring of the system without output signals. Only values are read and a possible hacker cannot change any output signals that intervene in the process. This is an important advantage over asset management solutions that are embedded in control systems like DCS or PLCs. If these asset management data are transferred from control systems to cloud architectures for remote and location-independent analysis, this is a potential danger for hacker attacks in order to reach these controllers backwards and manipulate outputs at the controllers. With asset management solutions that are installed separately and have no connection to the process, this danger does not exist.

Communication

Regardless of the physical transmission selected, the last five years have shown that OPC UA (OPC Unified Automation) is an increasingly accepted data model for use in factory and process plants. It offers the adaptation within ETHERNET TCPIP other fieldbusses like PROFINET and the future mobile standard 5G. OPCUA is an operating system independent standard for the communication of data from the decentralized asset management level up to the use in cloud systems and ERP systems. OPC UA offers integrated basics for IT security and is increasingly recognized in process and manufacturing automation. It is also the basis of the future deterministic standard PROFINET TSN.

In addition to the data model, the introduction of the 5G mobile communications standard offers a variety of options for transferring data from asset management parallel to the existing IT of a production plant. As soon as the asset management data is integrated with the company IT network, there is a gateway for hacker attacks. This can be avoided if the asset management data is consistently separated. With the introduction of 5G, there is no longer any need to communicate asset management

data via the local IT network. 5G promises data rates up to 20 times faster than 4G which offers the possibility for additional asset management sensors visual and akustic monitoring.

Data Analysis

The data analysis takes place in cloud systems, which make it possible to be accessible independent of location, so that they can be accessed on any end device worldwide. The decisive factor, however, is the analysis of the data. Depending on the process to be analyzed, this should be done in different applications on the cloud. As an example, a pump monitoring application in which the analysis of the current compared with the temperature and the vibration over time indicates possible necessary maintenance.

BIOGRAPHY

Dipl.-Ing. Ulrich H. Hempen was born in Germany. After two technical apprenticeships as a power plant electronics technician, he studied electrical engineering and graduated as a graduate engineer. He then worked from 1990-1995 at Hartmann&Braun AG as Product Manager for HART and Profibus transmitters, from 1995-2001 first as Product Manager and afterwards as Director for System Technology at Endress+Hauser AG, from 2001-2007 as Managing Director of the system integrator Endler&Kumpf and since 2007 as Head of Market Management for WAGO Kontakttechnik in Germany.

Modular Automation

Presenter: Ulrich H. Hempen, Head of Market Management, WAGO Kontakttechnik GmbH, Germany

(Author: Dr. Thomas. Holm, Dr. Michael Obst, Dr. JanLadiges, Dr. Thomas Albers, Prof. Leon Urbas, Prof. Alexander Fay, Ulrich Hempen)

KEY WORDS

Modular Automation, MTP, DIMA, Modular Plant, NE148, NAMUR

ABSTRACT

The modularization of process plants is regarded as a promising way of managing the future requirements of the process industry. The „Decentralized Intelligence for Modular Applications (DIMA)“ shows a method of Modular Automation meeting the requirements described in NE148 for the modularization of process applications. Studies to date have shown that the use of module type packages (MTP) is a promising way of describing process modules. The NAMUR working group 1.12 is currently working in collaboration with different ad-hoc working groups of NAMUR and the German ZVEI on the standardization of the MTP. This paper presents new findings on the description and integration of modules using MTP. The results will be executed on an application demonstrator to allow a practical assessment. In this way module and integration engineering software can be demonstrated.

Introduction

The requirements placed by the market on production in the process industry have changed considerably over the past decades. These changes are mainly characterized by fluctuating procurement and sales markets (see [1]) as well as the shortening of product life cycles, particularly also with regard to chemical products [2]. Furthermore, ever shorter innovation cycles are required and there is an increasing demand for the customization of products [3]. It has to be expected that these background conditions will become increasingly prevalent, particularly in the future environment of Industry 4.0 [4]. All the more reason, therefore, to achieve the market maturity and financial viability of product and technology innovations quickly, an early market launch of new products is regarded as a critical factor in the financial success of a production [5]. One requirement that can be deduced is the ability to adapt the production plants, the production volume and the product portfolio to actual market conditions. However, in conventional plant construction, there is a dichotomy between increased flexibility in capacity on the one hand and production efficiency on the other [6]. Neither continuous production nor batch production are currently optimally geared to meeting these market requirements in conventional plant construction. As a result, production companies are frequently forced to accept considerable production losses in order maintain as optimum a price/sales ratio as possible. New products are accordingly only launched for reliable markets, whilst new and promising technologies are only utilized with considerable delay [6]. Location-based production costs vary, whilst emerging countries are raising their production index [1]. Political uncertainties worldwide may cause a production location that was regarded as optimal during the planning phase to no longer meet the requirements of the plant owner during the operative phase. The need for the mobility of production plants is therefore one of the key factors in future production success [3]. Reuse through modularization is considered a key technology for managing the above challenges in the field of small-scale production plants [7]. The modularization approach represents a considerable advance in shortening the time required for the construction and planning of small to medium-sized production plants [2]. Through the use of sector specific