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EXPANDED KEYBOARD-VIDEO-MOUSE (KVM) TECHNOLOGY IMPLEMENTATION FOR ADVANCED REACTORS

Richard Turk
Senior Project Manager

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thinklogical A BELDEN BRAND

EXPANDED KEYBOARD-VIDEO-MOUSE (KVM) TECHNOLOGY IMPLEMENTATION FOR ADVANCED REACTORS

Richard Turk
Technology Resources LLC

Richard Cooper
Vice President
Thinklogical LLC

Wei Lai
Deputy Director of Training Department
Sanmen Nuclear Power Plant

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Objective

- Technology Resources as a nuclear I&C and HFE specialist is working with Thinklogical, a leading KVM system designer to provided greater visual display functionality for nuclear plants.
- 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
  - Extend remote information access

Generation III+ Video Displays

- Generation III+ Advanced Light Water Reactors with advanced digital I&C are nearing completion or already operational
- With the widespread use of large screen video displays, Keyboard-Video-Mouse (KVM) technology has been and important enabler in providing a more centralized Human System Interface (HSI).

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Generation III+ Control Rooms

- Centralized Integrated Consoles
- Large panel multiple screen “wall” displays
- High Integrated with Distributed Control System
- Focused on Plant System Status

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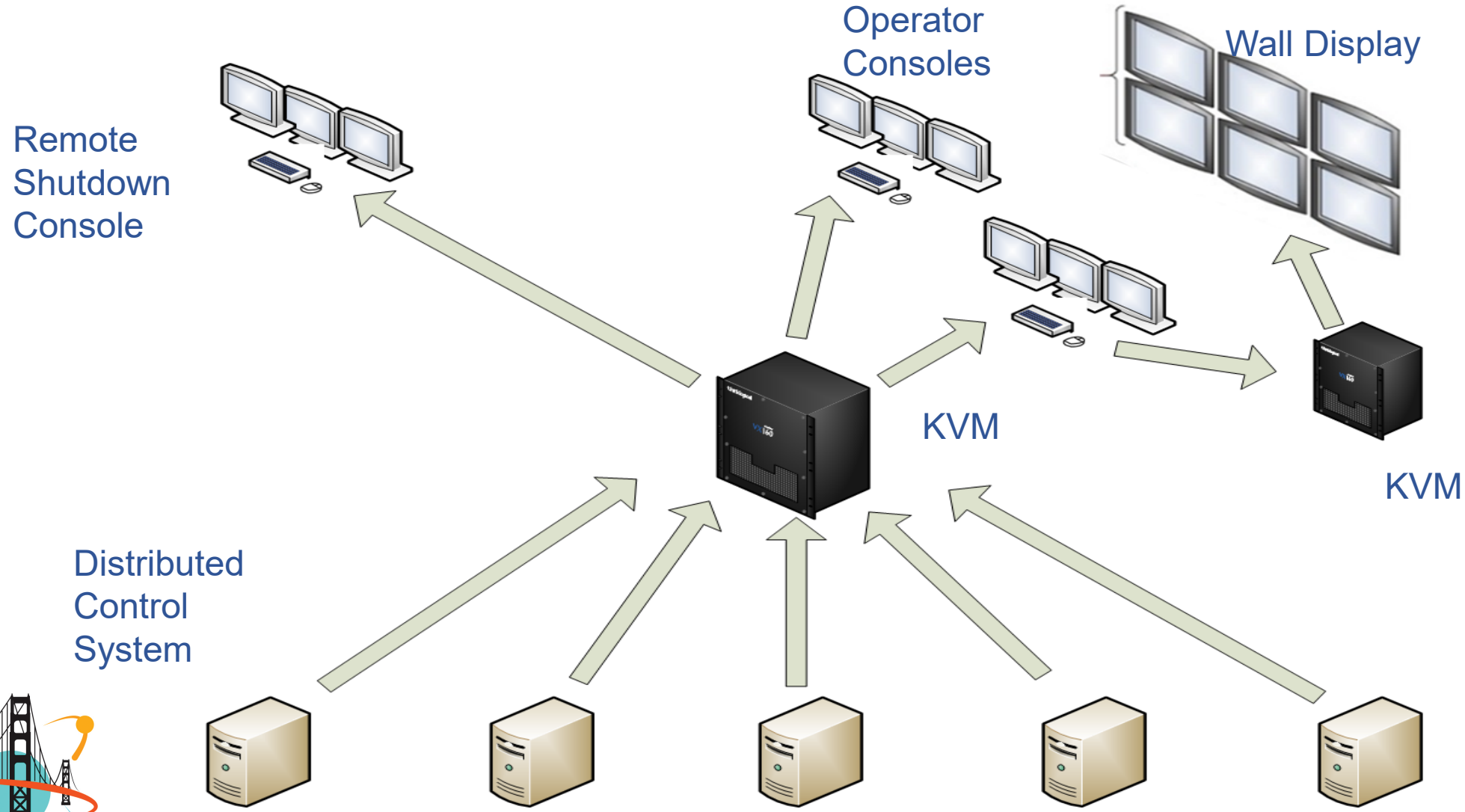
Generation III+ Control Rooms Limitations

- Basic I&C architecture had been established and licensed early in the design process.
- Limited KVM Large application to essentially non-safety system (e.g., DCS)
- Meanwhile the KVM technology has continued to advance with increasing capabilities for signal transmission range, fidelity, security and reliability.
- This paper describe the advance features of KVM technology that can be applied at the outset of Advance Reactor I&C design to help fulfill the promises of Advanced Reactors.

AP1000 & APR 1400 Use of KVM



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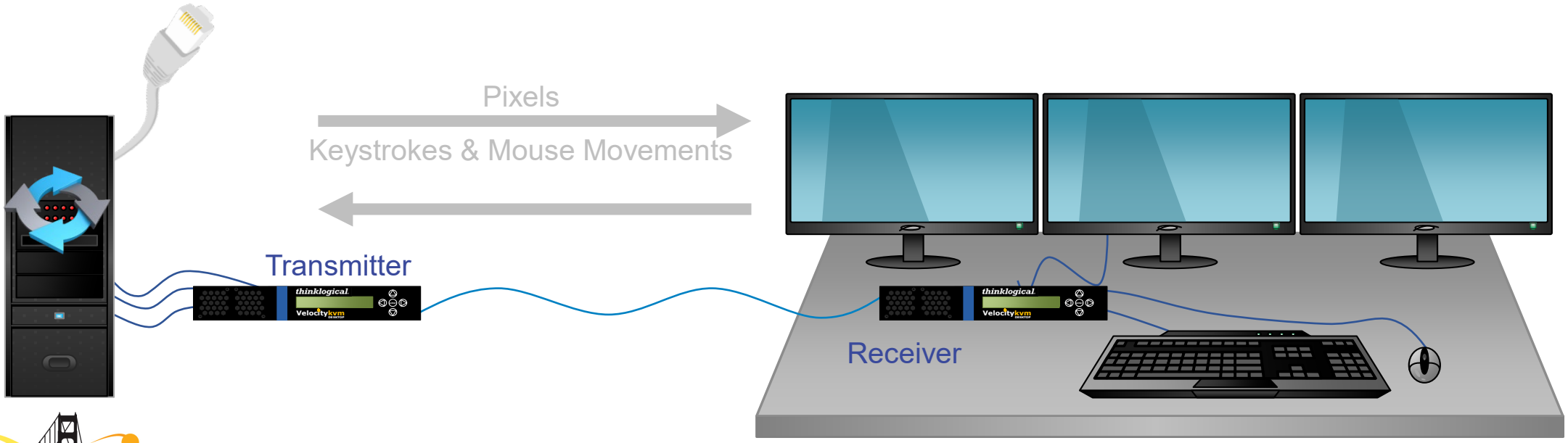
KVM Device Basic Function

- Present visual and media information from multiple computer inputs on single or multiple screens using a single keyboard and mouse
- Provides for centralized integrated control consoles instead of discrete control panels
- Simplifies Operator physical movement in task analysis
- Provides integrated information visuallization



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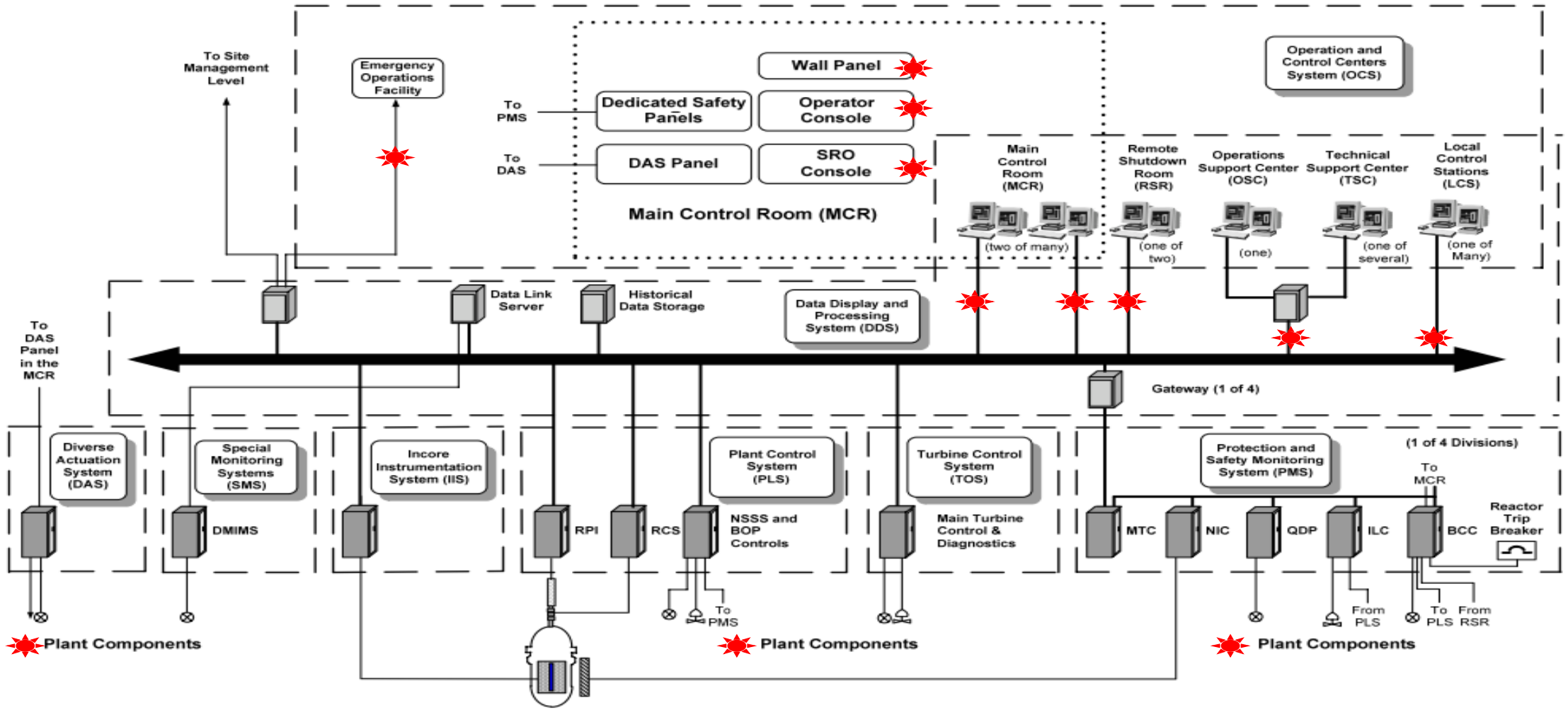
AP1000 Use of KVM



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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 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

Military Command and Control

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

Oil and Gas Drilling

Significant safety concerns

Realtime decisions

Big data

- Geological
- Meteorological
- Resources
- Business data
- Multiple locations
- Asset Management

Grid T&D Control Center

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

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Key Features of the AP1000 Fiber Optic KVM Extension Network

- **2N (1 + 1) Redundancy**
  - Every component in question has an additional component available should that component fail
- **Automatic Failover**
  - A feature of the product in which it automatically switches from a component that fails to a backup component – without human intervention, powering down, rebooting or special programming beyond what is provided as standard
- **Hot Swappable**
  - A feature of the product where a component may be replaced during operation – without powering down, rebooting, or affecting other components of the system

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

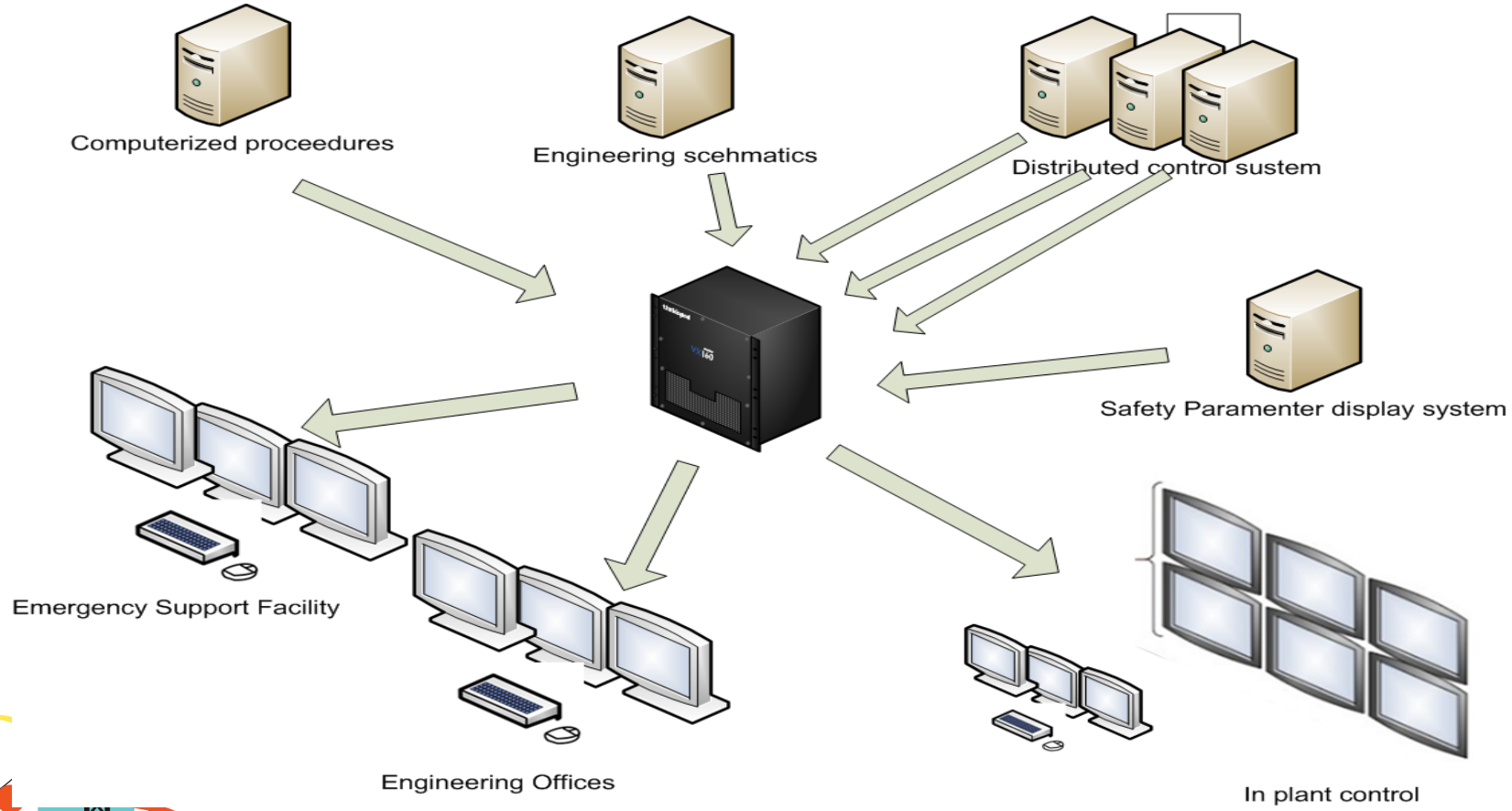
Expanded usage of KVM Networks in Advanced Reactors

- 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.

https://www.thinklogical.com/ATCC


Thank You