Optimisation of protection,

the cornerstone of radiation protection,
a view on the NORM industries

Fernand Vermeersch

Chairman of the EAN

Italian Radiation Protection congress,
Cagliari, Sardinia, 27th-29th September 2023

http://www.eu-alara.net/

Content

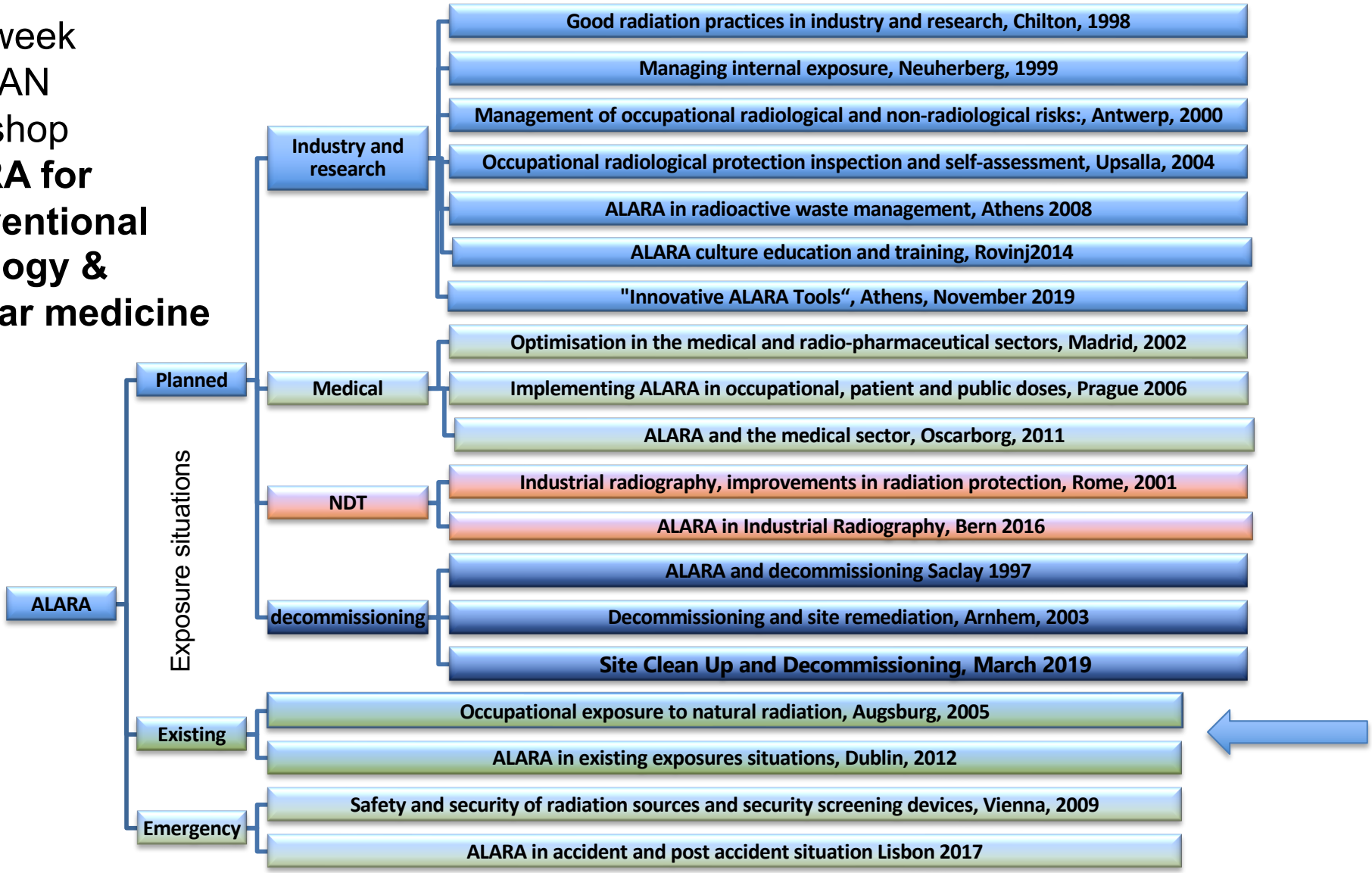
- The activities of European ALARA Network
- Ionising radiation and radiation protection
- The basic principles of radiation protection
- Optimisation
- The ALARA process
- Reasonableness in the ALARA process
- Benefits of the ALARA process
- Conclusion and the way forward

ALARA Network objectives

- The European ALARA Network
  - Promote a wider and more uniform implementation of the ALARA principle for the management of worker, public and patient exposures in all situations,
  - Provide a focus and a mechanism for the exchange and dissemination of information from practical ALARA experiences
  - Identify and investigate topical issues of common interest to further improve the implementation of ALARA

EAN has organized **19** workshops since 1996

Next week
20th EAN
Workshop
ALARA for interventional radiology & nuclear medicine



Subnetworks

EASN European ALARA Sub-Network on Research Reactors (2002-2009)

EMAN European Medical ALARA Network (2009-2012)

EAN

EAN NDT European ALARA Network on **NDT** (Non-Destructive Testing) (2003)

EAN-NORM European ALARA Network for Naturally Occurring Radioactive Material (2007) (merged in 2017 with EU NORM to create European NORM Association)

ERPAN European Radiation Protection Authorities Network (2005) (yearly meeting)

We are pleased to announce that the next ENA workshop will take place in Rome (Italy) from 15th to 17th May 2024. It will be hosted by the Italian National Institute of Health with the support of the Italian Radiation Protection Association.

https://ena-norm.eu/

http://www.eu-alara.net/

Recent and planned activities

Workshop on reasonableness IRPA

Liaison ICRP, TG 104 mobile sources

Working group on ALARA for Radon at Work

- Publication and presentation, IRPA conference

http://www.eu-alara.net/

Recent and planned activities

Workshop on workplace monitoring, Cyprus

- Co-organisation IAEA and EAN
- Invitation to central European and Asian countries
- June 2022

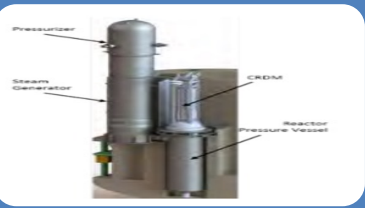
Webinar “the application of the justification principle, the choice of the exposure situation and the categories of exposure in the context of NORM and radon”

8th, December 2022

Development of ALARA in interventional radiology and in the use of novel radio-pharmaceuticals , 20th EAN Workshop

ALARA for interventional radiology & nuclear medicine

2-4 October 2023

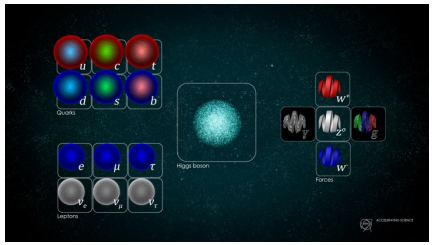


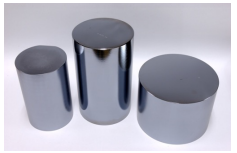
SMR ?

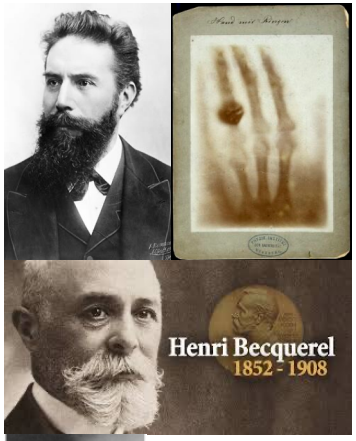
http://www.eu-alara.net/

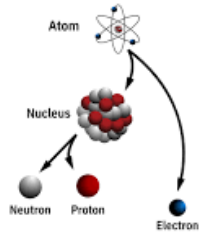
EUROPEAN ALARA NETWORK

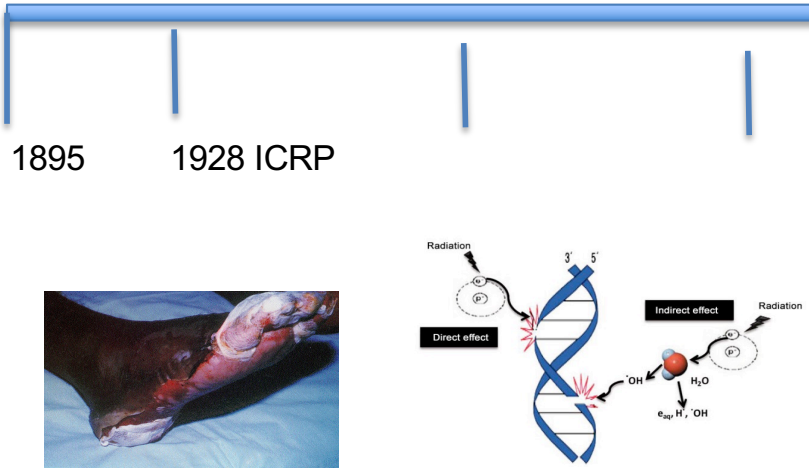
Ionising radiation

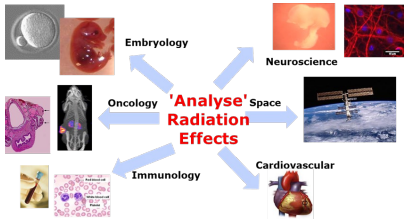


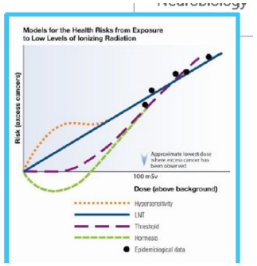








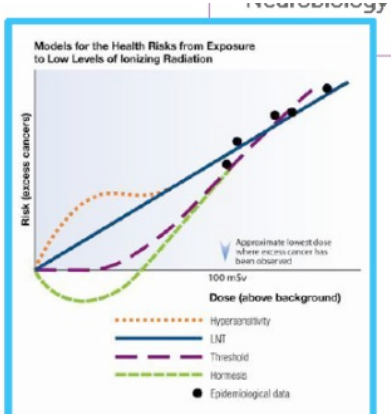


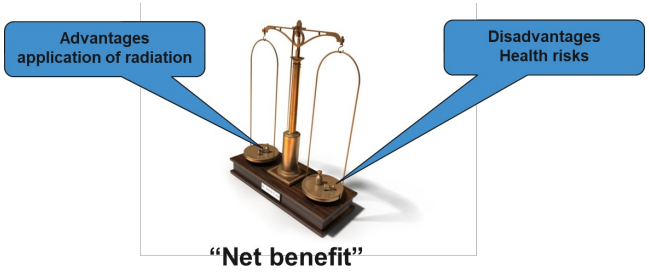


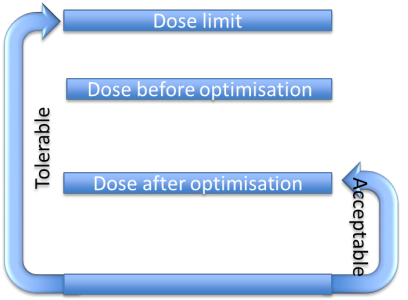
http://www.eu-alara.net/

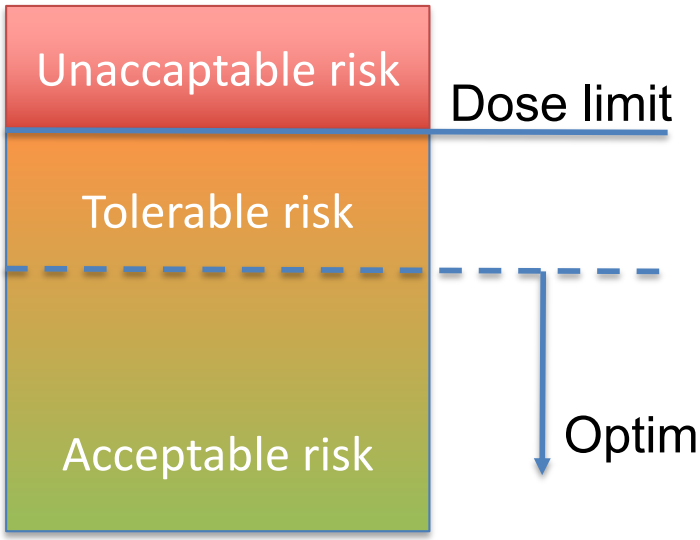
Basic principles

- Linear dose-effect with no threshold (stochastic health effects)
- Basic principles of radiation protection
  - Justification
  - Optimisation → ALARA
  - Dose limits



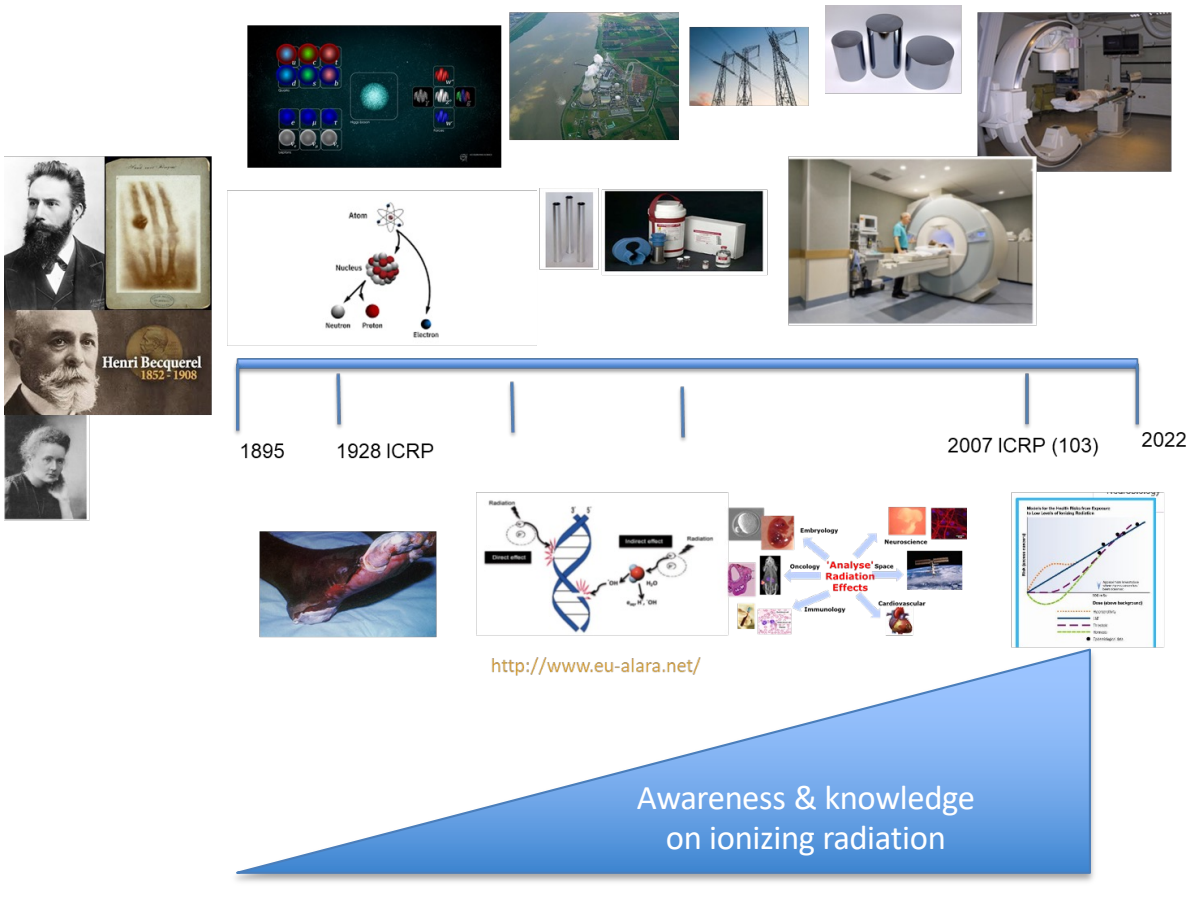






NORM industry ←→ Planned

- Use of minerals…
- Mining ….
- 18th -19th century
  - Coal
  - Oil and gas
- 1843
  - Phosphate industry
  - Deposits
- 1950
  - review on radioactivity in sediments, petroleum, brines
- 1980
  - Potential risk NORM activities recognized



http://www.eu-alara.net/

NORM industry

- Extraction of rare earth elements.
- Production and use of metallic thorium and its compounds (i.e. for their metallic, not fissile or fertile, radioactive properties).
- Mining and processing of ores (other than uranium or thorium for the nuclear fuel cycle).
- Oil and gas recovery process.
- Manufacture of titanium dioxide pigments.
- The phosphate mining and processing industry.
- The zircon and zirconia industries.
- Production of metal (tin, copper, iron, steel, aluminium, niobium/tantalum, bismuth,etc.).
- Combustion of fossil fuel (mainly coal).
- Water treatment.
- Geothermal energy production.
- Cement production and maintenance of clinker ovens.
- Building materials (including building materials manufactured from residues or by-products).

http://www.eu-alara.net/

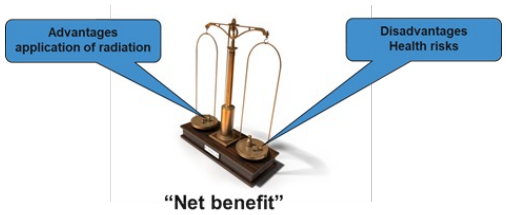
Reference:
NORM Industries and Regulatory Considerations, IAEA, https://nucleus.iaea.org › sites › training › norm

Screening of NORM activities

Characteristics of NORM

- Natural radionuclides **already existing** in the materials
- Normally low exposure
- Unlikely tissue reaction
- Very diverse industries, **variability**
- **multi-hazards** and radiological risk rarely dominant
- Natural sources of radiation are present everywhere (**ubiquity)**
- Large throughput of raw material, refining, concentrating, component of raw materials, products, residues
- Radiation issues are usually not known or not expected or not wanted
- Can have high public profile
- Regulation is required when above certain levels

Justification



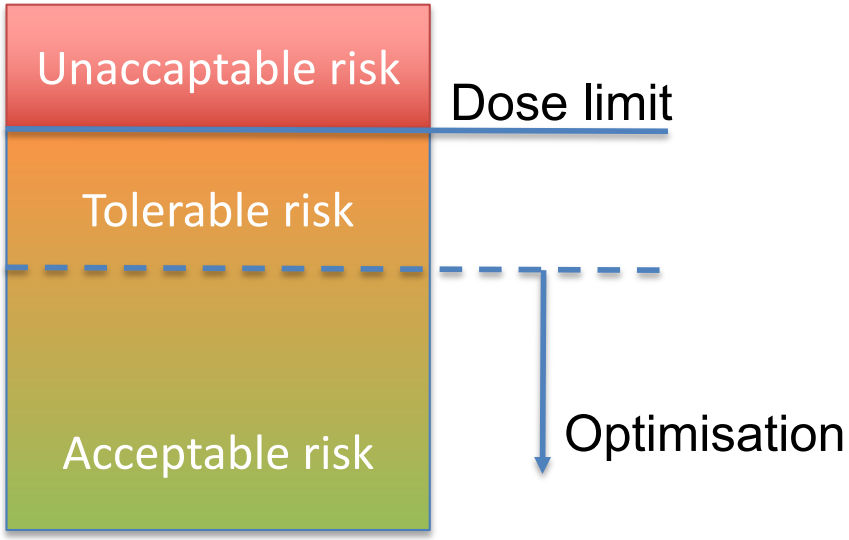
Any decision that alters the radiation exposure situation should do more good then harm

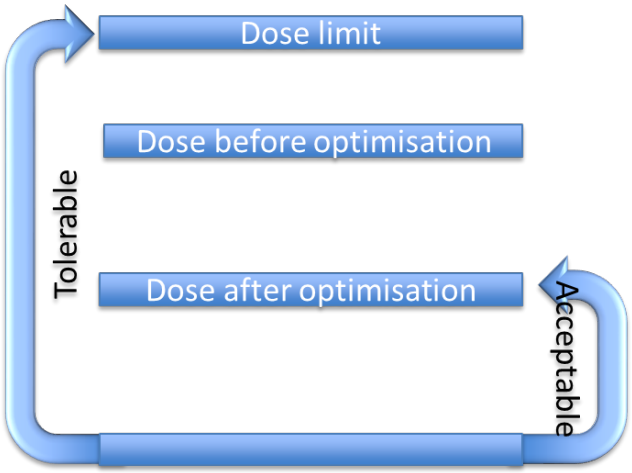
- Planned
  - Using ionizing radiation, source should do more good then harm
- NORM
  - Controlling the radiation exposures should do more good then harm

- If criteria exceeded, regulatory control must be considered
- based on the graded approach to regulation
  1. Exemption
  2. Notification
  3. Notification + registration
  4. Notification + licensing
- The graded approach is implementation of optimization of protection
- Other forms of industrial regulation may contribute to the control of radiation:
  - Occupational health and safety (OHS) regulation (dust control)
  - Environmental protection regulation (licenses)

Optimization

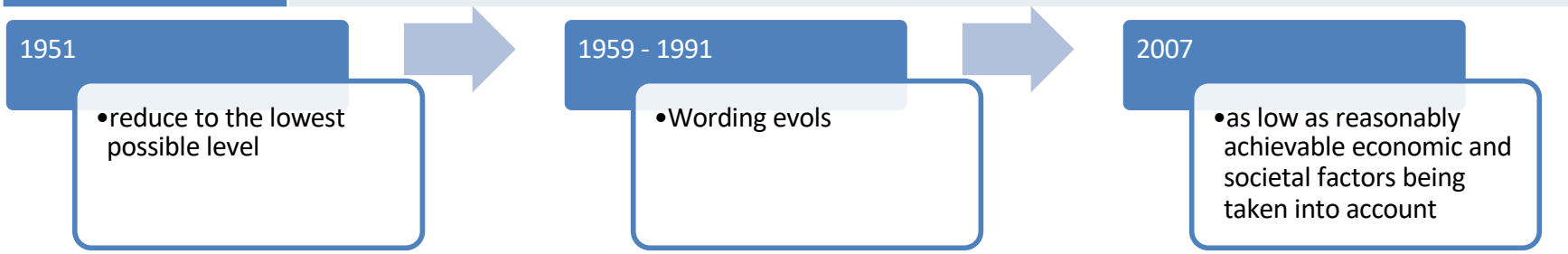
- Reduce exposure to an acceptable level





Evolution of ALARA wording

(ICRP, 1951)	To reduce exposures to the lowest possible level
ICRP Publ. 1 (ICRP, 1959)	To keep the exposure of large population as low as practicable
ICRP Publ. 9 (ICRP, 1966)	All doses (should) be kept as low as is readily achievable economic and social consideration being taken into account
ICRP Publ. 22 (ICRP, 1973)	All doses (should) be kept as low as reasonably achievable economic and social consideration being taken into account
ICRP Publ. 26 (ICRP, 1977)	All exposures shall be kept as low as reasonably achievable economic and social factors being taken into account
ICRP Publ. 60 (ICRP, 1991)	The magnitude of individual doses, the number of people exposed and the likelihood of incurring uncertain exposures shall all be kept as low as reasonably achievable economic and social factors being taken into account
ICRP Publ. 103 (ICRP, 2007)	The likelihood of incurring exposures, the number of people exposed, and the magnitude of individual doses should all be kept as low as reasonably achievable economic and societal factors being taken into account



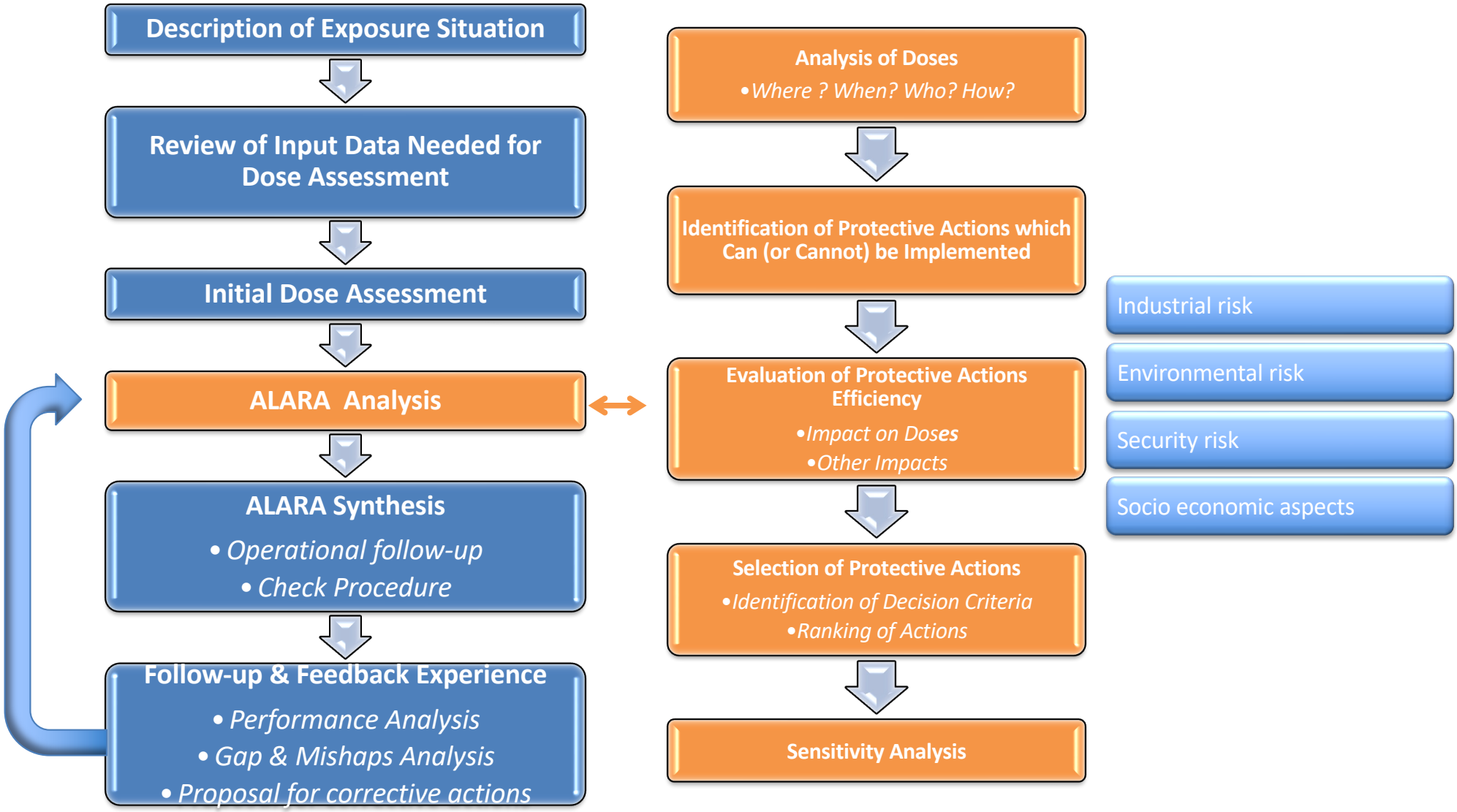
Prevailing circumstances

http://www.eu-alara.net/

Acceptable level of risk

http://www.eu-alara.net/

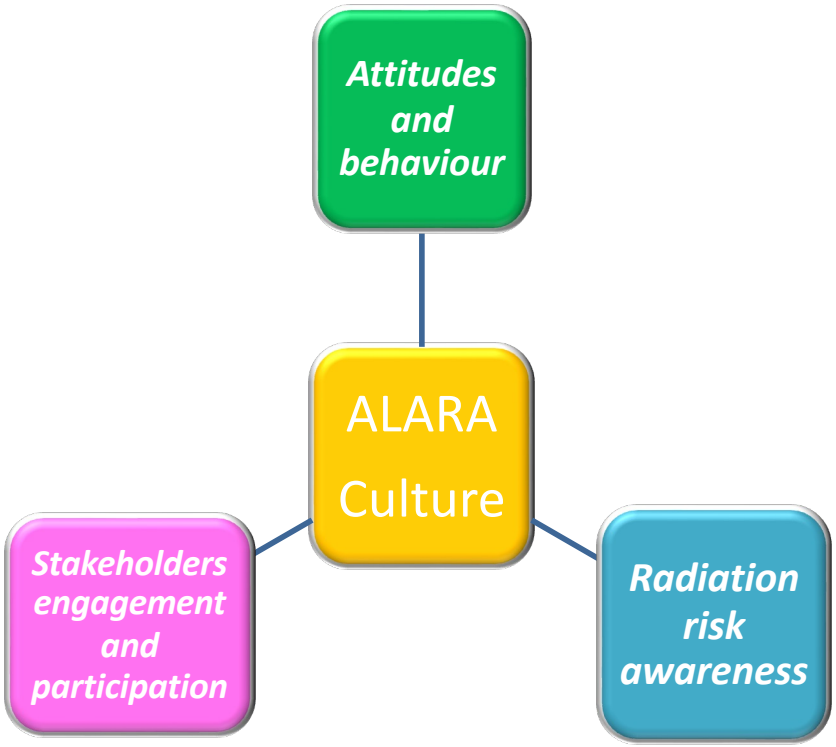
The ALARA PROCESS: a structured method



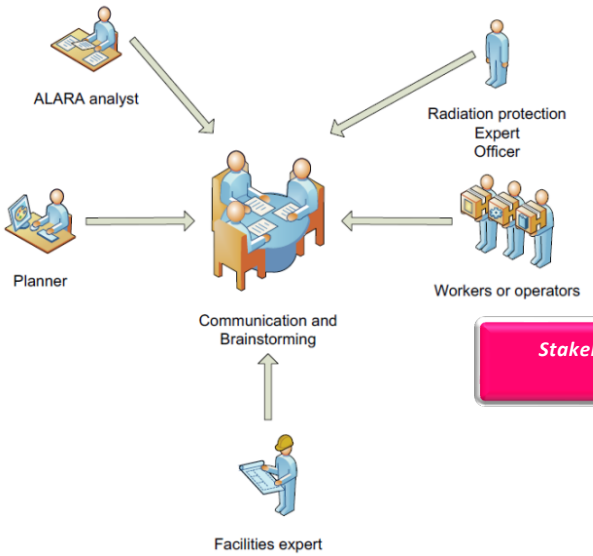
Optimization

- Planned (deliberate)
  - Well established in nuclear industry
  - Has led to dose reductions
  - Dose constraints
  - a driver for safety culture (holistic approach)
  - Culture for safety
- NORM (existing)
  - Characterization
  - Prevailing circumstances
  - Graded approach
  - Legal criteria
  - Reference levels
  - All hazard approach
  - Culture for safety

Safety culture ALARA Culture



Stakeholders



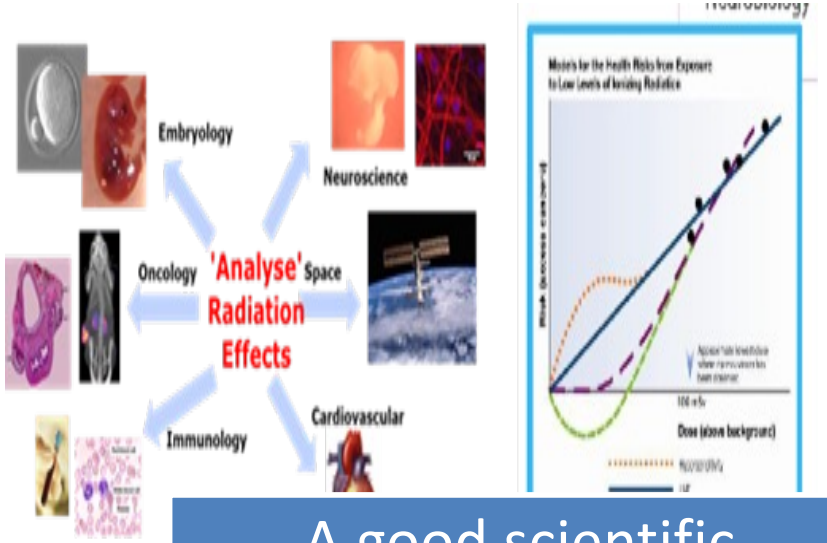
Stakeholders engagement and participation

- Competent authorities
- Licensees
- Manufacturers, suppliers and designers
- Radiation protection professionals
- Professional associations
- Exposed workers
- The public

NORM

Education and training

- Transparent information, education and training commensurate with the risk
- The involvement of the different stakeholders support a comprehensive deliberative optimisation process



A good scientific understanding of the risk

A good understanding on risk perception

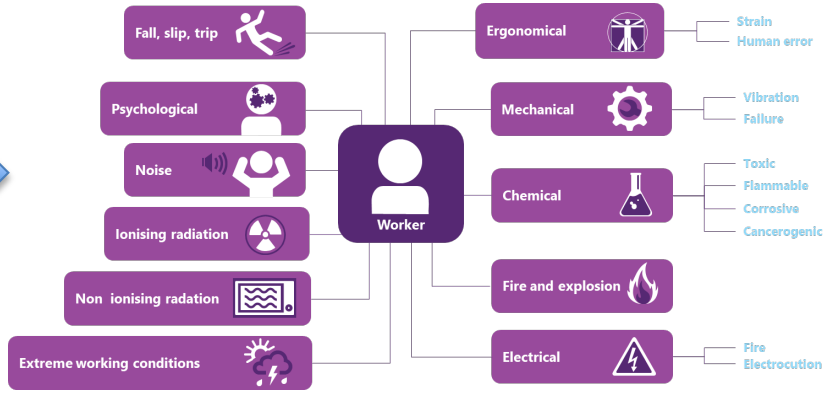
Reasonableness

ICRP 138 (2018)

- The pursuit of reasonableness as “the permanent quest depending on the **prevailing circumstances** in order to act on knowledge and experience, to **do more good than harm** (beneficence/non-maleficence), to **avoid unnecessary exposure** (**prudence**), to seek fair distribution of exposure (**justice**), and to treat people with respect (**dignity**).

IRPA: IRPA perspective on “reasonableness” in the optimisation of radiation protection (2021)

- Judgement call
- Proportionality
- Stakeholder engagement
- Holistic approach
- Avoid over conservatism
- Optimal use of societal resources
- Radiation safety culture
- Auditability, transparency



NEA/CRPPH: Optimisation: rethinking the art of reasonable (2020)

- Broadly in line with the current recommendation in ICRP 103(2007), but emphasis on the multidisciplinary, multi-dimensional nature of the complex circumstances to consider. Consider the whole risk-vector.

Benefits of optimisation

In fact the optimisation approach can be seen as a reference framework, a state of mind and attitude

- Allowing an individual and/or an organization to act in a **responsible way** in order to **manage risks** and **giving safety the priority it should have**
- Characterized by **risk awareness**, **balanced judgement of risk and benefits**, and the capability to develop and use required skills and tools for risk assessment and management
- Realized through transdisciplinary education and training tailored at each level and stakeholders
- Supported by **management commitment** and management system
- Support feedback from the field and **continuous improvement**

Benefits of optimisation

- Already considerable feedback and literature on optimisation and ALARA
- Feedback from different organizations from practice EAN, EAN-NORM, ISEMIR, EMAN, ISOE, UNSCEAR, EFOMP, ….
    - ISEMIR-N

Conclusion

- Do we benefit by using the optimization approach?
  - Dose reductions are achieved in different field applying ionizing radiation
  - Promotes the **risk-awareness** supporting safety, safety culture and **stakeholder involvement**
  - Promotes good governance, **balanced judgement and allows optimal use of resources**
- Optimisation is a cornerstone of protection and radiation protection

Conclusion optimization for NORM

- Do we benefit by using the optimization approach in NORM ?
  - adequate protection can be achieved through the justification and optimization principle for NORM activities
  - the protection will be optimized in an integrated and graded approach for the protection of workers, the public, and the environment
  - where radiation protections complements the protection strategy already in place or planned to manage other hazards
- Optimisation is a cornerstone of protection and radiation protection and takes in its structured transparent deliberate process the prevailing circumstances into account

EUROPEAN ALARA NETWORK

Gaining interest in the EAN and its activities?

www.eu-alara.net

And remember that EAN is an open network!

Thank you for your attention

Questions ?

http://www.eu-alara.net/