ANS 11th Nuclear Plant Instrumentation, Control and Human-Machine Interface Technologies

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EXPERIENCE WITH GROUP-VIEW, WALL PANEL DISPLAYS OUTSIDE THE NUCLEAR INDUSTRY

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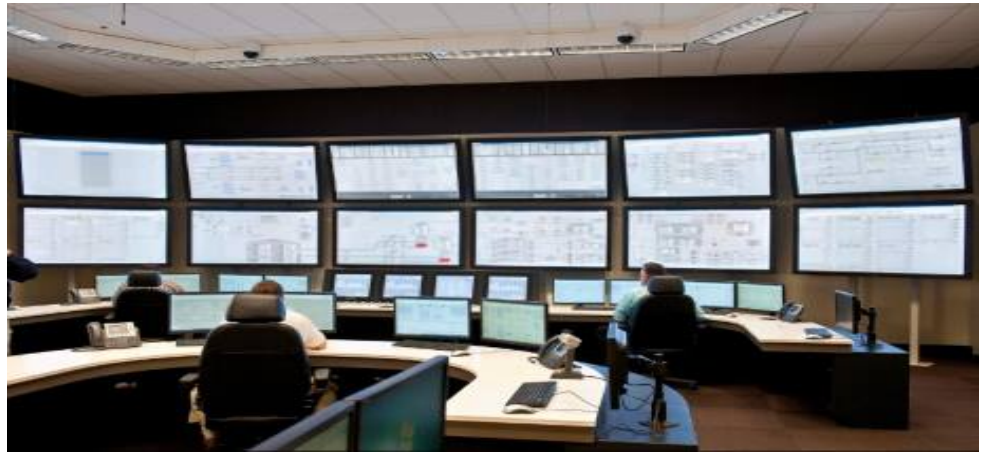
Introduction

- Generation III+ Advanced Light Water Reactors with advanced digital I&C are nearing completion or already operational
- Compared to their predecessors these control rooms represent a major step change in the display of information.
  - Large panel multiple screen “wall” displays using Keyboard Video Mouse (KVM) networks are the centerpieces of the control rooms
  - While a very dramatic change for the nuclear industry, other industries have years of experience with these types of displays in operations centers and so called “war rooms”.
- This paper will outline some of that experience.



Background

- Technology Resources is a nuclear I&C and HFE specialist working with Thinklogical to provided greater visual display functionality for nuclear plants.
- Thinklogical provides High Performance, Secure KVM & Switch Systems for Secure Control, Distribution, and Management of Video-Rich Data
- Is the supplier of the KVM System for AP1000 as well as for many implementations in other industries

Background (continued)

- Functionality improvement goals include:
  - Further simplification of Human System Interfaces (HSI) both inside and outside of the control room
  - Expanded information integration
  - Enhanced cyber security
  - Improved reliability
  - Lower cost
  - Extended remote information access

Examples

- Oil and gas industry drilling Realtime Operations Centers (ROC) that use Asset Integrity Management (AIM) as an overarching approach to address a multitude of complex business challenges.
- Military command and control center with wall display and KVM routing systems that are considered mission critical, providing highly sensitive content to users who are driving key operations and making mission critical decisions.
- Air traffic control systems and associated training facilities.
- Electric transmission and distribution Control Room and Backup Control Center (BCC), miles from the main control system.

Key Features of advanced KVM

Advantages currently being realized at installations like military command and control centers, electric grid transmission control centers and oil and gas drilling real time operations centers include:

- Control Station layout optimization
- No RF interference
- No interference with other equipment
- Less heat & noise
- Fiber optic isolation
- No electrical emanations
- Secure, no eavesdropping
- Safer– no sparks
- Lightweight
- Non conductive
- Solid state drives for storage
- FPGA architecture

Oil and Gas Drilling

Significant safety concerns

Real-time decisions

Varied data

- Process
- Geological
- Meteorological
- Resources
- Business

- Asset Management

Oil and Gas Drilling (continued)

- Following the BP spill the drilling industry drilling faced a multitude of complex operational and business challenges.
- Asset Integrity Management (AIM) to ensure safe and cost-effective operations has been instituted via centralized “Real-Time Operating Centers” (ROC).

BP Gulf of Mexico ROC

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Oil and Gas Drilling (Continued)

Compared to dedicated control a ROC is an exponentially more data rich environment, evolving to include high-resolution video and audio surveillance.

It is more collaborative in two significant ways:

1) different disciplines and functions are working within the same room, and;

2) field and headquarters personnel are working together through virtual video tele-presence technology.

Shell has real-time operations centers in six major hubs around the world that are primarily used for multidisciplinary well planning, optimization engineering and 24/7 real-time monitoring of global assets.

Military Command and Control

- High reliability & security
- Demanding situational awareness
- High real time risk.
- Wide ranging inputs

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Military Command and Control

Combat missions as well as intelligence, surveillance and reconnaissance (ISR) missions are increasing controlled and monitored from C2 facilities .

Asymmetrical threats, multi-domain battle locations, and dynamic mission requirements make information acquisition and analysis a key weapon.

Command and control center's wall display and KVM routing systems are considered mission critical. They usually provide highly sensitive or very important content at various security levels.

Military Command and Control (continued)

- The U.S. Navy's MQ-4C Tritonis UAV is designed to support a variety of all-weather maritime ISR missions.

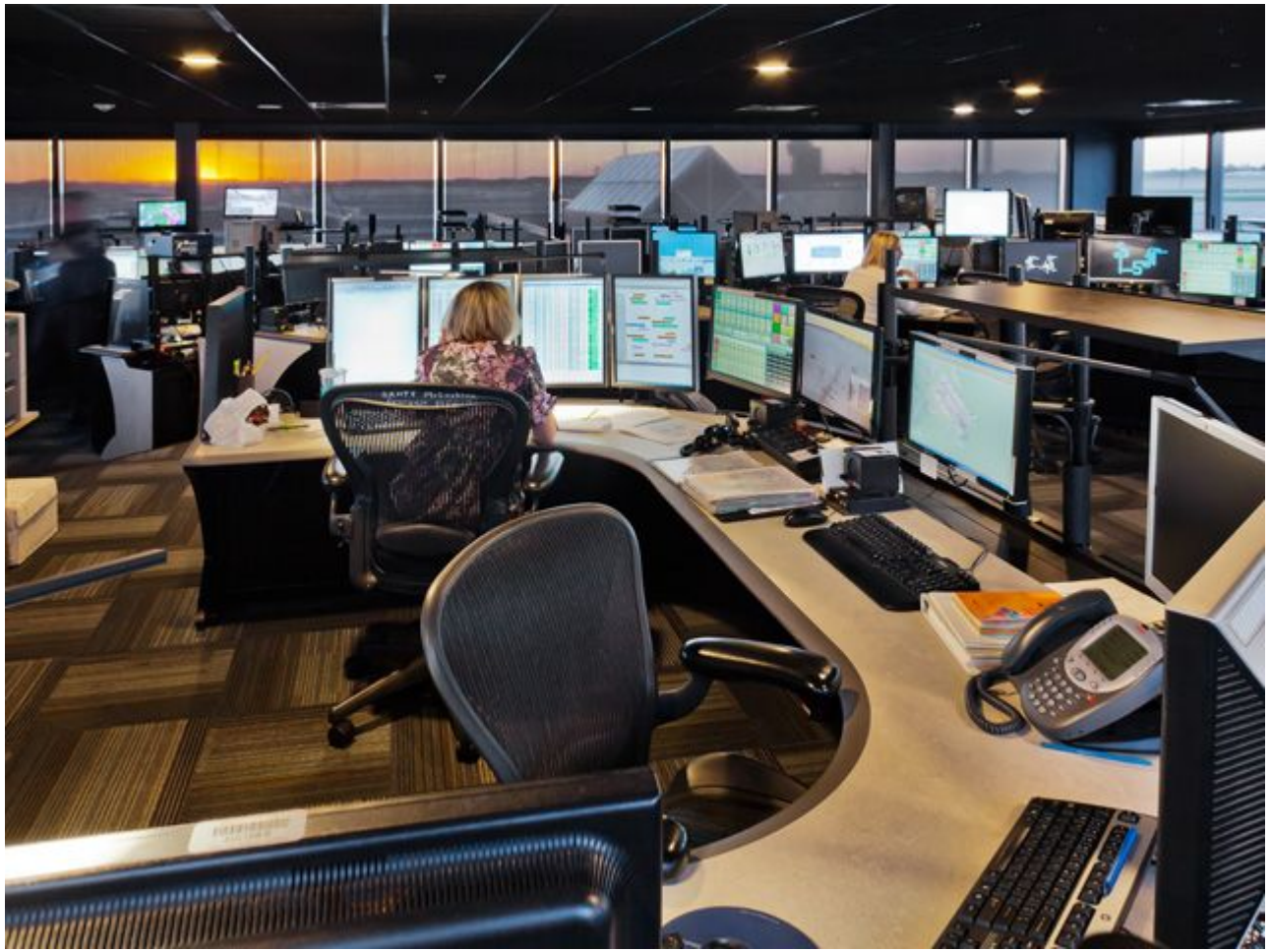
- A high-end KVM and display system provides an infrastructure for ISR mission control, data collection and dissemination with continuous situational awareness.

Military Command and Control (continued)

- The KVM based wall panel system provides operators access to multiple systems without compromising security
- Accredited to EAL 4, and for use in NATO multi-classification environments

Air Trafffic Control (ATC)

- Secure Facility
- Continuous Operator Attention &Concentration
- Human Reliability Challenges
- Simulator Training



Air Traffic Control (ATC)

- High-performance KVM extension and routing solutions provide clear readily understandable displays of information
- These systems must be responsive to the heightened security requirements and regulations
- Limits ATC operational risks, improve workflows, abide by regulatory compliances, and provide state-of-the-art visualization solutions.

Grid T&D Control Center

- High Reliability
- Simulation Needs
- Training Needs
- Emergency Response Planning

ISO New England Control Room

Grid T&D Control Center

- Forecast, dispatch, and monitor the flow of high-voltage electricity every minute of every day.
- Coordinate hundreds of diverse power resources and thousands of transmission components to meet the region's constantly changing demand.
- Withstand the sudden loss of a power plant or transmission equipment caused by weather, mechanical failure, or other triggers.

Visualizing the Grid in Real Time

ISO New England's state-of-the-art, 4,000-square-foot control room is regularly enhanced with the latest tools and alarms that enable system operators to rapidly assess real-time conditions at every point on the grid.

The 60- by 15-foot digital wallboard displays:

- A dynamic, real-time representation of the six-state generation and transmission system in relative geographic location
- All major substations, all 345 kilovolt (kV) and 230 kV transmission lines, and most 115 kV transmission lines
- Live feeds continuously updated with generating unit output, transmission line voltages, electricity flow amount and direction, system frequency, and other data

Source:
www.iso-ne.com

Side monitors display power transfers with neighboring regions, news reports, local weather, and regionwide lightning strikes. Desktop monitors display specialized software tools used to run the grid. In total, control room staff can access over 3,000 screens of grid operations information, which are run on hundreds of computer servers and data-storage systems. A 24-hour technical support staff manages these systems.

HSI & Human Factors Benefits of KVM

- Access and operate more than one computer with only one set of mouse, keyboard and video for less task complexity and increased productivity
- Functional selection of displays enables simpler and faster task execution, reducing operator burden.
- Increased cyber security: Fiber optic isolation, no USB data ports, hard drives or network cables accessible at operator station (insider threat)
- Move computers from operator station to secure IT machine room to reduce heat, noise, and clutter for improved work environment

HSI & Human Factors Benefits of KVM

- Smooth keyboard and mouse performance for accurate human/system interactions with reduced frustration
- High resolution, low-latency video distribution for increased visibility and clarity, reduced eye strain
- Allows for display sharing for supervisory oversight, peer review or verification and Human Performance (HuP) monitoring.

KVM Extensions Off-Site

- High end KVM networks' transmission signals between the host computer and the operating station can be extended large distances
- Distances of up to 50 miles have been tested.
- Presents opportunity to share the operations and other information with and between offsite facilitates such as emergency support facilities, engineering conference room, executive office buildings, maintenance centers, etc.
- Also as distances increase centralized control of multiple remote reactor installation becomes feasible

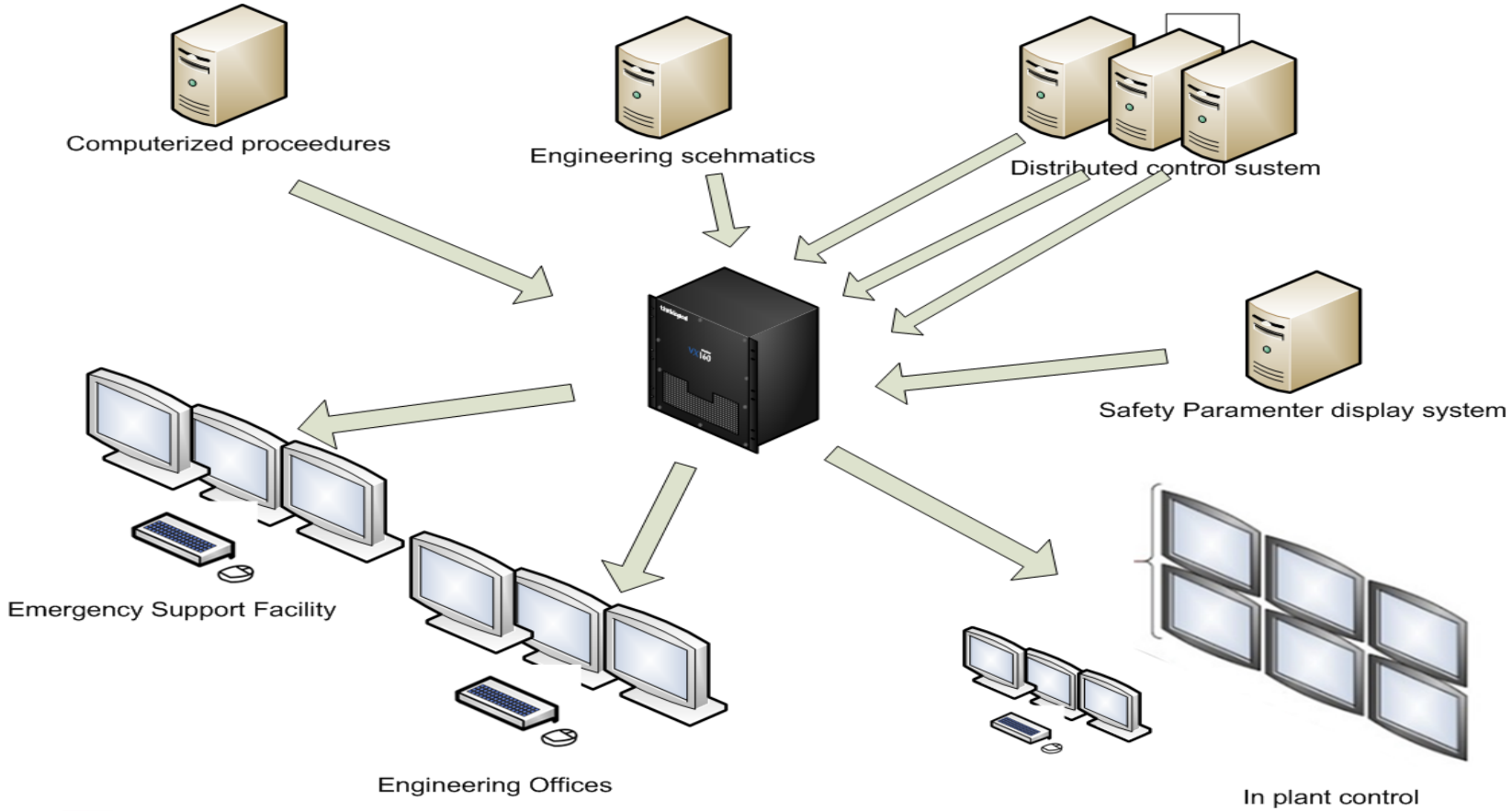
Expanded usage of KVM Networks in Advanced Reactors

- In Generation III+ digital control rooms many computer related aspect of managing the plant as an asset, not related directly to operational control were treated as independent systems.
- In many cases these system were not provided by reactor supplier, but were left for the owner operator to develop and were incorporated into the control room with additional LAN workstation and desks.

Expanded usage of KVM Networks in Advanced Reactors (con't)

- These included computer systems for:
  - Engineering document management,
  - Operating procedures,
  - Configuration management,
  - Maintenance and work management, etc.
  - Corrective Action Programs
  - Asset management
- With Advanced Reactor development still in the early stages of development, with the eventual owner operator a member of the development team, there is an opportunity for further integration at individual control stations using an expanded KVM network.

Expanded usage of KVM Networks in Advanced Reactors (con't)



- Further HFE Task Simplification
- Computerized Procedures
- Enhanced Cyber Security
- Enhanced Fire Protection
- Flexible Layout
- On-site Off-site linkage

The Northern Virginia Advanced Technology Concept Center (NVTACC)

- NVATCC is a 2,300-square-foot advanced concepts center, is located in Tysons Corner, Virginia.
- The center is home to a laboratory and conference room designed to highlight and demonstrate the most advanced technologies used in situational awareness, command and control, visualization, decision support, collaboration, training and briefing environments.
- The center provides hands on exposure to the latest in technology. not only about the each individual solution, but how they work together providing an overall concept for new facilities.

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