

**Explanatory Meeting on the Methodology for Technical and
Scientific Support Organizations Self Capability Assessment**

19-21 February 2024, IAEA, Vienna, Austria

Introduction to NRSC: **activities and challenges**



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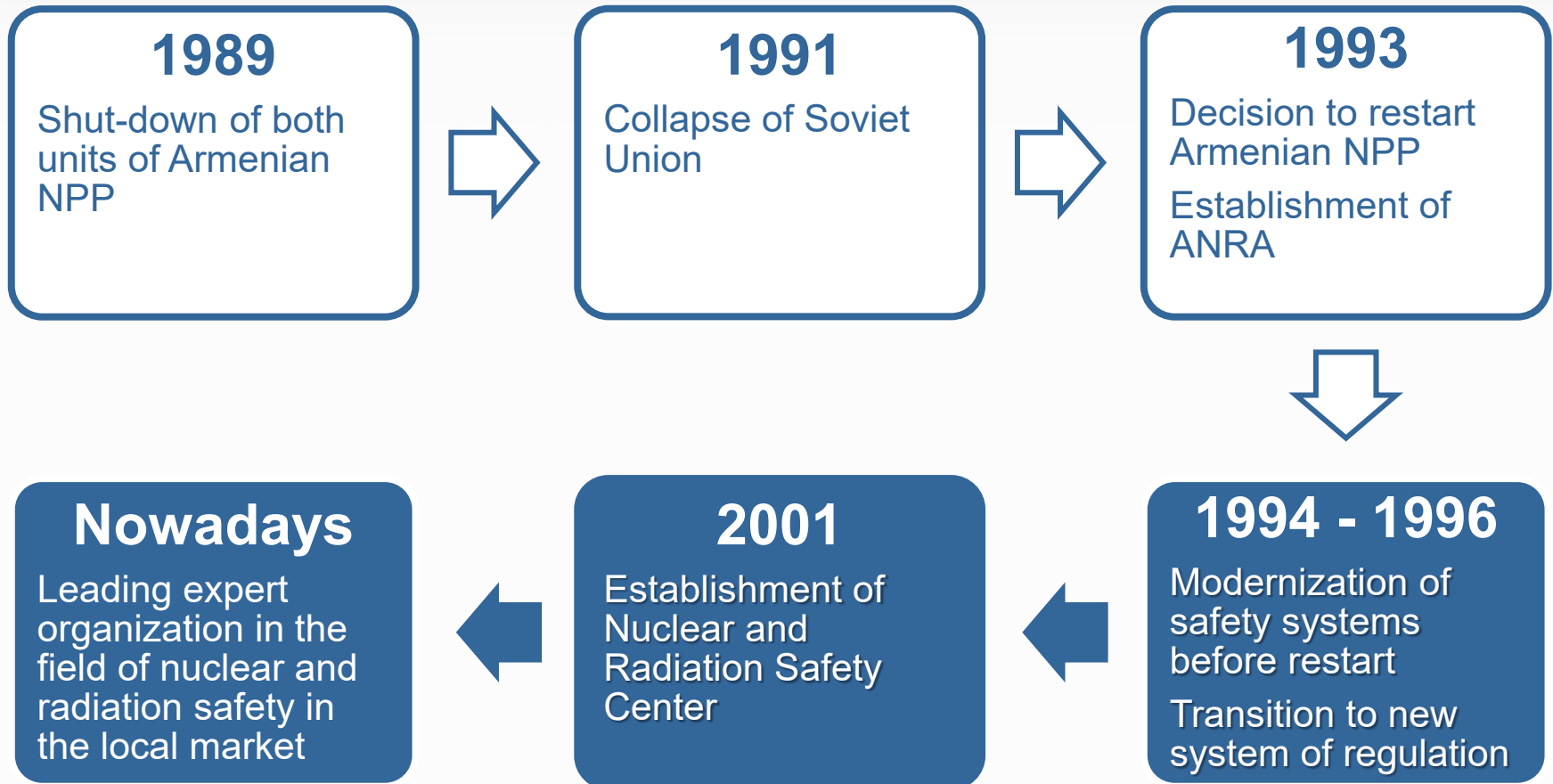
Introduction to NRSC



Project-oriented scientific and research company providing technical support to the national regulatory authority for nuclear and radiation safety – Armenian Nuclear Regulatory Authority



Historical overview



Relationships with ANRA

**IAEA GSR Part 1
Main Atomic
Law**

Functions and
competence of
Regulatory Body

In fulfilment of these
functions ANRA benefits
from the technical and
scientific services and
expert advice provided by
NRSC

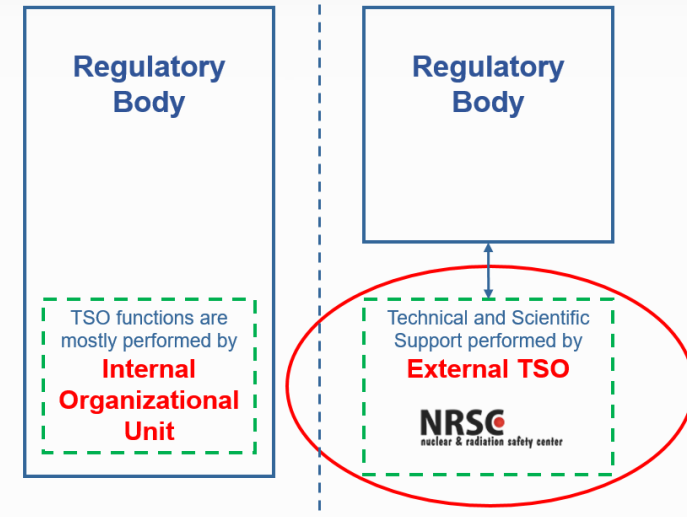
ANRA
(Government of Armenia)
owns 10% of NRSC shares

**IAEA GSR Part 1
Requirement 20**

RB shall obtain technical
or other expert
professional advice or
services in support of its
regulatory functions.....

General information about NRSC

- External TSO
- Organizational and legal form – Closed Joint Stock Company
- For profit company that works on contracts only
- Operates under the formal arrangement (contract) with ANRA
- Considers conflict of interest
- Independent, science driven entity that is free to set its own objectives, methods, training and research to maintain scientific excellence
- Adopted the strategy of continuous development, uses the best available tools and techniques
- Has a good command of problems existing in the field and is participating in the ANRA's support projects as a local sub-contractor
- Committed to the ANRA's principles and values



Vision and mission

VISION

- To be the first choice of the customers from the public sector in Armenia and in the Caucasian region who are in need of research, analyses and assessments to enhance the safety of nuclear and non-nuclear installations

MISSION

- To provide technical support and enhance expertise to the Regulatory Authority in the field of nuclear and radiation safety to protect people, property and environment

NRSC activities

SUPPORT TO ANRA

- Safety assessment, analyses and review
- Development of safety regulations
- Support to development of national reports under International Conventions
- Research and development
- Support to inspections
- Support to emergency preparedness and response
- Radiation protection and safety
- Environmental monitoring

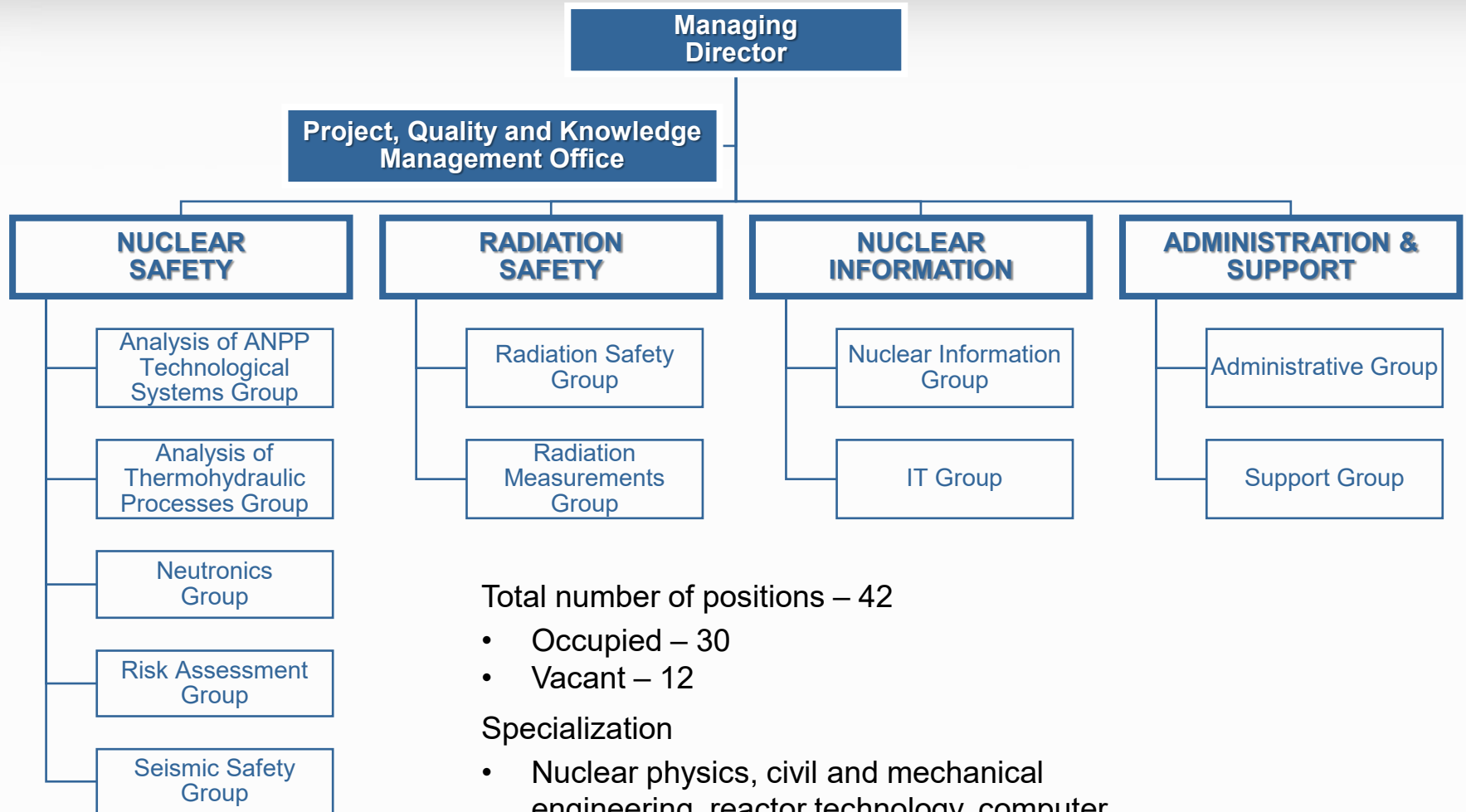
SUPPORT TO OTHER AUTHORITIES AND ENTITIES



GAINING, MAINTAINING AND DEVELOPING EXPERTISE

- Capacity building
- Research and development
- Lessons learned and enhancement of capabilities
- Development of models, tools and infrastructure

Organizational chart



Total number of positions – 42

- Occupied – 30
- Vacant – 12

Specialization

- Nuclear physics, civil and mechanical engineering, reactor technology, computer science, management and administration

NRSC quality management system (1)

- NRSC QMS meets the requirements of ISO 9001:2015 standard
- Scope of certification:
 - Technical and scientific expertise, safety analysis
 - Research and development in the field of nuclear and radiation safety, security of nuclear facilities
 - Radiation measurements
- Validity:
 - 12/02/2023 – 11/02/2026



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NRSC quality management system (2)

MANAGEMENT PROCESSES

MP 01:
Company strategy
and development

MP 02:
Company planning
and control

MP03:
Resource
management

MP 04:
Company
communication

MP 05:
Process management



CORE PROCESSES

CP 01:
Expertise and review of nuclear and
radiation safety

CP 02:
Radiation measurements

CP 03:
Research and development



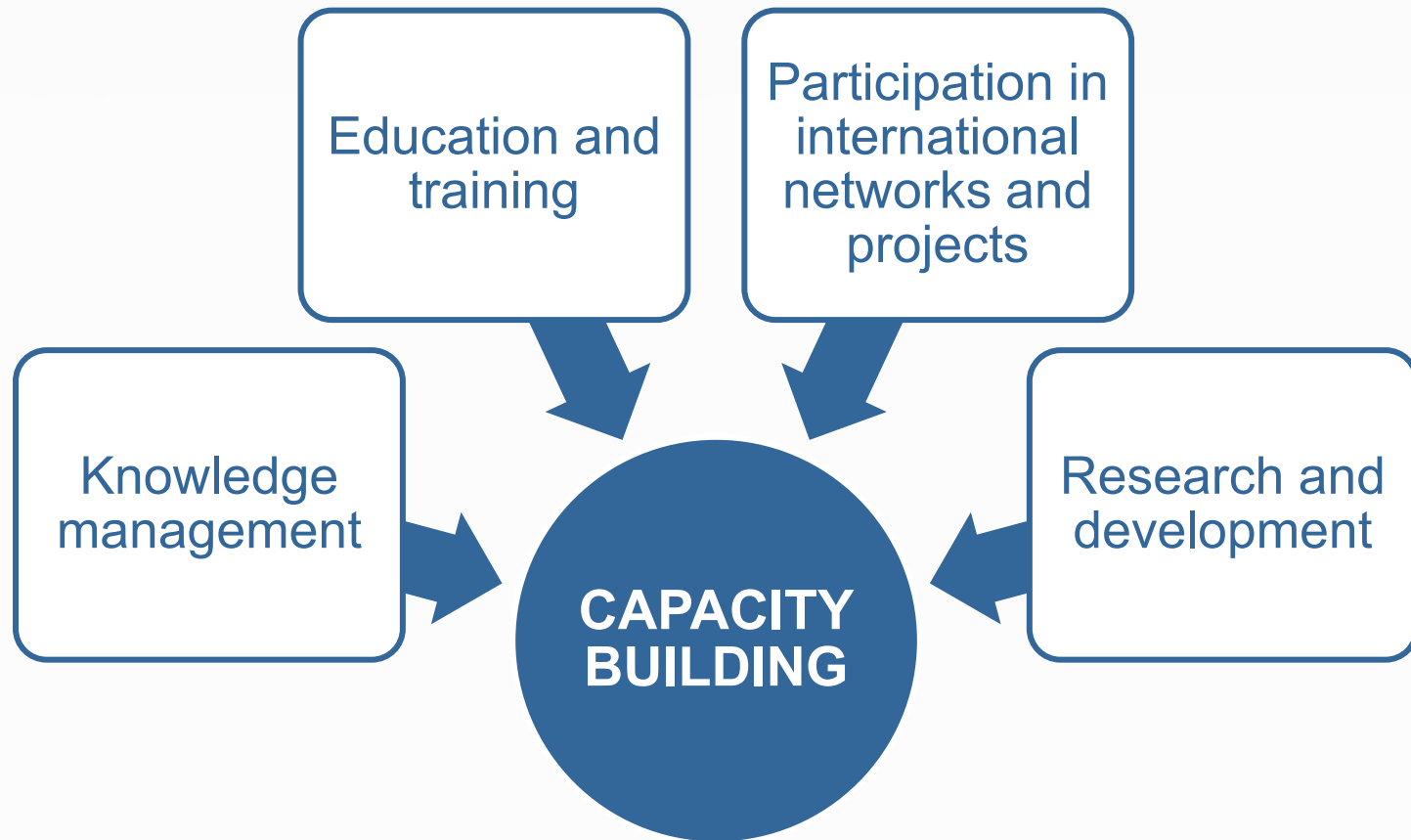
SUPPORT PROCESSES

SP 01:
Procurement

SP 02:
IT management

SP 03:
Knowledge management

Technical knowledge, expertise and capability



KM programme and strategy

KM Programme

- No formal KM programme in place (in development phase)
- To develop KM programme it's needed develop and implement strategies to introduce beneficial KM programme

Strategy

- No separate strategy for KM in place
- KM as a part of the Management System (QMS) is included in QMS improvement programme (Work plan)

WORK PLAN Continuous Improvement of NRSC Quality Management System

Implementation period: 01/02/2023 – 30/12/2025

Involved staff: KQM (MS), PM (MS), Pr-Qs, Group Leaders
Armen Amirjanyan (AA), Surik Bznuni (SB), Yeghishe Gondakyan (YG), Albert Hovhannisyan (AH), Anna Harutyunyan (AHar), Lusine Davtyan (LD), Arpi Khachatryan (AKh), Valery Melkumyan (VM)

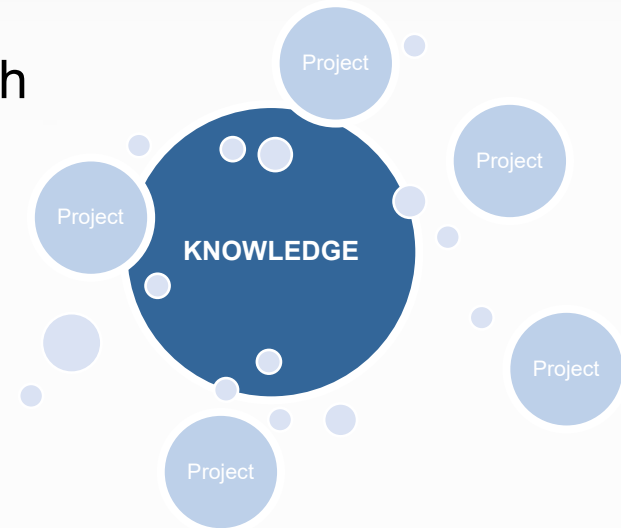
1. General QMS activities

N	Activity	Responsible	Deadline	Status
1.	Management review 2022	MS	28/02/2023	Done
2.	Management review 2023 (status September 2023)	MS	30/10/2023	Done
3.	Management review 2023	MS	29/02/2024	
4.	Management review 2024 (status September 2024)	MS	31/10/2024	
5.	Management review 2024	MS	28/02/2025	
6.	Management review 2025 (status September 2025)	MS	31/10/2025	
7.	Management review 2023	MS	27/02/2026	
8.	Project audits	All project leaders		Continuous
9.	Company risk management (2023)	AA, MS	30/01/2023 + quarterly update	Done



Learning from experience

- NRSC is a project-oriented company and the experience and knowledge are gained through implementation of numerous projects (mainly R&D projects) covering different aspects of nuclear and radiation safety
 - Development of new capabilities
 - Lessons learned
- External collaboration in sharing experience and knowledge is also an opportunity for learning



Use of human error prevention tools

- The necessity to apply human error prevention tools is mostly conditioned by the specifics and presence of risks when carrying out R&D activities
- Discussions are held during weekly seminars

PRE-JOB BRIEFING

- Team involved in performing an important activity come together and discuss the critical steps involved, situations where errors may be likely and possible countermeasures, consolidate knowledge from past experience just before the start of the activity
- Opportunity to learn from each other, to impart experience from senior to junior team members and provide a forum to exchange experiences, to avoid duplication of efforts

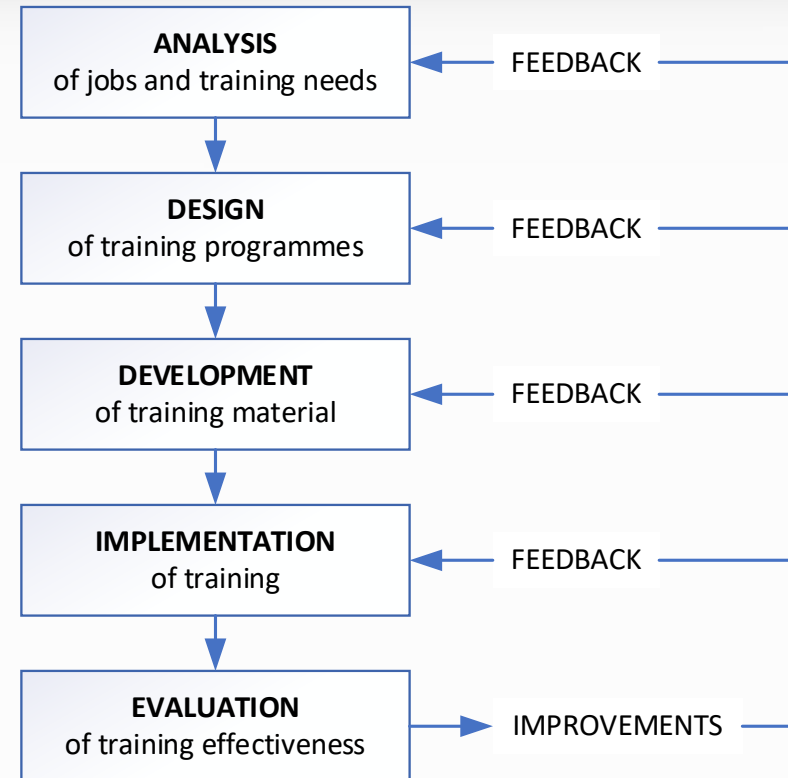
POST-JOB REVIEW

- Meeting of all personnel involved in an activity where the lessons learned - what went well and what can be done better - are discussed



Education and training at NRSC

- Approach to training – SAT
- Initial education, training and work experience are supplemented with continuing professional development and refresher training
- Participation in training events/workshops organized by the international organizations, in recognized topical meetings



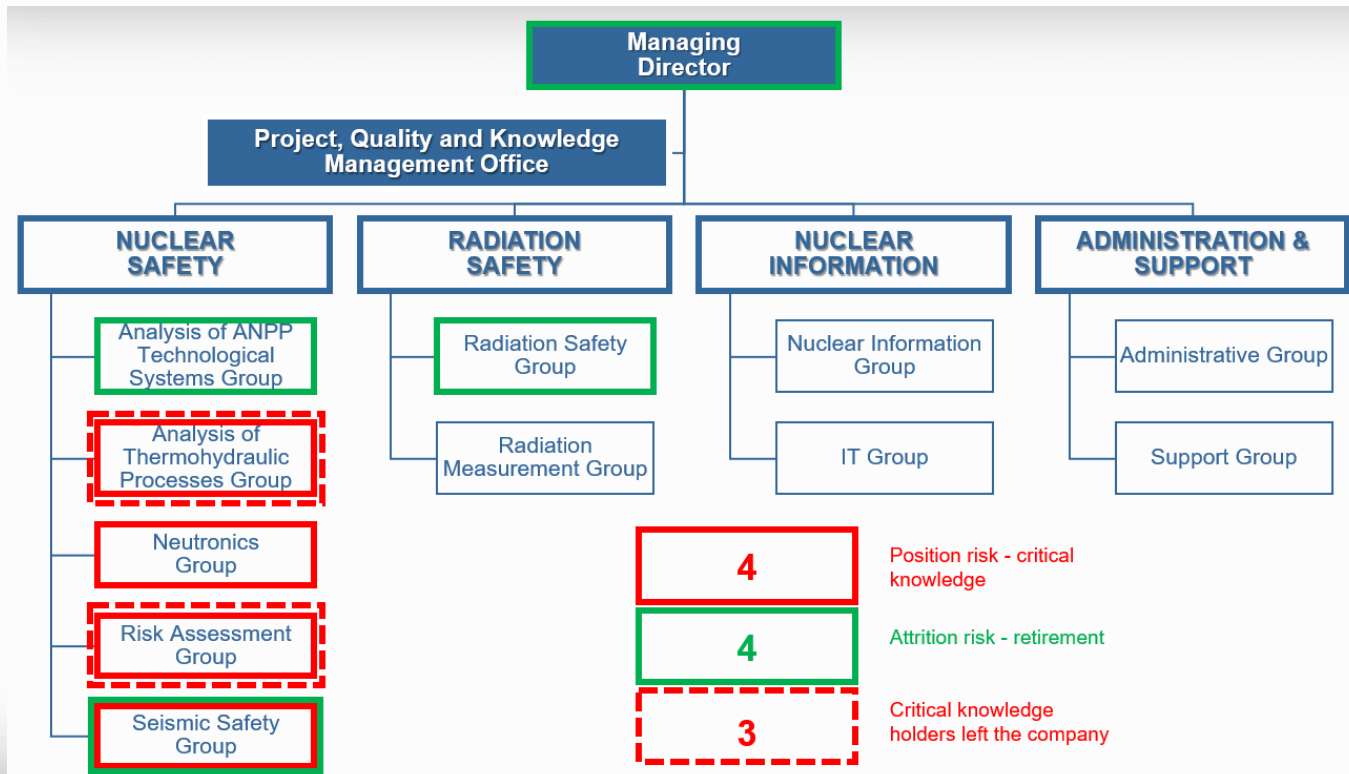
Education and training for external organizations

- NRSC is preparing new specialists for ANRA:
 - Separate task in the annual service contract with ANRA
- NRSC is involved in preparation of specialists with specialization in the field of nuclear and radiation safety in Armenia:
 - Lecturing the courses in reactor physics, energetics at the Yerevan State University and State Engineering University
 - Providing trainings to other organizations on a contract basis (medical institutions, industrial facilities, etc.)

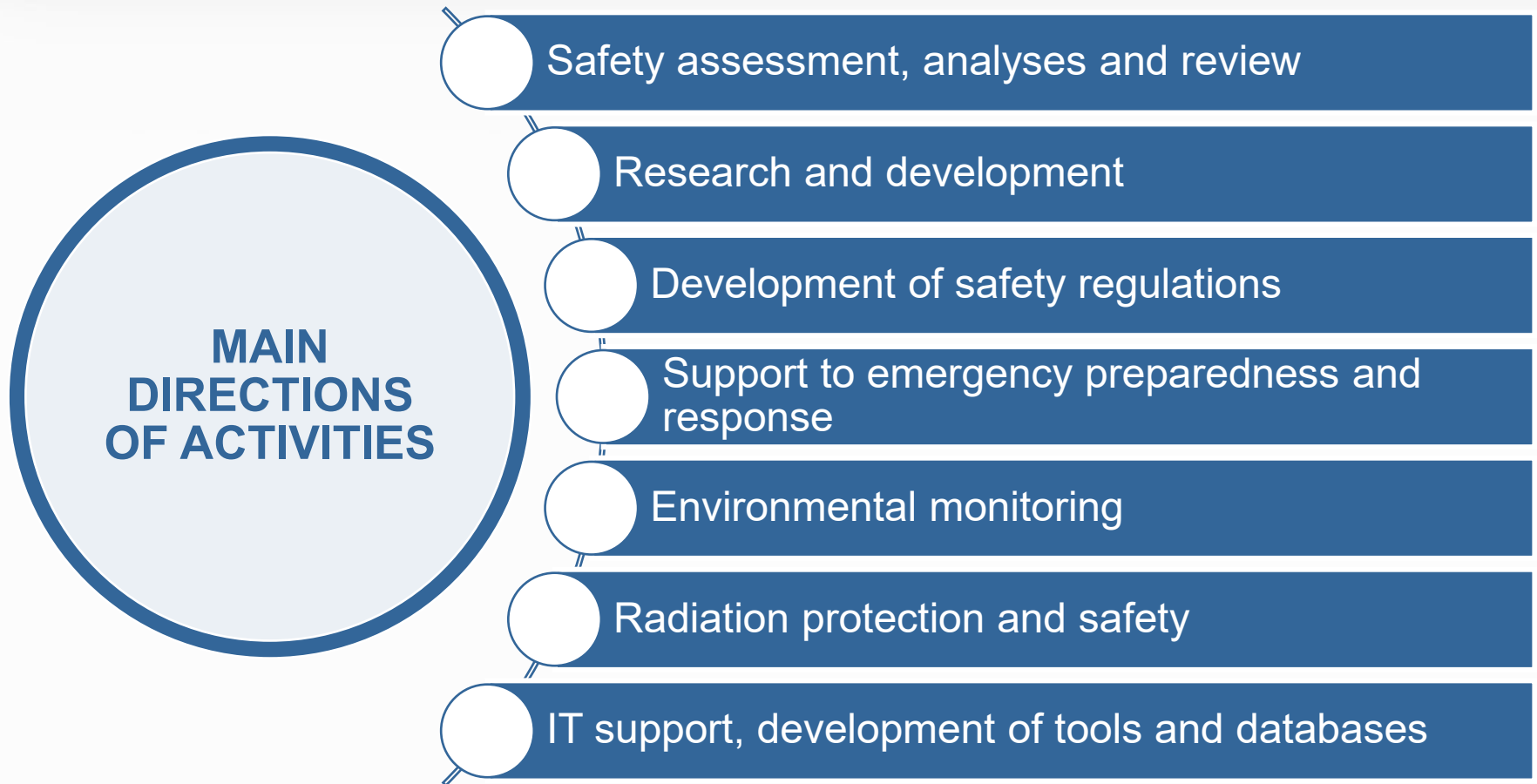


Knowledge loss risk assessment

- KLRA focuses on two key parameters:
 - Position risk
 - Attrition risk
- KLRA has a purpose to identify those individuals in the company who are critical to its continued success



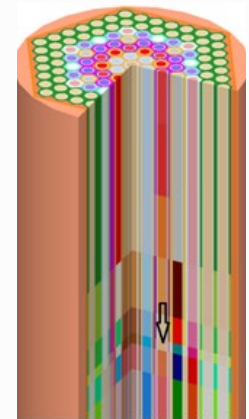
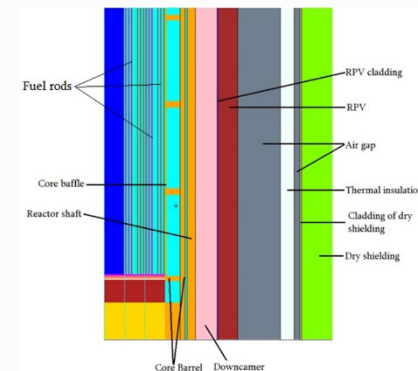
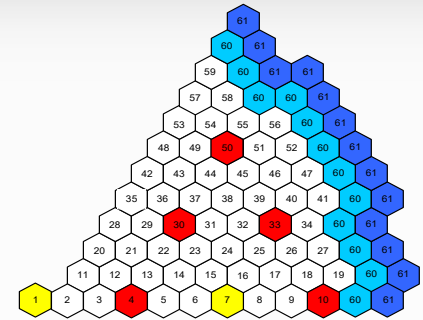
NRSC specialization



NRSC capacities (1)

Neutronics and nuclear fuel

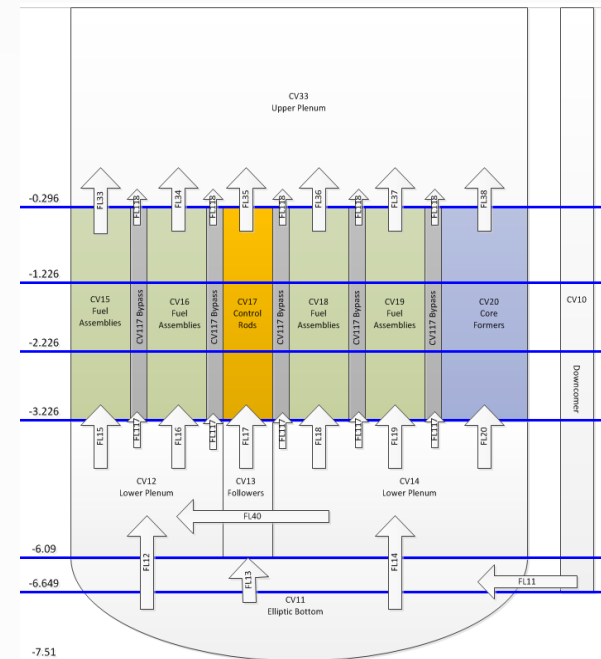
- Nuclear reactor core performance and reactivity accidents analysis
- Neutron-nucleus interaction cross-section libraries development
- Spent fuel dry storage and pools criticality analysis, spent fuel decay heat analysis
- Reactor pressure vessel fluence analysis
- Nuclear fuel depletion analysis
- Spent fuel shielding analysis



NRSC capacities (2)

Thermal hydraulic analysis

- T-H analysis to support ECCS and SS modifications
- DBAs and Severe accident analysis
- Confinement T-H analysis, including hydrogen, aerosol and isotope behavior
- Radiological consequences analysis
- CFD analysis



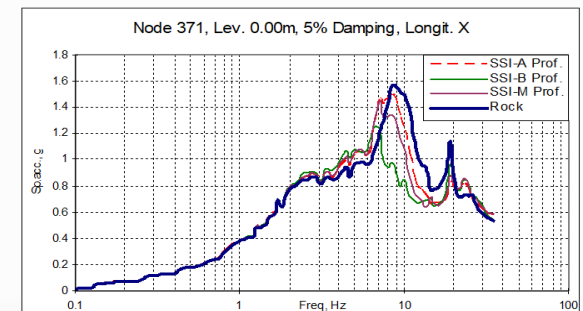
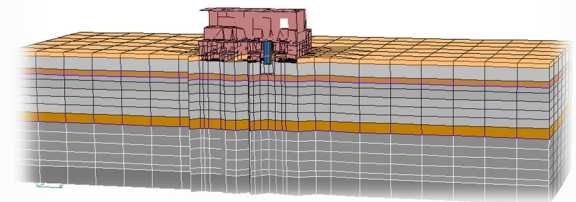
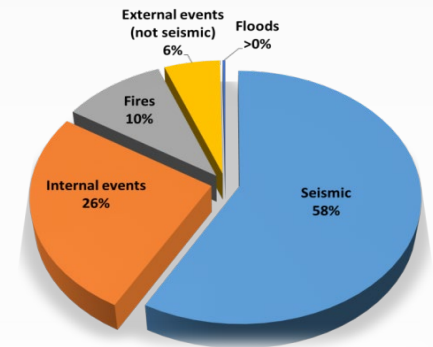
NRSC capacities (3)

Risk assessment

- Development of PSA models (internal IEs, fires and external hazards)
- Application of PSA models for risk-informed decision-making

Seismic safety

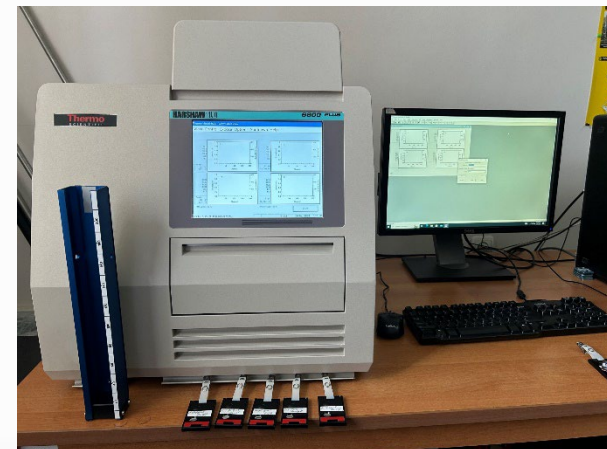
- Seismic and structural analyses to support ANPP Seismic Re-Evaluation Program
- Study of NuScale design features suitability for ANPP site



NRSC capacities (4)

Radiation safety and radioactive waste management

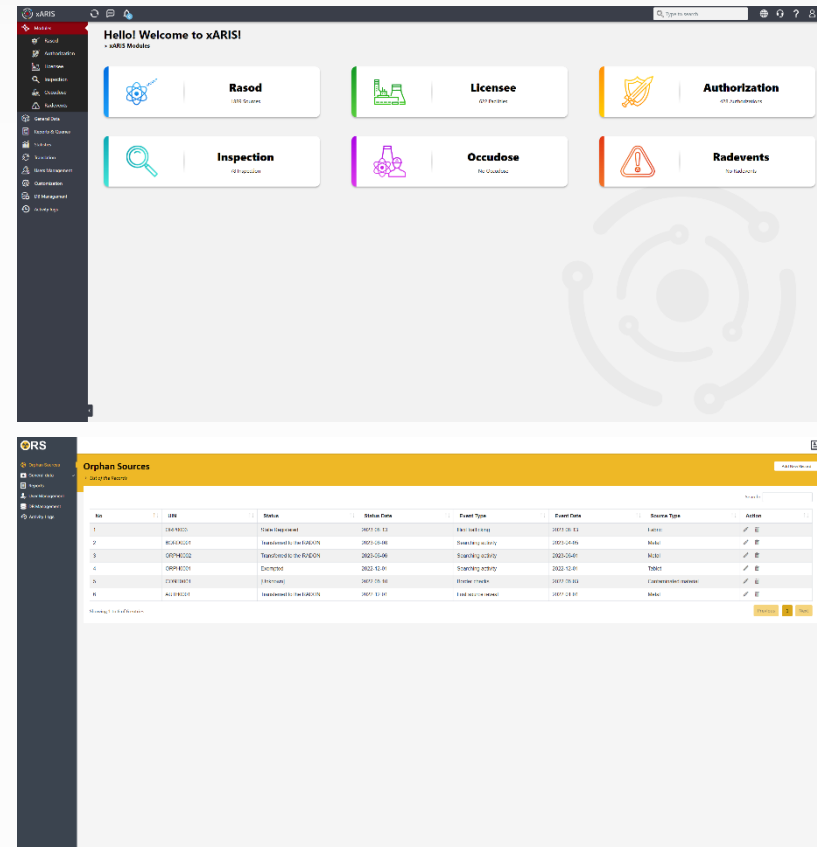
- Radioactive waste management and decommissioning issues (review, expertise, development of documents, etc.)
- Individual radiation monitoring and environmental monitoring
- Search and recovery of orphan radiation sources
- γ - spectrometry
- X-ray testing, quality control
- Shielding calculations
- Assessment of radiological consequences of radionuclide releases to the environment



NRSC capacities (5)

Development of special tools

- Advanced Regulatory Information System (ARIS)
 - To support Regulatory Authorities in management of regulatory activities
 - Registration of IRS, licensing, inspections, occupational doses and radiation/security events
- Orphan Radiation Sources Database (ORS)
 - To support Regulatory Authorities in the management of orphan sources from the moment they are detected to the end state of the source
 - Results of radiation measurements



Support to ANRA (1)

Support to licensing ANPP safety upgrading process

- NRSC conducts ANPP safety assessment to support ANRA in its decision-making
 - Reactor core coolant system modernization
 - Reactor confinement spray system modernization
 - Probabilistic safety assessment of spent fuel pools
 - Analysis of radiological consequences of DB and BDB accidents
 - Installation of Jet Vortex Condenser
 - Analysis of hydrogen generation during BDB accidents
 - Installation of confinement sump protection system



Support to ANRA (2)

Support to development of regulations

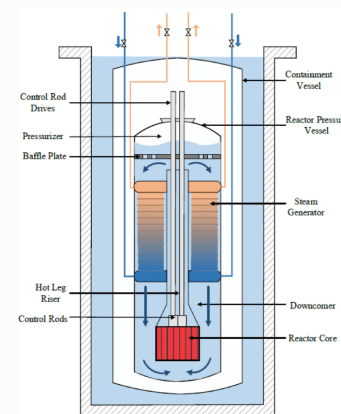
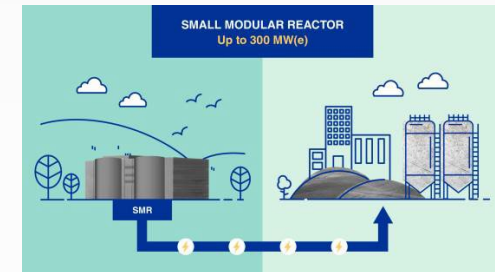
- NRSC provides support to ANRA in the development of regulatory infrastructure – laws and regulatory requirements
 - Draft New Atomic Law (on-going)
 - Draft of BSS to align Armenia's regulations with new IAEA standards and EU directives (on-going)
 - Draft of Requirements on safe management of radioactive wastes
 - Draft of Design safety requirements for new NPP
 - Draft of the Requirements to physical protection of nuclear and radioactive materials and nuclear installations
 - Draft of Site evaluation requirements
 - Draft of Seismic hazard assessment guide



Support to ANRA (3)

R&D to support safety regulation

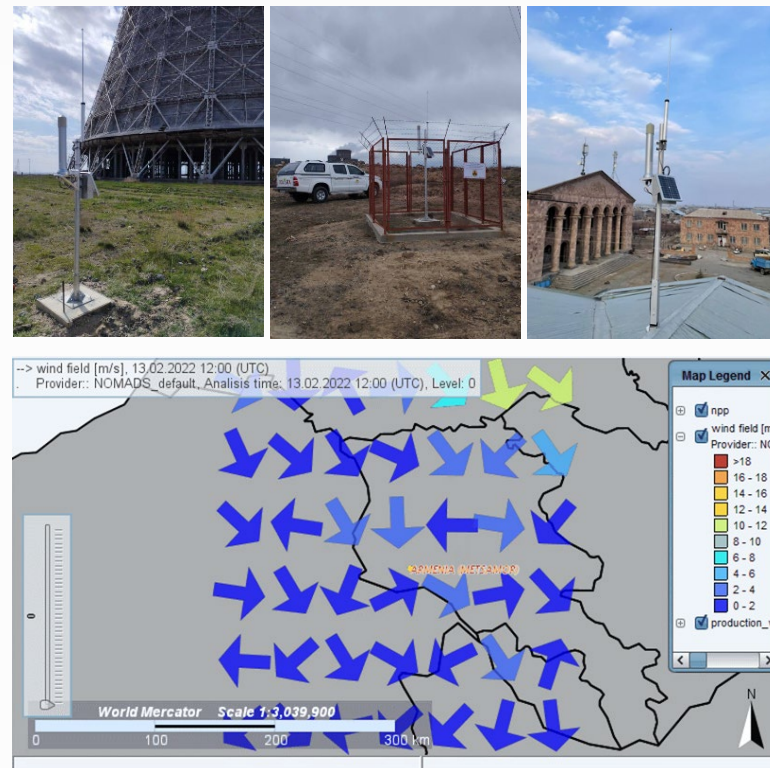
- NRSC takes full responsibility for the R&D programme of ANRA
- R&D areas:
 - T-H and neutronics analyses to support design changes of ANPP
 - Risk analysis to support safety optimization of ANPP
 - Seismic safety and structural analyses to support seismic upgrading program
 - Radiation safety and protection to support radioactive waste management and sources' safety programs
 - Security of nuclear and radioactive materials to support improvement of security system of facilities
- In the last years in R&D activities the main emphasis was on:
 - Needs of NRSC and ANRA in development of capabilities for licensing design lifetime extension of ANPP Unit 2 and construction of new NPP
 - Development trends and new approaches in the field of nuclear and radiation safety



Support to ANRA (4)

Support to emergency preparedness and response

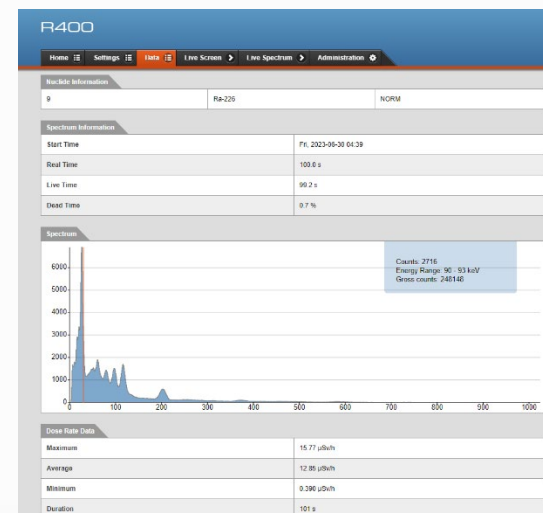
- Participation in emergency groups' activities of ANRA's ERC
- Development of emergency procedures and scenarios for exercises
- Training of ANRA's staff on emergency preparedness
- Operation of Early Warning Radiation Monitoring System (EWRMS)
- Operation of Decision Support System for Nuclear and Radiological Emergencies - JRODOS



Support to ANRA (5)

Support to inspections of facilities and activities

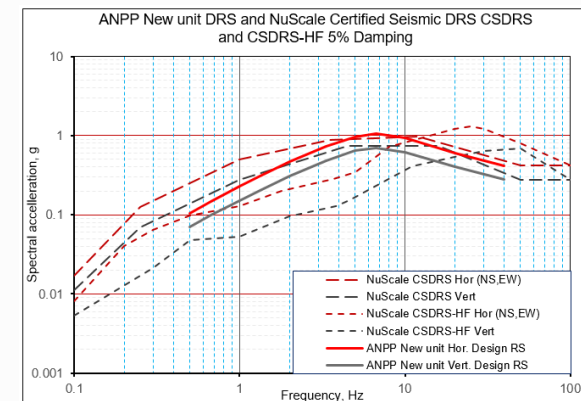
- Support to development of inspection programmes
- Conducting radiation measurements during inspections
- Environmental monitoring
- Incident response in case sources are identified (including at borders' check points)
- Identification and characterization of nuclear materials



Support to ANRA (6)

New NPP - technology assessment and selection

- New safety features of SMRs, and their experimental and theoretical basis
- Survey of SMR design and licensing status
- Gap analysis of Armenian regulatory requirements and licensing framework
- Study of the expediency and feasibility of deployment of SMRs in Armenia
- SMRs seismic design suitability for the Armenian NPP



National and international cooperation

**Armenian Nuclear
Regulatory Authority
(ANRA)**



**Armenian Nuclear
Power Plant
(ANPP)**



**Armenian Scientific
Research Institute
for Nuclear Plant
Operation
(ARMATOM)**



**JSC Rusatom
Service**



**International Atomic
Energy Agency
(IAEA)**



**United States
Nuclear Regulatory
Commission
(U.S. NRC)**



**United States
Agency for
International
Development
(USAID)**



**International Science
and Technology
Center
(ISTC)**



**Gesellschaft für
Anlagen-und
Reaktorsicherheit
mbH
(GRS)**



**Institute for
Radiological
Protection and
Nuclear Safety
(IRSN)**



**Brookhaven National
Laboratory
(BNL)**



**Pacific Northwest
National Laboratory
(PNNL)**



**Argonne National
Laboratory
(ANL)**



**Advanced Systems
Technology and
Management, Inc.
(AdSTM)**



**Oak Ridge National
Laboratory
(ORNL)**



**National Nuclear
Security
Administration
(NNSA)**



Bertin GmbH



**Karlsruhe Institut für
Technologie
(KIT)**



**Hospitals, dental
clinics**

**Industrial facilities,
educational
institutions**

Participation in networks and topical meetings (1)

WWER Regulators' Forum - participant

- Established in 1993
- Objective:
 - To foster enhancement of the nuclear safety and radiation protection in the interested countries through utilization of the collective experience, information exchange and consolidation of efforts of the national nuclear safety authorities to study safety problems and improve regulatory policies and practices
- Working groups:
 - PSA: Use of PSA methods (Armenia is a participant)
 - Reactor physics: Verification of reactor physics related computer codes with actual commissioning test data (benchmark exercises); exchange of information on commissioning tests (Armenia is a participant)



Participation in networks and topical meetings (2)

WENRA - observer

- Established in 1999
- Objectives:
 - To develop a common approach to selected nuclear safety and radiation protection issues and regulation, in particular within the EU
 - To serve as a network of nuclear safety regulators exchanging experience and discussing significant safety issues
- Armenia uses the WENRA and various IAEA platforms for the study and application of the regulatory lessons learned



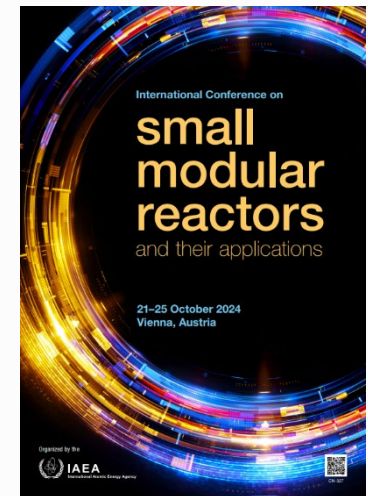
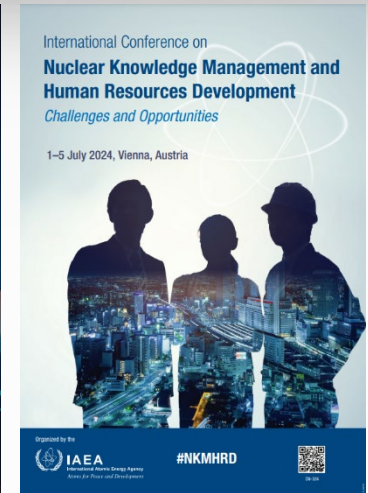
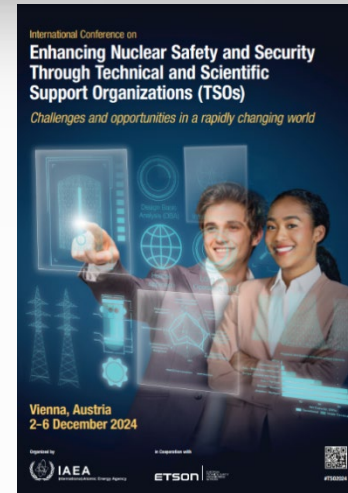
Participation in networks and topical meetings (3)

- Participation in the recognized international topical meetings:
 - Code Applications and Maintenance Program (CAMP)
 - AC2 User Meeting (COCOSYS)
 - Probabilistic Safety Assessment and Management (PSAM)
 - Physics of Reactors (PHYSOR)
 - International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH)
- Benefits from participation:
 - Familiarization with the experience of other countries/ companies is a good learning possibility
 - Defining NRSC knowledge status, evaluate applicability of the other countries' experience to NRSC and generate ideas for further development
 - NRSC knowledge/experience is shared with other participants



Participation in networks and meetings (plans for 2024)

- Membership to TSO networks:
 - IAEA TSO Forum (TSOF)
 - European TSO Network (ETSON) – under discussion
- Participation in International Conferences:
 - International Conference on Enhancing Nuclear Safety and Security Through TSOs (December 2024)
 - International Conference on Nuclear Knowledge Management and Human Resources Development (July 2024)
 - Participation in International Conference on Small Modular Reactors (October 2024)
 - Participation in US NRC Annual Regulatory Information Conference (March 2024)



Challenges (1)

- Challenges of expanding nuclear power programme
 - Lifetime extension of the Armenian NPP Unit 2 – to 2026 (1st), 2036 (2nd)
 - Construction of new NPP (no decision yet regarding design) – by 2036
 - Lack of competence, workforce for R&D activities, NPP construction, operation and decommissioning
- Site approval and licensing process of a new NPP unit
- Regulatory oversight of the safe operation and aging management of ANPP Unit 2
- Regulatory oversight of decommissioning of ANPP Unit 1
- Regulatory oversight of radioactive waste and spent fuel management

Challenges (2)

- Establishment of Radiation Laboratory
 - Creation of conditions that meet modern requirements for the implementation of radiation monitoring and control, ensuring the protection of population from the possible harmful effects of ionizing radiation
 - To be operated by NRSC – long delay with establishment due to non-provision and repairment of premises
- Establishment of Radioactive Waste Management Organization (“National Operator”)
 - NRSC proposal is under review by the Government – to be operated by the NRSC
- Efficient response to a possible radiological emergency situation
 - Coordination of the work of involved parties
- Harmonization of nuclear regulatory and legal infrastructure with the EU resolutions taking into account obligations undertaken by the Republic of Armenia in connection with CEPA

Challenges (3)

- Limited funding from the state budget
 - 25% of total budget
- Recruitment of the next generation
 - Shortage of new talents for recruitment
 - Low interest to working in nuclear field – increased interest to working in IT sector
- Challenges of ageing workforce
 - Retirement age of some critical knowledge holders (long term employees) is close
- Increased external staff turnover
- Non-availability of ready-to-work recruits in the labor market
- Ineffective communication and knowledge sharing among the national stakeholders in the national nuclear safety infrastructure
- Weaknesses in cooperation with educational organizations, quality of university education in the nuclear field

Thank you for attention!

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