THE IRES ELECTRONIC SEAL

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In the framework of the French Support Program for the IAEA Safeguards, the "Institut de Protection et de Sureté Nucléaire" (IPSN), developed an electronic seal called Integrated and Reusable Electronic Seal (IRES) that enables independent verification by different inspectorates (IAEA, Euratom, and National Inspectorate)

Furthermore, a bilateral co-ordination between Euratom and French domestic safeguards takes place in some French facilities regarding a common approach concerning the seals especially in case of crisis situation.

The seal can be remotely interrogated by radio frequency and integrated to other Containment/surveillance systems by serial line RS 485. Data are authenticated and the IRESMAG software manages in the seal reader all functionalities of the seal and records inspection data compatible with the IAEA's Seal Database.

I THE MAIN FEATURES OF IRES

The main features of the IRES seal are the following

- Interrogation by different inspectorate, allowing independent conclusions
- Recording of events including tampering in a non-volatile memory
- Authentication of data
- Remote interrogation by an inspector or/and automatic for unattended systems or remote monitoring
- Data encryption in case of remote monitoring
- Reusable

In the light of the results of the feasibility study, prototypes, developed by the SAPHYMO Company, have been demonstrated, in France, between July and September 1999, with data remote transmission to Vienna.

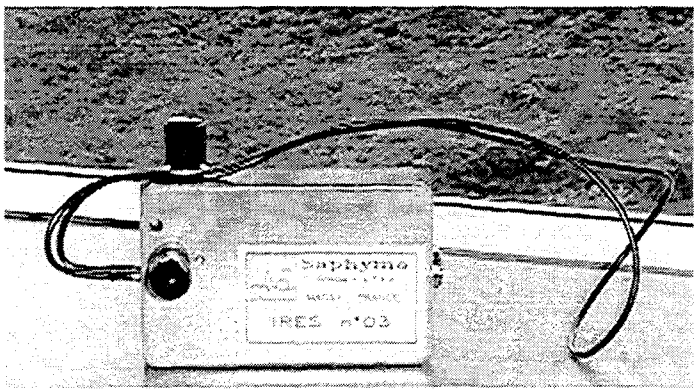

Figure 1 : IRES Prototype

II SEAL TECHNICAL DESCRIPTION

The seal is manufactured as far as possible with existing industrial components, as following:

Seal enclosure, contains all components of the seal except the seal wire. The size of commercially available aluminum enclosure is 64*58*34 mm.

Sensor element "Sealing wire" : enables to fit through the containment parts for sealing and also to attach to the seal case and electronics. It is a special electrical cable containing a sensitive element able to detect any unauthorized attempt of tampering. This cable was selected to be easy to fit and resistant, with a diameter of 3 mm.

A dedicated watertight connector embedded into the seal enclosure performs the attachment to the electronics. This connector allows easy connection with gloves.

Continuous measurement of the resistivity corrected by the temperature insures the tamper indication to detect any unauthorized attempt.

Electronics, records any change in the status of the sealing wire connected and other tampering events and produces an internal data base containing a list of date and time stamped events which can be retrieved upon request (by the inspector during inspection or automated in remote monitoring applications). The database includes also state of health messages confirming the proper performance of the seal components (self-diagnostics).

The main micro controller manages all the seal functions. It is designed to minimize the power consumption.

The authentication micro controller hosts the authentication software DSA elliptic and the private key. The length of the key is 192 bits.

The EPROM has a capacity of 128 KO that is sufficient to record more than 1800 events and parameters. Furthermore, the memory stores parameters such as ID and specific code introduced at the factory and at a maintenance site of the inspectorate.

The Communication link, enables the data transfer between seal and seal reader. This is performed by radio frequency communication with a frequency of 470 MHz. It utilizes a standard protocol. The power consumption is some mA in communication and less than 1 μA in sleeping mode. The information transferred to the interrogating device is always authenticated between the seal and the seal reader and additionally encrypted in the case of remote monitoring. The access control utilizes the authentication technique, private/public key system. The advantage of this communication mode is to permit the verification of a seal placed into a glove box.

The serial line is RS 485 standards and the connector hosts the external power supply as well. The connector is watertight and easy to connect even with gloves.

The temperature sensor detects any sudden variation of temperature and records those variations. In addition it corrects automatically the measure of the cable resistivity. It is located close to the enclosure. Also the detection of abnormal variation of the temperature will be recorded before that the other components should be affected.

Batteries, are 3 R6 lithium type, in case of stand-alone mode. Batteries are exchangeable only during the maintenance of the seal. An additional back up battery ensures recording of events in case of main batteries failure.

The seal reader enables the inspector to attach detach and collect the seal authenticated data (status and performance) by remote data acquisition. The seal reader consists of a commercial portable computer notebook running a standard operating system Windows NT 4 and a specialized custom made interface device to establish the radio communication link to the seal.

The management software, is located in the seal reader. Seal data are stored, authenticated, evaluated by the management software, displayed on the screen with a possibility to print out tables for on-site inspections. The management software enables to produce inspection reports directly compatible with the IAEA seal database. The transmission to the remote monitoring station can be achieved directly from the seal by mean of authenticated serial line RS 485.

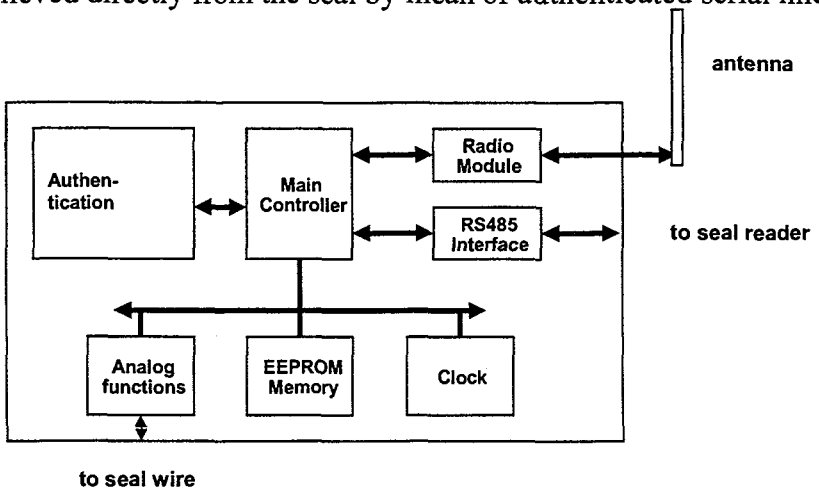

Figure 2: Synoptic of electronics board