



Monitoring of circuit
breakers

IEEE Switchgear Committee
November 1999
Pittsburgh, PA

**Extra High Voltage Circuit Breaker Monitoring
and
Approach to the Concept of Maintenance on Demand**

ALSTOM

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INTRODUCTION

Advances
in:

Micro
processors

Processes
controlled

Deregulation
Competitive
Environment

Reduced Costs
and Reduced
Maintenance

With high reliability monitoring of
circuit breakers

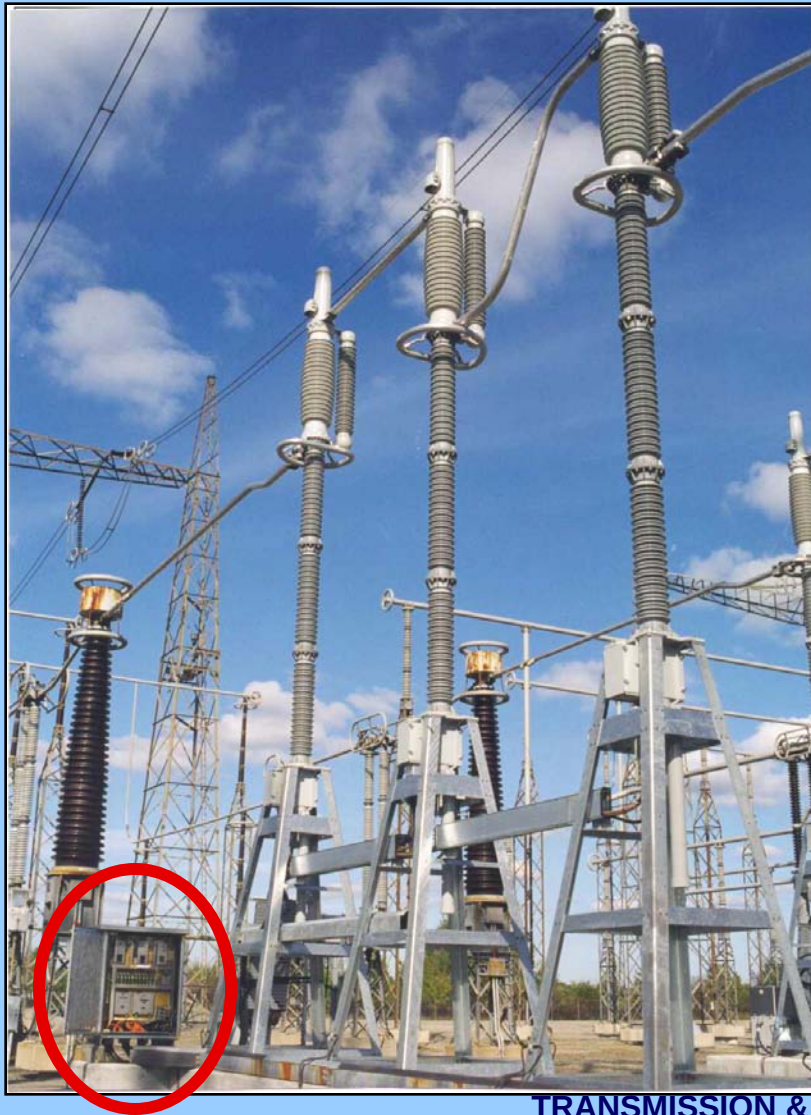
Lead to increase of:

Availability

Reliability

& Reduce
Maintenance
Costs

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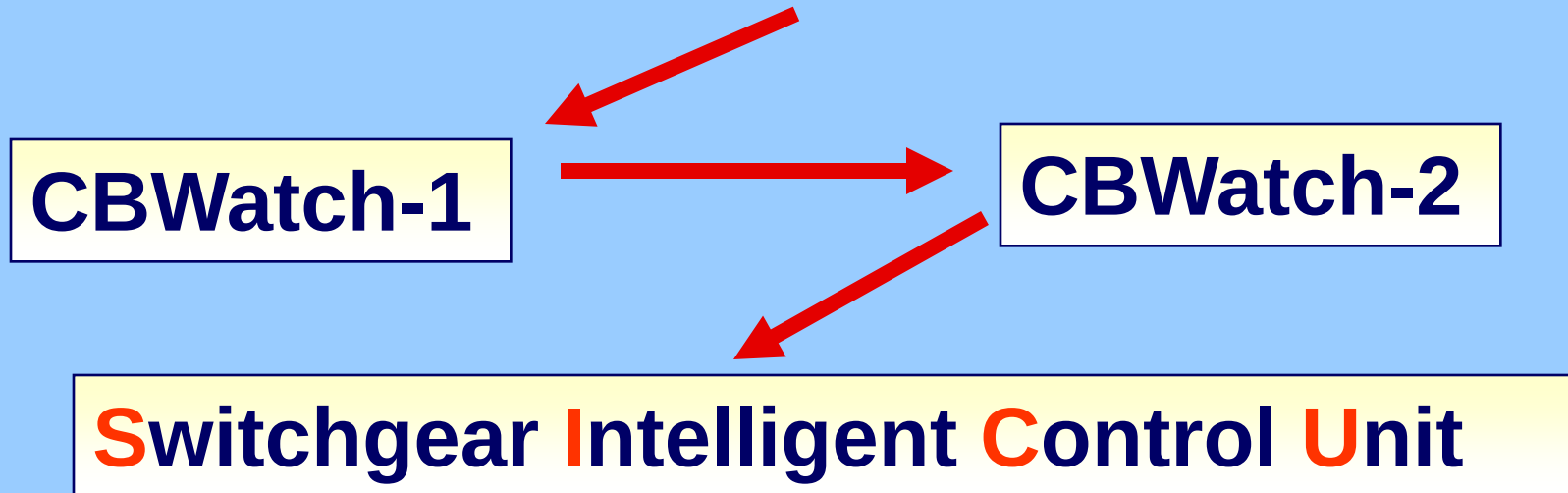


BPA & Ontario Hydro:
Monitoring and Control
Early 1990's



TRANSMISSION & DISTRIBUTION
High Voltage Switchgear

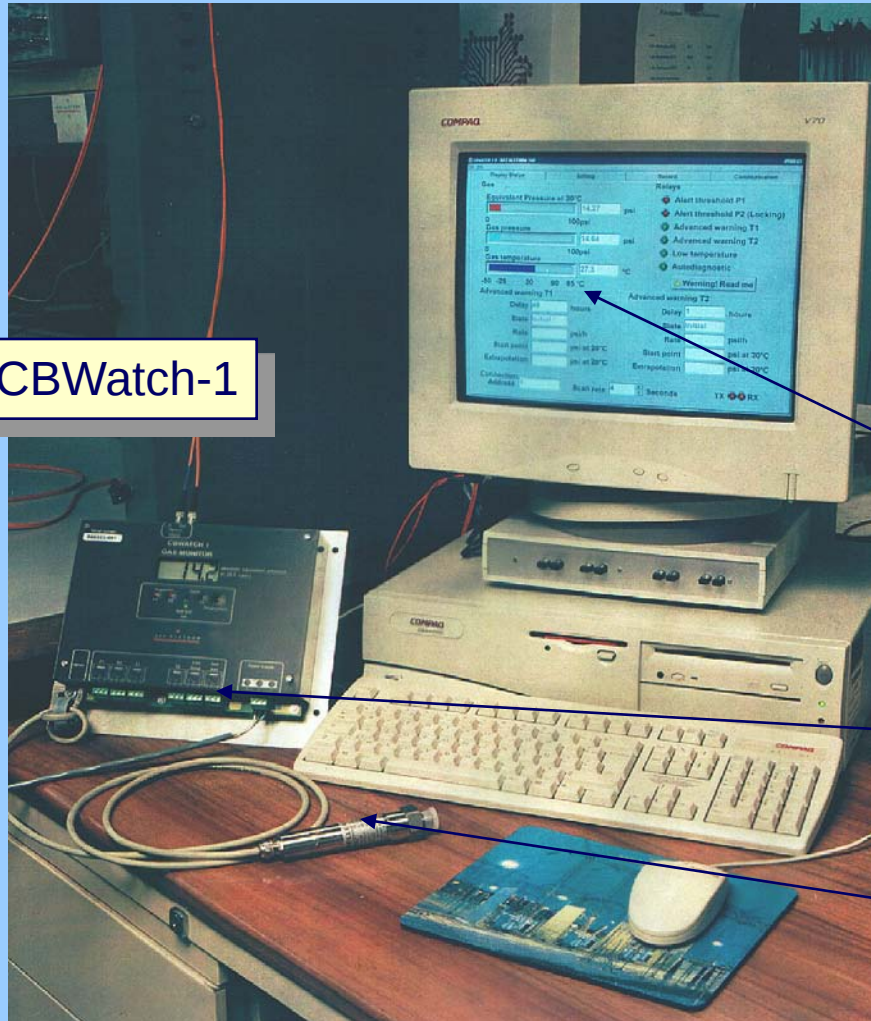
Late 1990's, early 2000's.
The CBWatch Family



Part 1.
CBWatch-1
SF₆ Monitoring System

- **Description : Local displays**
- **LCD (3 1/2 digits): Displays the temperature compensated pressure at 20°C: i.e. a density.**
- **LEDs display alarms and warnings:**
 - P1 threshold = refilling pressure & alarm,
 - P2 threshold = lock-out pressure & alarm,
 - T1 advance warning (low leakage rate),
 - T2 advance warning (high leakage rate),
 - Low temperature (liquefaction),
 - Self-diagnostic OK.

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CBWatch-1

Human Machine Interface.

Software Running

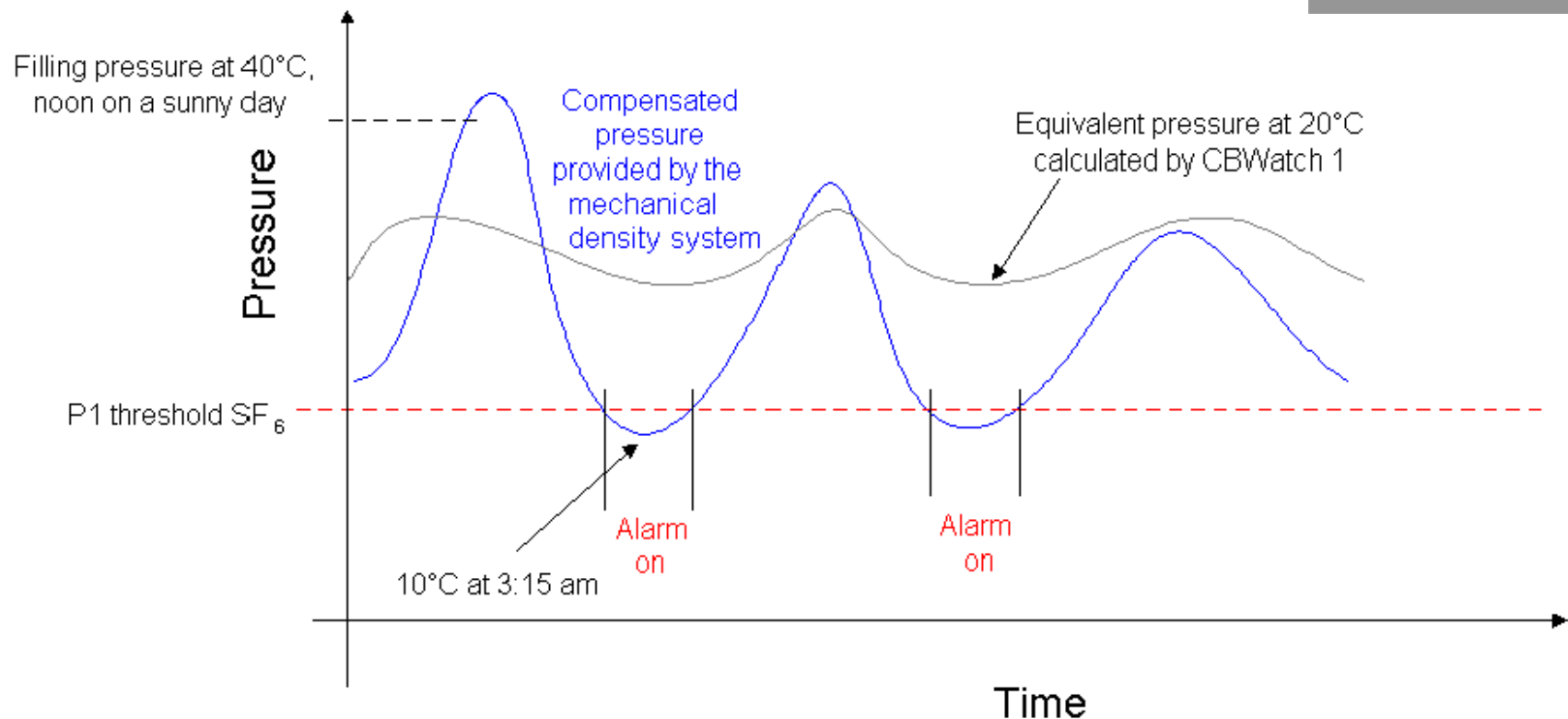
CBWatch 1

Sensor made by Keller

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- **Example:** Circuit-breaker installed in the New Mexico desert:
- Effect of wide temperature variation (30°C) between **day** and **night**

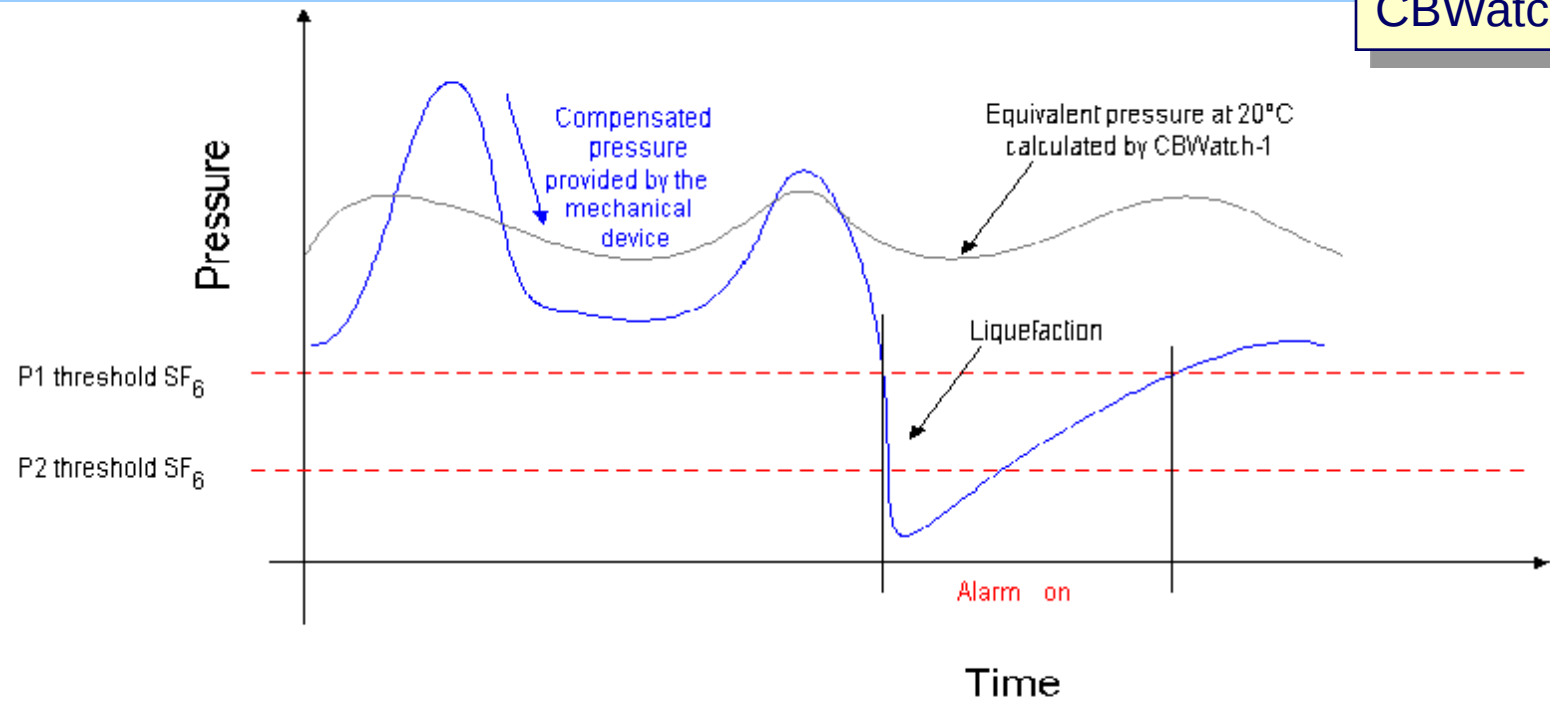
CBWatch-1



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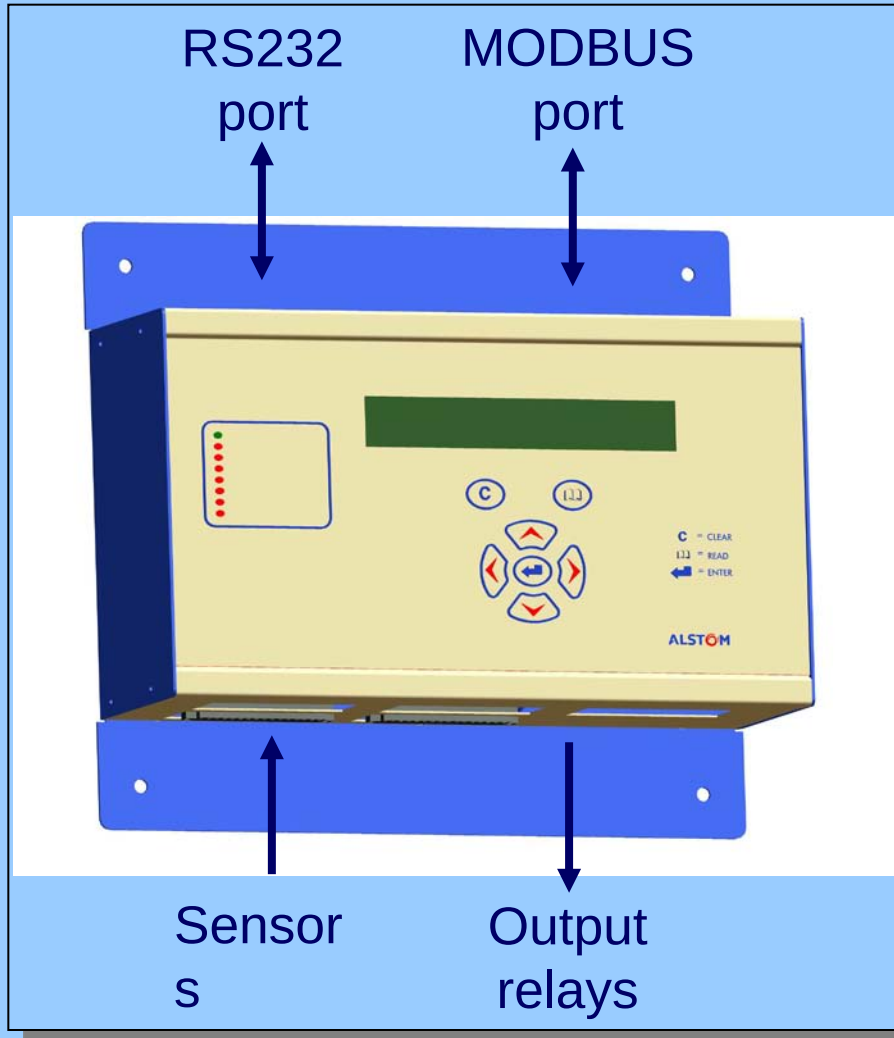
- **Example: Breaker at James Bay (Northern Quebec)**
- When, exceptionally, temperature falls below the liquefaction point:
- A conventional densimeter will activate the P2 threshold (refilling required),
- CBWatch1 will send the message: **Temperature too low. Do not refill.**

CBWatch-1



Part 2.
CBWatch-2
Modular monitoring system

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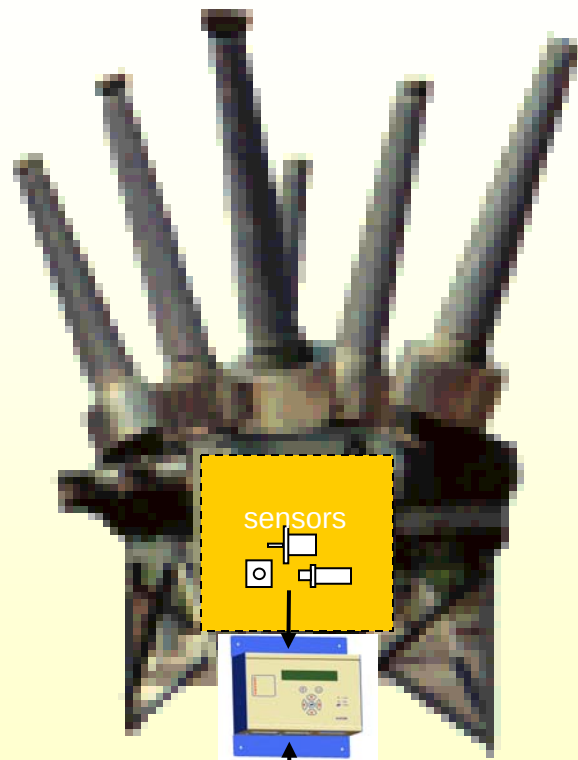


- **Modular system:**
Installation of any combination of functions (SF₆, operations, ...)
- Industry standard sensors
- Local display and keyboard (option)
- **Communication:**
 - Local RS 232 port
 - RS 485 MODBUS port
 - Output relays

CBWatch-2

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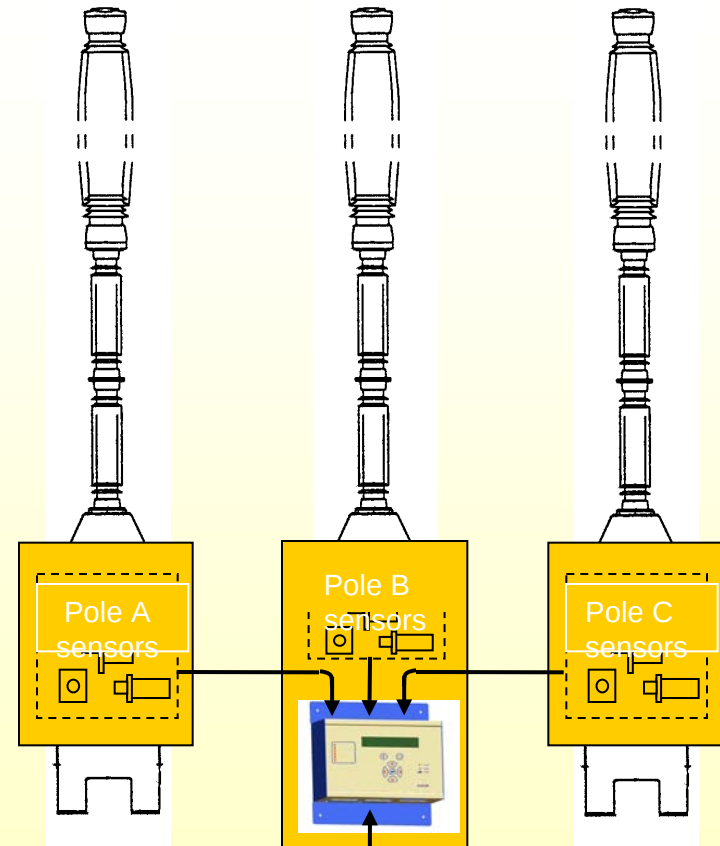
1 operating mechanism



INTERFACE

CBWatch-2

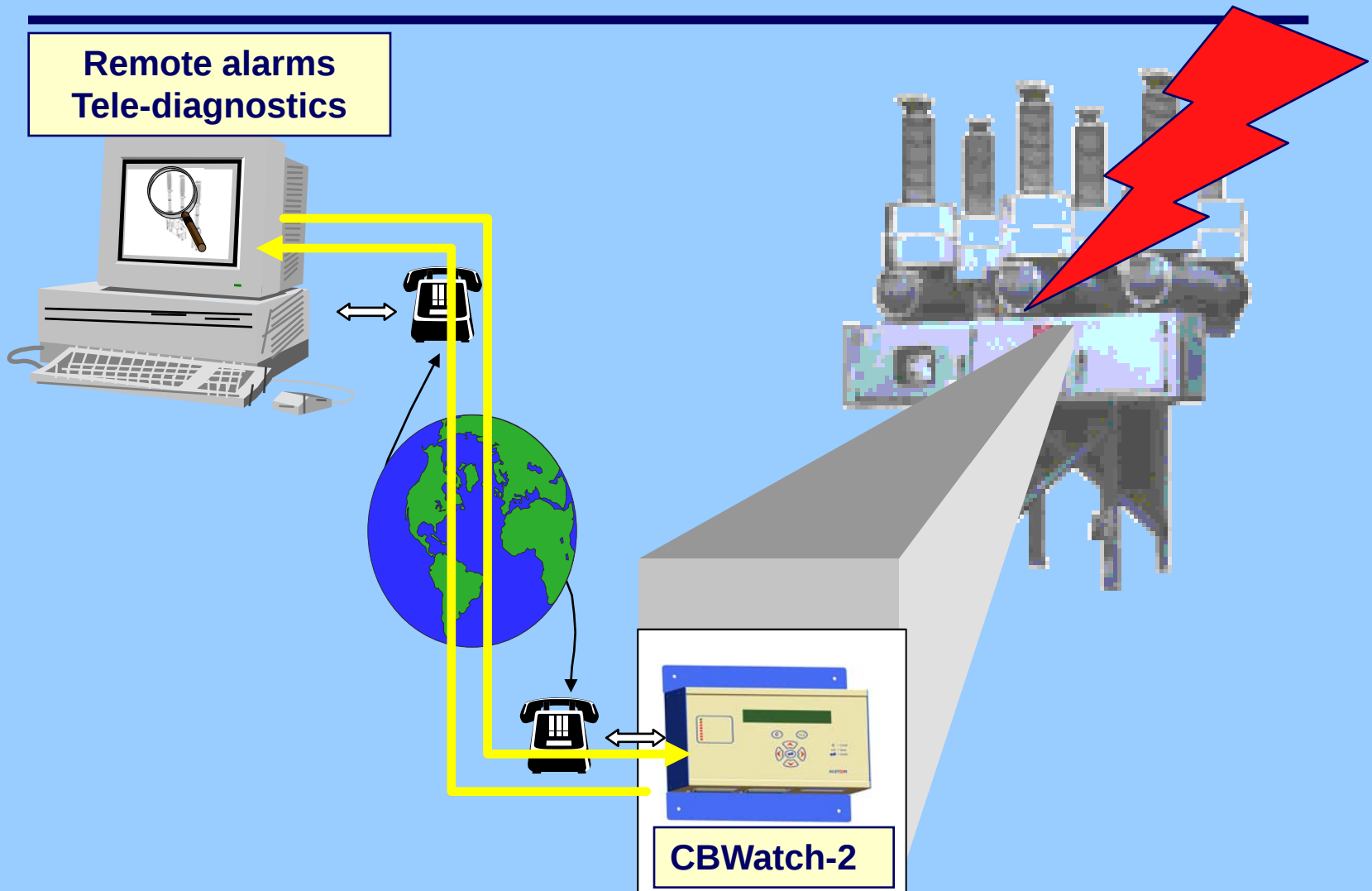
3 operating mechanisms



INTERFACE

TRANSMISSION & DISTRIBUTION

High Voltage Switchgear



Coil current sensor:

Small O-ring current transformer

Position sensors:

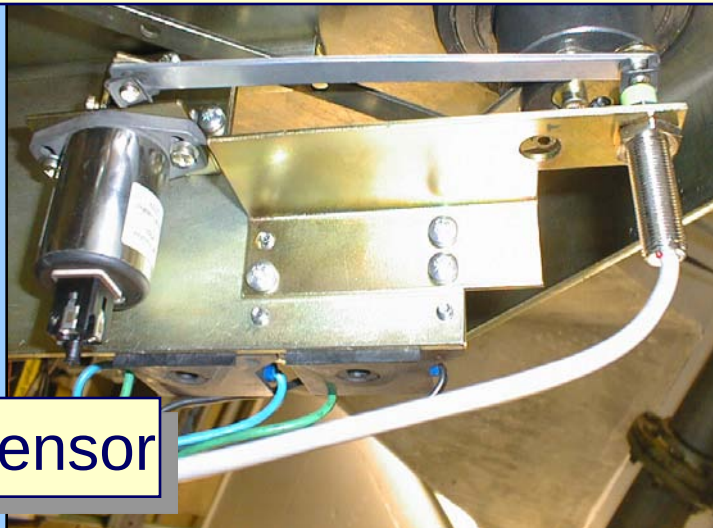
- Auxiliary contact
- or Electronic position sensor (Magnetic sensor)

Travel sensor: (Option):

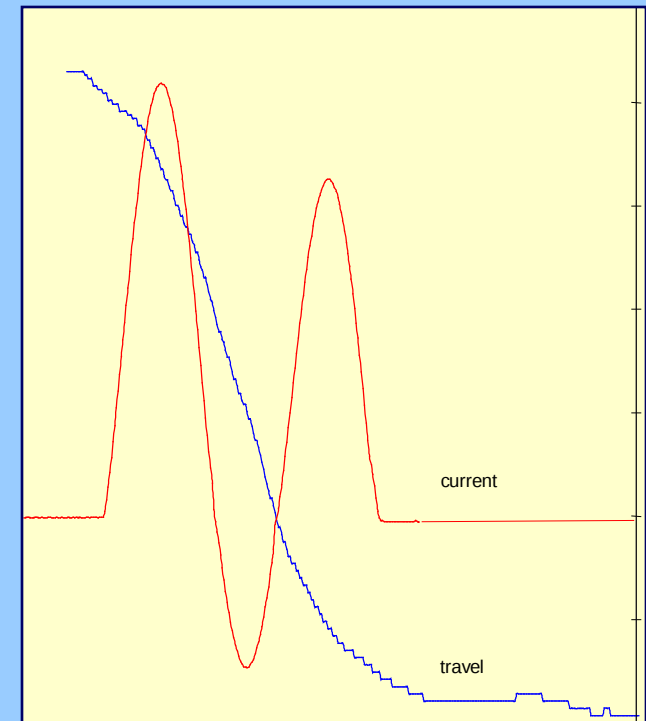
- 4-20mA rotary position transmitter

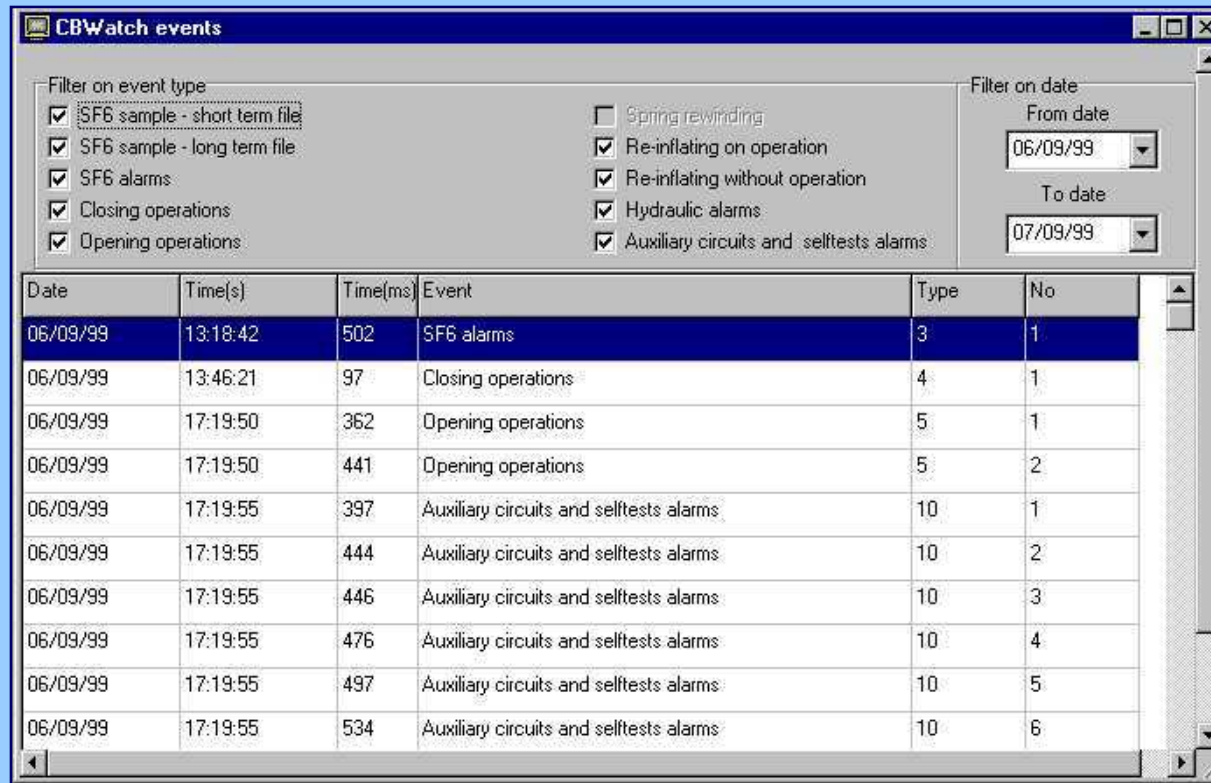


Coil command sensors & Auxiliary CT



Travel sensor





The screenshot shows the 'CBWatch events' window. It has a filter section at the top with checkboxes for event types and date filters. Below the filters is a table of recorded events.

Date	Time(s)	Time(ms)	Event	Type	No
06/09/99	13:18:42	502	SF6 alarms	3	1
06/09/99	13:46:21	97	Closing operations	4	1
06/09/99	17:19:50	362	Opening operations	5	1
06/09/99	17:19:50	441	Opening operations	5	2
06/09/99	17:19:55	397	Auxiliary circuits and selftests alarms	10	1
06/09/99	17:19:55	444	Auxiliary circuits and selftests alarms	10	2
06/09/99	17:19:55	446	Auxiliary circuits and selftests alarms	10	3
06/09/99	17:19:55	476	Auxiliary circuits and selftests alarms	10	4
06/09/99	17:19:55	497	Auxiliary circuits and selftests alarms	10	5
06/09/99	17:19:55	534	Auxiliary circuits and selftests alarms	10	6

Checking the recorded events as saved by the CBWatch-2

Part 3.
Switchgear Intelligent Control Unit
SICU

Two markets
**Two products with as much
common elements as possible**

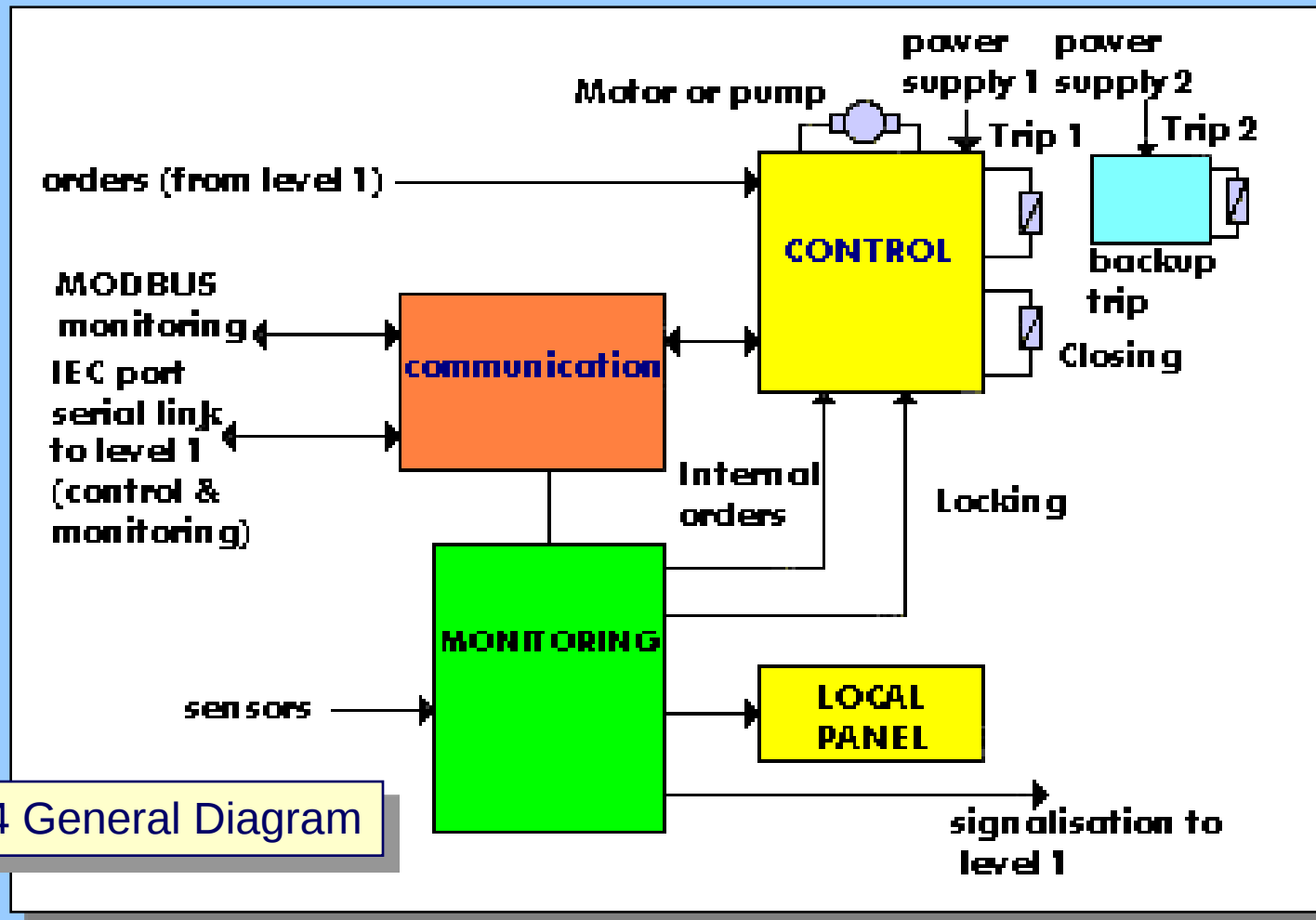
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graph TD; A[Two markets<br/>Two products with as much<br/>common elements as possible] --> B[Stand alone monitoring<br/>- short term<br/>- one product: CBWatch-1 or 2<br/>Modular monitoring system]; A --> C[Integrated control & monitoring<br/>- medium term<br/>- one product: SICU-4<br/>Same sensors as CBWatch-2<br/>Same hardware base, as in<br/>CBWatch-2]; B <--> C;
```

Stand alone monitoring
- short term
- one product: CBWatch-1 or 2
Modular monitoring system

**Integrated control &
monitoring**
- medium term
- one product: SICU-4

Same sensors as CBWatch-2
**Same hardware base, as in
CBWatch-2**

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SICU 4 General Diagram

Conclusion

Monitoring Systems: single purpose

Monitoring Systems: multiple purposes

Monitoring & Control Systems: circuit breakers
plus others switching devices

Remote access to Monitoring and Control
decreases the maintenance cost

Increase availability and overall reliability of the transmission system