

# Antineutrinos in Support of IAEA Safeguards

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Division of Technical Support  
Department of Safeguards



*Atoms for Peace: The First Half Century  
1957-2007*

# Outline

- Overview of IAEA activities
- Antineutrinos and IAEA safeguards
- The future of Safeguards
- Discussion of roadmap

# Nuclear Science and Applications

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**Water Resources**  
**Environment**  
**Human Health**  
**Programme of Action for Cancer Therapy - PACT**  
**Radioisotope Production and Radiation Technology**

**Nuclear Sciences and Applications**

**Focus on Nuclear Applications**

Reference materials produced at IAEA laboratories in Seibersdorf and Monaco help laboratories improve the reliability and comparability of measurements obtained by nuclear analytical techniques. [Read More](#)

**Events**

11 - 16 October 2010.  
23rd IAEA Fusion Energy Conference.  
Daejeon, Korea Republic of.

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**About NA**

[Mission & Role](#)  
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**EDITORIAL**  
  
Dr. W. Burkart

**Publications**

Mass Screening Techniques for Selecting Crops Resistant to Disease. [Details](#)

**Related Links**

[Coordinated Research](#)  
[Databases](#)  
[Reference Materials](#)

**Partnerships**


[Collaborating Centres](#)

SAGNA

**Expert Opinion**

G. Viljoen, Section head, Animal Production & Health. IAEA helps to improve the productivity of cattle, camels and yaks in Mongolia.

# Technical Cooperation


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26 July 2010
FONT SIZE A + A -

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TC Home

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**Forms**

- Nomination Forms for Fellowship and Scientific Visit
- Nomination Form for TC training course
- Nomination Form for Meeting/Workshop
- Personal History Form for assignment as TC Expert

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**TC regional sites**

- Africa
- Asia and the Pacific
- Europe
- Latin America

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**Regional Agreement/ Cooperative Agreement sites**


- AFRA
- ARASIA
- ARCAL
- RCA



**Inside IAEA Technical Cooperation**

**News, Features & Reports**

**Improving livestock productivity in Mongolia (13 July 2010)**



IAEA helps to improve the productivity of cattle, camels and yaks in Mongolia through better nutrition and reproductive management. [Read more](#) »

**Ana María Cetto, DDG and Head of the Department of Technical Cooperation, visits IAEA Member State Azerbaijan (11 June 2010)**

Ms Cetto met government officials to discuss the technical cooperation programme in Azerbaijan. Ms Cetto also received an honorary doctorate from the Azerbaijan Academy of Sciences. [Read more](#) »

**Combating Childhood Obesity in Latin America and the Caribbean**

**Events Calendar**

[Latin America Training Courses and Meetings](#) »

[TC Seminar Series](#) »

[IAEA Meetings](#) »

**TC Organization**

[TC Organizational Structure](#)

**Books & Publications**

**NEW** The annual report on 2008 Technical Cooperation Programme activities, and its supplement, are now available online. [Read more](#) »

Fact Sheets from the Department of Nuclear Energy on support available to TC projects are now on-line. [Read more](#) »

[TC Feedback](#) | [TC Glossary](#)

**Project information**

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**CPFs**



# Nuclear Energy

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**Department of Nuclear Energy**  
Fostering the Efficient and Safe Use of Nuclear Power

**Highlights**

**IAEA Receives Austrian Knowledge Management Award**  
09 July 2010  
On 24 June 2010, the IAEA's Nuclear Knowledge Management programme received The Column of Knowledge award for 2010 from Knowledge Management Austria. [Full Story »](#)

**Change of Leadership in the IAEA Division of Nuclear Fuel Cycle and Waste Technology**  
05 July 2010  
Mr. Tero Varjoranta has assumed the position of Director of the Division of Nuclear Fuel Cycle and Waste Technology in the IAEA Department of Nuclear Energy effective 1 July 2010. [Full Story »](#)

**News on Nuclear Information and Knowledge**  
18 June 2010  
The latest issue of the IAEA's Nuclear Information and Knowledge Newsletter discusses democratization of scientific and technical information and visibility on the Web. [More »](#)

**More Information**

**Nuclear Power: Status and Outlook**

**ACCESS TO NUCLEAR POWER**  
Beneficial, Sustainable, Responsible

**Upcoming Major Conferences organized by the Department of Nuclear Energy**

23rd IAEA Fusion Energy Conference  
Daejeon, Korea Rep. of  
11-16 October 2010

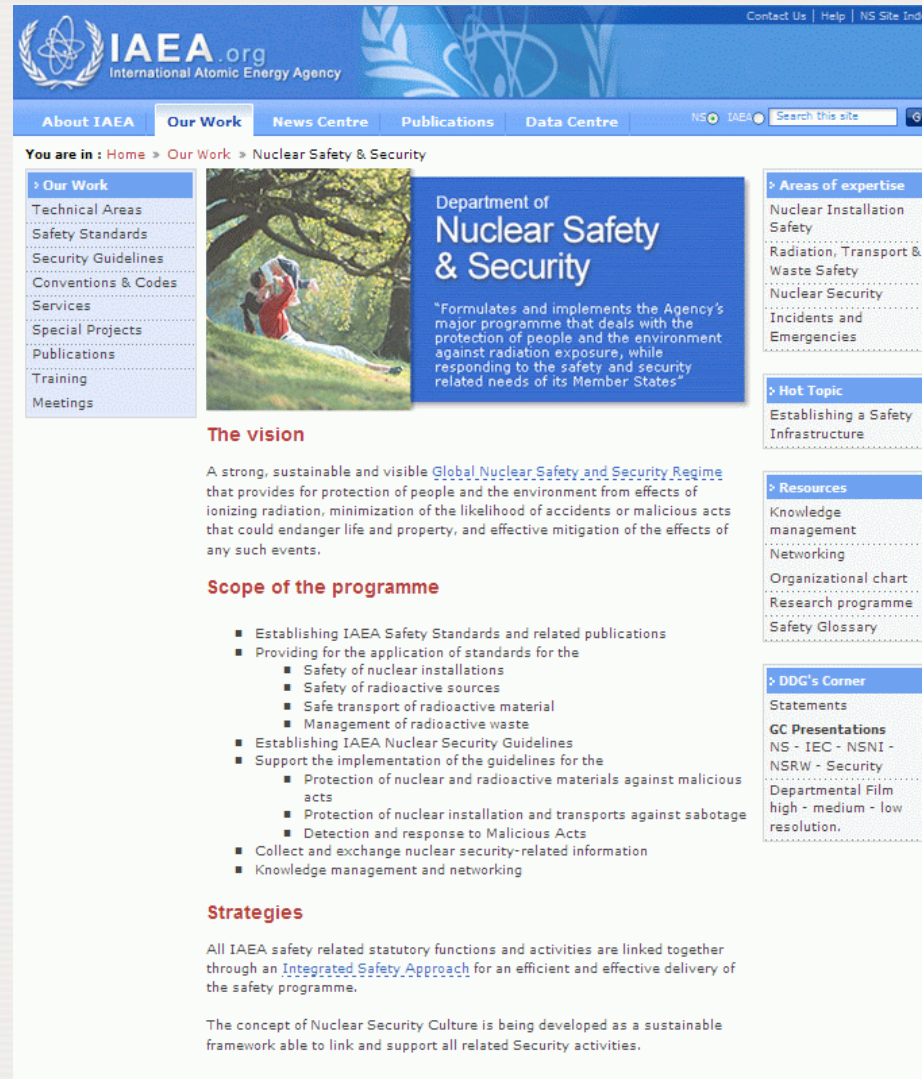
**Launching Nuclear Power Programmes**

[Considerations to Launch a Nuclear Power Programme](#)

[Milestones in the Development of a National Infrastructure for Nuclear Power](#)

[Evaluation of the Status of National Nuclear Infrastructure Development](#)

# Nuclear Safety and Security



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You are in: Home > Our Work > Nuclear Safety & Security

**Our Work**

- Technical Areas
- Safety Standards
- Security Guidelines
- Conventions & Codes
- Services
- Special Projects
- Publications
- Training
- Meetings

**Department of Nuclear Safety & Security**

"Formulates and implements the Agency's major programme that deals with the protection of people and the environment against radiation exposure, while responding to the safety and security related needs of its Member States"

**Areas of expertise**

- Nuclear Installation Safety
- Radiation, Transport & Waste Safety
- Nuclear Security
- Incidents and Emergencies

**Hot Topic**

- Establishing a Safety Infrastructure

**Resources**

- Knowledge management
- Networking
- Organizational chart
- Research programme
- Safety Glossary

**DDG's Corner**

- Statements
- GC Presentations
- NS - IEC - NSNI - NSRW - Security
- Departmental Film
- high - medium - low resolution.

**The vision**

A strong, sustainable and visible [Global Nuclear Safety and Security Regime](#) that provides for protection of people and the environment from effects of ionizing radiation, minimization of the likelihood of accidents or malicious acts that could endanger life and property, and effective mitigation of the effects of any such events.

**Scope of the programme**

- Establishing IAEA Safety Standards and related publications
- Providing for the application of standards for the
  - Safety of nuclear installations
  - Safety of radioactive sources
  - Safe transport of radioactive material
  - Management of radioactive waste
- Establishing IAEA Nuclear Security Guidelines
- Support the implementation of the guidelines for the
  - Protection of nuclear and radioactive materials against malicious acts
  - Protection of nuclear installation and transports against sabotage
  - Detection and response to Malicious Acts
- Collect and exchange nuclear security-related information
- Knowledge management and networking

**Strategies**

All IAEA safety related statutory functions and activities are linked together through an [Integrated Safety Approach](#) for an efficient and effective delivery of the safety programme.

The concept of Nuclear Security Culture is being developed as a sustainable framework able to link and support all related Security activities.

# Nuclear Safeguards

The screenshot shows the IAEA.org website interface. At the top, there is a navigation bar with links for 'Contact Us', 'Site Index', 'News Feeds', and 'Signup for News'. The main header features the IAEA logo and the text 'IAEA.org International Atomic Energy Agency'. Below this is a secondary navigation bar with tabs for 'About IAEA', 'Our Work', 'News Centre', 'Publications', and 'Data Centre', along with a search box labeled 'Search this site' and a 'Go' button.

The main content area is titled 'You are in : Home » Our Work » Verification » Safeguards'. It is divided into several sections:

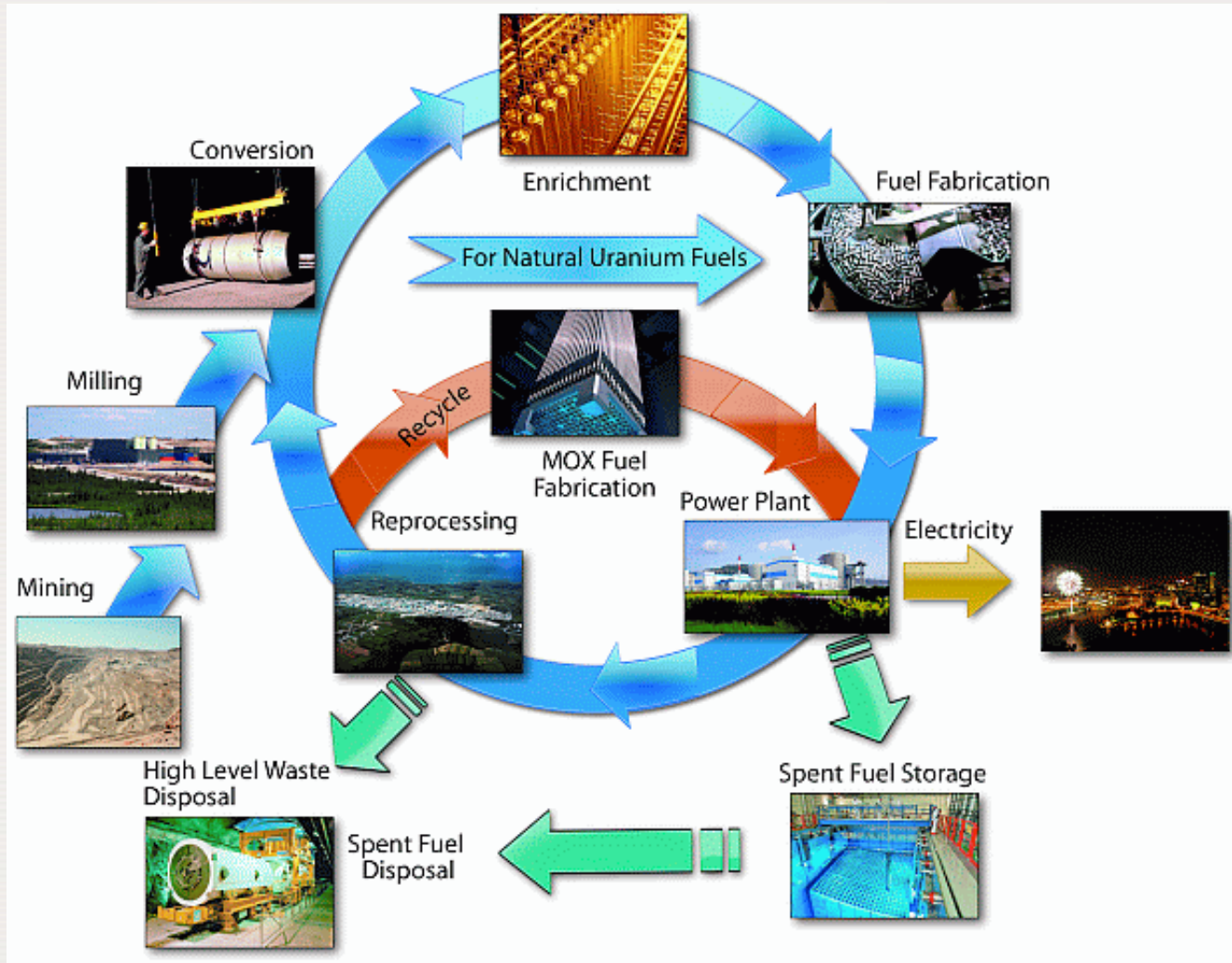
- Safeguards Home**: A sidebar menu with links for 'About Safeguards', 'What We Do', 'Legal Framework', and 'Statements'.
- Department of Safeguards**: A central section with a quote: "Effective IAEA safeguards remains the cornerstone of the world's nuclear non-proliferation regime aimed at stemming the spread of nuclear weapons and moving towards nuclear disarmament." -- Olli Heinonen --
- Inside Safeguards**: A large central box containing two columns of links:
  - Statements & Reports**: Includes 'Safeguards Implementation' (with a sub-description: 'The IAEA annually reports on safeguards implementation to the Agency's Board of Governors. Latest Statement and Background') and a link 'More Statements... »'. Also includes 'Symposia & Events' with a sub-description: 'Symposium on International Safeguards: Preparing for Future Verification Challenges, 1-5 November 2010, Vienna, Austria' and a link 'More Meetings... »'.
  - Mission & Role**: Includes links for 'Safeguards System of the IAEA', 'Organizational Structure', 'Mission of Divisions', and 'Additional Publications'.
  - Safeguards Concepts & Definitions**: Includes links for 'IAEA Statute' and 'Safeguards Glossary [pdf]'.
- Legal Framework**: A sidebar menu with links for 'Treaty on the Non-Proliferation of Nuclear Weapons (NPT)', 'Safeguards-Related Treaties & Documents', and 'Information Circulars (INFCIRCs)' (with sub-links for 'INFCIRC/153 [pdf]' and 'INFCIRC/540' and a 'More... »' link).
- Safeguards Status**: A sidebar menu with links for 'Safeguards Agreements', 'Additional Protocols', and 'Safeguards Action Plan [pdf]'.

# IAEA Safeguards Objectives

- Safeguards are applied by the IAEA to verify the **correctness and completeness** of declarations made by States about the **exclusively peaceful use** of their nuclear material and activities and thereby reducing the risk of proliferation of nuclear weapons.



# The Nuclear Fuel Cycle



# Safeguards Implementation

- 237 safeguards agreements in force in 163 States
- 2,036 inspections in 2008
- ~ 250 Safeguards Inspectors
- Limited funding ~ €110M regular budget
- Improving implementation through
  - Additional Protocol
  - Integrated Safeguards (IS) Approach

# The Division of Technical Support

Wide variety of safeguards equipment/techniques:

- Containment and Surveillance (C/S)
  - Containment verification
  - Seals
  - Cameras
- Non Destructive Analysis (NDA)
- Destructive Analysis (DA)
- Environmental Sampling (ES)

# Non Destructive Assay (NDA)

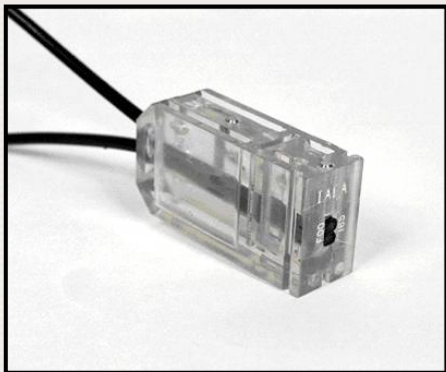
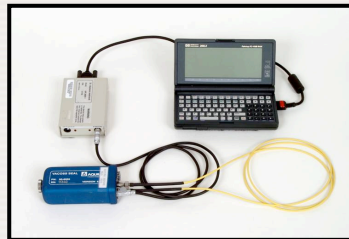
~100 different types of NDA equipment :





# Containment and Surveillance (C/S)

## Seals



# History of antineutrinos and IAEA SG

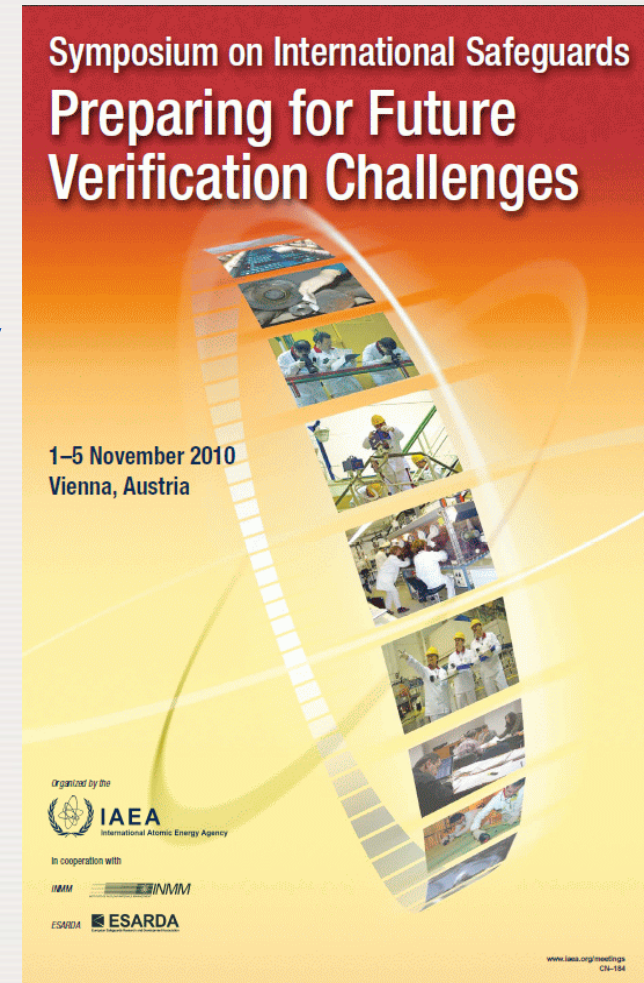
- 2003 – *Meeting to Evaluate Potential Applicability of Antineutrino Detection*
- 2008 – *Experts and Users Meeting on Antineutrino Detection for IAEA Safeguards*
- Attendance at AAP2007, AAP2009

# The future of Safeguards?

- Increasing material and facilities under safeguards
- Not expected to see similar increases in resources being provided to the Dept.
- Gen III and Gen IV reactors
- Non-traditional NFC
- Involvement in disarmament verification / non-NPT treaties

# Symposium on International Safeguards

- Every 4 years
- Excellent representation from antineutrino community
- 8 abstracts submitted
- Concrete opportunity to further the profile of the technique





# Roadmap

- Things that the community can do
  - Present a clear vision of what antineutrino detection can offer safeguards
  - Decide on individual areas of expertise
  - Offer staged pathway to implementation
- Things that the IAEA can do
  - Issue a call for proposals (SP-1)

# Conclusions of the Workshop

- The meeting concluded that antineutrino detectors have unique abilities to nonintrusively monitor reactor operational status, power and fissile content in near realtime, from outside containment.
- Several detectors, built specifically for safeguards applications, have demonstrated robust, long-term measurements of these metrics in actual installations at operating power reactors, and several more demonstrations are planned.
- It was agreed that the detector design is sufficiently robust and mature as to allow a reusable module to be developed that could be adapted to specific reactors.

# Recommendations of the Workshop

The following recommendations were made by the workshop:

- It was recommended that the IAEA consider antineutrino detection and monitoring in its current R&D program for safeguarding bulk-process reactors;
- It was recommended that the IAEA should also consider antineutrino monitoring in its Safeguards by Design approaches for power and fissile inventory monitoring of new and next generation reactors;
- It was recommended that there should be further interaction between IAEA and the antineutrino research and development (R&D) community, including regular participation of IAEA safeguards departmental staff into international meetings;
- It was recommended that IAEA safeguards departmental staff visit currently deployed and planned neutrino detection installations for safeguards applications;
- It was recommended the IAEA work with experts to consider future reactor designs, using existing simulation codes for reactor evolution and detector response.