External Leak Detection Camera System

Lessons Learned

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High Level Overview of Business Unit

North West Crude Line – crude oil pipeline across mountainous terrain and residential areas, both rural and urban

CPL NWC Pipeline

- ~ 85 miles
- 10 remote controlled block valve sites
- 20 cameras
- 4 - 5 personnel support

External Leak Detection Compliance

PHMSA – The Pipeline and Hazardous Materials Safety Administration in the U.S.

PHMSA's mission is to protect people and the environment from the risks inherent in transportation of hazardous materials – by pipeline and other modes of transportation

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PHMSA identifies block valve sites as critical

External Leak Detection Solutions

Initial Evaluation

- Radioactive isotope tracers
- Level detection
- All encompassing vaults
- Hydrocarbon sniffing dogs

Approval For Video Monitoring

PHMSA Sanctions Camera Solutions

What Were Our Options?

- No proven leak detection solutions
- Trail cameras
- Consumer grade solutions
- 24-hour manned surveillance
- Temporary / movable camera systems

Initial Solution – Construction Site Camera System

PROS:

- Accessible now
- Turn-key installation
- Quick deployment
- Small footprint
- Coverage of maintenance issues

Camera system made for construction site security

CONS:

- Cost prohibitive - $1700 per month
- Transmission limitations (inclement weather)
- Video broadcasted over public domain
- Risk of video hijacking
- Prone to vandalism
- Not permanent
- Not capable of leak detection

Chosen Solution

Recommended by Chevron Energy Technology Company

- Proven industrial video solution
- Designed for hydrocarbon applications
- Hazardous area certified camera hardware
- Integration with SCADA / HMI / PLC
- Ability to use existing low-bandwidth SCADA networks

Video System Overview

- Cameras
  - Thermal imaging for leak detection
  - Video-pan, tilt, zoom for overall site surveillance of multiple preset locations
- Video engine for on-site recording and alarming
- Live, still image and video clips in alarm conditions
- Communicates with PLC for alarm transmission
- Video and alarm integration with SCADA / HMI

Video System Overview

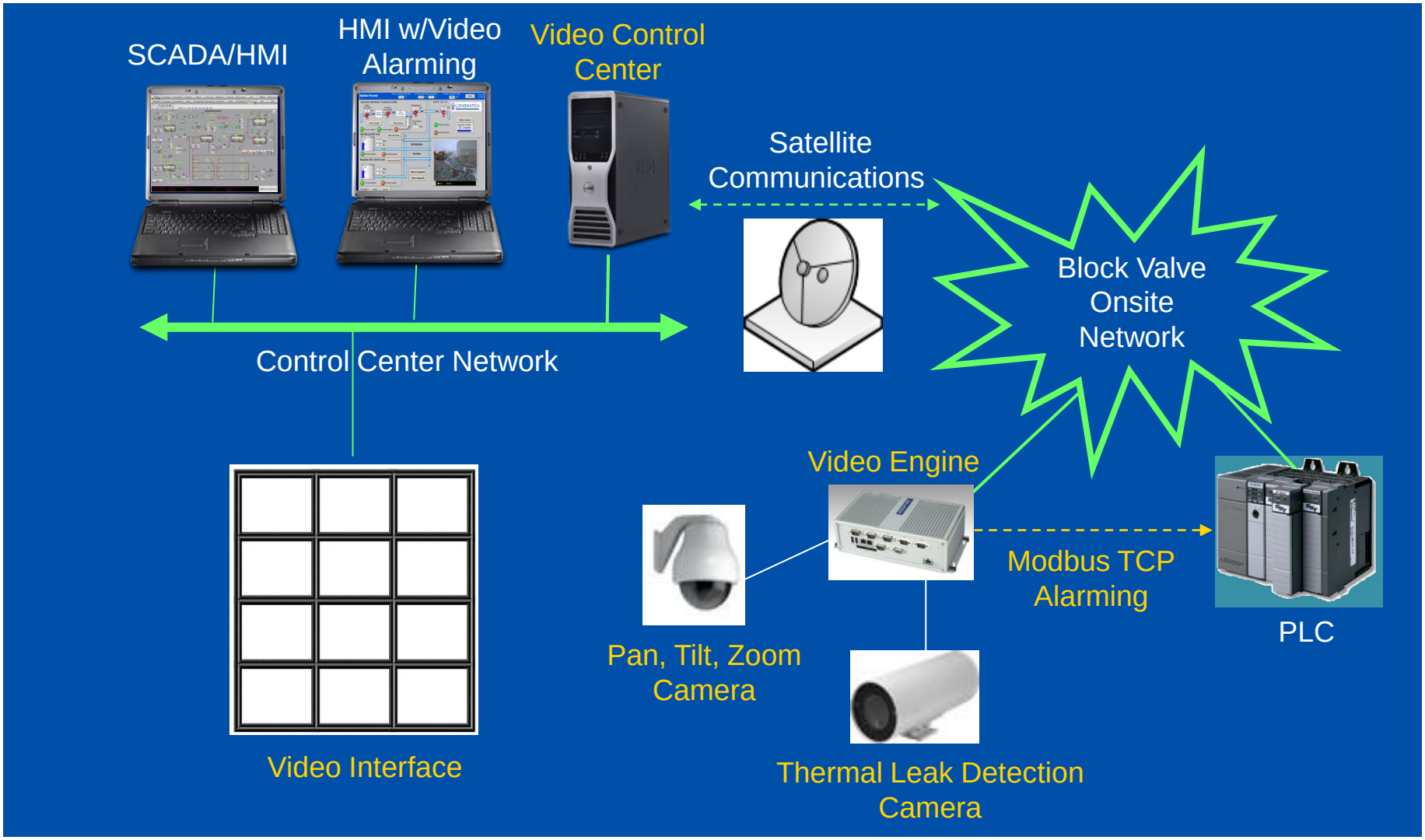
Block Valve Site

Control Room

Video Control Center

- Video Viewing/Playback
- Alarm/Event management
- SCADA integration
- Central Configuration

System Architecture



Video System Value

Recording at the edge: Real-time, high-resolution video capture with distributed storage and distributed processing. Easily scalable and tolerant against network issues and equipment outages.

Video Recording on Alarm: Creation of recorded video clips when PLC or Leak Detection Events occur. The video is transmitted to the Control Center with the alarm. Allows operators to assess the situation quickly and respond appropriately.

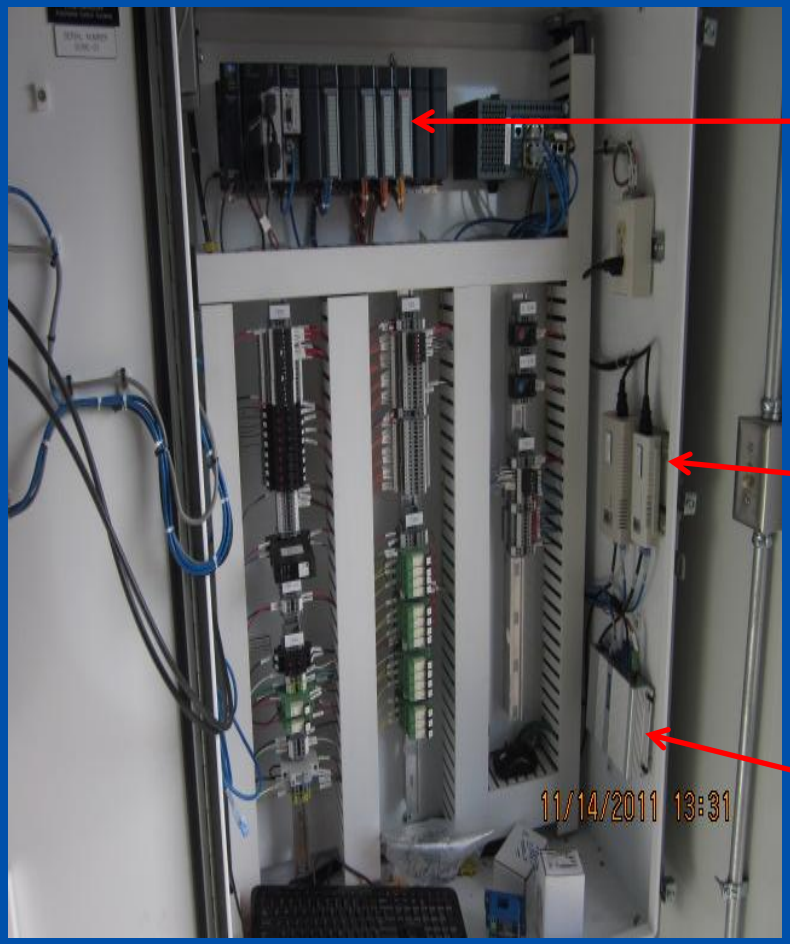
SCADA/HMI Integration: Video and alarming can be integrated directly to the PLC and HMI screens. Reduces errors and speeds response to events.

Bandwidth Efficiency: Store and forward video architecture along with advanced video compression algorithms allow the video to be tailored to any network.

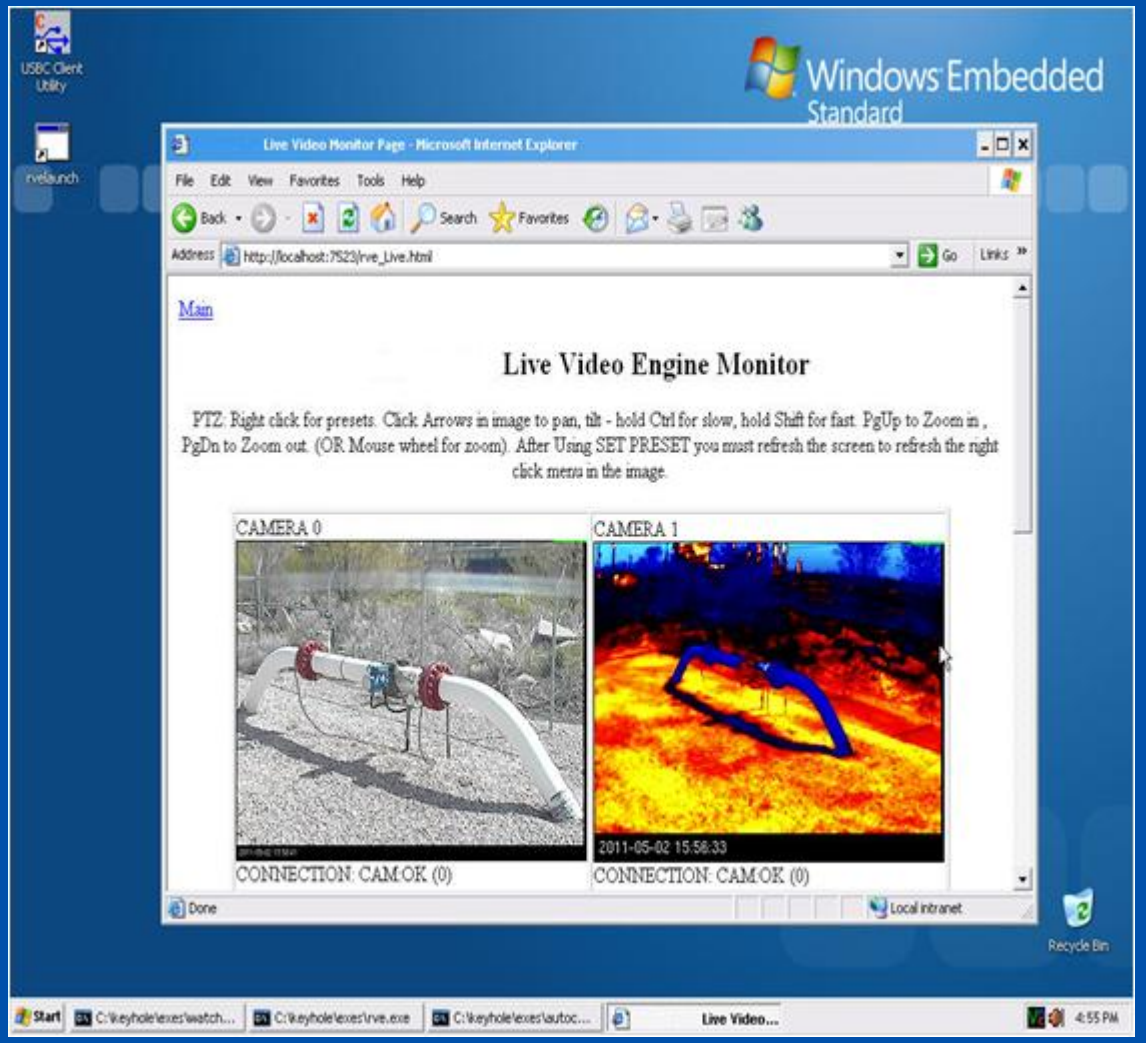
Remote Site Layout

Control building housing PLC/video engine, battery bank for back up and VSAT equipment

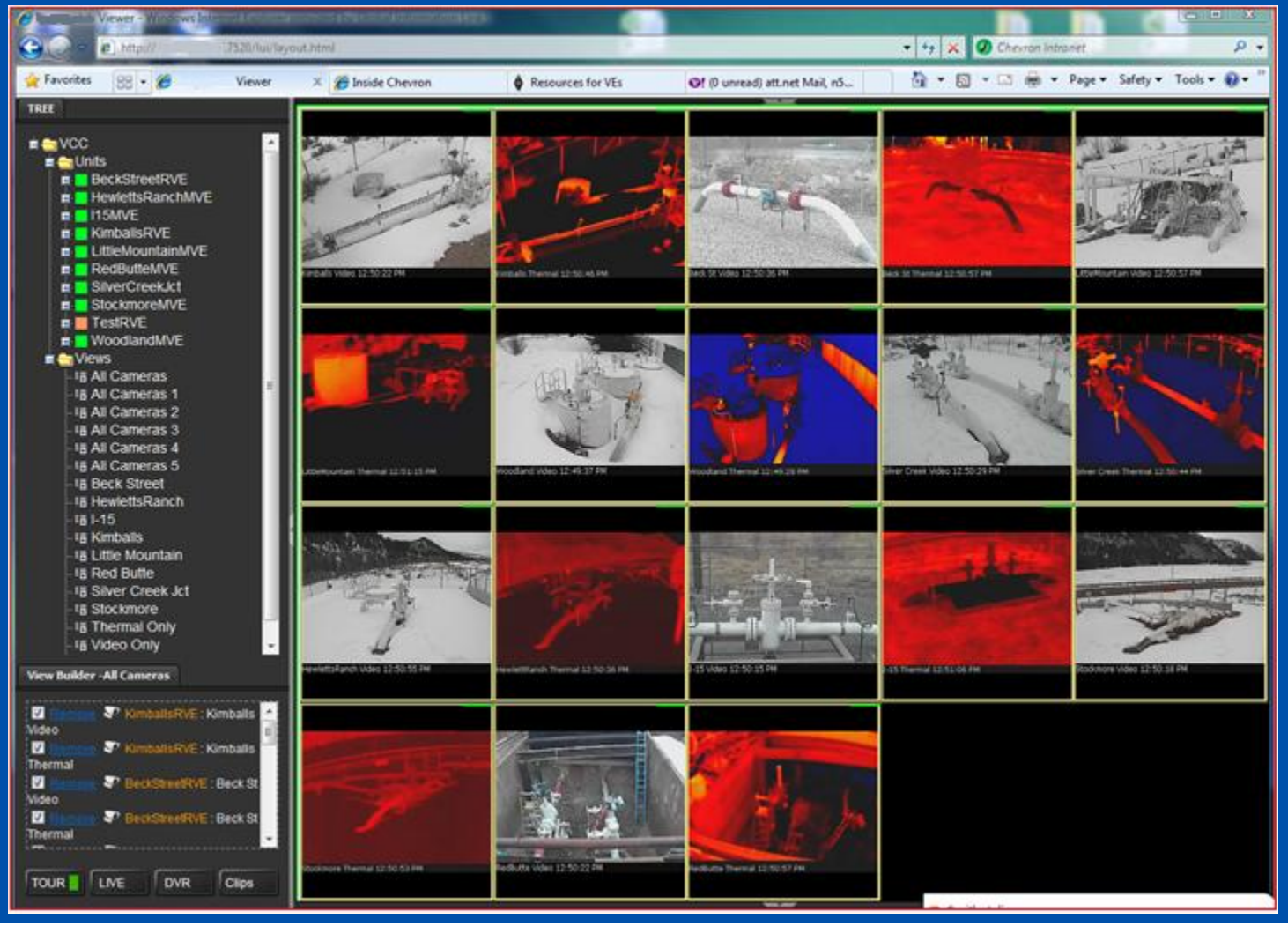
Main Components: GE RX3i PLC, Mid-Spans Provide Power-Over-IP, Micro Video Engine



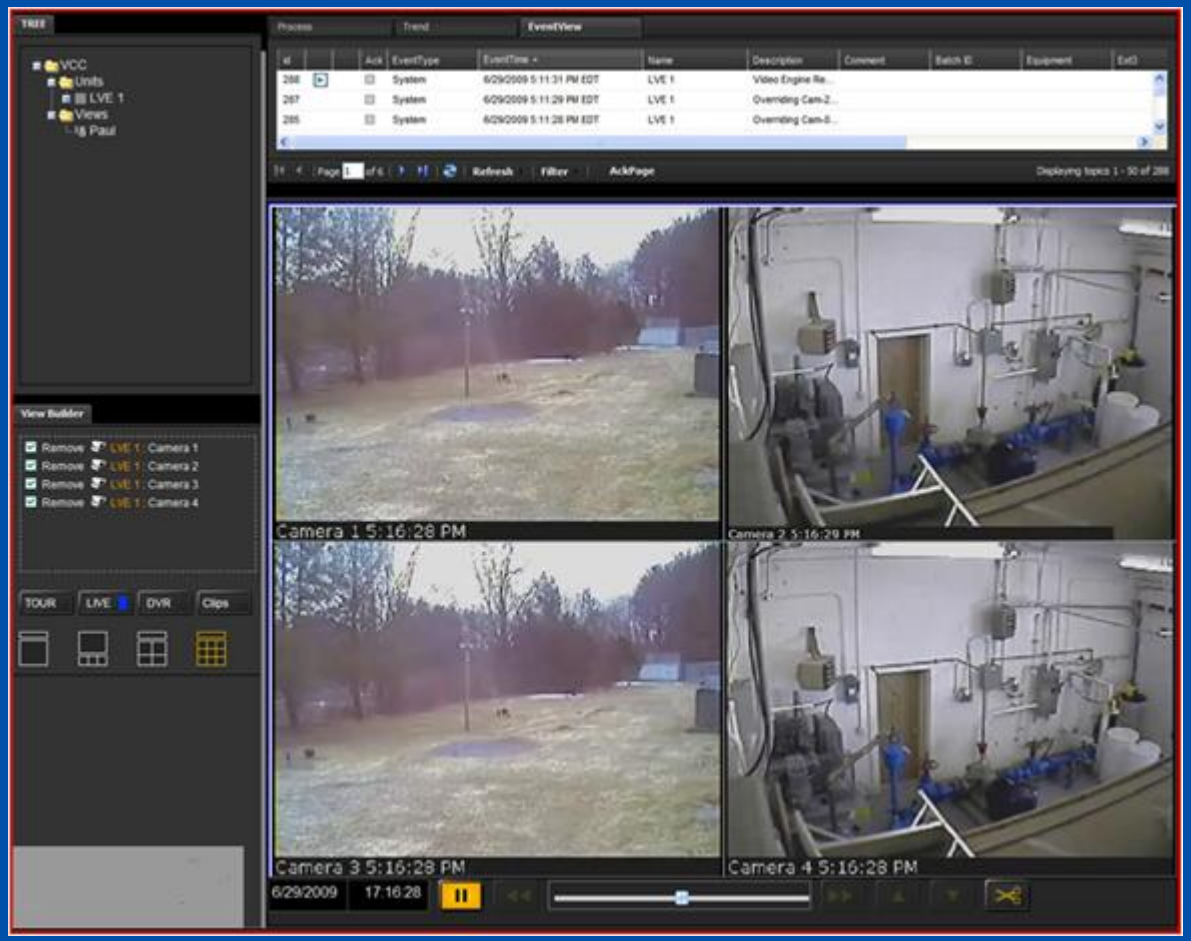
Thermal and Video Cameras



Video System Interface at the Control Center



Video System Interface at the Control Center – Alternative Views



Best Practices – Standardized Design

Standardized Design

Capability to rollout a single, proven architecture to multiple sites

Overview

- Battery backup system & power components
- Process control hardware
- Communication equipment
- Intrusion detection components
- Cameras and video system hardware
- Connectivity and configuration guidelines

Lessons Learned

False Alarms

Thermal camera video analytics – basic motion detection not suited for a leak detection application

- Environmental conditions
- Changes in light level
- Animals
- System maintenance overhead
- Results in disarming of the system to stop false alarms

Hardware Failures

Faulty hard disk drives/manufacturing defects

- Site visits required to replace hardware at all locations
- Change of hardware vendor resolved the issue

System Optimization Moving Forward – Action Plan

Overcome Bandwidth Limitations

- Integrate a new cellular communication network for all block valve sites

Improve Leak Detection Reliability

- New specialized thermal imaging camera designed for leak detection
- Tool becomes more about investigation than detection

Reduce False Alarms

- Implement a multi-tiered Video Analytics Solution along with the thermal camera

Improve Overall Site Security

- Integrate fence detection, access control and video analytics

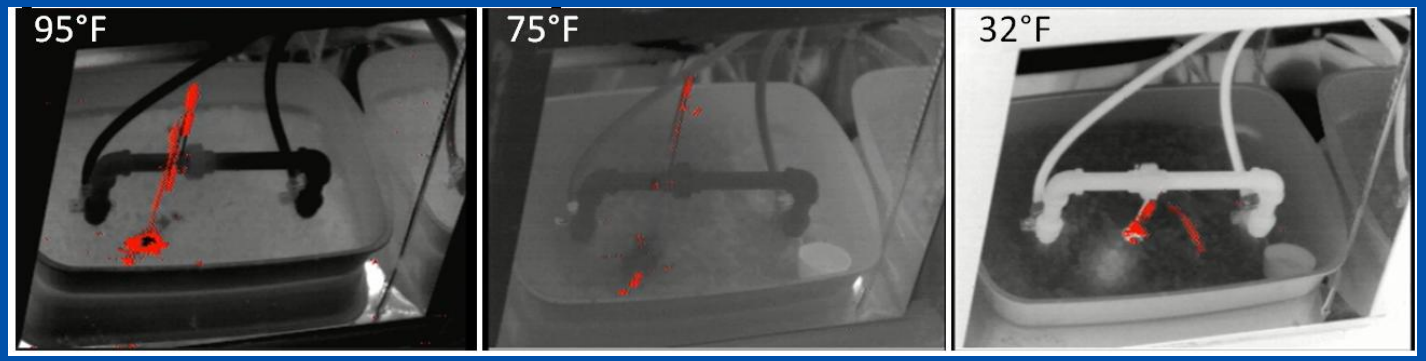
Cellular Network Solution

EVDO Cellular Modem

- Create a dedicated network for video and leak detection while maintaining SCADA network for alarming and control
- Removing video use from the existing SCADA network
- Increase overall bandwidth for improved video performance
- Bandwidth: 400-700 kbps
- Data Security

Specialized Leak Detection Solution

- Advanced, proprietary pipeline leak detection capabilities
- Multi-tiered video analytics to protect against false alarms



Improvements to Site Security & Surveillance

Fence Vibration Detection System

- Intelligent sensors reliably detect attempts to climb or cut a fence, while ignoring distributed noise from wind, rain or vehicle traffic
- Pan, tilt, zoom camera automatically move to the disturbance to record a video clip which is sent to the Control Center

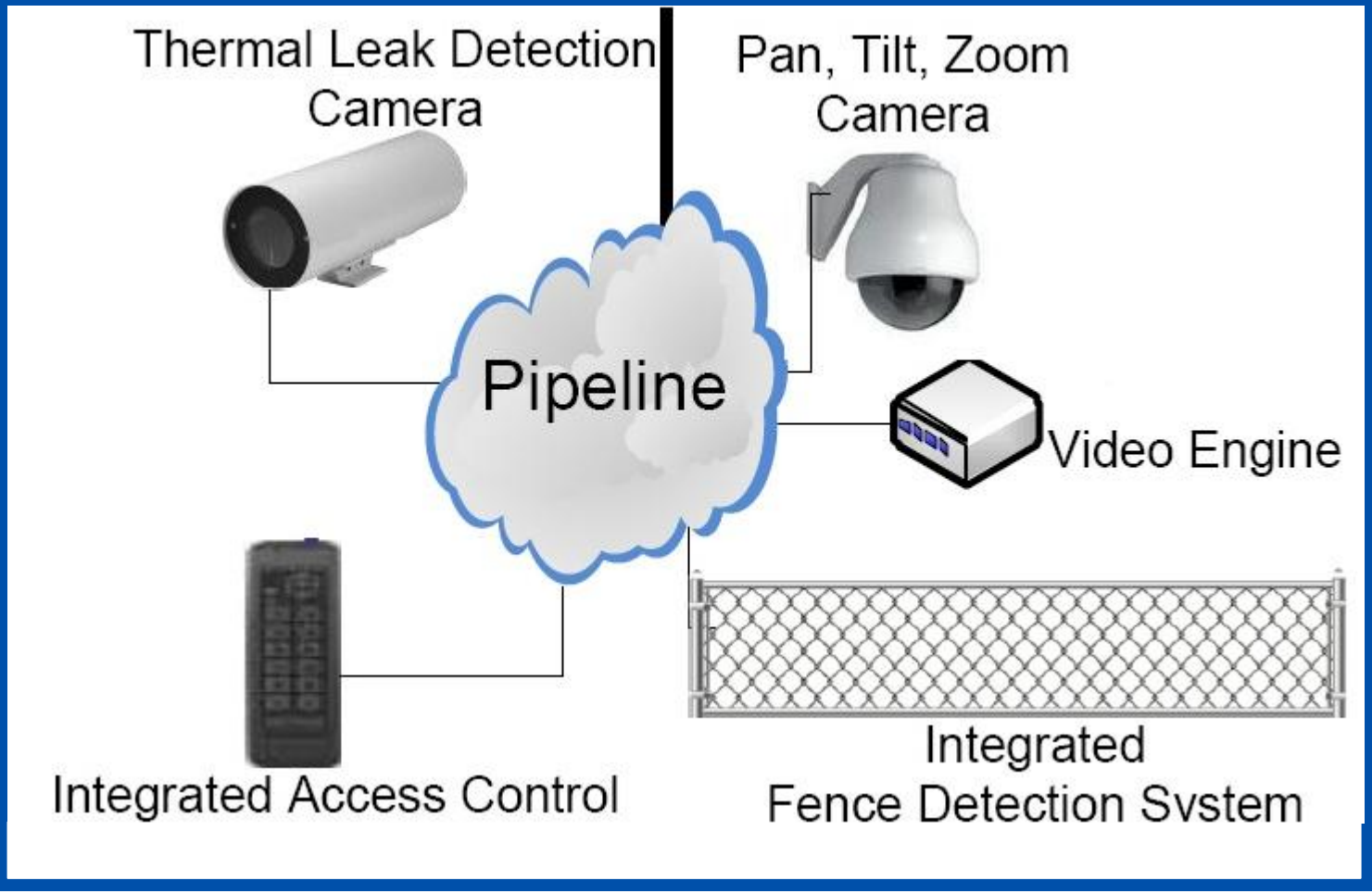
Improvements to Site Security & Surveillance

Integrated Access Control System

- Access control devices integrated with the video engine
- Ability to arm and disarm the surveillance system remotely
- Video clips can be created on entry/exit of sites
- Ability to control access to sites within the SCADA / HMI

Improvements to Site Security & Surveillance

Complete Leak Detection and Surveillance Solution



Thank You!