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Improvement of Design Information Verification capacities by specific implementation of available geophysics

C. Antoine ⁽¹⁾, **X. Derobert** ⁽²⁾, **M. Richard** ⁽¹⁾
J. Dumoulin, D. Leparoux, G. Villain ⁽²⁾ **M. Munsch** ⁽³⁾

(1) CEA, Commissariat à l'Energie Atomique et aux énergies alternatives, Paris ; (2) IFSTTAR, Institut français des sciences et technologies des transports, de l'aménagement et des réseaux, Nantes ;
(3) EOST, Ecole et Observatoire des Sciences de la Terre, Strasbourg.

Email of the main author: claudе.antoine@cea.fr

Efficient safeguards (SG) implementation at complex installations is critical for the Agency to better fulfil its mandate in providing assurances of the absence of diversion of nuclear material at declared facilities. Structures might be difficult to access, making the Verification of Design Information (DIV) or the Complementary Access (CA) a real challenge to inspectors. Geophysical techniques such as ground penetrating radar (GPR), authorized by IAEA for inspection in 2006, could help inspectors to get a larger and better comprehensive view of an installation and its activities. They could provide information by mapping infrastructures and their content and any accessible geophysical anomalies.

After an analysis of SG Inspections targets and operational context, two families of alternatives and complementary appropriate techniques were identified. Inside a building, tools such as GPR (electromagnetism properties), Thermography (thermal anomalies), Impact Echo or Ultra Pulse Echo (sonic parameters) will help verifying the structure of a wall, its contents such as tubes, as well as the structure of a slab. It will also enable access to the information about the space beyond wall or slab and its content such as void and metallic or plastic features. In addition, activity of features such as pipe beyond wall will be addressed by their temperature. Outside a building, GPR, Magnetism (magnetic parameters) and Active Seismic (velocity of elastic waves), will provide information on the existence or absence of underground structures or features such as tanks, pipes, sewers, ... The combination of these complementary and alternative techniques will ensure more reliable results.

The selection of such geophysical techniques, the analysis of their capacities and limits regardless to IAEA objectives, and their implementation mode were analysed by CEA as part of the French Support Programme, with the support of IFSTTAR, former Laboratoire des Ponts et Chaussées (LCPC) bringing its expertise in NDT and subsurface survey, and its geophysical test site, with recent involvement of EOST (Ecole et Observatoire des Sciences de la Terre) for magnetism.

The geophysical signatures of anomalies for DIV inspection objectives were analysed for different inspection contexts. GPR was implemented in a first step. Other preselected techniques could be soon implemented. The programme produced specific basic and continuous training program, field examples catalogue to help inspectors, standard acquisition and processing configurations and possibilities of software simplification. The program mainly aims to get useful data from inspection. Recent deeper analysis of an appropriate field approach lead to usage of lighter techniques before the slower one.

Beyond technical approach, one remaining challenge is the full integration of such particular and new techniques requiring specific skills and usage in the IAEA, leading to all processes adaptation, from identification of appropriate usage identification during inspection preparation to specific training, maintenance and data handling as well as processing and interpretation processes.

Despite the issue to manage low frequency usage, some limitations and the requirement for a specific training for core of inspectors, these additional tools based on available equipment, gives to IAEA the capability to better address future challenges by getting information actually not accessible.

Keywords : DIV, complementary access, safeguard inspection, undeclared activities, geophysics