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IMPLEMENTATION OF THE MPC&A OPERATIONS MONITORING (MOM) SYSTEM AT IRT-T FSRE "NUCLEAR POWER INSTITUTE" (NPI)

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DISCLAIMER

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ABSTRACT

The Material Protection, Control and Accounting (MPC&A) Program has been working since 1994 with nuclear sites in Russia to upgrade the physical protection (PP) and material control and accounting (MC&A) functions at facilities containing weapons usable nuclear material. In early 2001, the MPC&A program initiated the MPC&A Operations Monitoring (MOM) Project to monitor facilities where MPC&A upgrades have been installed to provide increased confidence that personnel are present and vigilant, provide confidence that security procedures are being properly performed and provide additional assurance that nuclear materials have not been stolen. The MOM project began as a pilot project at the Moscow State Engineering Physics Institute (MEPhI) and a MOM system was successfully installed in October 2001. Following the success of the MEPhI pilot project, the MPC&A Program expanded the installation of MOM systems to several other Russian facilities, including the Nuclear Physics Institute (NPI) in Tomsk. The MOM system was made operational at NPI in October 2004. This paper is focused on the experience gained from operation of this system and the objectives of the MOM system. The paper also describes how the MOM system is used at NPI and, in particular, how the data is analyzed. Finally, potential expansion of the MOM system at NPI is described.

MOM SYSTEM AT IRT-T FSRE "NPI"

The Thermal Research Reactor-Tomsk (IRT-T FSRE) NPI MOM system is shown schematically in Figure 1. The system is comprised of four subsystems. Each subsystem consists of a base station and four associated cameras. In addition the system has three review stations that are located in the physical protection system (PPS) laboratory, the chief engineer's office and the director's office. The objectives of each subsystem are given briefly below and in greater detail in the following sections:

System 1: Monitors personnel and guard force operations in the vicinity of the fresh fuel storage vault.
System 2: Monitors personnel and guard force operations in the event that the SNM portal monitor is triggering. The system also monitors locations of critical importance to the PPS.
System 3: Monitors personnel and guard force operations during the movement of nuclear material (NM) in the material balance area (MBA).
System 4: Monitors personnel and guard force operations when leaving the (MBA).

All system cameras are configured to take time-lapse images to confirm continuous operation of the MOM system as well as ensure system stability and configuration control.

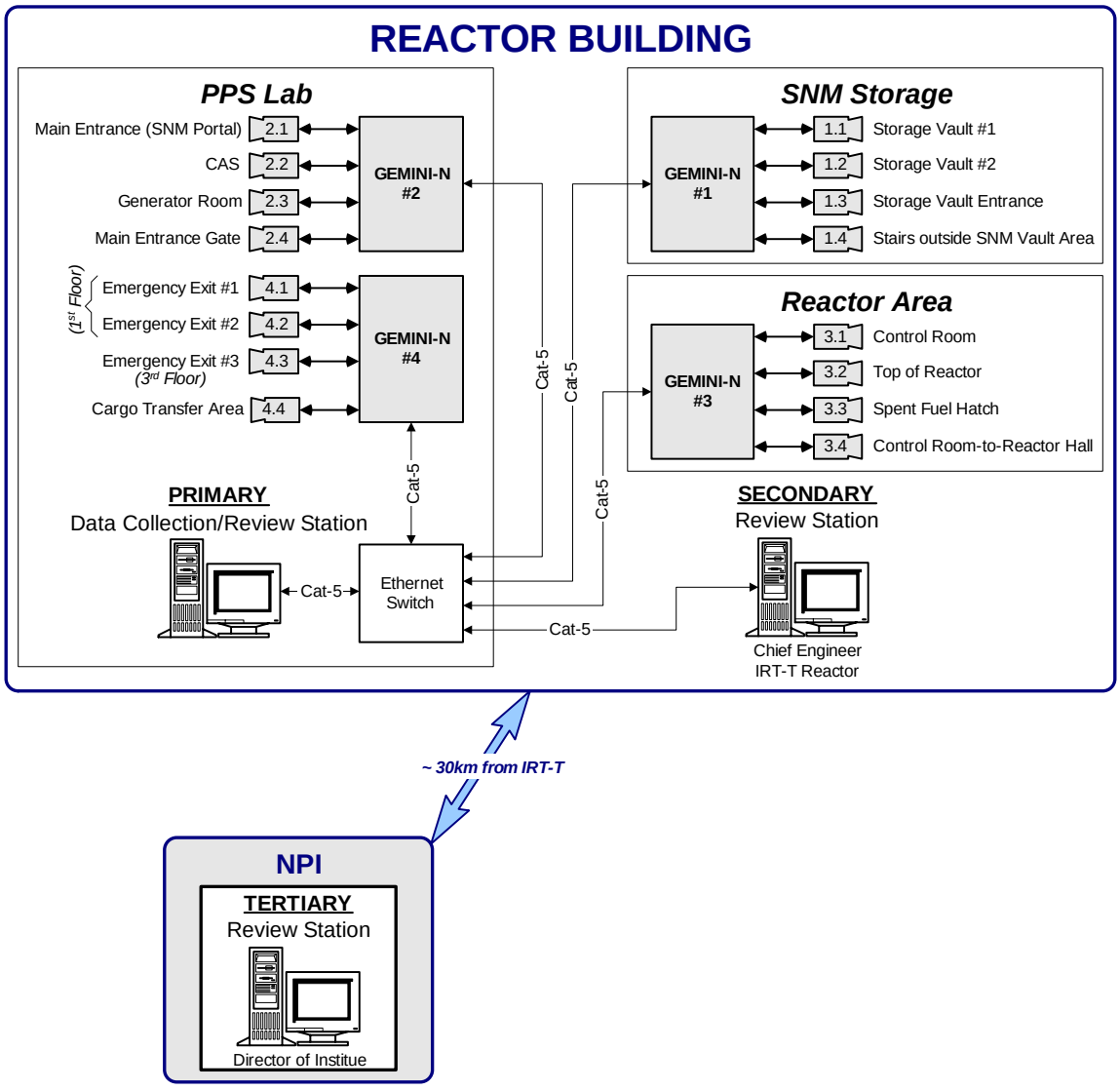

Figure 1: Schematic of the MOM System at IRT-T FSRE "NPI"

MPC&A SYSTEM MONITORING STRATEGY AT IRT-T FSRE "NPI"

System 1

As indicated in Figure 1, three of the cameras in System 1 (cameras 1.1 - 1.3) are located in or nearby the fresh fuel storage vault. The fourth camera (camera 1.4) is located in the stairway in the immediate proximity of the vault. Cameras 1.1 through 1.4 verify that two-person access is being adhered to. Camera 1.2 remotely triggers camera 3.4. Cameras 1.1 and 1.2 also verify that the two-person rule inside the fresh fuel vault is being followed. In addition, cameras 1.1 and 1.2 are used to monitor activity associated with physical inventory taking (PIT) and daily administrative checks (DACs). Cameras 1.3 and 1.4 are also used to monitor material movement in the storage entry and stairway. Camera 1.3 remotely triggers camera 1.4.

System 2
Camera 2.1 monitors the exit from the reactor building through the SNM portal monitor. In addition this camera monitors the actions of the health physics service and reactor pro-force during situations when the SNM portal monitor is actuated. The camera is triggered by an independent alarm signal from the SNM portal monitor.

Camera 2.2 is intended to monitor the actions of the reactor pro-force in the Central Alarm Station (CAS) during select alarm events.

Camera 2.3 monitors personnel actions in the PPS backup power generator room. The camera is triggered by motion detection.

Camera 2.4 is intended to monitor how the pro-force personnel follow the rules and instructions that are in force at the vehicle check point. In particular, the camera monitors the search procedure of vehicles driving into the protected zone and the two-person rule. The opening of the checkpoint gates triggers the camera using a balanced magnetic switch (BMS) on the gate.

System 3
Cameras 3.1 and 3.2 monitor personnel movement in the control room and reactor areas respectively. Camera 3.1 takes one image every hour (timelapse), while camera 3.2 takes timelapse images every 5 minutes. Camera 3.3 monitors material movement in the spent fuel area using motion detection. Camera 3.4 monitors material movement from the storage area through the control room to the reactor hall, and is triggered by Camera 1.2 via the LAN for a duration of five minutes.

System 4
Cameras 4.1 through 4.3 monitor appropriate personnel presence during non-emergency periods. The assignment for each camera is as follows:

Camera	Emergency Exit Door
4.1	110
4.2	117
4.3	334

All cameras are activated through the use of a BMS on the exit doors.

Camera 4.4 monitors the cargo transport area. The intent of these cameras is to verify the actions of pro-force and health physics personnel with respect to proper search procedures. The camera is triggered by BMSs on the transport and personnel doors.

MOM SYSTEM REVIEW STATIONS AND DATA COLLECTION SERVER.

Review station 1. (Data Collection Server)
Review Station 1 is installed in the PPS laboratory. It allows for review of the images received and stored from any camera. The review station also allows the review of real-time images from any camera. The images received from all the cameras are stored in the data collection server.

The server is configured in such a way as to store these images in defined directories, separate for each camera and depending on whether it is an alarm image or not. It is possible to change the system configuration and its parameters from the server. Access to PPS lab is limited and access to the review station is password protected.

Review Station 2
Review Station 2 is installed in the chief engineer's office. This review station has the capability to view stored images, as well as the ability to view any camera in the "real-time" mode. Access to this station is password protected and the ability to change the system configuration is not available at this location.

Review Station 3
Review Station 3 is installed off-site, in the office of the Director of the Institute, and is not included in the MOM system local area network. Information is provided to the Director on a CD-ROM when necessary. This review station is used for evaluating the information generated by the MOM system in the event of violations of accepted procedures and rules at the IRT-T reactor. Access to this station is password protected and system configuration cannot be changed from this station.

MOM SYSTEM USE AT IRT-T FSRE "NPI"

The MOM System at the IRT-T FSRE "NPI" is used in accordance with the objectives and system design. With the help of the MOM system the administrative personnel in the person of the chief engineer and/or the PP service head are able to monitor compliance with the procedures and regulations in place at their facility during the operational processes.

EXPANSION OF THE MOM SYSTEM AT IRT-T FSRE "NPI"

In response to the decision to install additional equipment for the physical protection system at IRT-T, it was decided that the MOM system should also be expanded. Two additional SNM portal monitors were installed at the facility in the autumn of 2007. One monitor is located at the pedestrian entry point and the other monitor is located at the vehicle entry point. The design of the MOM system expansion for the purpose of monitoring the operational procedures associated with the newly installed portal monitors has already been developed. One additional camera will be installed and connected to System 2; this camera will be triggered by alarm signals from the pedestrian SNM portal monitors. Camera 2.4 will be triggered by the alarm signals from the vehicle portal monitor.

CONCLUSIONS

During the period of the MOM system operation at the IRT-T FSRE "NPI" the following positive attributes were discovered:

1. MPC&A operations and procedures are monitored by the safety service and pro-force with the ability to draw conclusions of how well they are being followed by facility personnel
2. The MOM system has the capability to review "pre-alarm" images, prior to an event occurring. This could not be accomplished through the use of an analog system.
3. The capability to focus only on those events of interest, versus other systems that require the review of all data, simplifies the analysis.
4. The system contributes significantly to the resolution of disputable issues that have arisen during the fulfillment of MPC&A procedures.
5. System maintenance support carried out by Canberra Albuquerque, Inc. specialists.

During the operation period of the MOM system at the IRT-T FSRE "NPI" reactor the following issues were identified:

1. The IBM Travelstar® hard drive did not perform to the original equipment manufacturer's (OEM) specifications and was replaced in the field.
2. A Gemini-N power supply board failed in the field and was replaced. Root cause analysis has determined this singular event that occurred relatively early in the operation of the system to be attributed to infant mortality. This failure occurred in only 1 out of 19 installed base stations across 5 installed sites.
3. Low image quality; however, all MOM operational procedures can still be identified and resolved in the current hardware design.

In summary, the MOM system installed at the IRT-T FSRE "NPI" reactor in October 2004 is an excellent addition to the physical protection system. The facility administration has received a good system, which allows them to monitor how well procedures and personnel instructions are being followed.