

Optical Sensor Monitoring and Analysis Platform

INTELLIGENT SENSOR SYSTEMS LTD



Mission

- To provide high quality integrated intelligent sensing solutions to make the energy industry safer, greener and more efficient.
- To develop reliable, cost-effective system solutions for our customers in the harsh-environment and industrial applications. We will achieve this by empowering our dedicated team and leveraging strong partnerships with our customers.
- To be the preferred source of total solutions for our customers, driven by our passion for new sensor products and technologies while maintaining the highest standards of service and support
- Our Vision:

Today's creative innovation is the foundation for tomorrow's better world

Outline

- Optic Fibre Sensor Products
- Optic Fiber Sensor Systems for monitoring hazard sources
- Demonstration Projects

Optic Fibre Sensor Products

- **Fibre Optic Temperature Sensors**
- **Fibre Optic Liquid Level, Pressure Sensors**
- **Fibre Optic Methane Sensors**
- **Fibre Optic Strain and Displacement Sensors**
- **Fibre Optic Seismic Sensors**
- **Fibre Optic High Temperature and High Pressure Sensors**

Fibre Optic Temperature Sensors



Temperature Sensors for High Voltage Switch Temperature Monitoring



General Purpose **Temperature Sensors**

Fibre Optic Liquid Level, Pressure Sensors



Liquid level sensor



High Temperature and High Pressure Sensor for Oil Well Down-Hole Logging

Fibre Optic Methane Sensors

- **Measurement Range:** 0-10%, (0-100%)
- **Measurement Error:** $\pm 0.05\%$, (Below 1%)
 $\pm 0.5\%$ (Above 1%)
- **Response Time:** < 20s
- **Calibration Period:** 6 Months

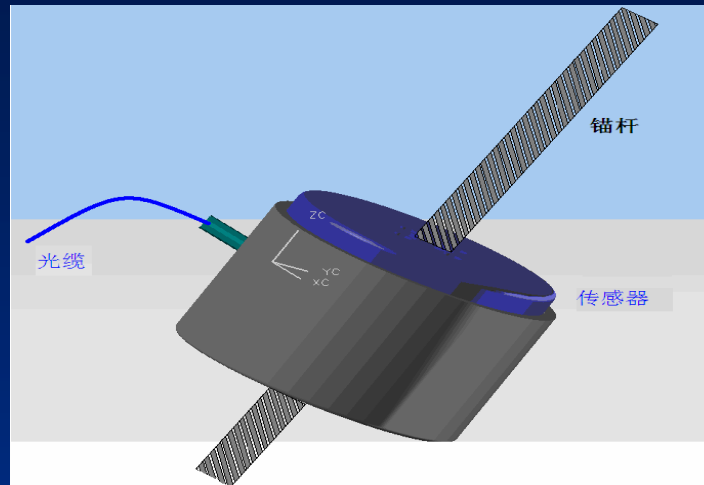
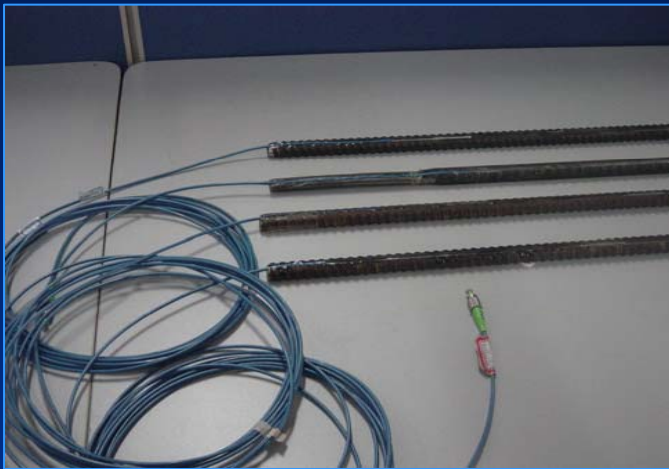
Features:

- **Not Charged;**
- **High Sensitivity ($\pm 0.05\%$)**
- **Long Calibration Period: 6 months**
- **Not Affect by Humid Environmental Impact**
- **Large Dynamic Range (0-10%;0-40%;0-100%)**



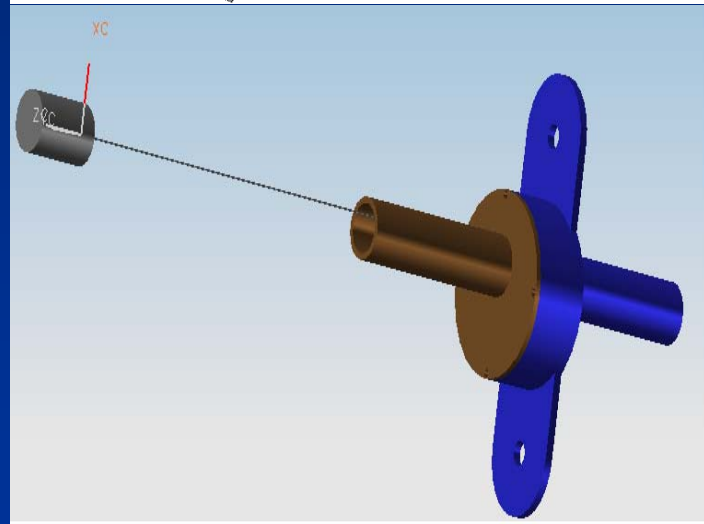
Fibre Optic Strain and Displacement Sensors

- FBG pressure sensor
- Small draft, online monitoring



Principle:

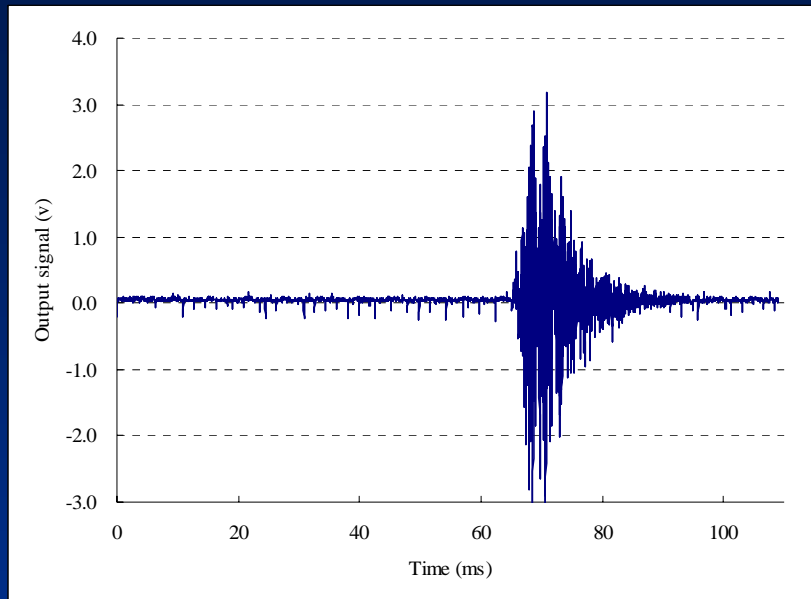
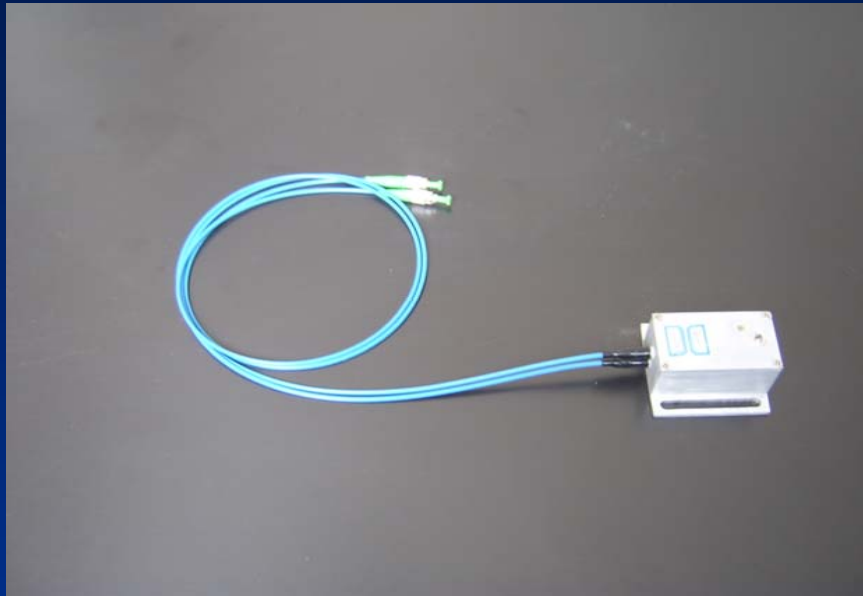
To convert the force at the anchor into the FBG internal deformation



To convert the displacement between the fixed anchor and the sensor into the wavelength change from the FBG

- FBG Roof separation monitor
- Measured Depth: 3~4m
- Accuracy: 0.5mm
- Range: 0~200mm

Fiber Optic Seismic Sensor



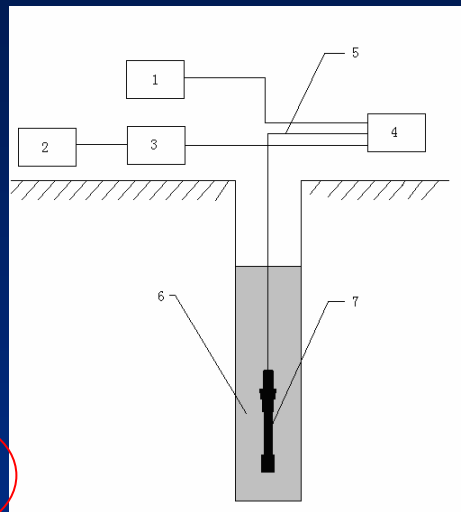
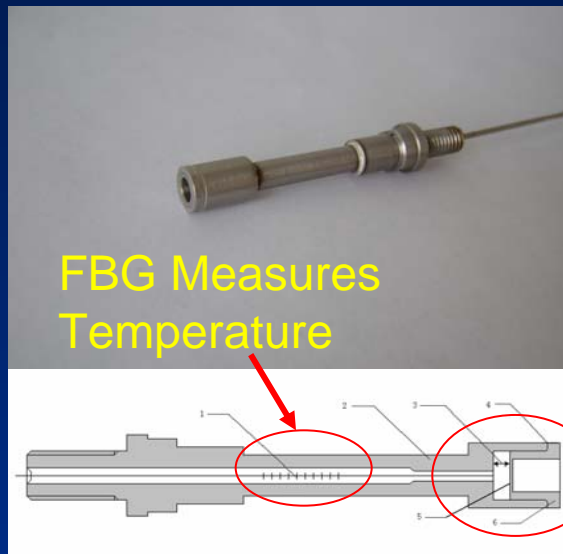
- OF Seismic Sensor
- Remote monitoring
- No active electrical components
- Immune from EMI
- High sensitivity

Specification:

Dynamic Range: 90dB;

Band width: 5~200 Hz

High Temperature/Pressure Sensor



P-F Cavity
Measures Pressure

Specification:

Temperature Range: -20 to 350 C. Accuracy: +/- 0.3 C;

Pressure Range: 0 to 40MPa, Accuracy: +/-0.2%

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Why OFS Early Warning Platform?

- Since the sensor head does not have any active electrical components, it is intrinsically safe when used in the hazard environment such as coal mines ;
 - OFS based monitoring network is capable to monitor the conditions of mine roof, electrical and mechanical equipments and detect rock burst, hazard gas, fire, flood, etc;
 - OFS system addresses the constraints of multi-location and multi-parameter online monitoring issues;
-

Advantages of OFS Early Warning Platform

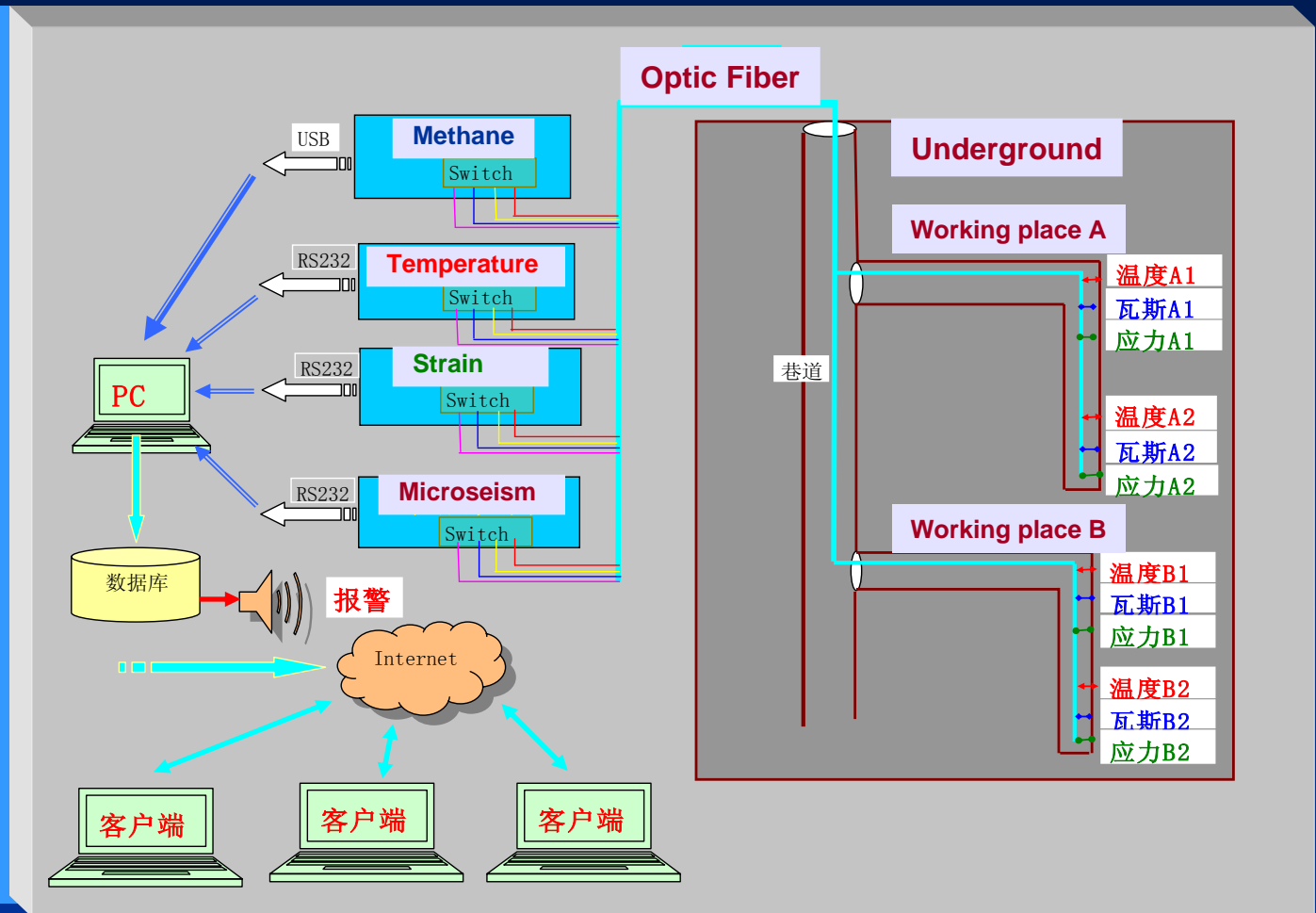
- **Intrinsic Safety:** data collection and transmission can be fully achieved through the fiber which is intrinsic safe;
 - **Multi location and multi parameter:** The on-line remote monitoring at multi locations (over a few kilometers) and with multi parameters can be achieved with an optical fiber network.
 - **Multi-functional:** one fiber-optic sensor may probe a variety of gases, such as CO, O₂ and CH₄ etc;
 - **Intelligent decision-making:** the mine disaster is often caused by geology change, mining vibration, ventilation or support movement. By monitoring all these parameters in an integrated optic fiber intelligent sensor system, it is easier to identify the possible hazard before it occurred, hence enhance the disaster forecast through the early warning system.
-

Optic Fiber Sensor Systems Developed

- OFS for Mine roof/rock burst disaster detection
- OFS early-warning system for monitoring gases
- OFS early-warning system for fire preventing
- OFS detection system for flood control
- OFS detection system for on-line monitoring the Health and safety of electrical equipments

Fiber-Optic Coal Mine Safety Monitoring/Control System

- **Optic Fiber System:**
 - ➔ Methane
 - ➔ Strain
 - ➔ Microseism
 - ➔ Flood
 - ➔ Spontaneous Combustion
 - ➔ Electrical Equipment



Fiber Mine Roof Safety Monitoring

- Strain and Displacement Monitoring
- Seismic / Rock Burst Monitoring



Rock Burst Damage

Optic Fiber Methane Disaster Monitoring and Warning System



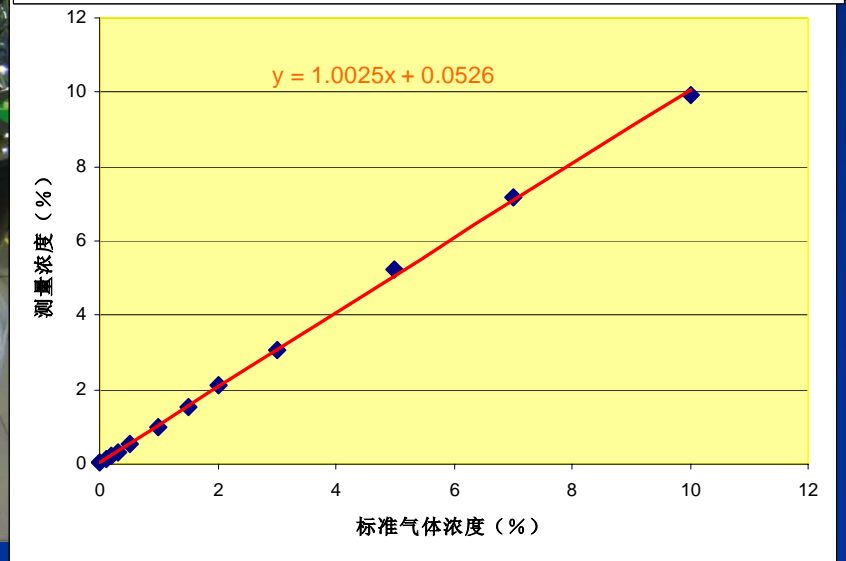
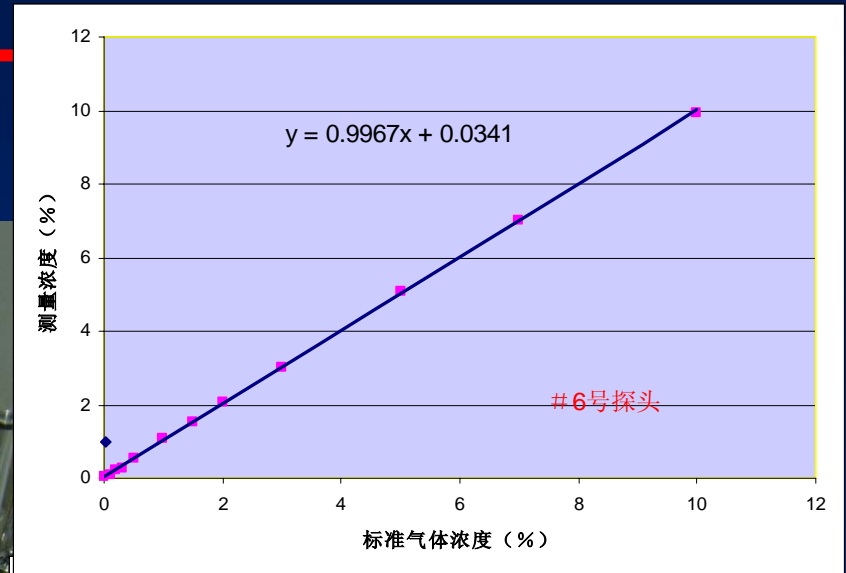
- Combine the Information of the concentration of methane gas, temperature and other parameters to set up a multi-variable expert system for early warning
- Enhance the monitoring capacity for early warning.

Test Results of Optic Fiber Methane Sensor

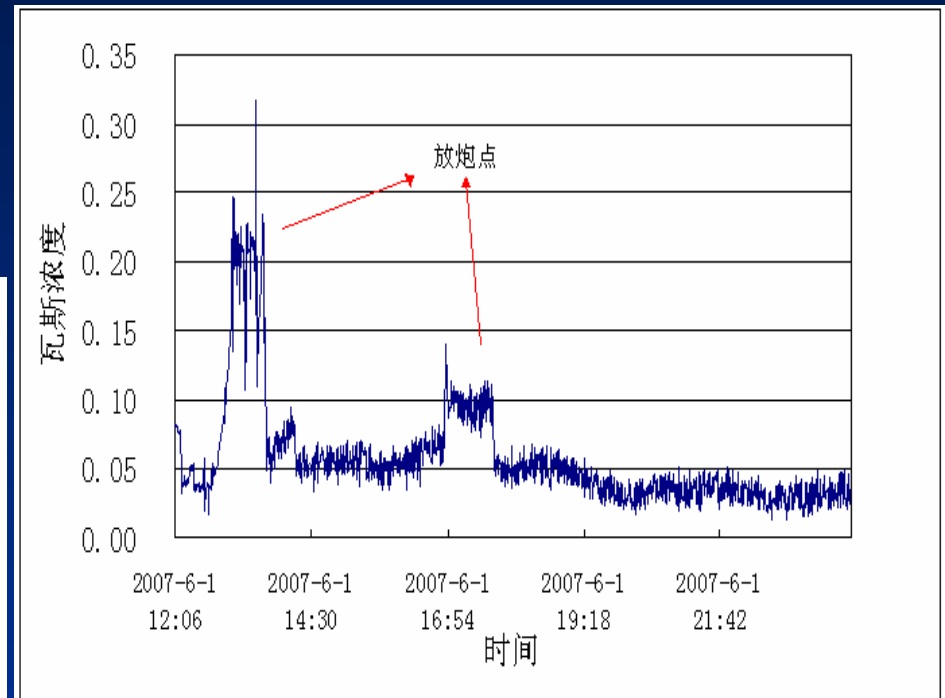
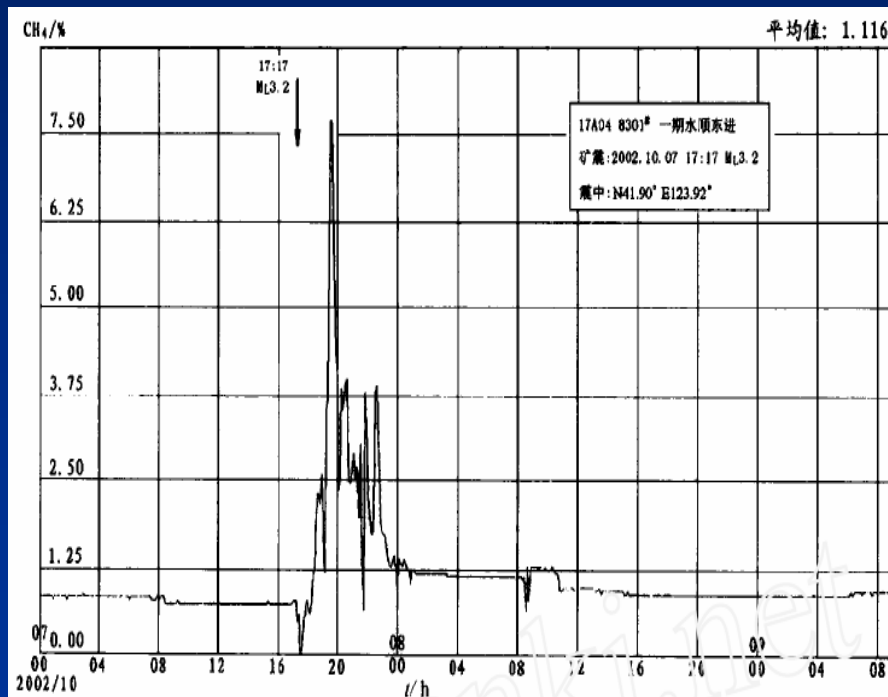
6 km Fiber cable



Different type of Methane sensors



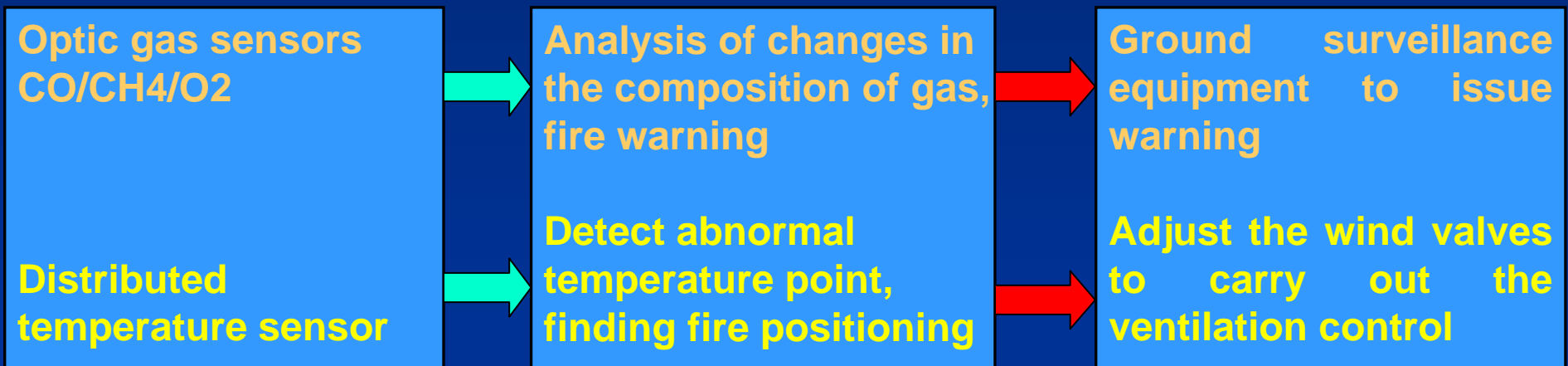
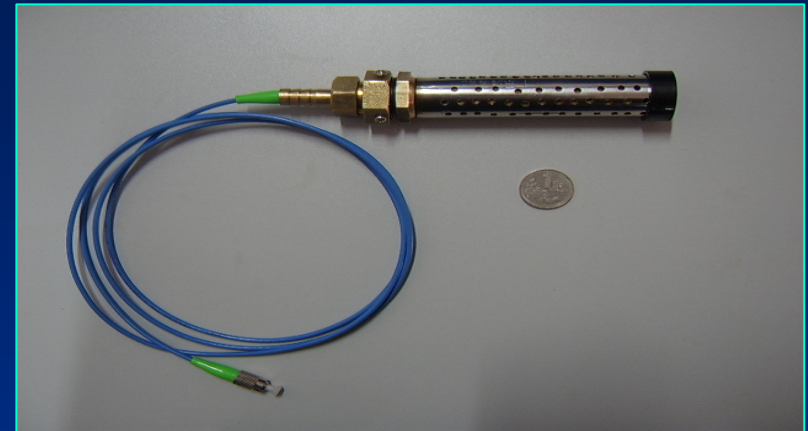
Optic Fiber Methane Disaster Monitoring and Warning System



OFS in the Fire Prevention and Control



- Early warning mechanism of the natural fire in the mined-out area,
 - ➔ Trace gas sensor to replace the tube bundle system
 - ➔ Temperature measurement
 - ➔ Analysis of changes in the gas composition



Based on Fiber-optic Distributed Temperature Sensor for Fire Detection

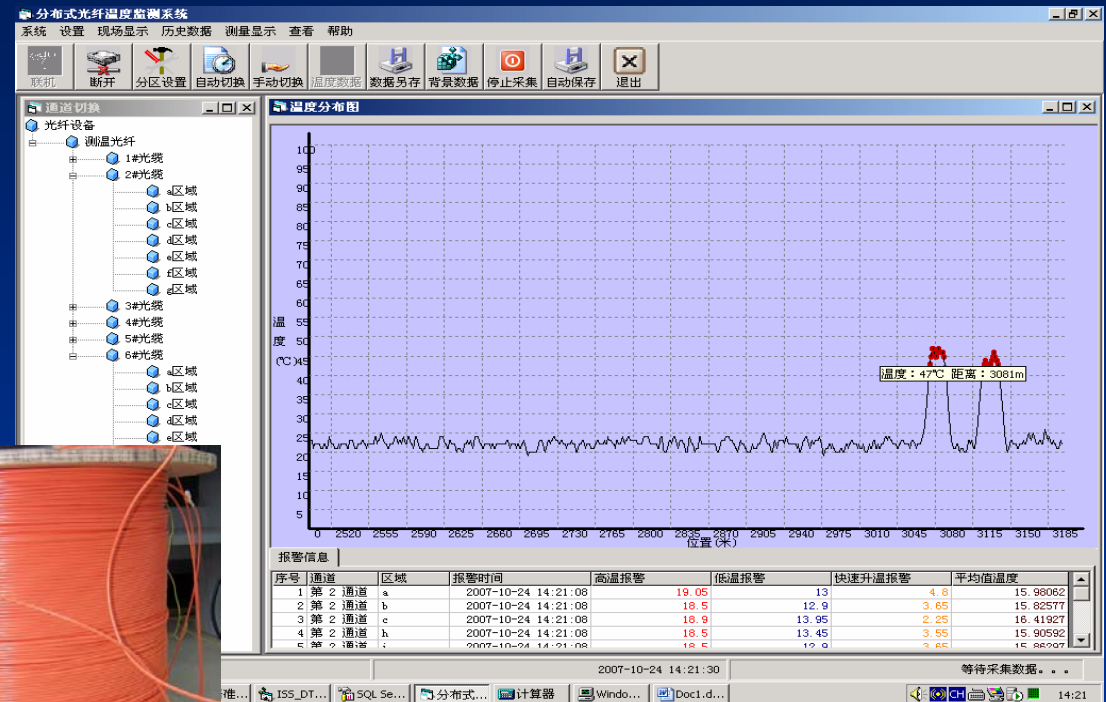
- Measure the temperature distribution along a 6 km fibre



Monitor System



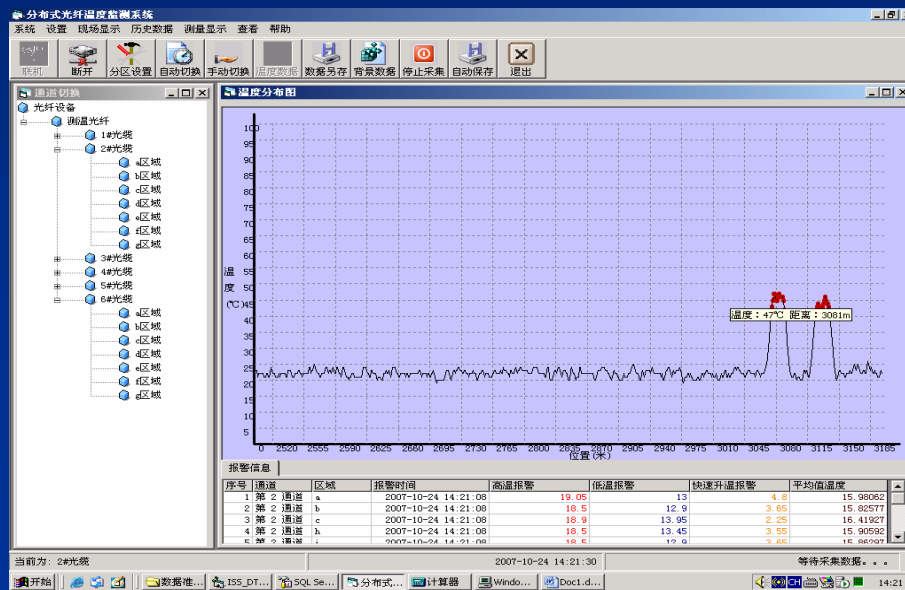
Sensing Fiber



Temperature distribution in a mined out area

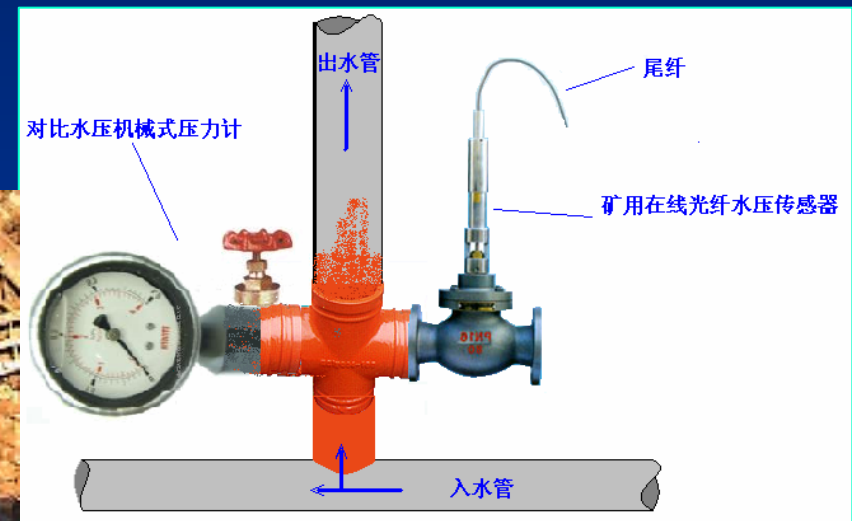
Fire Early Warning and Positioning on the Transport Belt

- Fiber sensing cable is embedded in the belt
- Point sensors to monitor motor temperature
- Intelligent cable with embedded fiber



Application of OFS in Flood Control

- Auto-mine drainage system
 - ➔ Fiber water level gauge,
 - ➔ automatic drainage system
- Monitoring water pressure in water-rich layer



Filed Comparison Test

OFS for Electrical and Mechanical Equipment Condition Monitoring

- Substation switchgear temperature monitoring
- Cable distributed temperature monitoring, fire early warning
- Intelligent Cable
- Fire early warning and positioning fire on the transport belt



Substation Switchgear Temperature Monitoring

FBG signal demodulation instrument

Substation control room



Fiber optic cable terminals Box



There are 6 to 12 temperature sensors in each switchgear



Optic fiber

Outline

- Optic Fibre Sensor Products
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Demonstration Project

- Zibo Coal Mine Group: black-Ling coal mine
 - Liaoning Fuxin Coal Mine Gas Power Plant
 - Laiwu GuJiaTei Iron-mine
 - Beijing's First Iron Ore Tailing Dam
 - Yankuang East Rail Power Substation
 - ShengLi Oil Field
-

煤矿安全综合信息监测系统现场安装示意图

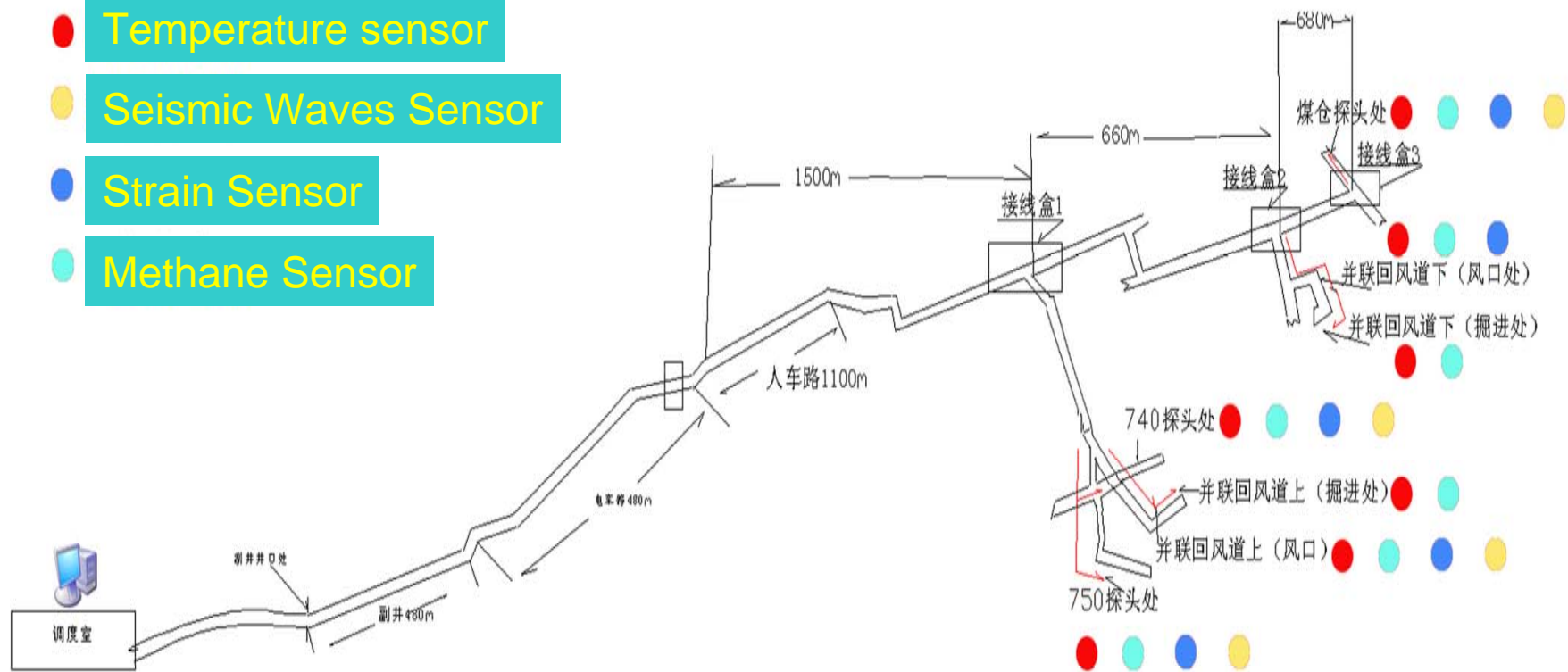
Zibo Black-Ling Coal Mine Demonstration Project

● Temperature sensor

● Seismic Waves Sensor

● Strain Sensor

● Methane Sensor



Zibo Black-Ling Coal Mine Demonstration Project

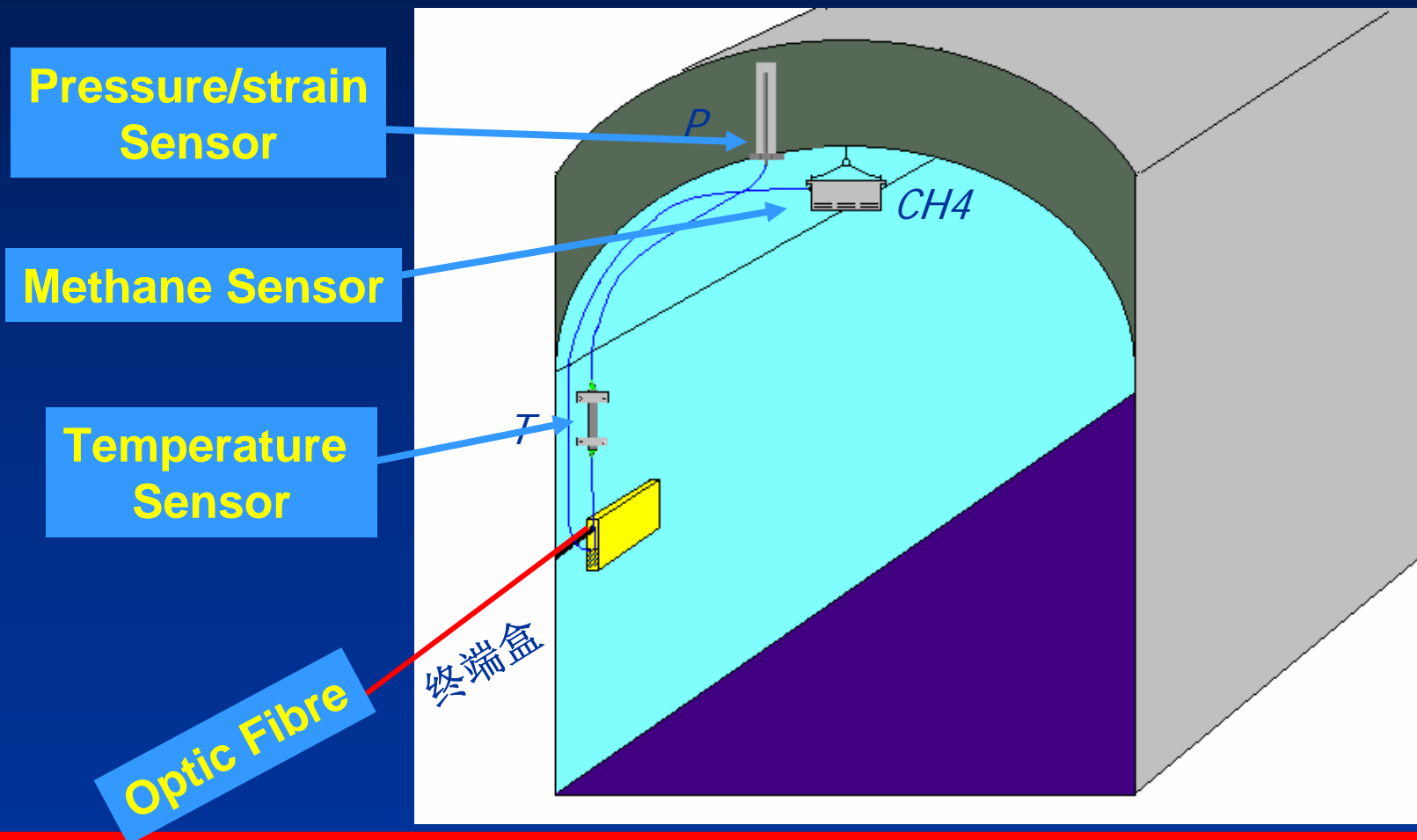
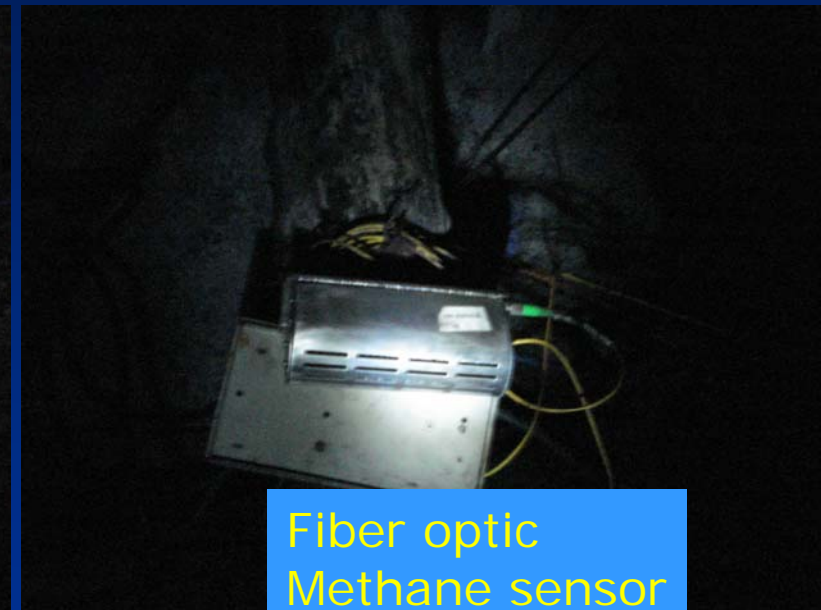
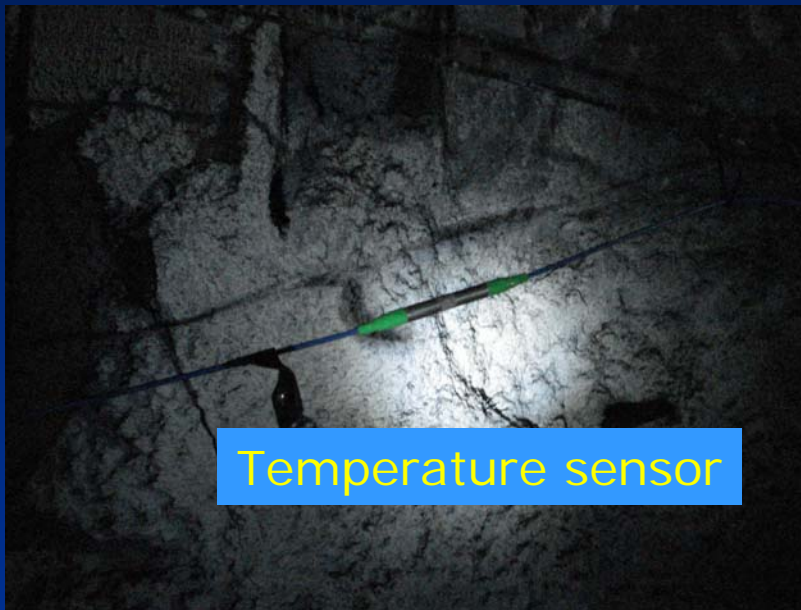


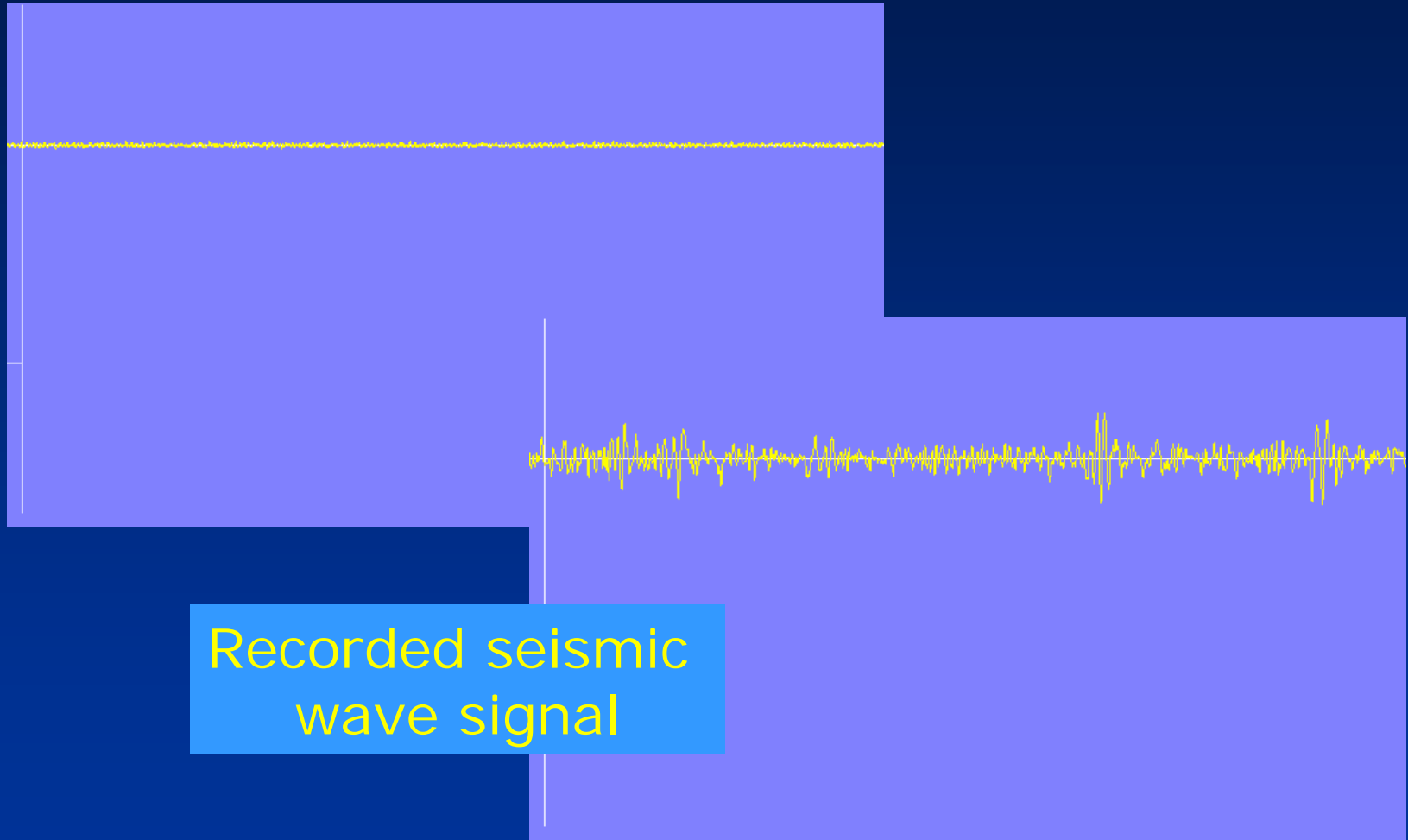
Illustration of Fiber Optic Sensor Installed in a Mine.

Zibo Black-Ling Coal Mine Demonstration Project



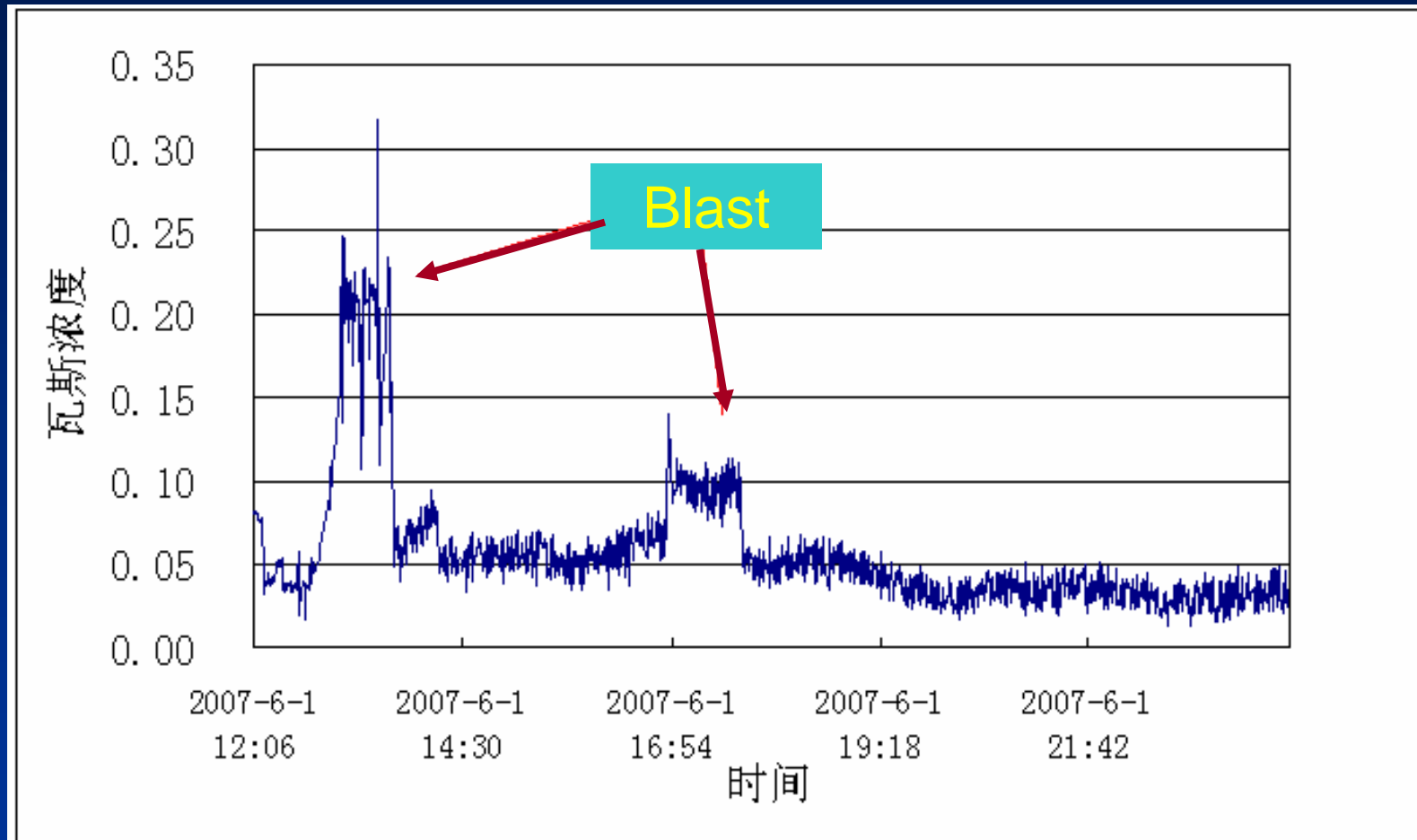
- Fiber Optic temperature sensor and methane sensor installed in an underground coal mine.
-

Zibo Black-Ling Coal Mine Demonstration Project



Recorded seismic
wave signal

Zibo Black-Ling Coal Mine Demonstration Project



Zibo Black-Ling Coal Mine Demonstration Project

煤矿监测系统 - Microsoft Internet Explorer

文件(F) 编辑(E) 查看(V) 收藏(A) 工具(T) 帮助(H)

地址(O) http://microsensor.gnway.net/mine/mainpage22.htm

煤矿监测系统

>>>您好! admin [退出登录](#)

全光纤煤矿安全综合信息系统 山东省科学院 山东煤炭局 淄博岭子煤矿

岭子煤矿通防智能化综合监控系统图 [查看大图](#)

功能列表

- 信息查看
- 修改密码
- 历史数据查看
- 实时数据查看
- 瓦斯实时查看
- 温度实时查看
- 应力实时查看
- 微震信号查看
- 参数设置
- 实时监控
- 每日报表
- 报警记录
- 用户管理

360总回风道:浓度 0.07%;温度 21.2°C应力 47 c 振动 m/s²上传时间 2007-04-30 11:13:00

0.070%

0.100%

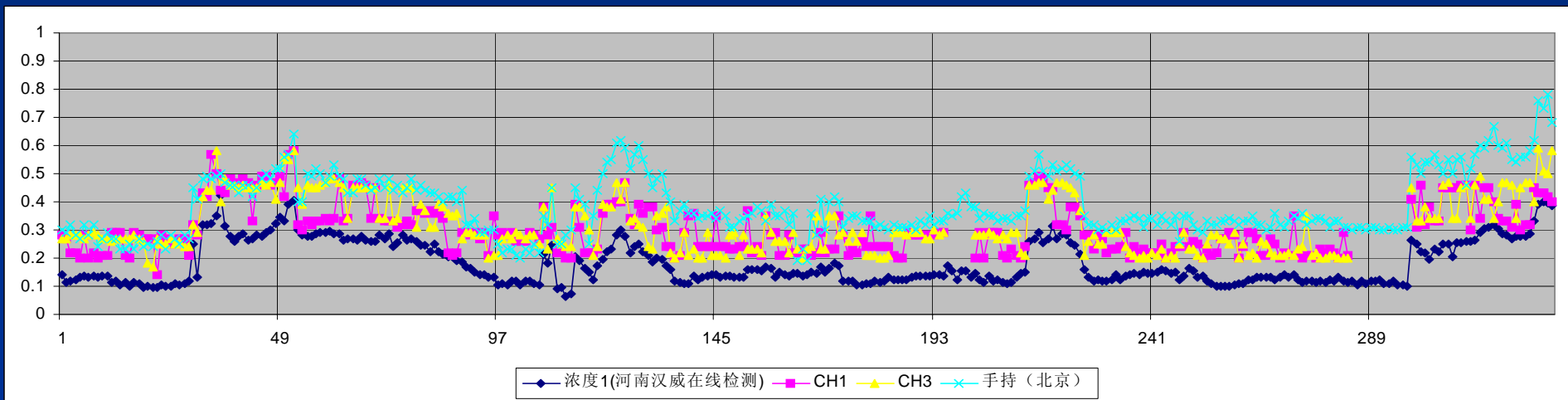
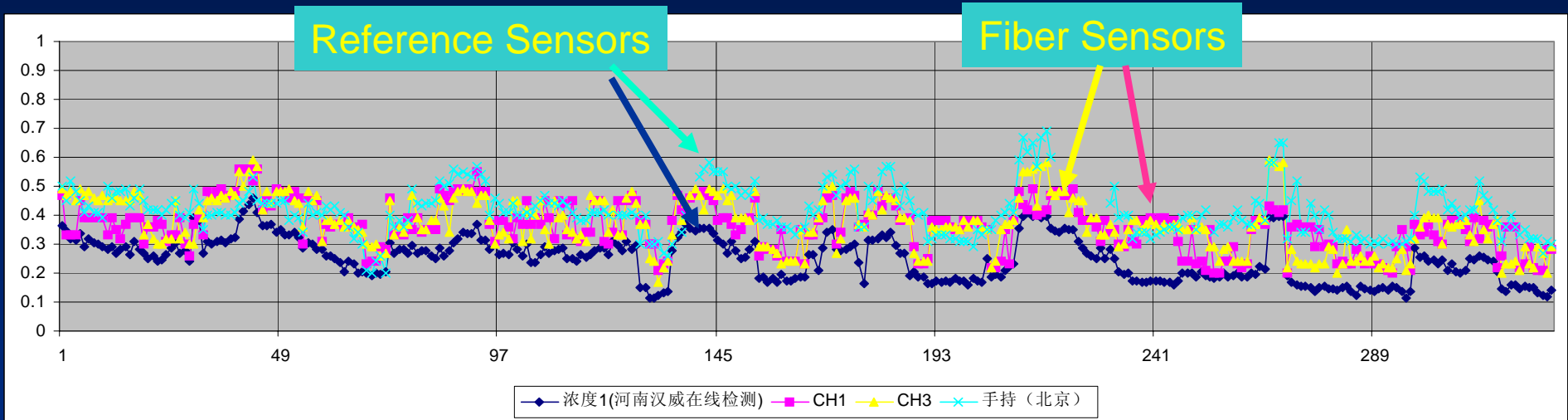
http://microsensor.gnway.net/mine/editbar_1.jsp

开始 煤矿监测系统 - M... 新建 Microsoft W... 2-point - 画图 13:35

Coal Mine Power Plan Methane Monitoring



Two-Week Test Results



Laiwu GuJiaTei Iron-Mining Program

[莱芜铁矿]光纤矿用解调系统 → 现场平面图

系统操作 现场显示 数据查询 报表 报警状态 设置 帮助



2008-06-15 11:33:41

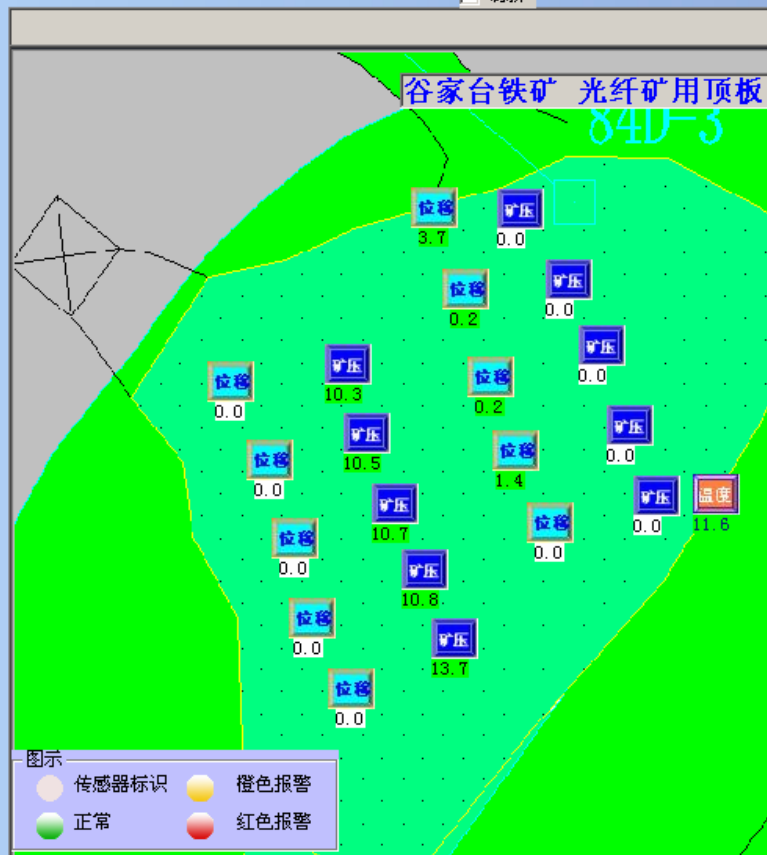


山东微感光电子有限公司
SHANDONG MICRO-SENSOR PHOTONICS LIMITED

- 现场显示
 - 现场平面图
 - 实时数据表
- 数据查询
 - 传感器查询
 - 报警查询
- 查看报表
 - 日报表
 - 月报表
 - 年报表
- 系统设置
 - 报警设置
 - 数据库设置
 - 信号解调设置
- 信号检测
 - 控制模式

● 现场显示 > 现场平面图

刷新



Laiwu GuJiaTei Iron-Mining Program

UA303数据采集器 Ver31

传感器

振动源

10-4 10-2 9-3

Mo Mo Fe Fe

25.0k 399.0k 309.1k 3256.10k 106.14k

帧和第一上限 10000 0通道 1通道 2通道 3通道 去直流 数据/频谱 10k 采样频率

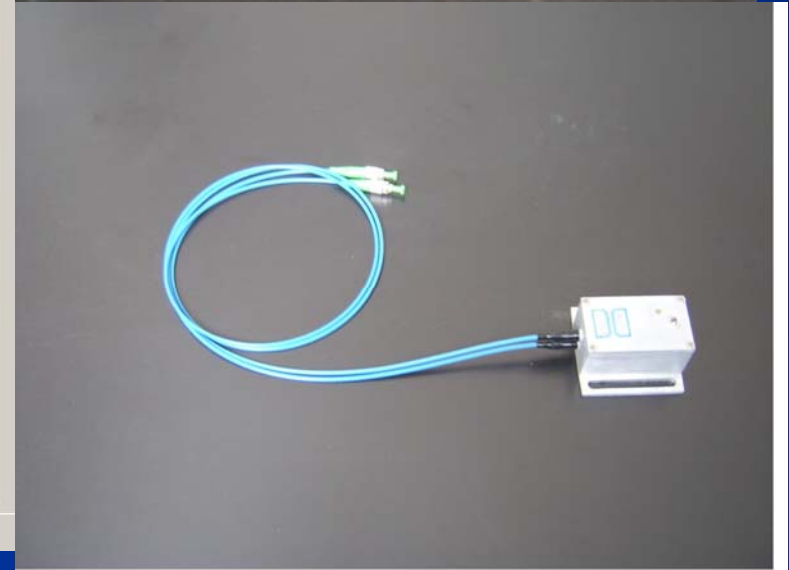
帧和第二上限 50000 起始通道 0 实时存储 16倍 电路增益

记录长度 39 传播速率 129 事件存储

打开文件 频谱分析 定位位置 X Y Z T 位置显示

实时采集 停止 隐藏设置

开始 UA303数据采集器 Ver31



Beijing's First Iron Ore Tailing Dam

系统操作 现场显示 数据查询 报表 报警状态 设置 帮助

2008-07-29 19:28:48

山东微感光电子有限公司
SHANDONG MICRO-SENSOR PHOTONICS LIMITED

开始扫描 停止扫描 现场显示 实时数据 报警状态 参数设置 功能导航

● 现场显示 > 现场平面图 刷新

数据更新时间：
2008-7-29 19:28:42

安科院 首云尾矿库坝

传感器信息

位置：尾矿库坝西坝A3-3

检测值：16.2 ℃

注：检测值为传感器安装位置坝面距检测孔内水面深度

报警状态：正常

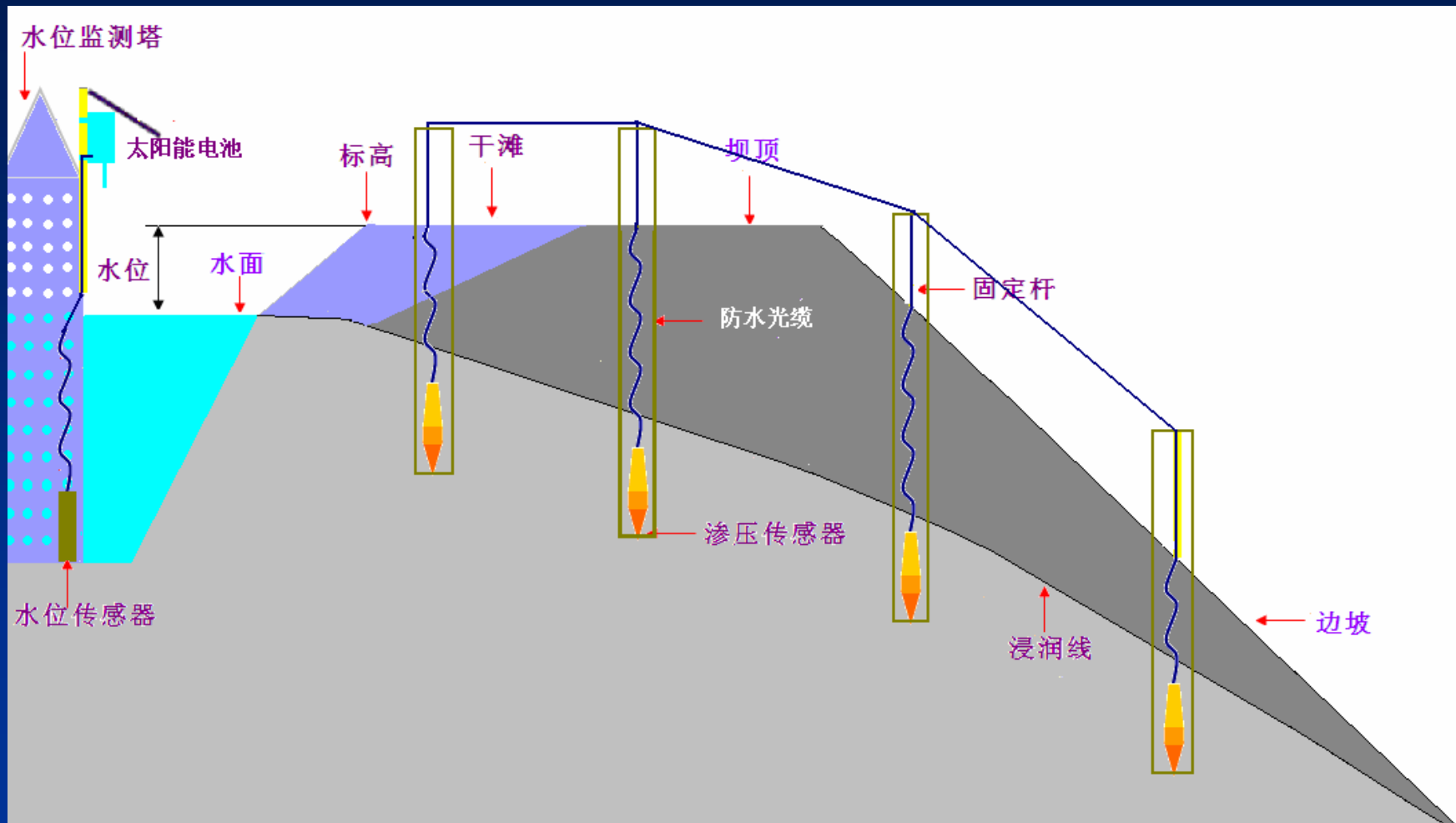
报警信息

报警信息	值	位置

清除

● 光纤渗压监测点 ● 电子渗压监测点

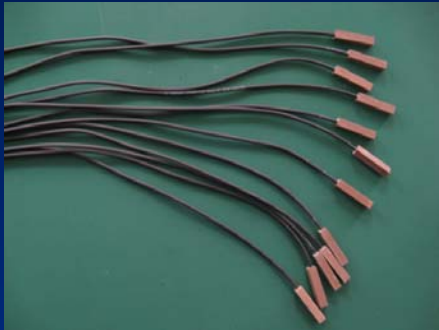
Beijing's First Iron Ore Tailing Dam



Beijing's First Iron Ore Tailing Dam



Yankuang East Rail Power Substation



Fiber-optic safety monitor in high voltage switchboard

Yankuang East Rail Power Substation



开关柜内下刀闸传感器布置图



开关柜进线传感器布置图

Fiber-optic safety monitor in high voltage switchboard

Yankuang East Rail Power Substation

铁东多点测温 V1.01

程序控制 ©

山东微感光电子有限公司 山东六方智能技术有限公司

开始检测 停止检测

● 铁东变电所

现场显示 铁东变电站

数据查询 开关柜查询 传感器查询 报警查询

查看报表 日报表 月报表 年报表

系统设置 报警设置 数据库设置 信号解调设置

信号检测 控制模式

图示 列表

1#主变低压侧 35KV所变-变压器主体

时间: 2007-3-2 11:18:00 位置: 6030[多种经营]> 上刀闸静触点> B相 现在温度: 6 °C

三十七处 多种经营 2#进线 [6002-3] 2#进线 [6002-2] 2#PT 华圣石粉 孟庄砖厂 搪瓷厂 西区 消弧线圈 6KV联络 [6000-2] 6KV开 [6000-1]

六处 2#电容 二十米桥

北库 二院 东区 [6029] 备用

[三十七处-西] [六处-西] [东区锅炉-西] [二院-东] [六处-东] [三十七处-东]

[东区-西] [多种经营-西] [二院-西] [东区锅炉-东] [多种经营-东] [东区-东]

电缆接头位置 电缆接头 [二院-3 (屋顶)]

电缆桥架 [电缆接头]

检测已经停止..... 13:55

开始 运行 网络 铁 温 第 找 在 铁 t. 13:55

Yankuang East Rail Power Substation



ShengLi Oil Filed



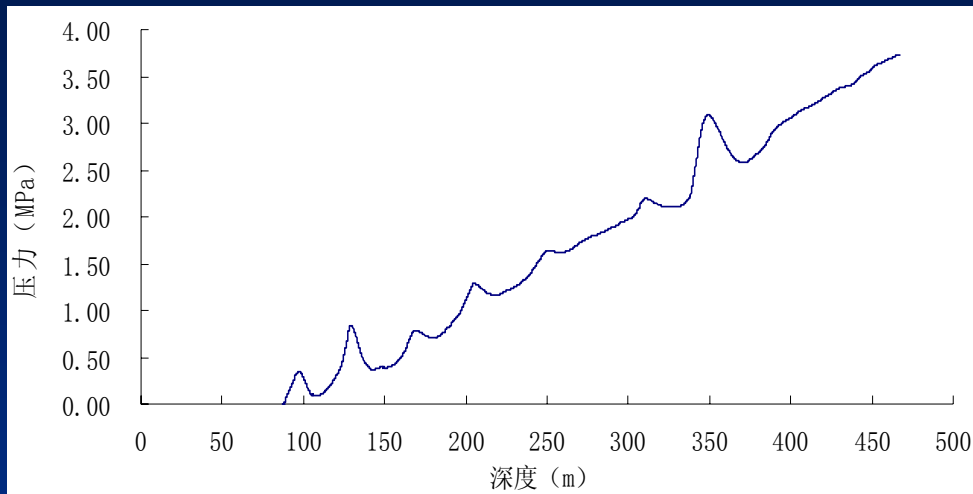
Prepare for install the sensor



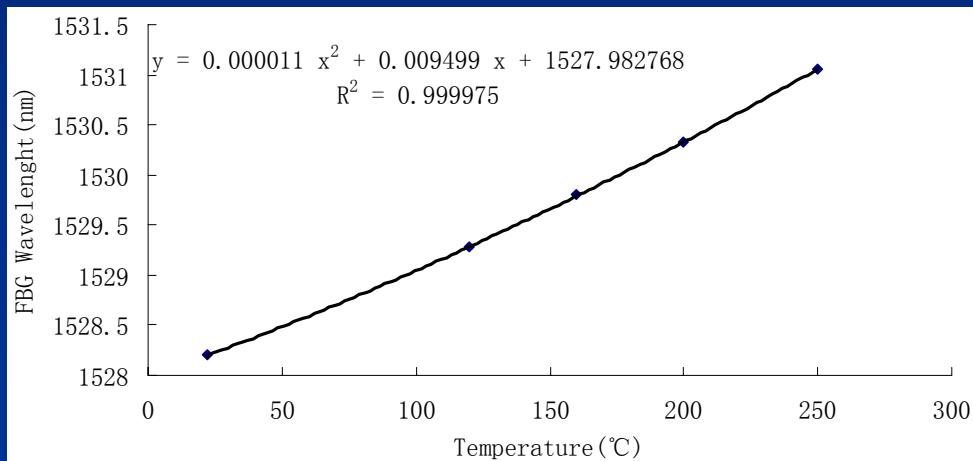
The measurement is taken as the sensor is dropped into the oil well



Shengli Oil Filed



Measured pressure vs
The depth of an oil well



Measured wavelength
variation vs temperature

Summary

- Fiber-optic sensors provide a reliable means for real-time monitoring and analysis of a variety of mine risk sources ;
- Fiber-optic sensor integrated safety monitoring system can issue early disaster warning based on multi-parameters such as the roof movement, the rock burst, hazard gas, water damage and spontaneous fire etc;
- After years of R&D effort, both optic sensors and integrated systems have been well advanced. The performance and stability of the sensor system have been widely tested in different applications. ,
- At present, the temperature sensing system has been certified, a number of other products have been on-site tested and will be gradually deployed in the wider field;
- The introduction of the fiber-optic sensor hazard monitoring and analyzing platform will play a key role in making our mines safer, greener and more efficient.