

21st Meeting of COMSATS Coordinating Council

Recent Research Activities at ICENS

Charles Grant and Johann Antoine

International Centre for Environmental
Nuclear Sciences (ICENS)



ICENS INTERNATIONAL CENTRE
FOR
ENVIRONMENTAL AND NUCLEAR SCIENCES

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CNS/ICENS History

- Originally the Centre for Nuclear Sciences, opened formally in June 1984
- Located on the campus of the University of the West Indies
- JM-1 SLOWPOKE-2 Research Reactor first achieved criticality in March of 1984 – only nuclear reactor in the English-speaking Caribbean



- The Centre for Nuclear Sciences was one of the first ten nodes of the new Network of International Centres of Excellence

- Acceptance into the COMSATS network encouraged the name change to the International Centre for Environmental and Nuclear Sciences (ICENS)
- Officially launched by the Prime Minister on September 2nd, 1997



Mrs. Benazir Bhutto addressing inaugural meeting of COMSATS



Project and Supply Agreement History



- Project and Supply Agreement signed between the Governments of Canada, the United States and Jamaica and the IAEA for the HEU Core – entered into force January 25th, 1984.
- INFCIRC/315 was terminated on September 4th, 2015 according to Article XII paragraph 2 of the Agreement.
- Project and Supply Agreement – INFCIRC/858 - signed between the IAEA and the Governments of the United States and Jamaica for the LEU Core – entered into force December 16th, 2013.

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Core Conversion- Project Management-International Cooperation



Provide Funding
Provide personnel
Remove HEU core
License NAC-LWT
Arrange Transportation to USA
Provide LEU powder
MCNP core model
License E53100
Start up neutron source
Commissioning rack
Commissioning tools
Commissioning rod

US-DoE, NRC, State, NNSA, DoT,
ANL, STS, SRS, EIC



Enact Legislation
Enact Regulations
Prepare facility
Documentation (remove)
Documentation (Convert)
MCNP core model
Permits and licenses
Local security
Emergency response
Commission LEU Core

ICENS, UWI, Port, Customs
Ministries
Energy, Security, Justice, Health,
Foreign Affairs, Transport,
Environment, Industry, Planning



Build LEU core (AECL/CNL)

CNL (AECL), NRCAN, Ecole
Polytechnique, Private
Contractors (5)



Arrange PSA
Provide Training (TCLA)
Provide Technical oversight
Provide Technical reviews
Safeguards

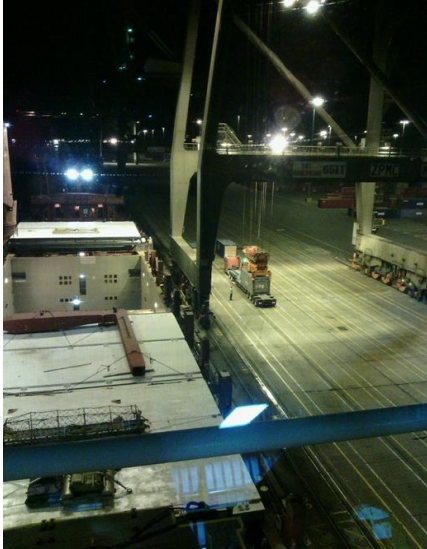
Office of the DG, Department
of Nuclear Energy DDG,
TCLA, IEC, NEFW, NSNI,
NSNS, Expert missions

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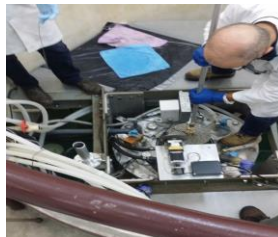
HEU to LEU Core Conversion



Caribbean region becomes free of highly enriched uranium – UN atomic watchdog



ICENS : International Centre for Environmental and Nuclear Sciences (ICENS) Director General Charles Grant (left) and Johann Antoine, Head of the Nuclear Analytical Lab, are shown assembling a low enriched uranium (LEU) core for use in Jamaica's Slowpoke research reactor.



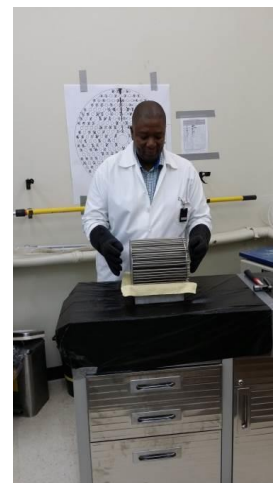
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JM-1 SLOWPOKE-2 Core

	HEU	LEU
Nominal Power	20 kW _{th}	20 kW _{th}
Excess Reactivity	4.0 mk	4.0 mk
Fuel	Extruded U-Al 28% Alloy	UO ₂
Cladding	Aluminium	Zircaloy-4
Moderator	Light water	Light water
Core Cooling	Natural convection	Natural convection
Core width	22 cm	22 cm
Core Height	22.1 cm	23.8 cm
Enrichment	93.18% U ²³⁵	19.86% U ²³⁵
Critical mass	~816.6 g	~1095.4 g
Fuel Pin Number	296	193
Max. Thermal Flux	10 x 10 ¹¹ ncm ⁻² s ⁻¹	10 x 10 ¹¹ ncm ⁻² s ⁻¹



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Complementary Techniques

Spectro-analytical



X-ray Fluorescence

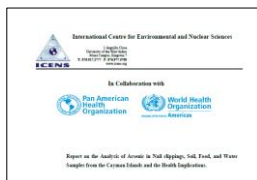


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Cayman Arsenic Investigation

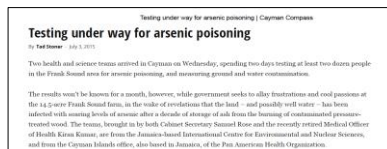
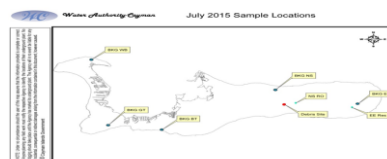
A report from the Water Authority of Cayman noted elevated arsenic levels from domestic wells that exceeded the WHO drinking water guidelines.



ICENS through the Pan American Health Organization (PAHO), was engaged to analyse biological and environmental samples from the area for potentially elevated levels of arsenic.

Soil, food and human tissue samples were collected and analysed by INAA and TXRF for arsenic.

Arsenic levels were found to be low for the most part in samples tested.



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Inorganic chemical analysis of Jamaican foods and associated soils

Development of Food Composition Tables

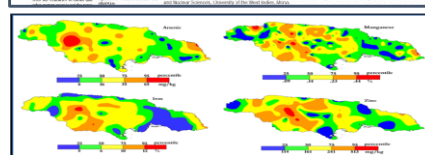
- Analysis of Cocoa samples for potentially toxic heavy metals
- EU has lowered cadmium limits for cocoa and chocolate products; effective January 2019
- Soil-plant cadmium ratios

Trace Elements in Cassava and determination of potential varietal differences in uptake of metals

- Collaborative work with UWI Chemistry Department
- Monitoring of heavy metals, stakeholders, cassava bread, etc.

Analysis of Jamaican sea fish for mercury and other elemental constituents

Further analysis of food samples from Ministry of Agriculture and Fisheries' (MOAF) Agro-parks.

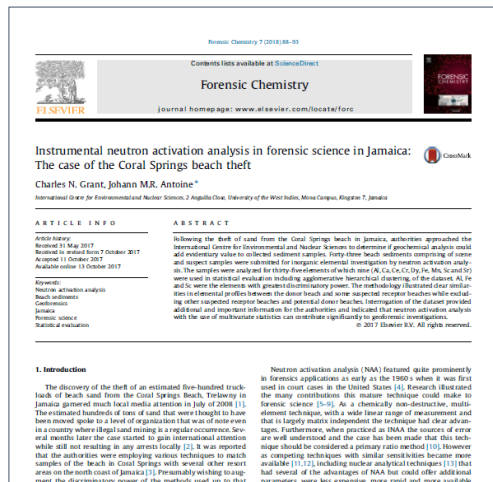


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Coordinated Research Project - Enhancing Nuclear Analytical Techniques to Meet the Needs of Forensic Science

- Project funded by the IAEA
- Three-year project (mid-2017 to mid 2020)
- Using and optimizing nuclear analytical techniques and associated techniques to fingerprint environmental, plant and food samples.
- Elemental data generated can be used to determine provenance for forensic applications such as illegal sand mining or food fraud.
- Project is in collaboration with the Institute of Forensic Science and Legal Medicine.
- ICENS has already conducted extensive research on fingerprinting food as well as using neutron activation analysis to add evidentiary value to forensic geological samples.



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Assessment of the Jamaican Marine Environment



- Sample collection to assess the current state of the marine ecosystem and formalize baseline assessment for sediments, seagrass, mangroves and corals.
- Key interest in heavy metal accumulation and uptake within marine ecosystem.
- Build a regional database for the Caribbean to include marine geochemistry data. In addition, supplement data to IAEA MARiS.



Air Quality Monitoring- Trace Elements & Particulate Matter

Study of Total Suspended Particles (TSP), PM₁₀ (coarse inhalable particles) and PM_{2.5} (fine inhalable particles).

Use of Nuclear Analytical Techniques (INAA and XRF) for the study of the emission and reception of atmospheric particulate matter and determining source apportionment

ARCAL Project RLA7023:
Assessing atmospheric aerosol components in urban areas to improve air pollution and climate change management.



Tisch Environmental Inc. 8-stage Non-Viable Cascade Impactors capable of filtration down to particles <0.43 µm



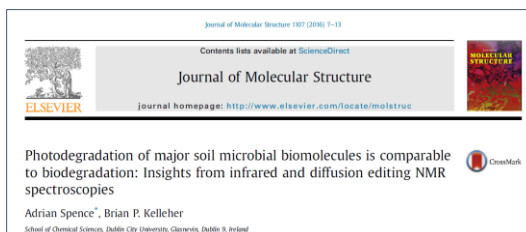
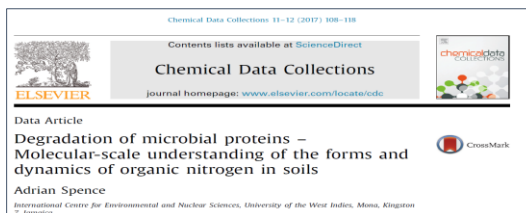
Radwag UYA 2.4Y microbalance was acquired with a readability of 0.1 µg



Climate Change and Biogeochemistry



Dr. Adrian Spence – Intergovernmental Panel on Climate Change (IPCC) nominated Lead Author: Climate Change and Land



TWAS Fellowships

- ICENS' has hosted several TWAS fellows- from Nigeria, Uzbekistan and Namibia.
- The latest TWAS fellow visited again and the collaboration was particularly successful leading to the develop of an air quality project and several publications.
- A memorandum of understanding (MoU) between ICENS and Namibia University of Science and Technology.



Air Quality and Climate Change in Small States of the Commonwealth- Jamaica and Namibia
WIT Transactions on Ecology & the Environment



Effects of Energy Production & Consumption on Air Pollution and Global Warming
Pollution and the Atmosphere: Designs for Reduced Emissions



Assessment of Natural Radionuclide distribution in shore sediment samples collected from the North Dune beach, Henties Bay, Namibia
Journal of Radiation Research and Applied Sciences

Radiation Protection, Monitoring & Measurement



- Principal radiation dosimeter instrument at ICENS is an Automated HARSHAW Model 6600 reader with an in built ^{90}Sr irradiator for the purposes of calibration.
- Quality assurance is ensured by frequent test readings using the internal irradiator; participation in inter-laboratory comparison studies.
- Routine monitoring – TLD cards, uniquely bar coded for each staff member are worn on the job for a month and then processed.

Latest News

House passes Bill to regulate nuclear technology

Wednesday, July 26, 2015 11:41 AM



Minister of industry, trade and commerce, Anthony Hahon (in photo)

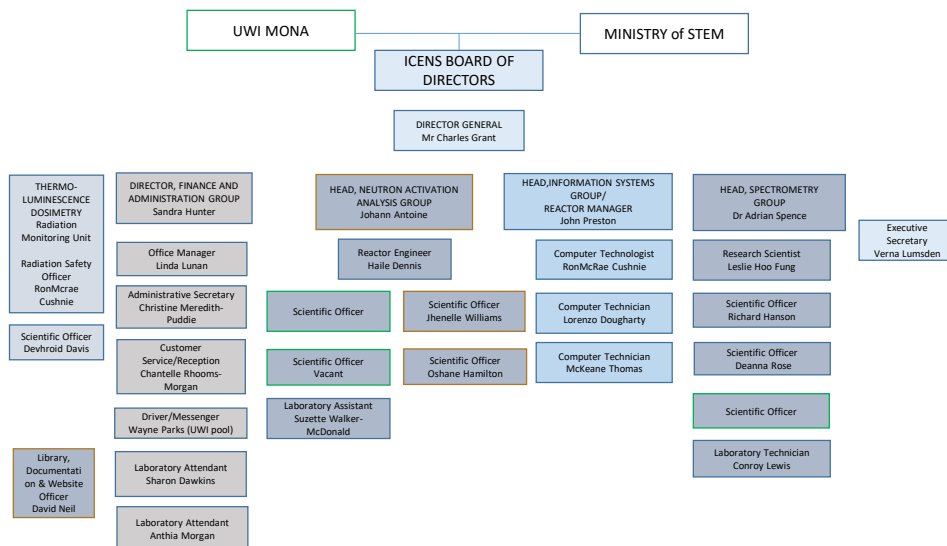
Expected increase in number of clients as legislature is enforced by regulatory authority

Facility Upgrade

- JAM 1001 02 Upgrading the Research Reactor Infrastructure at the University of West Indies, Slowpoke, Facility JM-1.
- Ageing, state of SSCs and equipment qualification: Obsolescence of electronics, repair of console. To be assessed for facility upgrade project
- Planned upgrade of analogue MK2 control system to the digital SLOWPOKE Integrated Reactor Control and Instrumentation System (SIRCIS).



Present Organizational Structure



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Future Work and Potential Collaborations

Collaborations

- IAEA/ARCAL
- PAHO/WHO
- TWAS
- Namibia University of Science and Technology
- Pure Earth – recently started

Future Projects

- Multi- Purpose Irradiator
- IAEA Small Island Developing States (SIDS) Project
- Expanded Training and Education using the JM-1 SLOWPOKE-2
- Mercury Project
- Facility Upgrade

Priority Research and Potential Collaborations

- Environmental Geochemistry
- Trace Elements in Air Particulate Matter
- Heavy Metal Pollution in Jamaica
- Mineral composition of food
- Trace elements in animal/human tissue/ Health
- Biogeochemical Cycles
- Forensics
- Trace and heavy metals in the marine environment

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Thank you for your attention!!

