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DATA COLLECTION SYSTEMS

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CONTINUOUS REMOTE/UNATTENDED MONITORING FOR SAFEGUARDS DATA COLLECTION SYSTEMS*

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Staff from Los Alamos have been involved in the development and installation of several major applications of unattended radiation monitoring systems in Europe, North America, and Asia. These types of systems were developed in response to the need for safeguards authorities to inspect more facilities, and to inspect facilities that were operating continuously, but with the same or reduced number of safeguards inspectors as before these new facilities and requirements arose.

In the full implementation, these types of systems are divided into data collection/review, analysis and accountability/record keeping/report generation. Data collection/review acquires data from the radiation detectors; eliminates redundant data; integrates data from other elements of the system such as mechanical sensors, video, and operator data; and produces a packet of all relevant data as its output. Data analysis uses the packet produced by the data collection/review system to perform the unique analysis needed for the particular system such as calculating grams of plutonium or using a neural network to recognize patterns and the occurrence of events. The data accountability system uses the analysis results to update its total safeguards information database and draw conclusions.

The data collection/review portion of present field systems is composed of all or parts of the generic unattended radiation monitoring system described below. The front end of such a system is a detector or detectors for radiation; these may include pulse-type detectors, ionization detectors, and NaI detectors. A data acquisition electronics (DAE) package (such as a GRAND or JSR-11) provides power for and processes the signals from the detectors and may run a Monitor program that collects data, temporarily stores data, and does limited on-line analysis. The Collect computer is connected to the DAE by a serial line and runs the Collect program, which uploads the data produced by the Monitor program, organizes and stores it on magnetic media, and is the focal point for the inspector's interaction with the system. Data are transported from the Collect to the Review computer by floppy or Bernoulli disks. The Review program organizes data from the other DAEs and other system data (such as mechanical sensors) into one database, provides capabilities that allow the inspector to easily and quickly review all data, and produces a packet of data associated with each event.

Nondestructive assay (NDA) systems are those in which a quantitative special nuclear material (SNM) value must be obtained by the inspector; this requires access to the data collection and data analysis system components. Radiation monitoring systems (RMS) are those in which the "answer" needed by the inspector is the time that a valid event occurred; a quantitative measure of the amount of SNM is not required.

Facility	System Type	Number of Systems	Typical Data Collection Length	Operating Years as of 3-94
PFPF/PCDF	NDA	10 JSR-11	60 s	34
CDM	RMS	16 GRAND	11 s	46
Joyo	RMS	2 JSR-11 3 GRAND	20 s 5-60 s	6 9
Monju	RMS	2 JSR-11 3 GRAND	20 s 5-60 s	4 6
Others	RMS	2 GRAND	1 s	2
Siemens	NDA	4 JSR-12	10 s	0

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Currently 42 unattended monitoring systems that collect data continuously are operating in the field. In addition there are five systems that collect data for shorter periods such as overnight, in unattended operation. The table summarizes the types of systems that run in continuous unattended mode at each facility, the data acquisition electronics packages used with each system, the typical events being detected, and the system years of continuous operation.

We see the following trends developing as these unattended measurement systems evolve:

- All systems now measure only neutron data (gross and coincidence) or gross gamma data or both; simultaneous neutron and gamma measurements will be needed. Techniques to automatically scan large samples in a continuous, unattended manner will be needed.
- The amount of data collected by these systems is very large. New techniques such as neural networks can be used to automate part of the pattern recognition-type analysis now done by the inspector.
- Centralized data collection would make the systems easier for inspectors to use and provide the possibility of real-time data review; this could be extended to remote review in Vienna. The hardware technology to integrate the system parts exists today. However, collecting data remotely from the acquisition systems introduces the problems that the data must be verified as actual data from the system and that all data from that system are transmitted. Presently different parts of the systems are authenticated by seals or data disks. New advances using the local operating network (LON) technology can provide authentication along with network media such as rf transmissions and power lines that may significantly reduce installation effort.
- Capabilities are needed to combine detectors and different DAEs with minimum effort in a new facility. Commercial process-control packages are being evaluated to see if they could provide these features with the reliability demanded by the long unattended periods, the flexibility to handle typical safeguards data, and the ability to quickly examine data collected for 30-90 days.
- Several different hardware solutions can be used to integrate the systems. A more difficult problem is to define the software protocol and data structures to handle all the types of data that might appear in these systems such as neutron, gamma, mechanical, video, and operator. Interfaces between the data collection/review, data analysis, and data accountability system must be defined.

Credits

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