Non-Destructive Testing of Cultural Materials

Objective

To provide modern testing services, including nuclear techniques, to customs officials, museums, galleries, and collectors of archeological artifacts and works of art to verify the authenticity of objects, prevent unauthorized export of cultural resources, and aid conservation or restoration efforts.

Background

A detailed understanding of the materials and structure of cultural artifacts is critical to evaluate their authenticity and to properly preserve their integrity. Export of pre-Columbian artifacts is severely limited under statute, but a large export trade in reproductions exists. Authentic artifacts are often exported as reproductions to avoid the restrictions. Improved analytical techniques are needed to verify that export materials are properly manifested and that authentic materials are not exported as reproductions. Conversely, museums and galleries need to ensure that materials they acquire are indeed authentic and not reproductions. The structure and composition of cultural artifacts is also important to guide conservation efforts. The choice of cements, fillers, stabilizers, and surface coatings that can be safely used depends on the make-up of the artifact.

Traditional chemical and materials tests cannot be used without damaging the artifacts, limiting their application. Non-destructive testing (NDT) therefor is an important tool in the examination of paintings, sculptures, ceramics, and other cultural materials. Nuclear techniques, including industrial x-ray or gamma radiography, x-ray fluorescence, and electron microscopy, can be used without harm to most artifacts, or can applied to much smaller fragments than would be required for other means of analysis.

Institutional and Organizational Factors

The Center for Nuclear Energy and Technology (CNET) has been approached by the national Customs service and by the National Gallery as part of their joint Working Group on Cultural Artifacts established under the Ministry of Tourism. The Working Group requires technical support to accomplish the enforcement and conservation goals that were set under the 1997 legislative act mandating stricter control of all pre-Columbian artifacts. The Working Group is considering new requirements for certification of all exports of cultural artifacts, including requirements for NDT. The technical means to apply NDT for certification is not currently available however, and conventional tests are unreliable, slow, and can damage the artifacts.

On-Going Program Activities

The existing NDT facilities at CNET are restricted to antiquated x-ray machines that not designed for use with the variety of sizes, shapes, and types of materials commonly encountered in cultural artifacts. Several analyses of cultural materials have been performed under special arrangement with the National

Museum, but there is no on-going large-scale program of NDT testing. Plans for an NDT facility are being prepared jointly by the Working Group and CNET, but critical components, in terms of equipment and expertise, will not be available without external assistance. Curatorial expertise is being provided through a grant from the U.S. Smithsonian Institute, in Washington D.C., but additional expertise is needed for design and installation of NDT equipment and train scientists and technicians in its use with cultural artifacts. Existing laboratory facilities may also require expansion to accommodate the new equipment, staff, and specimens involved in full-scale project implementation.

Scope of Activities for the Proposed Project

The initial phase of the project involves activities needed to create an operational NDT center. Expert assistance through the IAEA is needed to complete the design of the NDT facilities and select appropriate equipment. X-ray, gamma-ray, and electron microprobe facilities are currently planned. Training and analyst certification also will be needed before this equipment can be used for the types of materials anticipated, which are substantially different from the medical and industrial products with which CNET has experience.

The second phase will involve pilot-scale analysis of priority artifacts selected by the Working Group and awareness training for customs officials, gallery owners, and others involved with sale or control of cultural artifacts. This phase will establish the methods and procedures needed to include NDT in certification requirements, as well as establishing a broader knowledge of NDT technology and its capabilities.

Finally, in the third phase, the NDT center will become fully operational as a component in the certification process for all export or sale of cultural artifacts. Expanded use of NDT by the National Museum for detailed study and preservation of artifacts is also planned at this stage.

Expected Results

The project is expected to have a significant impact on the trade in cultural artifacts as well as conservation and preservation efforts within the National Museum. Unauthorized exports have resulted in major losses over the years, as well as fueling the looting of national historical sites. While improved testing methods are only one element in controlling this criminal activity, they will help prevent some of the most popular methods of smuggling goods. At the same time, testing will provide greater assurance to legitimate dealers that they are receiving the type of materials they expect and are in compliance with all regulations. On-going conservation efforts will also be assisted and improved curatorial methods to preserve our national cultural treasures will be made possible.

Follow-up and Application to Development Objectives

The proposed project will bring CNET into contact with new partners, opening up new possibilities for the application of nuclear techniques. Within the law enforcement sector, there are possible applications of

NDT in forensics. Materials analysis for engineering design and failure analysis is closely related to conservation applications. These follow-up applications will broaden the impact of the proposed project both within CNET and for national development in general.