



**IAEA**

International Atomic Energy Agency

# Nuclear Safety Knowledge Management and Capacity Building

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*Asian Nuclear Safety Network Education and Training Topical Group  
Regional Workshop on the Development of Nuclear Safety Knowledge Management Programme for the Regulatory  
Body,  
12-15 July 2022*

- ***Why?***
  - Why knowledge management?
  - Why for nuclear safety?
- ***What is nuclear safety knowledge, and what is NSKM?***
- ***Relationship of NSKM ...***
  - with Safety Standards
  - with capacity building
  - with GNSSN
  - etc.
- ***Selected IAEA activities***
- ***KM Tools and Methods (my recommendations)***

*Topic*

# **IMPORTANCE OF NUCLEAR SAFETY KNOWLEDGE MANAGEMENT AND NUCLEAR SAFETY CAPACITY BUILDING**

# Importance of knowledge management

- ***Knowledge Management has been identified as one of the key factors that can contribute to the safe and secure and efficient operation of nuclear activities and facilities in Member States***
  - Safety Standards
  - General Conference resolutions
  - IAEA conferences (HR 2014, NKM 2004, 2007, 2016)
  - Nuclear Safety Action Plan
  - INSAG 21, new INSAG 27 (2017)
  - IEM Reports = lessons learned from Fukushima

# Importance of KM for nuclear safety

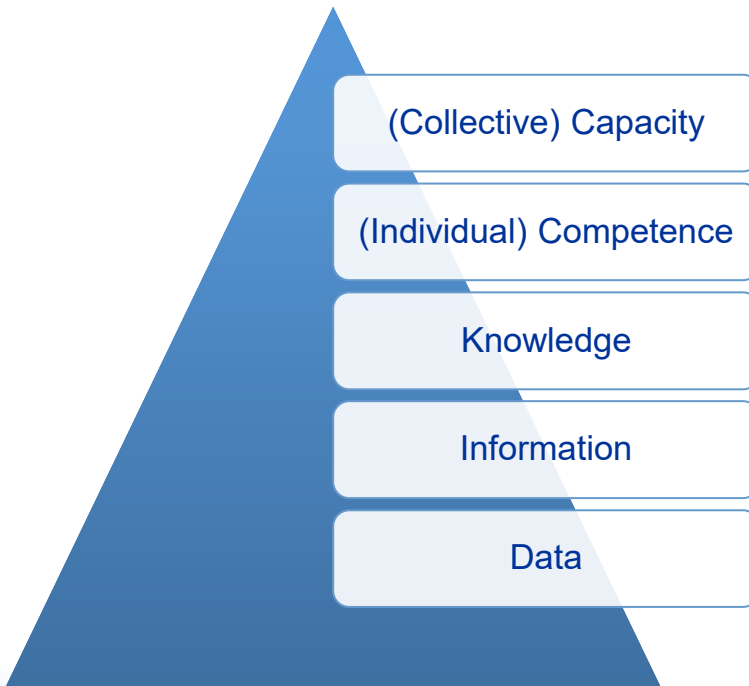
- ***KM for nuclear safety poses special challenges***
  - Knowledge base legally **mandatory**
    - Required for regulatory activity and operations
  - Manyfold **types** (legal, technical, operational ...)
  - Manyfold **owners** (regulators, TSOs, vendors, operators ...)
  - Lack of nuclear safety knowledge can have significant **implications**
    - Contrast to other knowledge types
  - Long timescales (decision basis)
  - Dual role of regulators (corporate and oversight)

*We now look into:*

# KNOWLEDGE MANAGEMENT BASICS

# Some KM Basics

## *Knowledge Pyramid*



## *"Capacity for Action"*

- Owning information is not equal to being able to use it for action
- "Information only becomes knowledge in the hands of someone who knows what to do with it." (Peter Drucker)

# Capacity, competence, knowledge

- **Knowledge**
  - ready for action
- **Competence**
  - Set of knowledge, skills and attitudes
  - Competent staff (a person)
- ***Capacity has to do with number of people who know something***
  - If two staff know the same things, the organization doesn't know more, just knows something twice
  - But: double production capacity!



# Manifold uses of KM



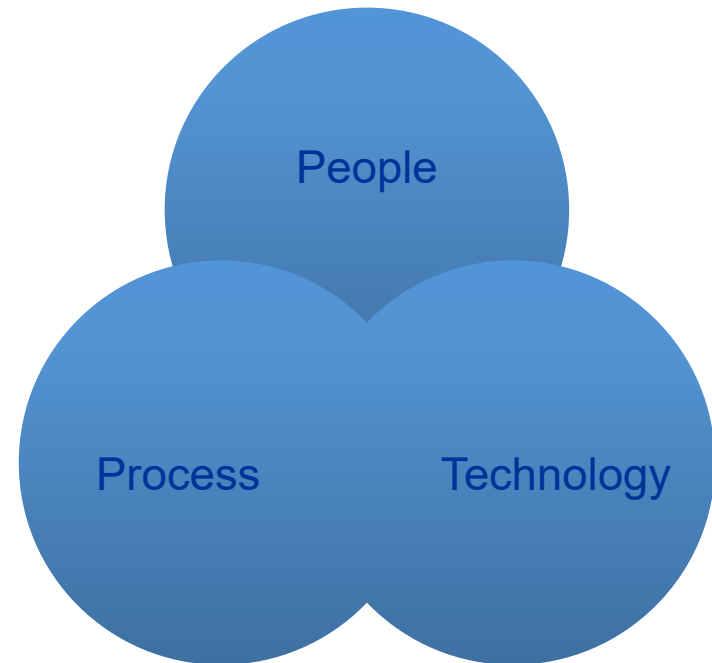
- ***Manifold uses***
  - each with existing and available sets of tools and techniques
  - KM is not equal to sharing everything and always

# The PPT Model of KM

## *Explanation*

- ***General observation:  
systems contain***
  - People
  - Process
  - Technology
- ***KM must consider all three  
areas***

## *The PPT Model of KM*



# The PPT Model of KM

- *Corresponding three historical sources and types of knowledge management today*
- **People – HR departments**
  - Human resources, training, life-long learning, workforce development, migration, recruitment, generational transfers, ...
- **Process – business consulting**
  - Communities of practice, mentoring, knowledge cafés, structured and open interviews, knowledge mapping, ...
- **Technology – ICT companies**
  - Internet platforms, search engines, document repositories, pro-active e-assistants, e-learning, ...

# Trend: importance of people

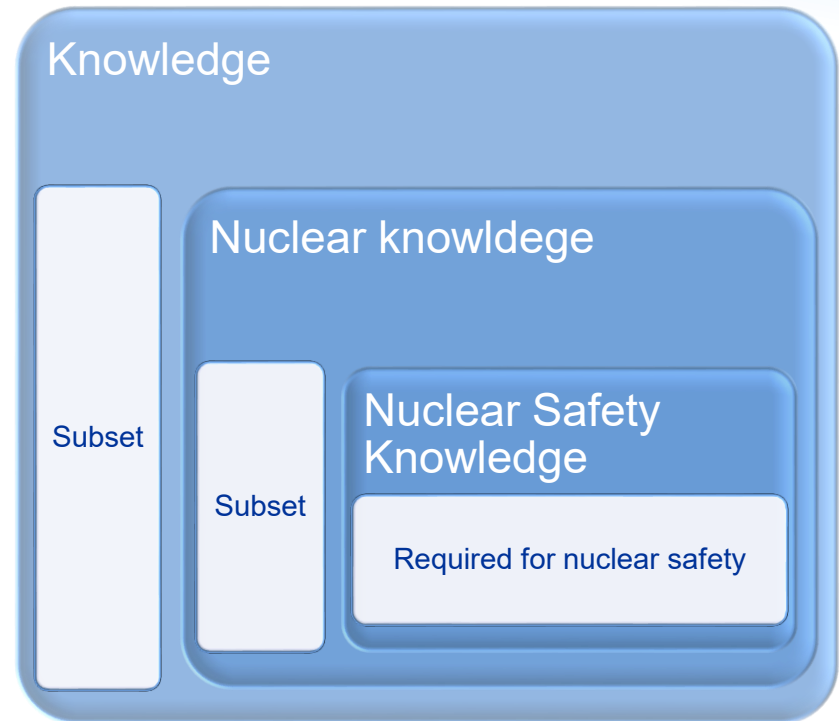
- ***Recent insight: importance of "humans" and "culture"***
  - 2016 IAEA International Conference on Nuclear Knowledge Management
    - Within the triangle of people, processes and technology, the *people* need more consideration.
    - "*Culture eats strategy for breakfast.*" (aircraft industry)
  - INSAG 27 (2017)

*Topic*

# NUCLEAR SAFETY KNOWLEDGE MANAGEMENT

# Nuclear safety knowledge

- ***Nuclear safety knowledge is***
  - ... that subset of knowledge owned by an organization, or other entity,
  - ... that is relevant to or required for nuclear safety.



# Nuclear safety knowledge

- ***Explanation***

- A regulator, for example, has a huge body of knowledge required for daily conduct of business.
  - A subset of this knowledge will be nuclear knowledge
    - and a subset of this will be nuclear safety knowledge.

- ***Examples***

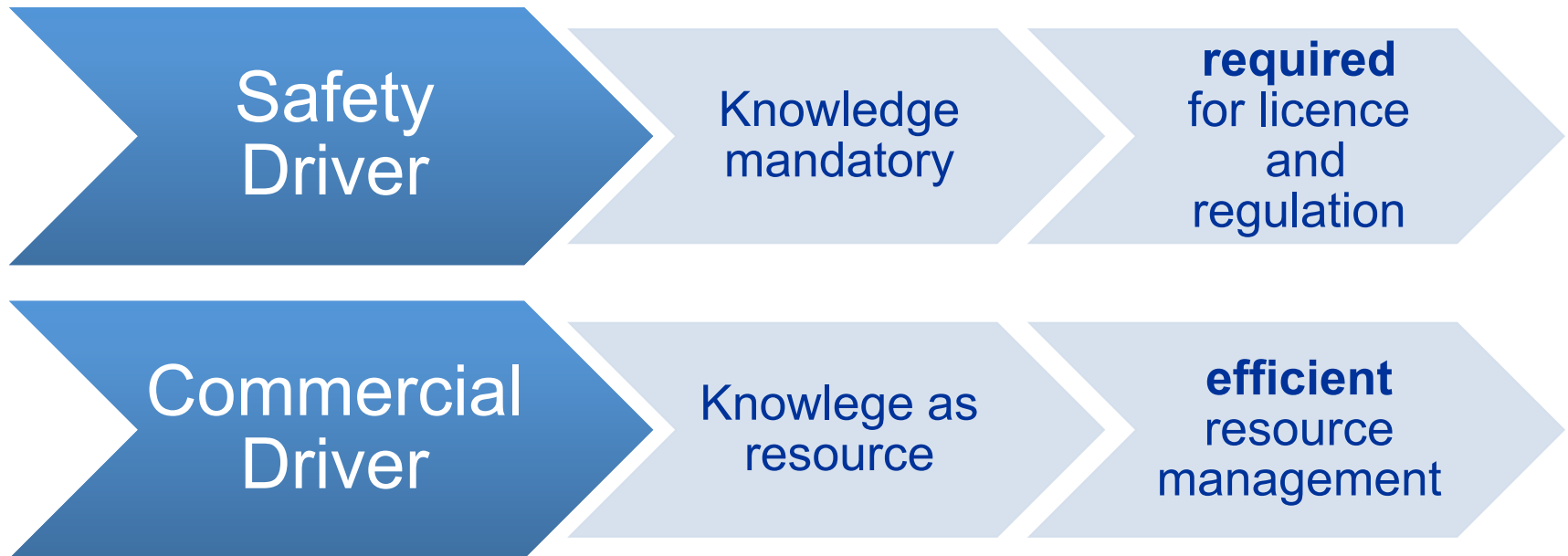
- Knowledge, but not nuclear knowledge
  - Knowledge about the payroll. It is needed for regulatory operation, but is not required for nuclear.
- Nuclear knowledge, but not nuclear safety knowledge
  - Knowledge specific to reactor designs that were developed, but never build or operated.
  - Can nevertheless be of high commercial value.

# Nuclear Safety Knowledge Management

- *Nuclear Safety Knowledge Management is the management of knowledge relevant to or required for nuclear safety.*
- ***Nuclear Safety Knowledge Management entails***
  - ... using knowledge management approaches, tools and techniques
  - ... for the purpose of nuclear safety



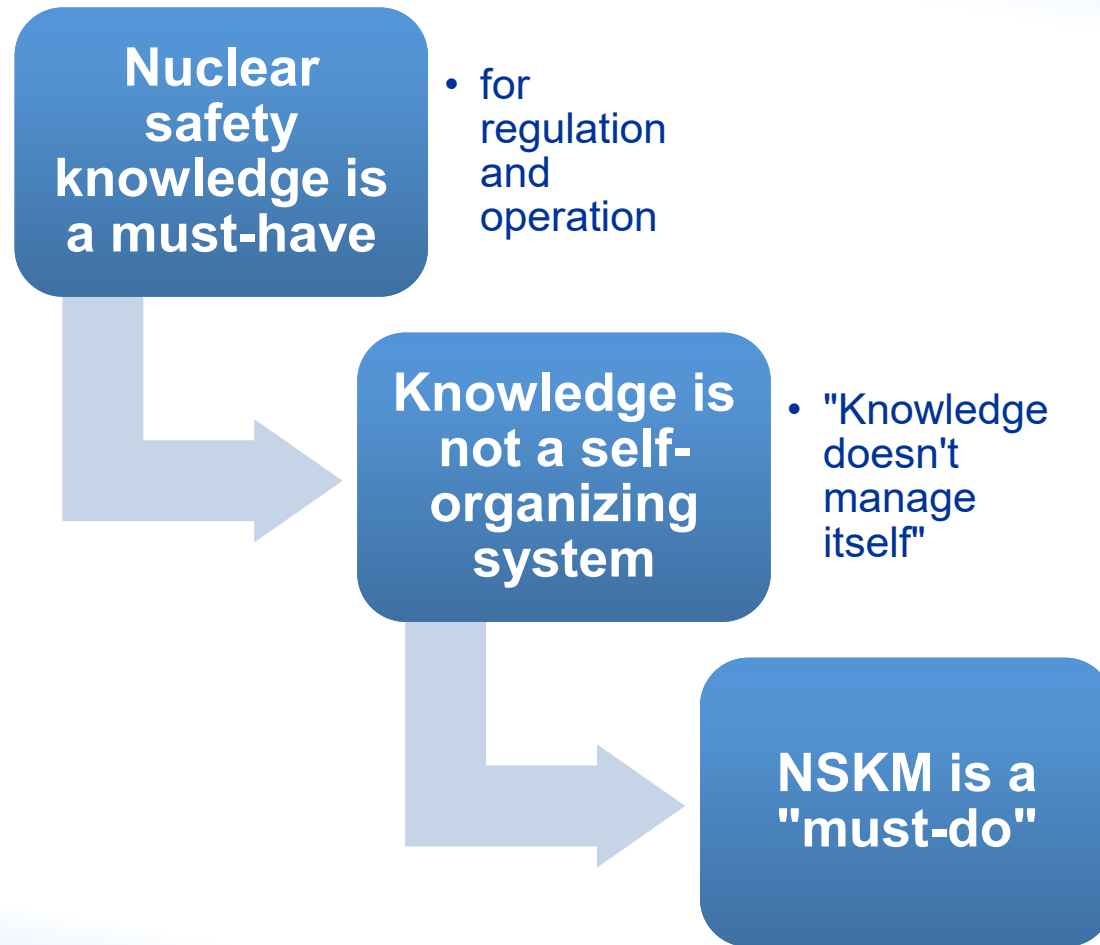
# Two Driver Model



# Two Driver Model

- ***Explanation: look at loss of knowledge***
  - Loss of **commercial** knowledge
    - Possibly less revenue for the utility
    - Possibly less commercial value of utility
    - Undesirable, but not critical
  - Loss of **safety** knowledge
    - Operator: stop operation?
    - Regulator: stop oversight = stop operation?
    - "Critical"

# "Must have" meanst "must do"



# General benefits of NSKM

- **Achieve *safe* operation**
  - Support culture for safety
  - Support leadership and management for safety
  - Support the integrated (systemic) approach to nuclear safety
- **Achieve *efficiency* gains**
- **Support intergenerational knowledge transfer**
- **Facilitate *innovation* and learning**
- **Identify and protect *sensitive* knowledge**
  - Security, safeguards, intellectual property
- **Contribute to an efficient and effective response in a nuclear or radiological emergency (EPR)**
- **Support *public awareness***

# Ultimate Objective

- ***The ultimate objective of all nuclear safety knowledge management activities is ...***
  - to sustain and improve the competence of individuals and
  - the capacity of organizations or countries
  - to use knowledge effectively and responsibly
  - **for (nuclear) safety.**

# NSKM is comprehensive

- ***The definition of NSKM is meant to be comprehensive***
  - Nuclear installation safety
  - Nuclear transport and waste safety
  - Nuclear radiation protection
  - Nuclear power
  - Nuclear applications
  - Legal, scientific, technical, institutional knowledge
  - All facilities and activities

# Levels of NSKM

## Global

- Global safety experience, incl. emergencies, joint human heritage
- Globalization of nuclear sector, workforce migration

## National

- National development plans, role of governments, coordination mechanisms
- Knowledge interfaces between regulator, TSO, operator, response organizations

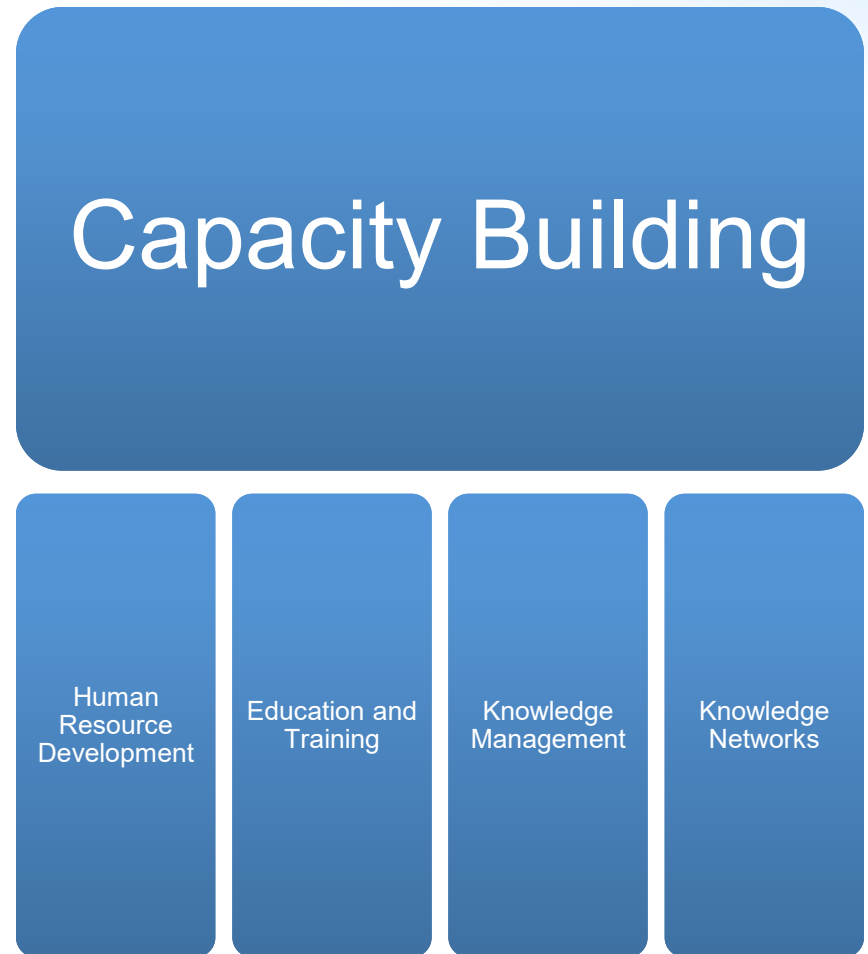
## Organizational

- KM as part of integrated management system
- Responsibilities of regulator, TSO, operator

## Individual

- Attitudes, learning, awareness, creativity.
- Career paths for each individual

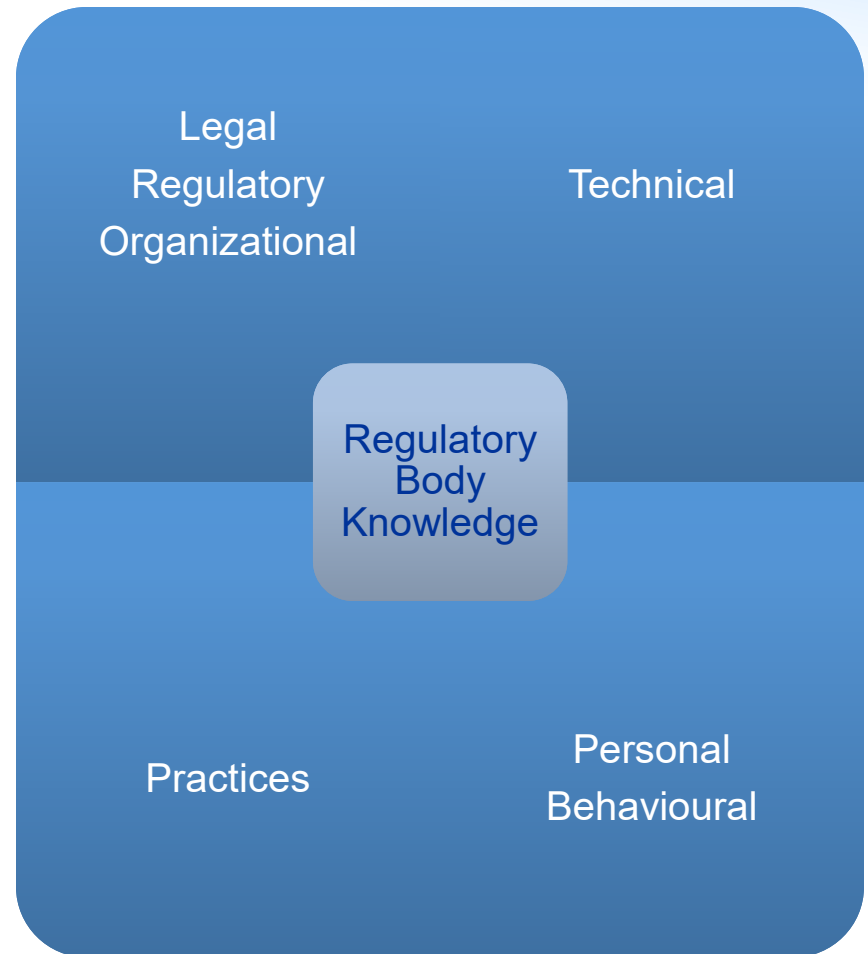
- ***Link NSKM to Capacity Building***
  - Umbrella approach



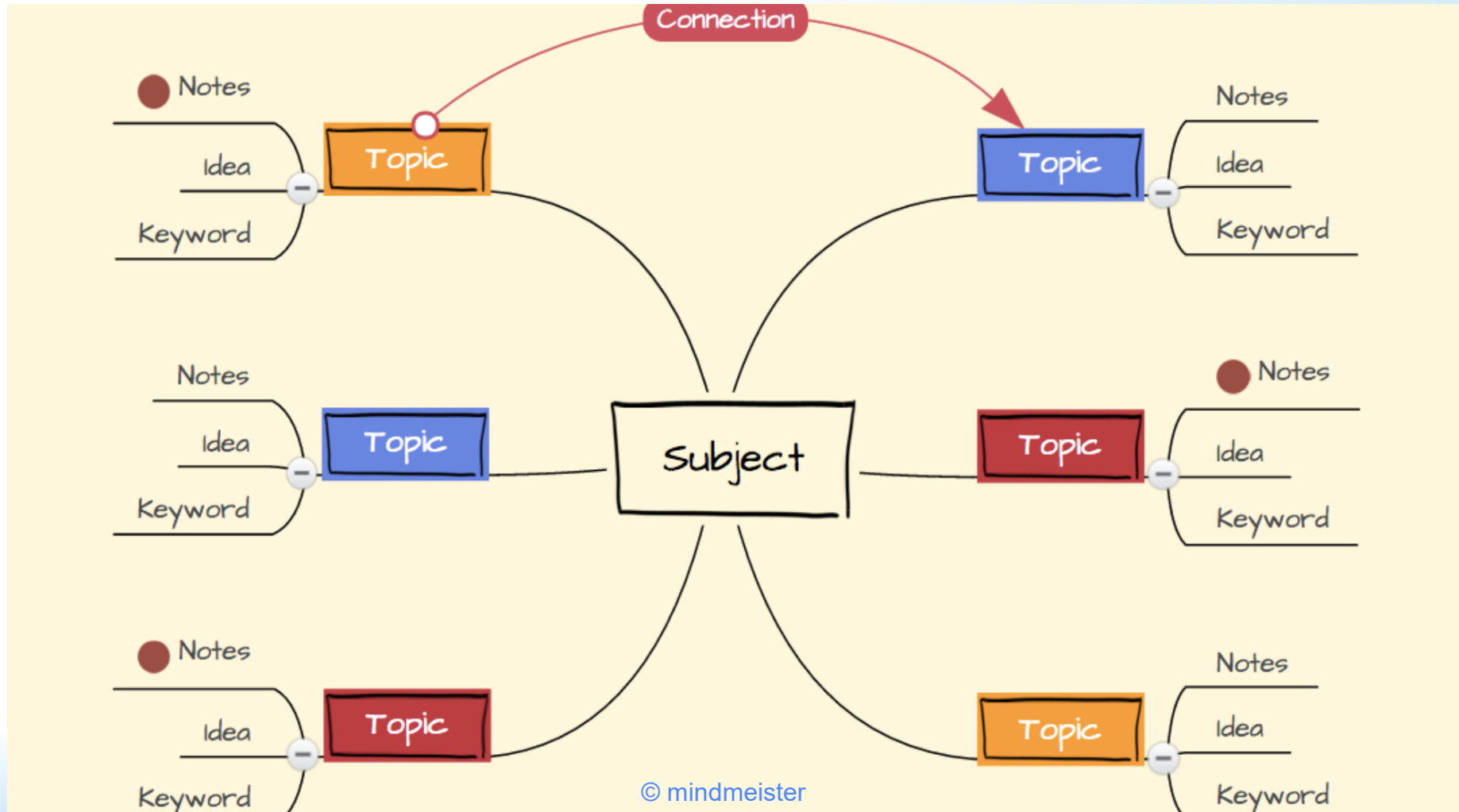


# Knowledge mapping

- ***Structure as used in mindmaps***
- ***"Four quadrant model"***
  - Initially a model for structuring *organizational competence* by four quadrants
  - SRS No. 79 (SARCoN)



# Mindmap example



*Topic*

# NATIONAL LEVEL CONSIDERATIONS

# Focus: National level

- ***Nuclear safety a national topic***
  - Governmental role
    - Leadership
    - Link to national sustainable development plans
    - Link to national energy plans
  - Nuclear safety involves many stakeholders
  - National HR planning
  - Workforce migration
  - University education
  - Existing nuclear safety networks (national, regional, global)
  - Knowledge exchange with neighbouring disciplines and society



# Focus: National and organizational

- ***Some individual organisations have individual NSKM programmes***
  - They are not connected on national level
    - Regulators – operators – academia – R&D organizations – designers: separate KM programmes
  - Lack of efficiency, effectiveness, friction losses
  - Risk of segmentation
- ***Connect individual knowledge management programmes!***

# Human resource planning: EHRO-N



JOINT RESEARCH CENTRE  
Institute for Energy and Transport (IET)

European Commission > JRC

HOME ABOUT DOCUMENTS RESOURCES ECVET

European Human Resources Observatory for the Nuclear energy sector



Top-Down Workforce Demand from Energy Scenarios - Alternative Demand Scenarios



JRC SCIENCE FOR POLICY REPORT

Top down workforce demand from energy scenarios: Sensitivity analysis



JRC SCIENCE AND POLICY REPORTS

Post Fukushima Analysis HR & Supply



JRC SCIENCE AND POLICY REPORTS

**Training Courses**

[Nuclear Reactor Theory](#)

**BELGIUM**

[PD621 Grade 91 and other Creep strength Enhanced Ferritic Steels](#)

**SPAIN**

[PD634 Comparison of Quality Assurance & Management](#)

**ITALY**

[Teleperm Xs-Special](#)

**GERMANY**

[Operation and Safety of PWRs](#)

**FRANCE**

[more](#)

**EHRO-N Member Login**

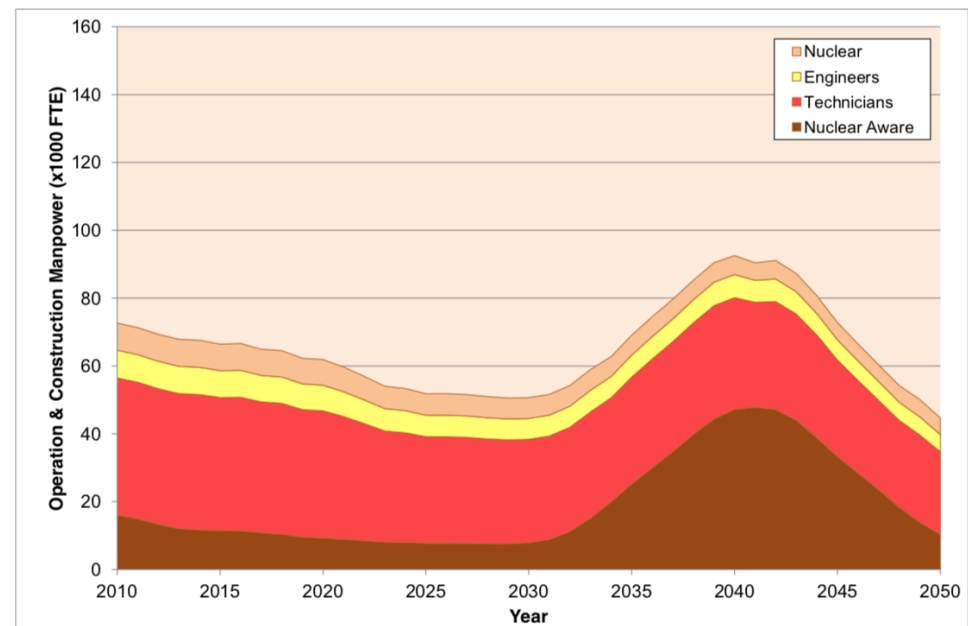
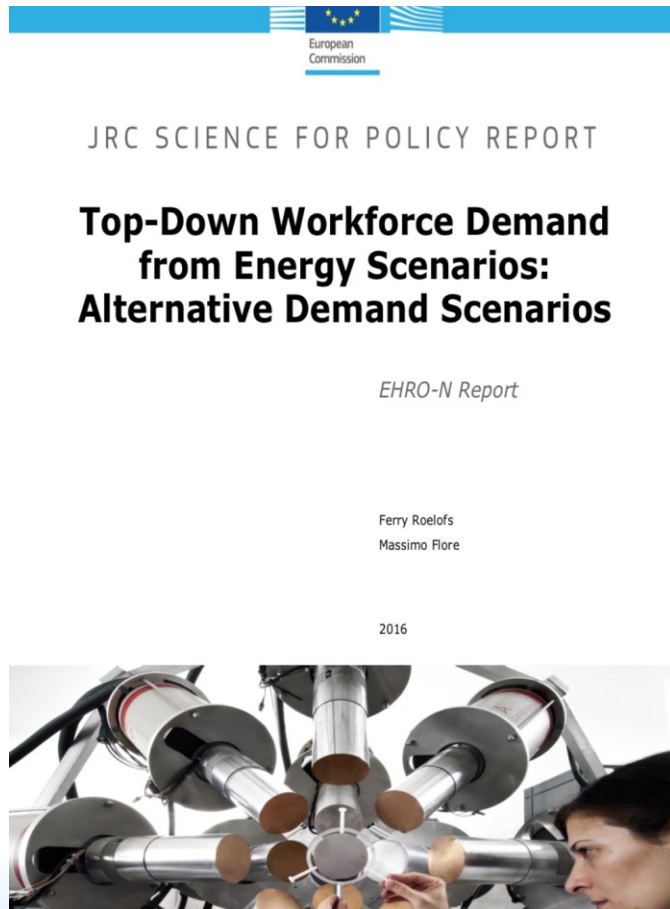


Figure 9: HR requirements for operation and construction of nuclear power plants in the energy efficiency demand scenario.



# National HR planning: Finland

## Report of the Committee for Nuclear Energy Competence in Finland

Publications of the Ministry of Employment  
and the Economy  
Energy and the Climate  
14/2012



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# National nuclear competence coordination: Germany

- ***Standing coordination mechanism***

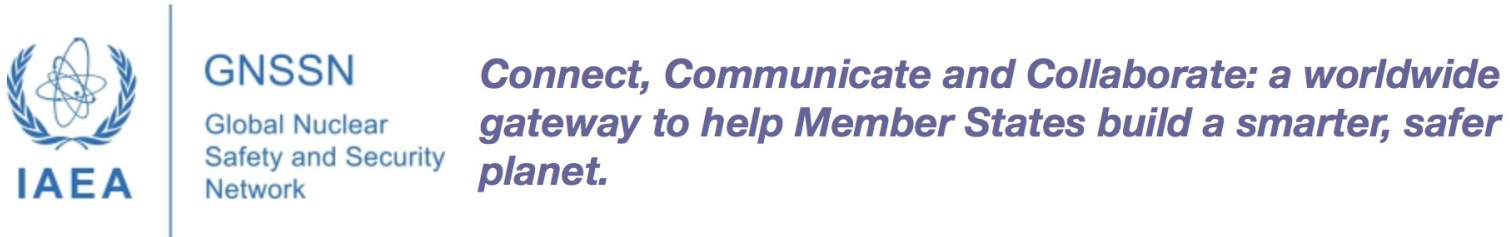
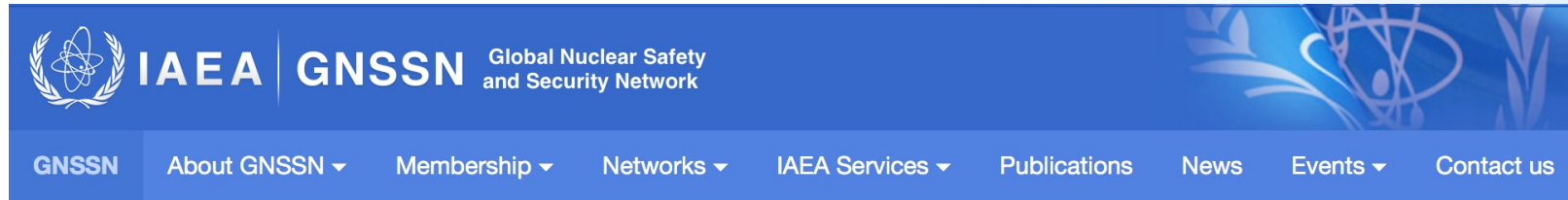
- founded in 2000
- all stakeholders, senior level
- "soft coordination"



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# IAEA ACTIVITIES AND PUBLICATIONS

# NSKM and GNSSN



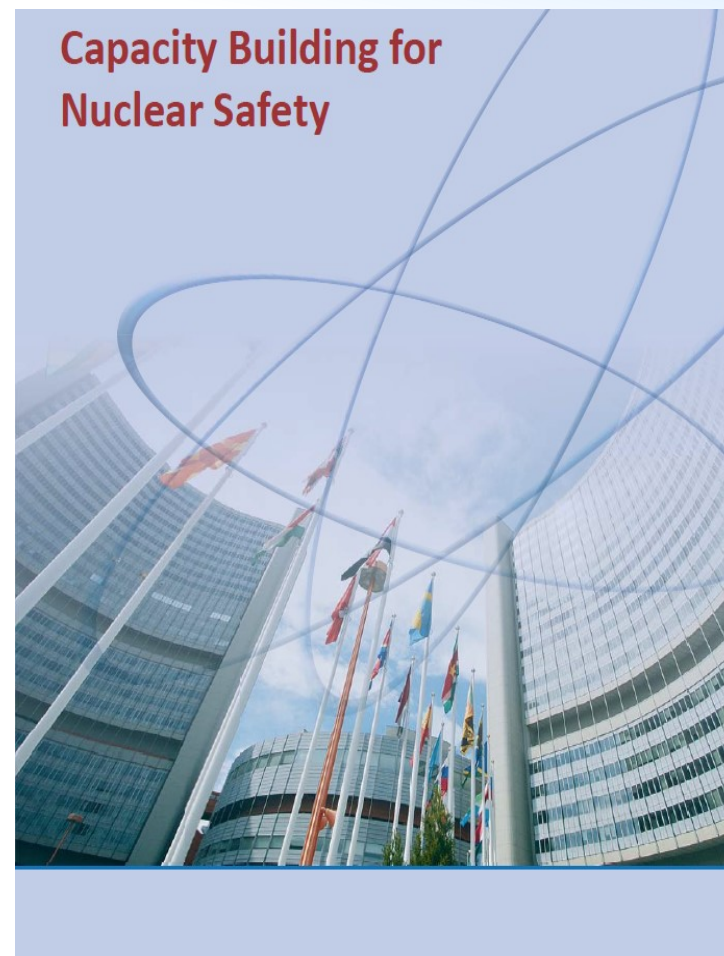
- ***Global Nuclear Safety and Security Network***
  - NSKM is integral part of GNSSN Mission
    - (Mission 1 of 3)

- ***Nuclear Safety Knowledge Platforms***
  - The Platform as the technology pillar of knowledge management for nuclear safety
  - Available to all Member States with expert technical support by the IAEA
  - Allows for areas for exclusive use by Member States

- ***Lessons learned from Fukushima***

- IAEA Report on Strengthening Nuclear Regulatory Effectiveness in Light of Accident at Fukushima Daiichi Nuclear Power Plant
  - Recommendations on KM for regulators
- IAEA Report on Human and Organizational Factors in Nuclear Safety in Light of Accident at Fukushima Daiichia Nuclear Power Plant
  - Recommendations on human resources and many KM issues
  - Integrated (systemic) approach to nuclear safety benefits from NSKM
- IAEA Report on Capacity Building for Nuclear Safety
  - Recommends using NSKM explicitly

- ***Capacity Building for Nuclear Safety (2015)***
  - IEM Series
    - i.e.: captures lessons learned from Fukushima
  - Source
    - International Conference on Human Resource Development for Nuclear Power Programmes: Building and Sustaining Capacity (2014)
  - Nature
    - Higher level conclusions and recommendations



- ***Safety Standards***
  - GSR Part 1
    - NSKM as part of national endeavour
  - GSR Part 2 + Guides
    - NSKM as part of an organizations management system
  - Most others dito

## IAEA Safety Standards

for protecting people and the environment

Governmental, Legal  
and Regulatory  
Framework for Safety

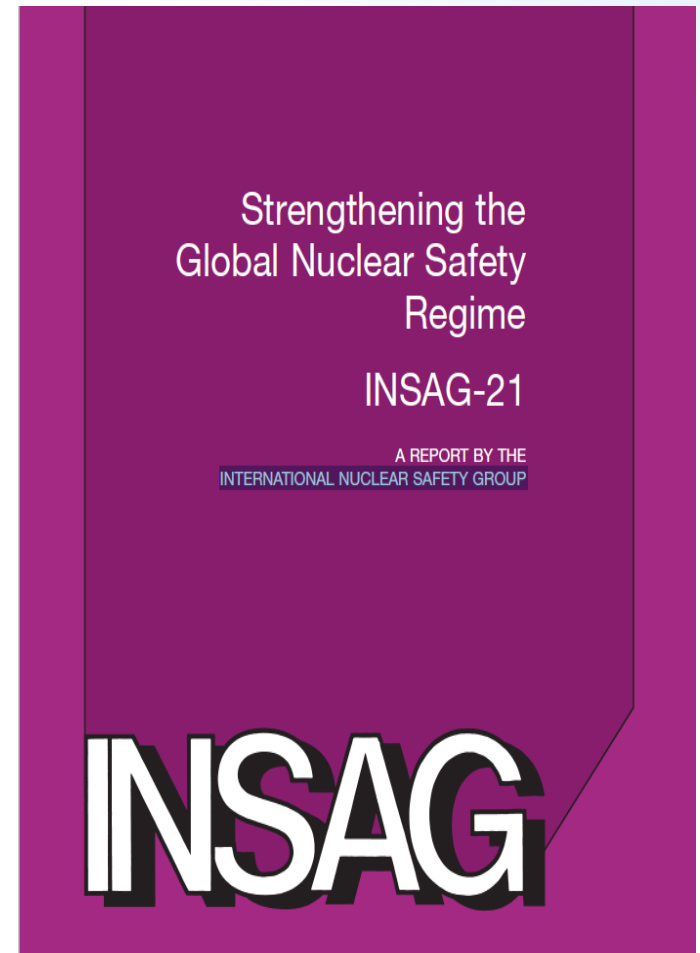
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General Safety Requirements

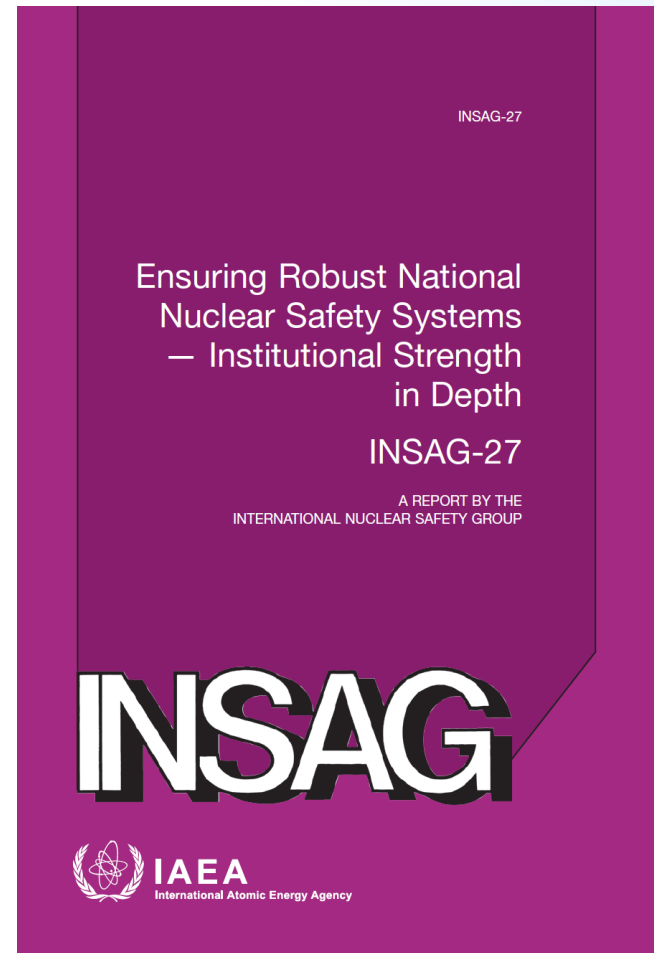
No. GSR Part 1 (Rev. 1)



- ***Elements of the Global Nuclear Safety Regime***
  - Calls for "enhanced exchange of operating experience for improving operating and regulatory practices"



- ***Ensuring Robust National Nuclear Safety Systems — Institutional Strength in Depth***
  - Connects to knowledge management and capacity building

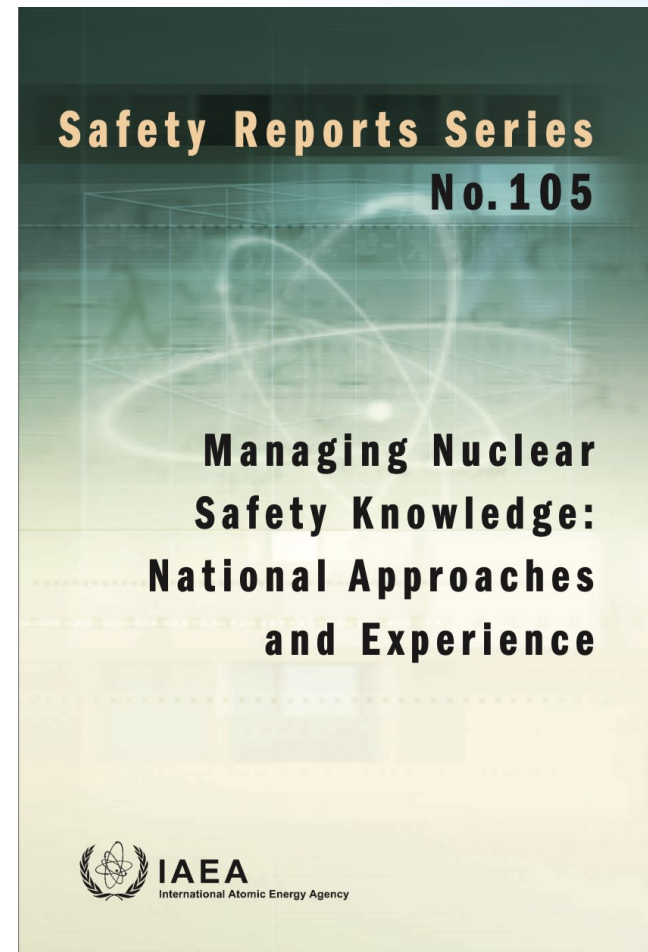


- ***Strength in depth (SiD) applied to the nuclear safety system***
  - Strong nuclear industry
  - Strong nuclear regulator
  - Strong set of stakeholders
- ***"‘Strong’ in this context refers to an inner strength to encourage and welcome challenge, to challenge others, to question and consider others’ options and advice, and to possess the competence and capacity to fulfil functions and duties."***

# INSAG 27 (2017)

- *"Crucially, the effectiveness of the application of these principles to both technical and operational safety and to the overall system depends on the people involved, their competence, their safety culture, and how they are organized and led. "*

- ***SRS Managing Nuclear Safety Knowledge***
  - Audience
    - Broad. All who deal with nuclear safety knowledge
  - Level
    - National
      - Specific challenges and benefits exist
  - Content
    - Conceptual basis of NSKM
    - Recommends national level strategy or national level coordination mechanism
    - Experience gained in Member States
      - Appr. 40 short summaries of activities and experience based on two IAEA conferences and one Technical Meeting (2017)



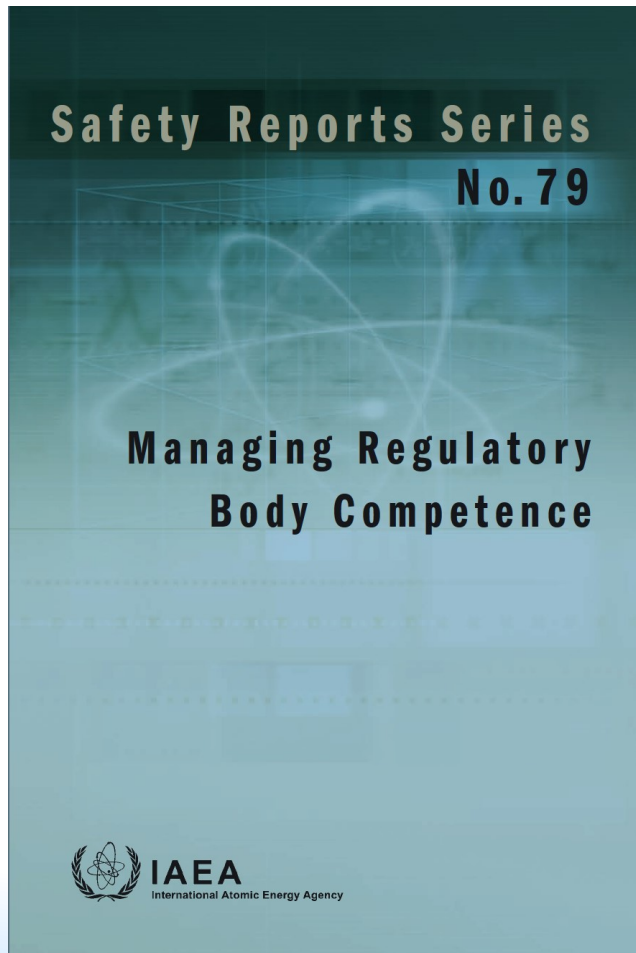
# SRS Managing Nuclear Safety Knowledge

- ***Excerpt: national level considerations***
  - Leadership role of governments to foster national approach
  - Need to involve many diverse stakeholders
  - Need to manage knowledge across organizational boundaries: knowledge interfaces
  - National human resource demand and supply planning
  - Coping with changing societal, political and technical environment to achieve long-term resilience
  - Develop a national memory
- ***Action: national level approach for nuclear safety capacity building and knowledge management***
  - national strategy
  - national coordination mechanism

# SRS Managing Nuclear Safety Knowledge



# IAEA publications for regulatory bodies



IAEA TECDOC SERIES

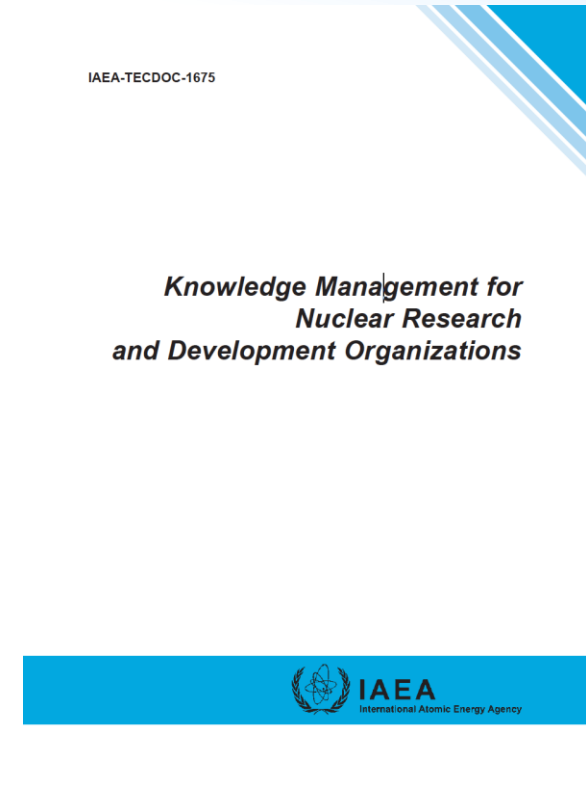
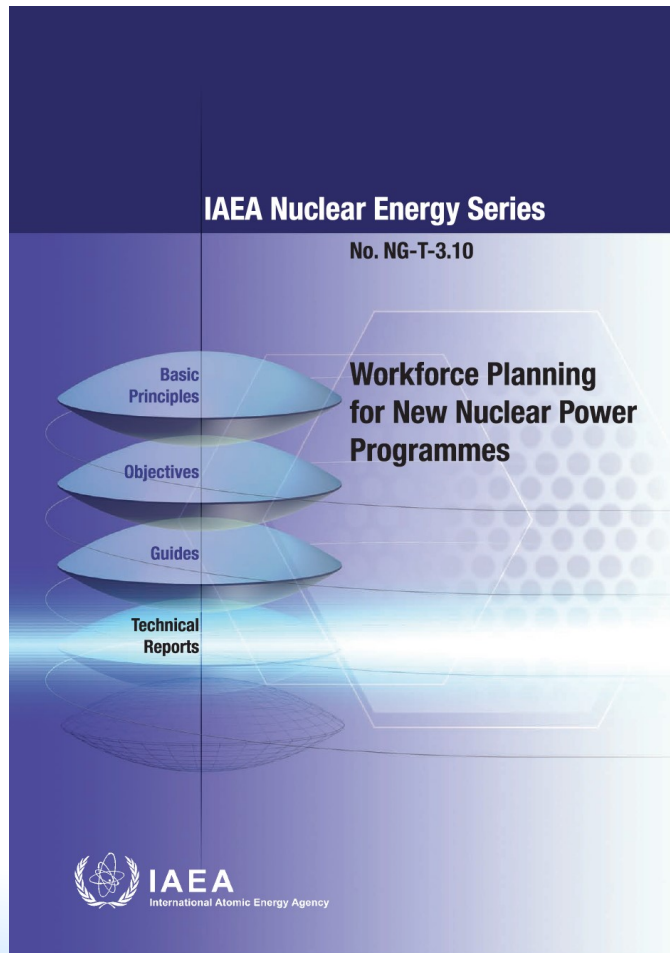
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**Methodology for the  
Systematic Assessment of the  
Regulatory Competence Needs  
(SARCoN) for Regulatory  
Bodies of Nuclear Installations**

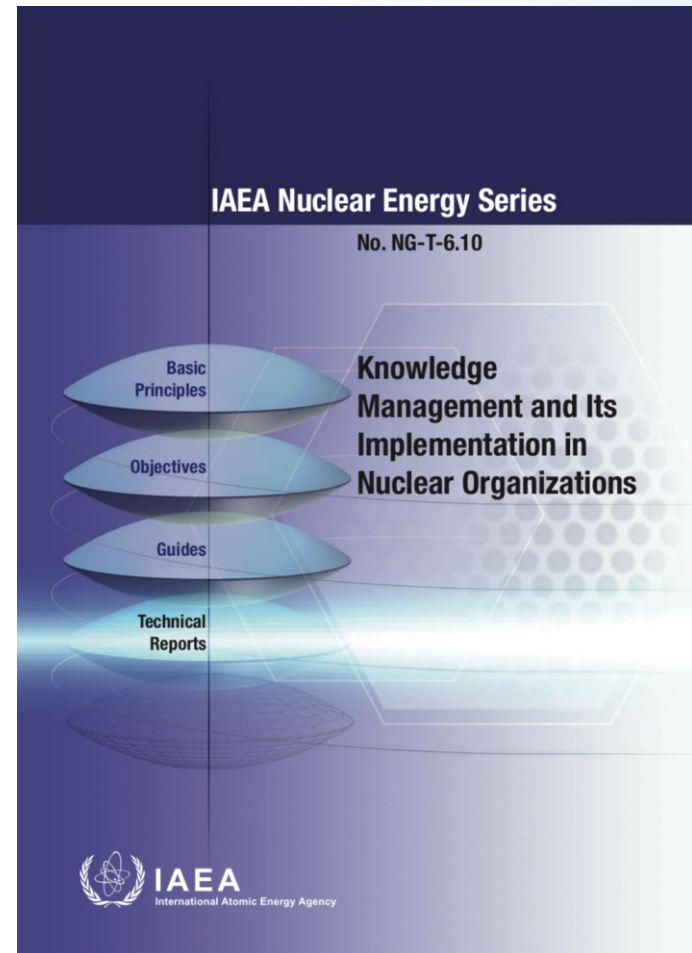
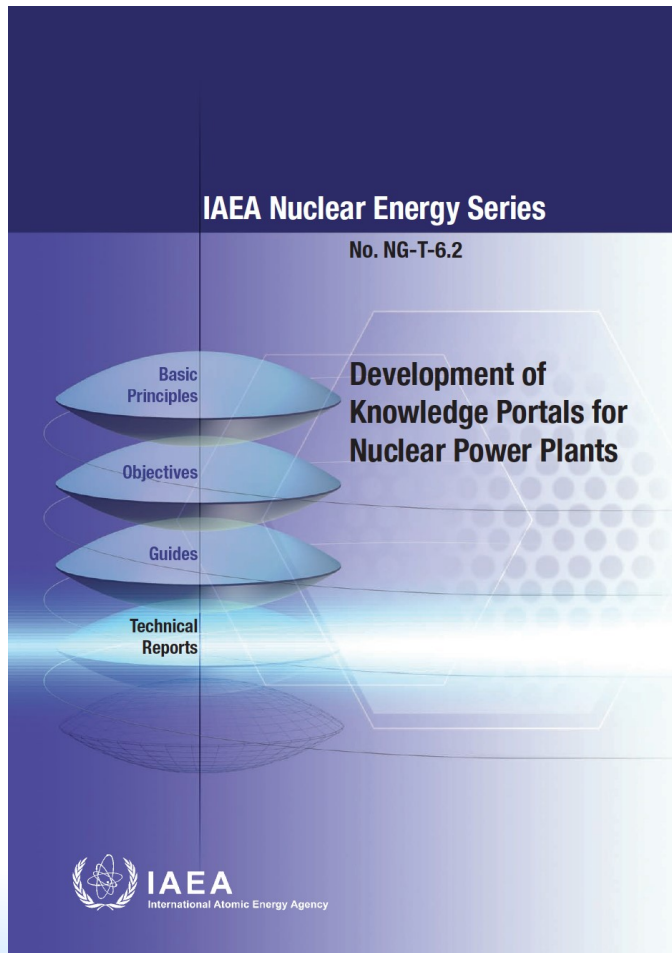


# IAEA Publications (Nuclear Energy)



KM Glossary in Annex

# IAEA Publications (Nuclear Energy)



*Topic*

# NSKM FOR REGULATORY BODIES

# NSKM for Regulatory Bodies

- ***Approach***

1. Knowledge management strategy
2. Knowledge management plan
  1. Avoiding knowledge loss (risk assessment)
  2. Ensuring knowledge transfer (routine activity)
  3. Build new knowledge and capacity (if required)
  4. Other
3. Implement knowledge management activities
4. Effectiveness evaluation

# KM Strategy at RB

- ***KM Strategy can include***
  - Objectives
  - Roles and responsibilities
    - CKO, leaders, all staff
  - Resources
  - Timeline
  - Internal communication
  - Interfaces with
    - Organizational integrated management system
    - organizational strategy and goals
    - national context

# KM Strategy at Regulatory Body

- ***Cover all areas of RB mandate***
  - review and assessment
  - authorization
  - inspection
  - enforcement
  - development of regulations and guides

*Topic*

# **SOME RECOMMENDED KNOWLEDGE MANAGEMENT ACTIVITIES**

- ***Passing on knowledge***
  - Use exit interviews and debriefings
  - Plan for overlapping incoming and leaving staff
  - use mentoring and shadowing
- ***Sharing knowledge***
  - Build and support communities of practice
    - define group
    - kick-off meeting
    - support with IT platform or coffee
  - Build an inventory of lessons learned
    - build (simple)
    - promote use (difficult)



- ***Human resource planning***
  - Use human resource demand and supply forecasting
    - Workforce planning (organization level)
    - National development plans (national level)
- ***Knowledge mapping***
  - Build knowledge maps
    - simple tools available cost-free
  - Perform knowledge gap analysis
  - Define corrective actions systematically

- ***Governance***

- Define leadership
  - Governmental leadership (national level)
  - Appoint a CKO (organizational level)
- Establish a formal strategy
  - Can be part of another strategy, e.g. as chapter
- Establish an implementation Plan
  - including resources
- Connect NKM to integrated management system
- Include performance indicators

- ***Pursure a national level approach***
  - Can be
    - a formal strategy or
    - a coordination mechanism
  - Govermental leadership
  - Involve all stakeholders
  - IAEA support available
    - SSR "Managing Nuclear Safety Knowledge"
    - "Assessment of Capacity Building"
    - Technical Cooperation or direct discussion

# Activities

- ***Technologies***

- Use community software and collaborative workspaces
  - IAEA support available!
  - Global Nuclear Safety and Security Network
- Use internal technical wikis

***Thank you for your attention!***