2017/5/1

IAEA 動態報告
2017/4/17- 4/28

CULTURE MEETS NUCLEAR SCIENCE IN BRAZIL

當文化在巴西遇上核子科學

Art conservationists and nuclear scientists may make an unlikely team, but in Brazil these specialists have joined forces to harness nuclear technology to preserve more than 20 000 cultural artefacts.

Applying nuclear solutions to industry — including the cultural industry — will be a key theme at the IAEA Technical Cooperation

報告摘要(KEY INFORMATION)

1. 在巴西，藝術保護主義者和核子科學家在技術合作會議上聯合利用核子技術來保存 2 萬多個文化藝術品。
2. 國際原子能總署和阿根廷的核管理局於 2017 年 3 月 21 日至 23 日在布宜諾斯艾利斯(Buenos Aires)舉辦了一次區域研討會，討論在非緊急情況下管理食品、飲用水和商品放射性的國際標準。
3. 近期國際原子能總署的能源需求分析電子資訊培訓班（MAED）吸引了來自亞洲、非洲、拉丁美洲和東歐 21 個國家的 116 名與會者。學習課程期間，總署能源分析師使用該分析工具預測未來能源需求。
4. 國際原子能總署要求成員國建立和加強環境汞監測工作，改進對海洋環境中汞的監測，並研究避免將這種有毒污染物轉移到食物鏈上。
5. 自 2012 年起，國際原子能總署和世界核營運協會簽署了備忘錄，以加強合作包括參與對方的安全審查工作及促進核營運商和監管機構之間的交流。
6. 2017 年 3 月核能署舉辦了一次關於水冷式反應器安全和性能提升的先進核燃料模組研討會。
7. 能源署透過其輕水式反應器事故耐受性燃料專家團隊（EGATFL）來開發先進核能級材料與燃料數據庫。

Conference from 30 May to 1 June in Vienna.

"By merging these two worlds together, we are preserving our heritage and uncovering details about our past in a way we had never done before," said Pablo Vasquez, researcher and manager of the multipurpose gamma irradiation facility at the Nuclear and Energy Research Institute (IPEN) in São Paulo, Brazil. "Radiation technology has become an essential part of our conservation process."

The multi-disciplinary group at IPEN has worked with the IAEA for more than 15 years to use radiation techniques to treat, analyse and preserve cultural artefacts ranging from art pieces to old military paraphernalia to public document archives (see Gamma irradiation). Among these are well-known pieces from artists such as Anatol Wladyslaw and Wassily Kandinsky, as well as modern Brazilian painters such as Tarsila do Amaral, Anita Malfatti, Di Cavalcanti, Clóvis Graciano, Candido Portinari and Alfredo Volpi.

From medical devices to cultural heritage

This technique helps to protect artefacts from the effects of the country's climate, Vasquez explained. "The problem in Brazil is the weather, the humidity, and natural disasters. We have a larger amount of fungi and termites than other countries do, and these can be destructive to books, paintings, wooden pieces, furniture, sculptures, and modern art."

Using gamma radiation is a much less invasive way to disinfect pieces than using conventional methods, explained Sunil Sabharwal, radiation processing specialist at the IAEA. "Using gamma rays is a better alternative because it is done at room temperature using no additional substances, unlike conventional decontamination methods that often involve heat or chemicals that can alter material," he said.

" We are better protecting the material without putting our hands on it," Vasquez added.

Uncovering clues buried in artefacts

Before treating a piece, the team analyses it using various nuclear and conventional techniques including radiography, X-ray fluorescence and X-ray diffraction (see X ray Diffraction). This process uncovers details buried in the pieces, such as the kind of pigment or metals the artist used. This helps the team identify the most appropriate preservation method.

The scientists used these analytical techniques to study a pre-Hispanic canvas from the collections of the Palace of the State Government of São Paulo. They took measurements that helped them determine the kind of paint the artist used and uncover details of how the piece of art had previously been restored. They also found hidden drawings under the original painting.

A hub of knowledge

Today the IPEN team's decades of experience is a main source of knowledge for many experts in the region and around the world. In 2016, IPEN

staff were involved in the first ever training course on this topic for Latin American experts. Organized by the IAEA, the course brought together conservators, restorers, museologists, librarians, curators and radiologists from ten countries in the region to learn about the different applications of radiation technologies in cultural heritage.

IPEN now has a long list of requests for support. Its staff work on objects from different countries and regularly train foreign scientists and cultural experts.

An interesting project in the pipeline, said Vasquez, is the possibility of bringing three mummies that have been attacked by insects and fungi to the institute for treatment from Ecuador. The IAEA is supporting this project with expertise and training.

"I am glad that experts and international organizations are placing more and more importance on preserving cultural heritage because our heritage is what represents the identity of our people," Vasquez said. "We must continue to work to protect it."

MANAGING RADIOACTIVITY IN FOOD, DRINKING WATER AND COMMODITIES

放射性在食品、飲用水和商品的管理

The IAEA and the Nuclear Regulatory Authority of Argentina have held a regional workshop in Buenos Aires from 21 to 23 March 2017, to discuss the application of current international standards for managing radioactivity in food, drinking water and commodities in non-emergency situations.

The workshop, jointly organized by the IAEA, the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, the Pan American Health Organization and the World Health Organization, was attended by 46 participants from 16 Member States and two non-Member States, Aruba and St. Lucia. The participants included high level experts and senior staff from regulatory bodies, industry, research organizations and government ministries charged with the responsibility for establishing national standards for radioactivity in food, drinking water and commodities that are traded, and for assessing compliance with such standards.

Food, drinking water and commodities may contain both naturally occurring and man-made radionuclides. When consumed or used, these products may expose people to radiation. For this reason, it is important to know the amounts of radionuclides in food and drinking water and, if necessary, control their distribution and harmonize national approaches in order to facilitate international trade.

The main purpose of the workshop was to seek feedback from countries in the Latin America and the Caribbean region on their experience in using the international standards, including the identification of any aspects requiring further clarification or development.

A number of countries in the region currently do not have programmes for monitoring radioactivity in food and drinking water. The workshop offered these countries an opportunity to learn from the experiences of others on how to design and implement an appropriate and cost-effective monitoring programme, including the management of situations where activity concentrations in the standards are exceeded. The first step in designing such a monitoring programme is to undertake baseline studies describing the situation nationally.

Participants at the workshop recognized the need to further harmonize the international standards in terms of scope, radiation protection criteria and terminology. They considered that the current system was unnecessarily complex, but that at the same time it did not adequately address all the situations that exist in the region.

Participants recommended that the same criteria for radioactivity content should apply to tap water, bottled water and mineral water. While it was recognized that mineral water often has a special status under national legislation, it was considered that the consumer has the right to expect the same criteria for all water, regardless of source. The participants also discussed the need to collect data on the natural radionuclide content of food produced in the region, both for comparison with radionuclides of artificial origin, and as a first step in considering the inclusion of natural radionuclides in international standards for food.

The workshop participants supported improved harmonization of the standards for radioactivity in food, drinking water and non-food commodities and requested the responsible international organizations to work together to this end.

This event was implemented within the framework of the IAEA technical cooperation project RLA9078, which aims at enhancing effective regional capabilities for protecting the public and the environment in Latin American and Caribbean countries.

IAEA E-TRAINING HELPS DEVELOPING COUNTRIES BUILD CAPACITY FOR ENERGY ASSESSMENT

國際原子能總署利用 E 化培訓幫助發展中國家建立能源評估能力

More energy analysts in Member States develop their skills in integrated energy planning and receive technical guidance for conducting national energy studies, through the IAEA's distance learning services.

A recent e-training session on the IAEA's Model for Analysis of Energy Demand (MAED) attracted 116 participants from 21 countries in Asia, Africa, Latin America and Eastern Europe. During the distance learning course from 13 to 24 March, IAEA energy analysts offered initial training on the use of this analytical tool. MAED supports projecting future energy demand based on targets for socioeconomic, technological and demographic developments in a country or a region.

Through online instruction, scientists and engineers from energy ministries, electric utilities, and regulatory bodies, received hands-on training in designing models, preparing data and interpreting results. These skills are key to applying MAED for national energy demand studies.

"MAED model will help us estimate the electricity demand in various sectors and implement that analysis in our activities," said Dr Alfredo Rodríguez, a participant from Mexico's National Institute of Electricity and Clean Energies (INEEL).

David Shropshire, Head of the IAEA Planning and Economic Studies Section, said the e-training extended the Agency's outreach for capacity building to Member States by building participants' modelling skills and preparing them for additional classroom training. "The feedback we receive from them during these sessions is incredibly important for us to further improve our training services," he added.

IAEA Tools on Evaluating Options for Long Term Energy Planning Development

With growing energy demand worldwide, the IAEA offers a range of assistance programmes, particularly for developing countries. The aim is to improve national and regional capabilities for performing integrated energy assessments to formulate long term strategies for sustainable energy development.

Energy modelling training sessions are an integral part of this assistance. They are important not only for transferring energy assessment methods and analytical tools but also to help users to understand and analyse emerging issues and identify the potential role

for various energy technologies, including nuclear power.

The IAEA's energy models are used by 138 Member States as well as 20 regional and international organisations. First introduced in 2008, the IAEA distance learning courses on energy assessments have so far trained more than 1,750 participants from over 100 countries.

The IAEA's suit of analytical tools that help countries independently develop their own national energy strategies include:

MESSAGE – Model for Energy Supply System Alternatives and their General Environmental impacts

WASP – Wien Automatic System Planning Package

ENPEP – Energy and Power Evaluation Programme

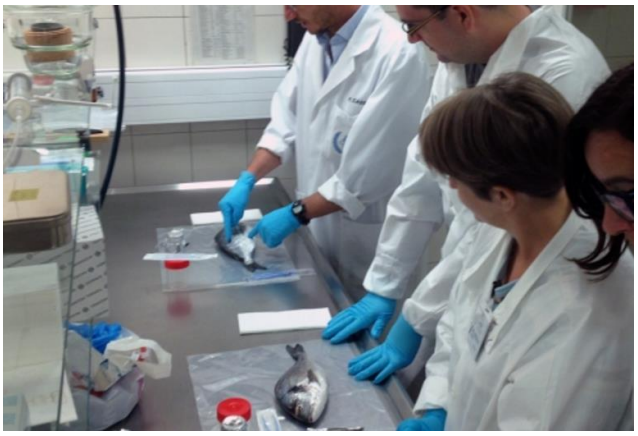
FINPLAN – Financial Analysis of Electric Sector Expansion Plans

SIMPACTS – Simplified Approach for Estimating Impacts of Electricity Generation

ISED – Indicators for Sustainable Energy Development

IMPROVING MERCURY MONITORING IN THE MARINE ENVIRONMENT AND IN SEAFOOD

改善海洋環境和海洋中的汞監測



The World Health Organisation (WHO) rates mercury as one of the top ten chemicals of major public concern, due in part to its persistence and tendency to accumulate in the environment and in organisms. In high concentrations, it can have devastating health effects with impacts on the brain and nervous system. With global seafood consumption nearly doubling in the past three decades and over 1 billion people around the globe relying predominantly on marine food sources for their protein intake, monitoring of mercury ocean concentrations is critical.

As a sign of the importance of addressing the issue of mercury in the environment, the Minamata Convention on Mercury was adopted

by 128 countries in 2013. The Convention prohibits numerous mercury-emitting processes and products and calls for limits to mercury emissions. Once the convention is ratified, Member States will be required to establish and strengthen environmental mercury monitoring efforts. The IAEA Environment Laboratories have long worked with Member States to develop detection techniques and improve monitoring of mercury in the marine environment, as well as study the transfer of this toxic pollutant up the food chain.

Released through industrial activities, coal power plants and artisanal and small-scale gold mining, mercury makes its way into the marine environment through various pathways such as rainfall and surface water. “Bacteria in the water column and sediment change mercury to methylmercury, an extremely toxic element, which can have serious negative effects on organisms and tends to bioaccumulate as it is transferred up the food chain” said Dr Emiliya Vasileva, Research Scientist in the Marine Environmental Studies Laboratory of the IAEA Environment Laboratories.

Concentration levels of methylmercury in fish increase exponentially higher up in the food chain. In its 2013 report on mercury in the environment, UNEP listed red tuna as having a median methylmercury concentration of 470 µg/kg and other top predators like sharks and marlin up to 800 µg/kg. The concentrations in individual fish can vary based on where they lived, and can in some cases be even higher.

The Marine Environmental Studies Laboratory (MESL) of the IAEA Environment Laboratories in Monaco has been working for many years to increase Member States’ capabilities to detect mercury and various mercury species like methylmercury and study transfer processes up the food chain. This includes the development, validation and distribution of recommended analytical procedures for the determination of mercury and methyl mercury in marine environmental samples, as well as the organisation of training courses and proficiency tests on the determination of mercury and methyl mercury in environmental samples.

Furthermore, to help with such analyses, the IAEA Environment Laboratories produce reference materials, which include samples of sediment, fish and biota. These can be used as part of quality control procedures during analyses, to validate analytical methods and to establish traceability to internationally agreed references. Reference materials play an important role in increasing the accuracy and certainty of environmental mercury measurements.

IAEA AND WANO STRENGTHEN COOPERATION TO INCREASE NUCLEAR SAFETY

國際原子能總署與世界核營運協會加強合作，加強核安全

The IAEA and the World Association of Nuclear Operators (WANO) can maximize safety benefits, increase efficiency and avoid conflicting advice by increasing cooperation on safety peer review services they offer to nuclear operators, said several delegates at this week's 7th Review Meeting of the Contracting Parties of the Convention on Nuclear Safety.

"Sharing resources and avoiding duplication of effort is an important enabler of more effective peer review services and increased safety," said Juan Carlos Lentijo, IAEA Deputy Director General and Head of the Department of Nuclear Safety and Security.

Increasing the efficiency of the reviews will be particularly important in anticipation of the increasing number of nuclear facilities worldwide in coming decades, said WANO Chairman Jacques Regaldo. WANO is a non-profit organization established in 1989 by the world's nuclear power operators to exchange safety knowledge and operating experience among operators of commercial nuclear power plants.

"By 2030, half of the nuclear power reactors will be based in Asia, and we will have many newcomers to nuclear power," he said. "There is real value for WANO to work together with the IAEA and others to help maximize the safety and reliability of nuclear power plants."

At a side event organized by WANO and the IAEA on the margins of the Review Meeting, representatives from the two organizations agreed to enhance their cooperation to strengthen operational safety globally and to support countries that are planning or considering launching nuclear power programmes.

"Our activities are complementary in nature and are bound by a common interest in keeping nuclear energy safe," said Greg Rzentkowski, Director of Nuclear Installation Safety at the IAEA. "For example, we both respond to existing and emerging challenges such as the need for harmonized approaches to strong safety culture implementation for both operators and regulators as well as support to countries new to nuclear power."

Strengthening safety culture

WANO Chief Executive Officer Peter Prozesky said that both the IAEA and WANO work to promote a strong safety culture in nuclear power to "avoid significant events that can have a physical impact on the public and environment." Both organizations need to work

with newcomer countries and countries that are rapidly expanding their nuclear power programmes to ensure that new units will meet the same standards of excellence as existing ones, he said.

"The IAEA has a stronger role to play in the early establishment of the capacity of a country to begin a new programme, and WANO engages at the time that an operator has embarked on the build of a new plant," Prozesky said. "We collaborate to help prospective new-build players create the appropriate infrastructure, skills and processes that will ensure safe operation."

Ramzi Jammal, Executive Vice-President of the Canadian Nuclear Safety Commission and President of the Review Meeting, said that "safety culture must be embedded in the supply chain from the manufacturer to the contractors and the subcontractors. Keeping in mind that the operators have the prime responsibility for safety, it is their responsibility and duty to prevent the use of counterfeit, fraudulent and suspect items, which could pose a safety risk. To mitigate this, the industry is responsible for identifying the suppliers who do not comply with nuclear safety requirements."

In 2012, the IAEA and WANO signed a Memorandum of Understanding to enhance their cooperation. The cooperation includes participation in each other's safety review missions, common working groups to provide emergency response support, and co-organised workshops and meetings to facilitate exchange of experiences, good practices and lessons-learned among nuclear operators and regulators.

NEA MONTHLY NEWS BULLETIN - APRIL 2017

核能署每月新聞稿 - 2017 年 4 月

ENHANCING SAFETY AND PERFORMANCE THROUGH NUCLEAR FUEL MODELLING

透過核燃料模組來提高安全性能

On 7-9 March 2017, the NEA organised a workshop on advanced nuclear fuel modelling for safety and performance enhancement of water-cooled reactors. The event brought together 80 participants from 18 member countries, representing a broad spectrum of stakeholders including academic and R&D institutions, the industry, technical support organisations (TSOs), regulatory bodies and international organisations. The workshop featured technical sessions on developments seen from the perspectives of modellers, utilities, fuel vendors and safety bodies, as well as on modelling in support of improvements during normal and off-normal operating conditions. Participants concluded that fuel modelling is now addressing issues that would not have been previously undertaken and is providing new insights. Advanced modelling is being used in the fuel design process, and its application to support licensing is being explored. The NEA Working Group on Fuel Safety (WGFS) will continue discussions on this issue in order to identify further areas where advanced techniques for fuel modelling could be utilised.

NEA COLLABORATIVE ACTIVITIES RELATED TO ACCIDENT-TOLERANT FUELS

NEA 的強化燃料協同活動

The broad spectrum of NEA collaborative activities underpinning nuclear materials research spans from modelling and simulation, including advanced multiscale and multiphysics methods, to the development of a database for current and advanced nuclear fuels. The NEA is also supporting collaborative efforts towards the development of advanced materials, such as fuels for partitioning and transmutation purposes and accident-tolerant fuels (ATFs) through its Expert Group on Accident Tolerant Fuels for Light Water Reactors (EGATFL) and through the activities of the NEA Halden Reactor Project. To find out more, see the article in the latest issue of NEA News on NEA collaborative activities related to accident-tolerant fuels oe.cd/NEA-34-2.