IFSS: The IAEA's inspection field support system

A description of computer support to safeguards inspectors

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Recently, highly automated nuclear facilities with enormous volumes of nuclear material accounting data have come into operation. A few others will become operational shortly. Analysis and verification of the data for safeguards purposes is manageable only with improved computer support in the field.

To assist its safeguards inspectors, the IAEA has developed the Inspection Field Support System (IFSS). It allows safeguards inspectors to collect, maintain, analyse, and evaluate inspection data on site at nuclear facilities.

Previously, field computer support to safeguards inspectors concentrated on providing measurement instrumentation with data storage, but data analysis capabilities were elementary. Also, generic statistical tools were available to handle data that inspectors could (usually manually) input into a computer. Electronic links between these two directions were rudimentary.

IFSS integrates the data required for verification and accounting so that inspectors will be able to devote more time to measurements and to derive conclusions at the site in a more timely manner. The system operates on stationary personal computers as well as on portable ones. Its introduction reflects the IAEA Department of Safeguards determination to further improve operational efficiency.

It should be emphasized that IFSS implementation is still under development. Several field installations have been made to obtain practical experience and to determine the system's effectiveness.

Basic design considerations

IFSS is built around a "core-engine". That is, it was assumed that certain functions and data flows could be defined in a generic way, despite differences between facilities and inspection procedures stemming from specific requirements in safeguards agreements or facility attachments. (*See accompanying figure.*) IFSS computer programs consist to a large extent of implementations of these basic functions. The need for a generic basis is dictated by the practical impossibility (due to resource constraints) of developing unique systems for each of the hundreds of facilities under safeguards.

Beyond these core functions, IFSS can be adapted for use at a facility that differs significantly from its concept of a standard facility, or to meet a particular inspection requirement. For example, a facility may handle different materials, and account for them using different types of codes. Or a facility may be subject to inspection requirements that are specific to it, such as reconciliation of pin and assembly data at a fabrication plant.

Another design consideration was the use of an operating system, hardware, and software that were widely used. This was to ensure ease of procurement and the widest possible selection of hardware and software tools, including the provision of maintenance for hardware and commercial software components. In addition, it was foreseen to serve as a means of facilitating any future interface or integration with operator-supplied systems, and with the IAEA's Safeguards Information System (ISIS).

Data requirements

The design was targeted for facilities where the volume of data is so large that it renders manual processing either impossible or so labour-intensive that additional manpower is required or other inspection activities must be curtailed. As a result, there are two basic data files required from the operator in machine-readable form: the general ledger and the itemized list of inventory. This information is necessary for an inspection; in the past, it was normally provided to the inspector in printed form. A standard format for the ledger and itemized list were defined. Almost any other

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format, if previously agreed, may be converted. Data elements necessary for inspection activities were included.

For records examination, the inspector needs to define, in addition to the operator's general ledger, the set of valid general ledger transactions. This serves not only to check ledger entries but also as the basis for the generation of the inspection report. Upon completion of records examination, the general ledger is archived for comparison with the State's reports at a subsequent inspection.

For inventory verification, in addition to the operator's itemized list of inventory, the inspector needs to define how material is to be stratified. For verification, not only the verification methods must be defined but also the non-detection probability, and the random and systematic error of the method. In some cases, the operator's declaration on material characteristics, e.g. the isotopic composition of plutonium, is required to support non-destructive assay (NDA) measurements.

Other data that might be required include the measurement uncertainty of the operator's NDA system and the uncertainty of destructive analytical methods.

Functions of IFSS

The current version of IFSS provides support for a number of inspection-related functions, including generating parts of the IAEA internal inspection reports which provide the basis for the annual Safeguards Implementation Report.

Before the system can be used in any inspection environment, specific to a facility configuration information — for example, description of material balance areas (MBAs) — must be specified and the details of the operator's electronic declarations clarified.

At the facility, an IFSS subsystem for records examination processes the operator's ledger, thereby assisting the inspector with his book auditing activity. This includes the stratification of the ledger and the generation of parts of the inspector's final inspection report.

Another subsystem compares inventory change reports (ICRs) extracted from the IAEA Safeguards Information System with previously examined operator ledgers, again generating parts of the final inspection report.

A third subsystem for inventory verification processes the operator's itemized list of inventory, assigning items to sub-strata, generating sub-stratum totals and sample plans, and parts of the inspection report. In addition, computerized support is included to calculate material unaccounted for (MUF) for MBAs and for the agreed key measurement points.

To facilitate the exchange of data, functions exist for transferring sample and isotopic data from IFSS to instrument computers and for obtaining feedback of results.

Other IFSS-related systems

Elements of IFSS have been incorporated into a "near-real-time" accountancy authentication system. An IAEA computerized data entry system for inspection reports provides support for capturing and storing inspection data on site. It includes a direct loading capability for the data into the central database of the Safeguards Information System. Additionally, a computer-based management system for seals that are applied by safeguards inspectors has been introduced at facilities and field offices to provide up-to-date information on sealed material; the system also permits direct loading into the IAEA's central safeguards database.

Development experience

To realize these system components, new software development techniques were tapped, new procedures had to be developed, and a comprehensive set of generic routines had to be successfully established. This was required to maintain a system-wide homogeneous inspector interface, implying that no matter on what level of software an inspector works, the use of the special keys on the computer keyboard would be the same (or very similar). Also, screen layouts look the same and messages appear at fixed locations on the output screen throughout the system. On-line help is always available by activating the same function key. The homogeneity of the user interface is expected to reduce the training effort for introducing new functions and to help new inspectors get familiar with the different components of the system faster. To facilitate the maintenance and storage of data in the field, a commercial database management system was selected.

During all development stages, close co-operation with the IAEA inspectorate was maintained. Using a prototype proved essential, since many function and system definitions had to be reviewed and revised from their original interpretations to make them more effective in the field.

Operational experience

Based on the practical experience in the past year, the following results may be given:

- ***Improved efficiency.*** Computerized methods are contributing towards higher efficiency in a number of ways. The inspectors' time is freed from time-consuming arithmetical checking of data, from data sorting, and from transcribing numbers. There is the possibility to obtain feedback at a very early stage, so that in case of problems, action can be taken on site.
- ***Quality assurance on site.*** The IFSS software has built-in quality control checks that provide for or assist in arithmetical consistency checks, stratification, sample planning, and selection.

● ***Integrated processing of data.*** Extensive use of electronic data exchange helps to ensure the accuracy of information from the operator's original declarations through the verification activities and into the Safeguards Information System database. Information collected and produced during inspections can be stored on site or at regional offices; it can be moved easily to another computer and it can be sent to the IAEA's main safeguards computer. Once stored, data can be used by all staff with a need and authority for access.

At some of the bulk-handling facilities under IAEA safeguards, the volume of data to be accessed is enormous. There are cases where the general ledger to be examined has 4000 records or the itemized list of inventory has some 20 000 items. Therefore, computer performance is of growing concern, both in terms of processing speed and disk or diskette access times.

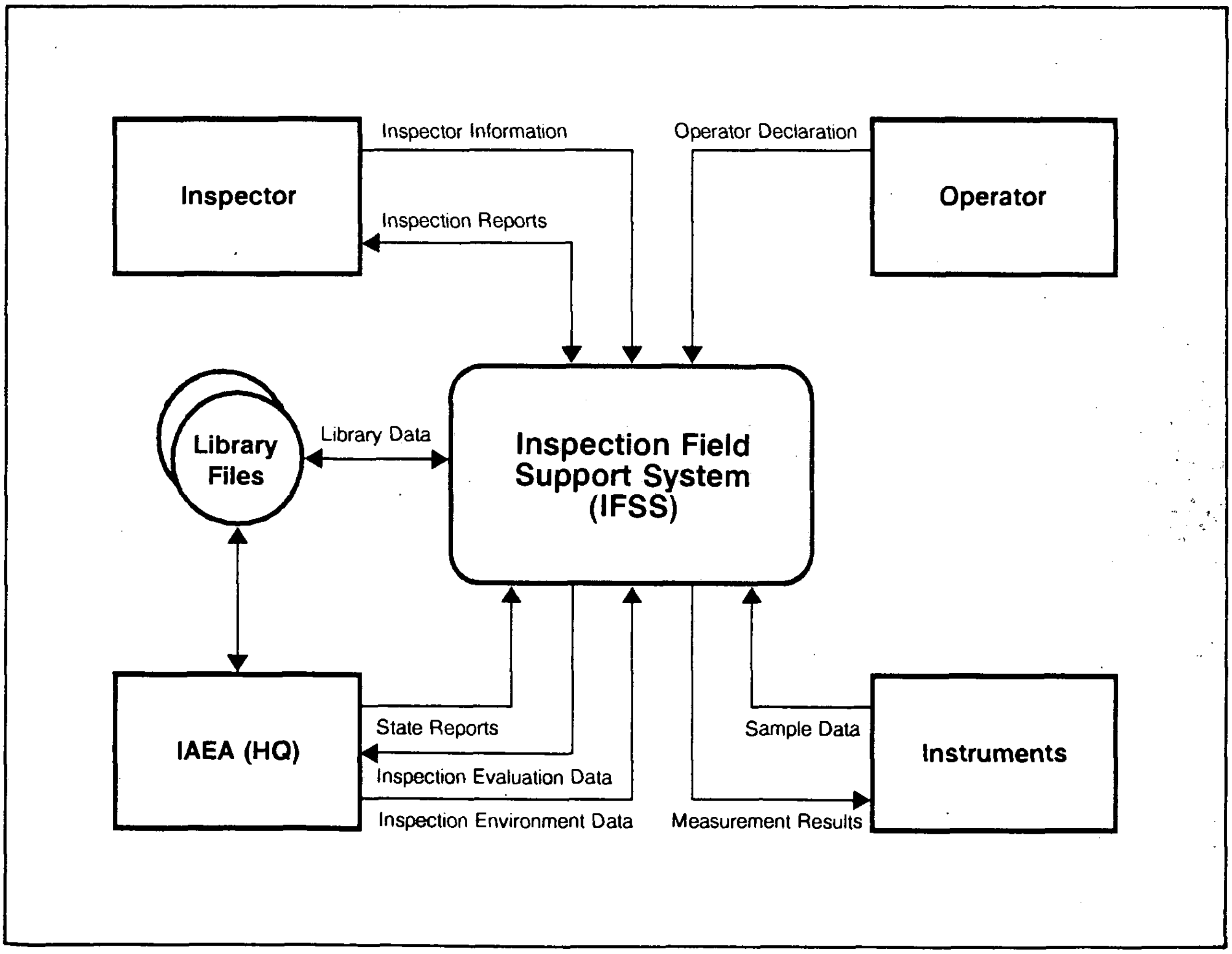
Additionally, the capacities of the computer equipment are an important factor. Because of increasing functionality, IFSS has grown in size and is run as an overlay structure according to the major processing paths. Because of speed and fixed disk storage requirements, older generation computers have proven to be inadequate, requiring replacement or upgrading.

To set up an IFSS system for a specific facility still requires an expert who is very familiar with the facility and its associated inspection procedures, as well as a computer expert. This may involve data file redefinitions, perhaps additional conversions due to facility specific requirements, and the adaptation of stratification and records examination criteria.

Personal computers used with IFSS should not be used for any other applications; this is one "information security" consideration.

Agreement with operators is required to routinely provide the inspector using IFSS with operator data on computer-readable media. This is essential to fully exploit the capabilities of IFSS, and to save significant amounts of inspector time for data entry.

Training is an activity which will require continued attention. Up until now, and because IFSS is still under development, training has been ad hoc in nature, being provided to those inspectors who were about to use the system. New releases of the system, a natural product of the development environment, have sometimes created difficulties. Since the end of November 1989, a formal IFSS training course has been offered through the safeguards training section.



Future plans

Further development activities will include two directions: integration of NDA instrumentation and the provision of more comprehensive on-site data evaluation. Currently, there is only an interface to the high-level neutron coincidence counter system which provides weight and composition data for items selected for measurement. However, other instrument systems are under development using established standard interface techniques, and they are expected to achieve the same degree of integration.

For some bulk facilities, the volume of accounting transactions is such that complete auditing is not possible. In this case, a method used for sampling, based on goal quantities, non-detection probabilities, and item size may be adapted. Further support for verification of inventory changes under continuous inspection regimes may be required. Periodic inspections may allow correlating the general ledger with the itemized list of inventory to identify candidates for verification. However, items verified under the continuous inspection regime may not belong to the inventory any more at the actual time of reporting. While not initially designed for item tracking, e.g. able to follow an item across inspections, IFSS could be adapted for this purpose.

For more comprehensive data evaluation, statistical tools are planned to include software that will help the inspector to track the achievement of his inspection goal at the facility.

At particularly complex facilities, different inspection activities may be carried out simultaneously supported by different IFSS systems. A means of networking these systems together to correlate data and to synchronize processes to obtain consistent results may be necessary. The provision of improved on-site evaluation tools is planned to include software that will help the inspector track the achievement of his inspection goal at the facility. Finally, expanding on what is currently done in one facility, the IFSS near-real-time accountancy authentication system may offer a new safeguards approach at other complex facilities. It provides both a future basis for authentication of software systems and an interface for near-real-time accounting programs.

For facilities where certain IFSS capabilities are not needed, it may be possible to remove these functions from IFSS to generate smaller and more efficient programs should this prove a necessity. Obviously, with an increase in workload (new functions, growing data volume) upgrades to the computer system will be required to keep inspector waiting times to a minimum.

Diablo Canyon nuclear power plant in California, USA. (Credit: USCEA)