Human System Interface Improvements using Advanced Keyboard-Video-Mouse (KVM) Technology

Richard Turk
Senior Project Director
Technology Resources LLC
5 Sutton Drive, Vernon CT 06066
rick.turk@comcast.net
(860) 819-0392

Richard Cooper
Vice President
Thinklogical LLC
1001Washington St, Milford CT 06460
richard.cooper@thinklogical.com
(484) 467-5633

Bradley Yeates
Cyber Security Manager
Plant Vogtle Units 3&4
blyeates@southernco.com
706-848-6913

INTRODUCTION

The first of the Generation III+ Advanced Light Water Reactors with advanced digital control rooms are nearing completion or, in some cases, already operational. These plant are the first designed to, and reviewed against, the Human Factors Engineering guidance of NUREG -0711 "Human Factors Engineering Program Review Model." Compared to their predecessors, the control rooms are characterized by the wide spread use of video displays of computer generated and/or stored information. These displays present the operator information and are the primary interface with multiple systems. This paper will describe how Keyboard-Video-Mouse (KVM) technology has facilitated an improved Human to System Interface (HSI) for these plants has the potential to offer similar HSI improvement as digital upgrades and control room modernization of operating plant are pursued.

BACKGROUND

Large panel multiple screen "wall" displays are the centerpieces of the advanced main control rooms of Generation III+ Nuclear Power Plants. The AP1000 control room wall display consists of 12 wide panel screens. Stations for operators in the MCR have four screens. Numerous other video displays are used through out the plant. The wall displays and other video displays are accessed from control stations using a keyboard and mouse and/or touch screens. Functions monitored, and in some cases controlled, by the displays include reactor protection, safety system actuation and control, distributed control of plant system and component control and computerized procedures.

Individual presentation of all the desired video let alone individual mouse and keyboard interaction would be an overwhelming interface for the operator. A key enabling technology for improving the Human System Interface (HSI) for advanced instrument and control systems has been the use of Keyboard-Video-Mouse (KVM) switching and extension.

IMPLEMENTATION

The AP 1000 KVM network makes it possible for a specific operator to access and operate more than one computer with only one set of mouse, keyboard and video. By the use of KVM operators have dynamic control of the large panel multiple screen "wall" displays for status overview and situational awareness. Likewise at individual operating stations operators have the ability for functional selection of displays on multiple screen operator control panels KVM switches and extensions also allows for display sharing for supervisory oversight, peer review or verification and Human Performance (HuP) monitoring.

The AP1000 KVM network allows the transmission of the signals between the host computer and the operating station to be extended large distance signals, The network also provides the ability to select on a input output matrix switch what is displayed at any operating station. This in turn allows significant flexibility in the location of computers and operating station, and centralization of displays for distributed computer systems For example, the AP 1000 Data Processing and Display System monitors information from computers distributed throughout the plant. Through the use of KVM extensions and switching the interface can be centralized. The KVM network uses a fiber optic infrastructure that does not have the distance

limitation of CATx cable. Additionally it is not susceptible to RF interference from radios, florescent lights or generating equipment and offers isolation between computer location and control room. The AP 1000 application KVM network transmits an uncompressed video to eliminate any latency and provide a image that minimizes eyestrain

The interfaces are distributed throughout the Operation and Control Center System which consists of the main control room, the technical support center, the remote shutdown room, emergency operations facility, local control stations and associated workstations for each of these centers. The Wall Panel Navigation System (WPNS) allows an operator in the main control room, to interact directly with the large-screen information system. The operator controls the large screen with the mouse and keyboard at the station, arranging the display of the screen.

RESULTS AND LESSONS LEARNED

The application of the KVM network in AP1000 and other Generation III+ projects presents a significant improvement in HSI over the previous generation of control rooms Additionally the experience gained offers the opportunity for further improvement in new plants and in the modernization of operating plants. The dynamic control of large panel multiple screen "wall" displays improved the operators capability for status overview and situational awareness. Functional selection of displays made at individual multiple screen operator control station result in simpler faster task execution reducing operator burden. Displays are shared for supervisory oversight, peer review or verification and Human Performance (HuP) monitoring

The use of the KCM network enhances cyber security by allowing the computer systems to be centralized within a secure, climate controlled data center. This protects the operational computer hardware from human exposure, thus reducing the potential attack surface from both malicious and non-malicious threats. It also consolidates engineering for heat and power loading and simplifies backup/recovery process in support of contingency planning.

In the future control room designs and modernization KVM technology offers a high degree of flexibility in the placement of computes and display locations leading to more efficient and effective HSI. A wide variety of computerized Engineering, Operations and Maintenance information such as schematics and procedures can be made available in Control room and remote operating station. Duplicate displays can be made available at offsite location such as Emergency Response facilities