Considerations on NIR Protection Principles

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ICNIRP charter

- Advancing Non-Ionizing Radiation Protection for the benefit of people and the environment
- Provide guidance and recommendations on protection from NIR exposure

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NIR covered by ICNIRP

- EMF with photon energy <10 eV
  (frequency <3 PHz = 3 x 10^{15} Hz, wavelength >100 nm)
  - UV (100 - 400 nm)
  - Visible (400 - 780 nm)
  - Infrared (780 nm – 1 mm)
  - High frequency (100 kHz – 300 GHz)
  - Low frequency (1 Hz – 100 kHz)
  - Static
- Infrasound (<20 Hz), ultrasound (>10 kHz)
  - Not audible acoustic waves

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ICNIRP 2002 General approach

- Methods of operation
- No basic philosophy / principles as in ionizing radiation protection
- More harmonization with ionizing radiation protection desired

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Process

- 2013: establishment Project Group
  - Members Main Commission
  - Members Scientific Expert Group
- 2014: joint meeting with IRPA, ICRP, ILO, UNSCEAR, WHO
  - Inventory and discussion on similarities and differences between IR and NIR protection
- Development draft protection principles
- To be discussed by Main Commission later this week

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Disclaimer

- This is work-in-progress !
- Ideas have only been discussed within Project Group, not by Main Commission
- Suggestions are welcome !

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Basic philosophy

- Adopt ICRP basic philosophy (Statement 103) where possible
- Adapt to NIR or develop specific philosophy when needed
- “Develop comprehensive system of radiation protection over the entire electromagnetic spectrum and for infra- and ultrasound that is as consistent as possible.”

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Basic premise

- "The aim of the system of non-ionizing radiation protection is to contribute to an appropriate level of protection against the detrimental effects of exposure to electric, magnetic and electromagnetic fields, optical radiation, infra- and ultrasound."
- ICRP (ionizing radiation): "…without unduly limiting the benefits associated with their use."
  - Social, economic, and political issues
  - ICNIRP does not address these issues, but leaves them to governments and authorities

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Fundamental principles

- Both IR and NIR: Protection of individuals and protection of the environment
- ICRP: risks and benefits for society should be balanced, benefits must outweigh the risks in order to be ethical
  - Has to be the same for NIR, but the balancing of risks and benefits falls outside ICNIRP's responsibility

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Core principles IR protection

- Justification, Optimization, Limitation
  - Justification: any alteration of the radiation exposure situation should do more good than harm;
  - Optimization: exposures as low as reasonably achievable (ALARA), accounting for economic and societal factors with restrictions on individual exposure to limit inequities in the dose distribution;
  - Limitation: application of dose limits (medical exposure of patients excepted)
- Cannot be applied as such to all NIR

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Problem: dose

- Concept of ‘dose’ not applicable to all NIR
- Dose: product of exposure level and duration
- EMF: for most effects only exposure level relevant
- Heating (RF & infrared):
  - Exposure time relevant
  - When temp returned to normal no residual damage
  - No adding up of effects
  - No reciprocity: effects of low-level long exposure ≠ high-level short exposure

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Justification

- Stochastic effects
  - Also in NIR: UV
  - Justification, risk tolerability: not issues for ICNIRP
    - Beneficial effect: vitamin D production
- Deterministic effects
  - Most NIR effects
  - Threshold
  - Justification: any decision that alters exposure situation should do no harm

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Optimization

- Stochastic effects: ALARA useful
  - What is ‘reasonable’: not for ICNIRP to decide
- Deterministic effects: ALARA not useful below threshold

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Limitation

- Can and should be applied throughout NIR range
- Generally ‘dose’ not applicable in NIR:
  - “the exposure level to any individual from sources in exposure situations other than medical exposure of patients should not exceed the appropriate recommended limits.”
- Special case: UV from sun
  - Can only be regulated in occupational situations (e.g. shielding, clothing)
  - General public: information, adapt behaviour

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Population groups

- Both IR and NIR:
  - Workers, general public, patients
- Workers
  - Relatively homogeneous and healthy
  - Informed about risks and measures to reduce
  - IR & UV (cumulative effects): exposed max 40 h / week
    - Not relevant for other NIR effects
- General public:
  - Heterogeneous, different health status
  - Not informed, cannot be expected to take measures to reduce risks

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Special categories

- Pregnant workers
  - Foetus: general population
  - Exposure depends on type of NIR
- Patients
  - Justification by physician
- Volunteers
  - Weighing the risks against benefits of scientific or medical progress
  - Ethical committee

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Biological vs health effects

- Biological effect:
  - Any change induced by a biological, physical or chemical factor in a biological system
  - May result in adverse health effects
- WHO: “Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity”
- Annoyance, perception: health effects?
  - Individual variation
  - May depend on exposure situation

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Substantiated effects

- Observed in more than one study by different investigators
  - Preferably in different biological systems or organisms
- Performed according to accepted scientific quality criteria, including for
  - Experimental studies: adequate dosimetry, sham-exposed group
  - Epidemiological studies: adequate description of investigated population groups, adequate identification and control for confounding factors and bias (Bradford Hill criteria)
  - Suitable statistical procedures
- Preferably systematic procedures be used following *a priori* defined protocols

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Setting exposure limits

- Determine health effect level:
  - For deterministic effects only, effect threshold
- Apply reduction factors:
  - Biological variability
  - Dosimetric uncertainty
  - Expert judgement

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Exposure limits

- Basic restrictions
  - Several provided as parameters that cannot be easily measured, (e.g. electric field inside an organism, absorbed energy)
- Reference levels
  - Electric and magnetic field present at the location of the exposure, but without the exposed object
  - Calculated in conservative way
  - Exceeding reference levels does not necessarily mean exceeding basic restrictions

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Indirect effects

- Electric discharge (metallic objects charged by exposure to EMF)
  - Considered by ICNIRP
- Electromagnetic interference effects (e.g. pacemaker)
  - Technical issues, not considered by ICNIRP

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Environmental effects

- Protection of humans to adverse health effects of NIR:
  - Provide protection of all individuals
- Protection of the environment:
  - Protect species, ecosystems and biota

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Transparancy, stakeholders

- For all steps in guideline setting process:
  - Be transparent as to why and how decisions are made
  - Provide detailed rationales and sufficient references to basic scientific material
- Public consultation
- Stakeholders:
  - No influence other than through the public consultation

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