

IAEA Safety Assessment Framework: MODARIA II Program overview

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IAEA

International Atomic Energy Agency

Statutory Obligations of the IAEA (1957): Safety Standards for Protection of People and the Environment

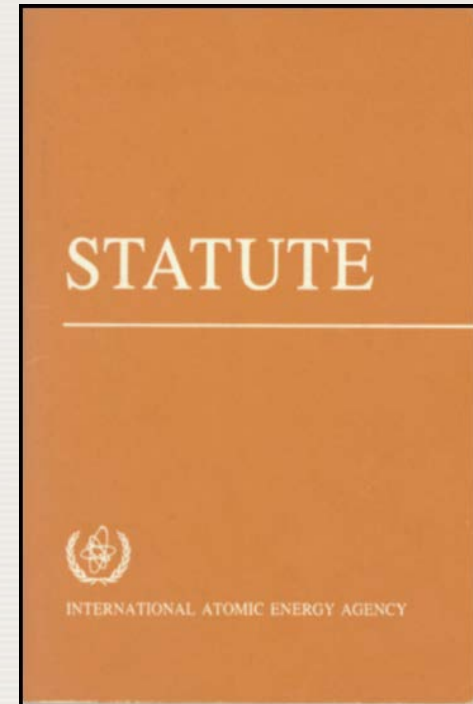
Article III, *Functions* Paragraph A.6.

“ To **establish or adopt**, in consultation and, where appropriate, in collaboration with

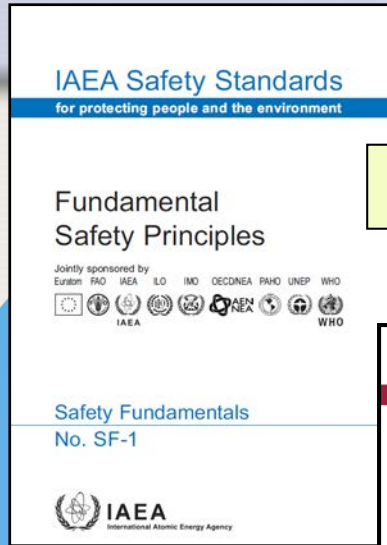
- the competent organs of the United Nations and
- with the specialized agencies concerned,

standards of safety for protection of health and minimization of danger to life and property (including such standards for labour conditions), and

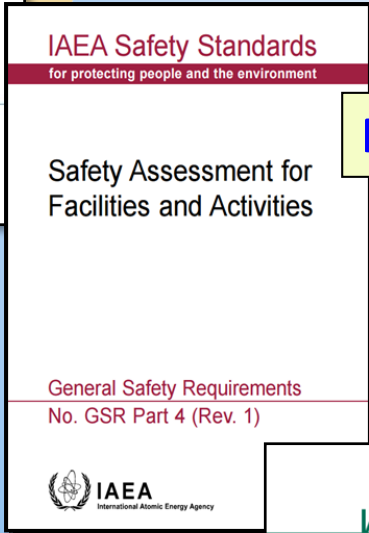
to **provide for the application of these standards** to its own operation as well as to the operations making use of materials, services, equipment, facilities, and information made available by the Agency ...; “



Safety Standards Categories

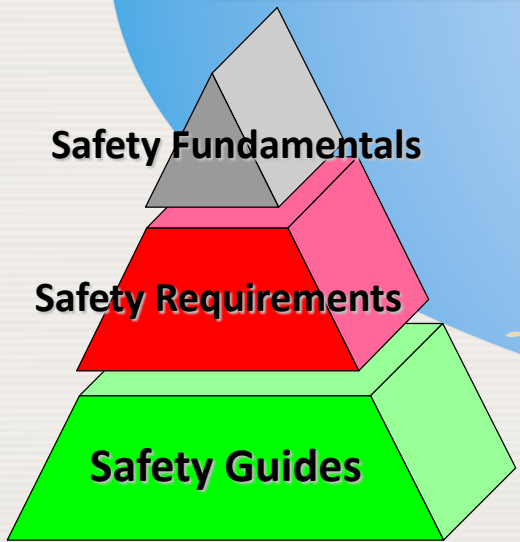
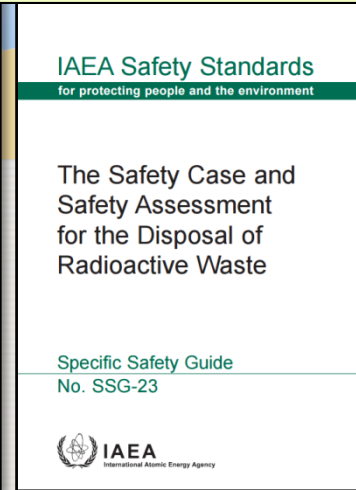
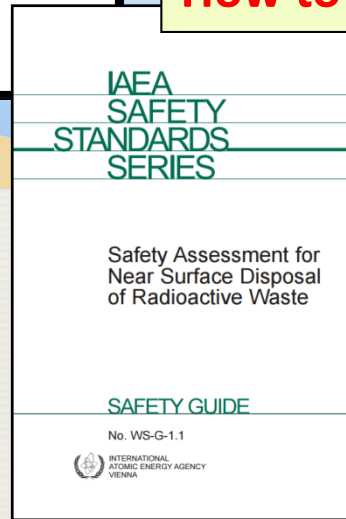


Fundamental Safety Principles



Requirements: What to do?

**Best Practice to Meet Requirements:
How to do?**



IAEA Basic Safety Standards (IAEA GSR part 3)

- **International consensus on Radiation Protection**

- Based on ICRP 103 (2007)

- **Defines responsibilities**

- Government and regulatory body
- Operator

- **Defines exposure situations**

- Planned, existing, emergency situation

- **Radiation protection principles**

- Justification, Optimization, Limitation

- **Radiological criteria**

- Public in all exposure situations
- Workers



IAEA Safety Standards

for protecting people and the environment

Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards

Jointly sponsored by

EC, FAO, IAEA, ILO, OECD/NEA, PAHO, UNEP, WHO



General Safety Requirements Part 3
No. GSR Part 3



Three exposure situations

- **Planned exposure situation**
 - Exposure due to **planned operation** of a facility or activity
- **Emergency exposure situation**
 - Exposure due to **accidents** or unexpected events requiring prompt action to reduce or avoid consequences
- **Existing exposure situation**
 - Exposure due to natural sources or **presence of radioactive contamination**
 - Need to control and reduction of exposure

Radiological impact assessment

IAEA Safety Glossary

Assessment of the expected radiological impacts of facilities and activities for the purposes of protection of the public and protection of the environment

Radiological impact assessment

- Prospective assessment of radiological impacts
- Conducted as part of any authorization process
 - New facilities and activities
 - Planning for remediation of affected areas
- Dose assessment during the management of emergencies

Previous International IAEA modelling testing programmes

- **1985-1991: BIOMOVs**
 - BIOspheric Model Validation Study, sponsored by SSI (Sweden)
- **1988-1994: VAMP**
 - Validation of Model Predictions, prompted by Chernobyl
- **1991-1996: BIOMOVs II**
 - BIOspheric Model Validation Study, with SSI, Sweden
- **1996-2001: BIOMASS**
 - BIOsphere Modelling and ASsessment, 1996-2001
- **2003-2007: EMRAS I**
2009-2011: EMRAS II
 - Environmental Modelling for Radiation Safety, 2003-2007
- **2012-2015: MODARIA I**
 - Modelling and Data for Radiological Impact Assessment

Goals of MODARIA

- **Improve capabilities in radiological impact assessment**
 - Test, compare and develop methodologies and models
 - Analyse, evaluate and compile data
- **Addressing assessments in planned, emergency and existing exposure situations**
 - For people
 - For flora and fauna
- **Forum for discussion and exchange of experience**
- **Support to fulfil regulatory requirements in Member States**

MODARIA I (2012 – 2015)

Themes and Working Groups

- **Theme A: Remediation of Contaminated Areas**
 - WG 1 Remediation strategies and decision aiding techniques
 - WG 2 Exposures in contaminated urban environments and effect of remedial measures
 - WG3: Modelling radiological impacts arising from NORM and radioactively contaminated legacy sites
 - WG4: Analysis of radio-ecological data
- **Theme B: Uncertainties and Variability**
 - WG 5: Uncertainty and variability analysis for assessments for routine discharges
 - WG 6: Environmental change in long term safety assessments of radioactive waste disposal facilities
 - WG 7: Models for accidental tritium releases
- **Theme C: Exposures and Effects on Biota**
 - WG8: Modelling exposures to biota
 - WG9: Radiation effects on populations of wildlife species
- **Theme D: Marine Modelling**
 - WG 10: Modelling of marine dispersion and transfer of radionuclides accidentally released from land-based facilities

Dissemination of results

- **IAEA Publications**

- Each working group prepared an IAEA (TECDOCS)
- Technical Report series (TRS) in some cases

- **Papers in peer reviewed Scientific Journals**

- Publication of results is encouraged
- Large number of individual papers published on initiative of the WG from results obtained during BIOMASS, EMRAS I, EMRASII, MODARIA

MODARIA I -> MODARIA II (2016-2019)

- 17 proposals generated from last MODARIA I meeting (11 Nov 2015), were largely integrated into the MODARIA II programme during March 2016 CM (consultancy meeting)
- **MODARIA II will have 7 Working Groups**
 - Integrating activities of Decision Making (WG 1) and Remediation (WG3)
 - Joining the work on Modelling exposures to biota (WG 8) and Modelling effects to biota (WG9)
 - Integrating the work on Tritium modelling (WG 7) into Modelling Discharges (WG 5)

*Proposals for Topics for the
IAEA's Environmental Network
MODARIA II:
"Modelling and Data for
Radiological Impact Assessments"*

July 2016

MODARIA II Working Groups

WG 1: Assessment and Decision Making of Existing Exposure Situations for NORM and Nuclear Legacy Sites

WG Leader: Ming Zhu (USA) Scientific Secretary : Tamara Yankovich

- Methods and **tools for radiological impact assessments** and application to specific situations
- Methodologies for **decision analyses for remediation and closure** of NORM and legacy sites
- **Communication** and engagement with relevant interested parties
- **Training** for end users for the use of the NORMALYSA software

WG 2: Assessment of exposures and doses plus effectiveness of countermeasures in urban environments

WG Leader: Kathy Thiessen (USA) Scientific Secretary : Tamara Yankovich

- **Experience in Japan** following the accident at the Fukushima
- Modelling the **dispersion and redistribution** of radionuclides in an **urban environment**
- Effectiveness and impact of **remedial measures for urban environments**

WG 3: Assessment and control of exposures to the public and biota for planned releases to the environment

WG Leader: Juan Carlos Mora (Spain) Scientific Secretary: Diego Telleria

- Develop and apply an **integrated approach** to assess the impact of releases to the environment on both **humans and biota** from ionizing radiation.
- Assessment of impacts from **short-term tritium releases**

WG 4: Transfer processes and data for radiological impact assessment, including radionuclide transfer in tropical and sub-tropical environments

WG Leader: Brenda Howard (UK) Scientific Secretary: Gerhard Proehl

- **Transfer parameters in Japan** determined after the Accident at the Fukushima NPP
- Analysis and **updating key parameters** for use in radiological impact assessment
- Assessment **models and data for tropical, semi-tropical and arid environments**

WG 5: Modelling radiation exposures and effects on wildlife

WG Leader: Nick Beresford (UK), Jordi Vives i Battle (Belgium), [F Alonzo, (France)]

Scientific Secretary: Diego Telleria

- Development of **simplified approaches for biota** dose assessment (“graded approaches”)
- Modelling possible **effects to populations and need to fulfil regulatory requirements**
- **Uncertainties** associated with the different approaches and models

WG 6: Biosphere modelling for long-term safety assessments of waste disposal facilities

WG Leader: Tobias Lindborg, Sweden Scientific Secretary: Gerhard Proehl

- Systematic, transparent and robust conceptual **framework for biosphere assessments** for radioactive waste disposal facilities
- Scientific basis of **long-term dose assessments and complementary plausible assumptions**
- Update/extension of the **BIOMASS-6 methodology, including numerical values** and models to assess the long-term dose to hypothetical members of the public

WG 7: Assessment of fate and transport of radionuclides released in the marine environment

WG Leader: Raul Perianez, Spain Scientific Secretary: Paul McGuinness

- Improvement of **fate and transport models** including processes not yet implemented
- **Reliability of models** for predicting dispersion under different situations (short term or long term)
- **Limitations of the models** to predict radionuclide dispersion in emergency situations

Further information

- **MODARIA II will run from 2016-2019**
- Final Technical Meeting in October/November 2019
- **One joint Technical Meeting per year of all working groups in Vienna**
- Enable cooperation between working groups to address cross-cutting topics
- **Interim Meetings**
- Held half-way between the Plenaries by the Working Groups, in Vienna or other places

MODARIA II
Modelling and Data for Radiological Impact Assessments

First Technical Meeting for MODARIA II

The first **Technical Meeting (TM)** for the MODARIA II programme will be held at the IAEA's headquarters in Vienna from **31 October to 4 November 2016**, during which the MODARIA II programme will be formally launched.

The objectives of the meeting are summarized in the **Prospectus and Notes Verbale** (in all official languages) which were recently circulated to all Member States.

Should you wish to take part in the TM, a **Participation Form (Form A)** must be completed and then forwarded to the competent official authority (Ministry of Foreign Affairs, Permanent Mission to the IAEA, or National Atomic Energy Authority) of your respective country, for onward transmission to the IAEA.

Please note that your participation will only be registered when we receive your fully endorsed Participation Form, completed in your name. After the deadline for receipt through official channels (**19 September 2016**) has passed, you will subsequently receive a formal invitation to attend the meeting.

For further information please contact MODARIA

<https://www-ns.iaea.org/projects/modaria/default.asp?l=116>

Next technical Meeting

2nd Technical Meeting

Vienna, 30 October – 3 November 2017



Thank you!



MODARIA I Working Groups

Theme A: Remediation of Contaminated Areas

WG 1 Remediation strategies and decision aiding techniques

- Decision theory and decision process
 - Limitation of science
 - Different countries, different decision processes, different decisions
- Engagement of interested parties
- Remediation planning

WG 2 Exposures in contaminated urban environments and effect of remedial measures

- To test and improve assessment models applied to contamination in urban environments
- Dispersion and deposition
- Short- and long-term redistribution following deposition events
- Effectiveness of potential countermeasures or remediation efforts

WG3: Modelling radiological impacts arising from NORM and radioactively contaminated legacy sites

- Assessments to fulfil the regulatory requirements of IAEA Standards
- Development of the MORMALYSA assessment tool for affected sites
 - Enhanced levels of NORM : e.g. U-mining
 - Enhanced levels of man-made RN, e.g. accidents, legacies, unregulated past practices
- Model-model and model-data comparison exercises

WG4: Analysis of radio-ecological data

- IAEA TRS-472 animal database revision (goat and cow milk)
 - Relationship between gut absorption and transfer parameters
 - Transfer to meat in semi-natural environments in Japan
- K_d datasets of soil and freshwater systems
- Derivation of conservative values for SRS-19 revision

MODARIA I Working Groups

Theme B: Uncertainties and Variability

WG 5: Uncertainty and variability analysis for assessments for routine discharges

- **Influence of national regulatory requirements**
- **Realism of models**
 - Sources of uncertainty and methods for their quantification
 - Environmental monitoring data in uncertainty analysis processes
 - Sensitivity analysis to identify key parameters
- **Distributions of parameters used in the different scenarios and codes**
 - Influence of correlations between different parameters
- **Comparison exercises with the different codes in the defined scenarios**

WG 7: Models for accidental tritium releases

- Development and application of **environmental tritium transfer** models
- Analysis of the **tritium transfer in terrestrial ecosystems**
 - Dry/wet deposition
 - Deposition during day/night,
 - Summer/winter
- **Inter-comparison of models** on specific scenarios
- Identification of knowledge gaps and assessment of their significance

WG 6: Environmental change in long term safety assessments of radioactive waste disposal facilities

- Projections of **long-term climate and landscape change** (reference futures)
 - Results for a **range of CO₂ emission scenarios** as a common starting point for assessments for international use
 - Method for downscaling to regional/site level
- Quantitative **modelling of landscape evolution**
 - Linked with climate modelling
 - Modelling **radionuclide transport through a changing landscape**
- Enable **consistent treatment of long-term environmental change** across different national radioactive waste disposal programmes



IAEA

MODARIA I Working Groups

Theme C: Exposures and Effects on Biota

WG8: Modelling exposures to biota

- Modelling exposure in spatially heterogeneous environments
- Comparison of **simple and complex dosimetric models**
- Development of **dynamic models**: Scenario for Fukushima marine environment
 - Biological half-life data for wildlife
- **Guidance on assessment for biota**: 'Lessons learnt' documentation

WG9: Radiation effects on populations of wildlife species

- Explore **effects on populations**
 - Acute vs chronic exposure
 - Laboratory vs field conditions
- Review of **existing population models** focussing on the field of application
- **Population modelling** methodologies - conceptual and mathematical description
- Applicability of population modelling in a radiation protection **regulatory context**

MODARIA I Working Groups

Theme D: Marine Modelling

WG 10: Modelling of marine dispersion and transfer of radionuclides accidentally released from land-based facilities

- **Fukushima releases in the Pacific Ocean**
 - Intercomparison of hydrodynamic sub-models
 - Intercomparison of dispersion models
- **The Baltic Sea: modelling Chernobyl fallout, 4 models involved**
 - NRPA box model
 - POSEIDON box model
 - USEV hydrodynamic model
 - THREETOX hydrodynamic model
- Results compared with HELCOM database measurements