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# TEACHING RADIATION PROTECTION PRINCIPLES – POSSIBILITIES FOR MORE EFFECTIVE APPROACH

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# Introduction

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## Radiation protection principles:

- ➔ One of the most important subjects in radiation protection courses for beginners
- ➔ Justify entire radiation protection system
- ➔ Establish confidence in radiation protection measures

## “Official” formulations:

- ➔ Formal
- ➔ Concise
- ➔ Aimed to embrace various practices

# Introduction (Cont.)



When someone tries to explain the principles, “natural” choice would be to use the examples from radiation protection.

But:

- ➔ Approach should be successful for people with previous knowledge and experience in radiation protection (but we are dealing with beginners!)
- ➔ It creates impression, that logic behind radiation protection principles is something “invented” for special and exclusive use in connection with radiation exposure (which is not true!)

# Introduction (Cont.)



## Reality:

- ➔ Justification, optimisation and use of some limits are present and used in many activities and aspects of our lives, but the use is not obvious, or not communicated.
- ➔ For most of the people, this approach in normal life is obvious and logic is accepted without special doubts.
- ➔ Especially for beginners, using analogies to “normal life” situations and “common” examples simplifies explanation of principles, increases effectiveness, and enhances understanding.

# 1<sup>ST</sup> Principle: Justification



## COUNCIL DIRECTIVE 96/29/EURATOM (Article 6):

*1. Member States shall ensure that all new classes or types of practice resulting in exposure to ionizing radiation are justified in advance of being first adopted or first approved by their economic, social or other benefits in relation to the health detriment they may cause.*

### Beginner's questions:

- ➔ What are economic, social or other benefits (**for me**)? How can **I** measure (feel) them?
- ➔ What is health detriment?
- ➔ How can we compare benefits and detriment?

**Simplifying (e.g. "use of sources must produce more good than harm") will put us in no better position.**



# 1<sup>ST</sup> Principle: Justification (Cont.)

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## Average person (attitudes and problems):

- ➔ Radiation is always “bad” thing
  - *there are also “bad” and “good” chemical compounds, like food additives, herbicides and pesticides, versus drugs, natural ingredients in food and cosmetics.*
- ➔ Use of sources (and consequent exposures) could be acceptable only if there is no other alternative
  - *Justification is easy!*
- ➔ Deterministic effect are comprehensible
  - *If I go to close to the source, it will harm me.*

# 1<sup>ST</sup> Principle: Justification (Cont.)



## Average person (attitudes and problems) (Cont.):

- ➔ Stochastic effects are somehow “grey” area
  - *You are giving me some numbers about risk, but what it means for me?*
  - *Am I, or am I not getting cancer?*
  - *If I do, when it will happen and will it be curable?*
  - *If I get cancer, is it possible to prove that it is from exposure at my job? I want to sue someone for compensation!*
  - *What about genetic effects? Have you seen those pictures from Chernobyl?*

# 1<sup>ST</sup> Principle: Justification (Cont.)

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## Us (problems):

- ➔ How to explain what risk is and what is detriment
- ➔ How to explain that occupational exposure just increases risk of getting cancer, other causes being much more important
- ➔ Why we believe that LNT hypothesis is conservative approach and not deception
- ➔ How to compare benefits for society and benefits for person
- ➔ How to explain that justification in radiation protection is societal decision, and not personal decision



# 1<sup>ST</sup> Principle: Justification (Cont.)

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**Society and persons must justify their actions!**

In normal life of **a person**, justification is called “**common sense**”:

- ⇒ People travel when their job requires it,
- ⇒ People visit doctor when they need to.
- ⇒ People undergo surgery when it is necessary.
- ⇒ People use drugs prescribed by doctor when ill

# 1<sup>ST</sup> Principle: Justification (Cont.)



But we do not act always strictly reasonably :

- ➔ People travel when needed and also when it is not needed
- ➔ People use cars instead of public transport,
- ➔ Some people use drugs without being advised by doctor
- ➔ Some people go mountaineering,
- ➔ Some people go skiing
- ➔ Some people smoke

In these cases justification is not strictly rational, **social or emotional factors outweigh other factors.**

For some of these activities, **risk is elevated but other factors prevail. It is personal decision!**

# 1<sup>ST</sup> Principle: Justification (Cont.)



**In society**, benefits (advantages) and detriments (disadvantages) are not necessary met in the same person.

Example: building highways

- ➔ From 1994 to 2010 528 km of highways were built in Slovenia.
- ➔ Benefit (society): less traffic accidents and lower number of road traffic deaths (in 1992: 492 killed and 2642 heavily injured in traffic accidents, in 2010: 138 killed and 865 heavily injured in traffic accidents, i.e. 72 % and 67% less).
- ➔ Other benefits (society): less time spent in travel, jobs (lower unemployment), lower burden to environment, traffic was moved from urban areas, etc.

# 1<sup>ST</sup> Principle: Justification (Cont.)



## Example: building highways (Cont.)

- ➔ Detriments (society): loss of agricultural land, loans to be paid, impact to natural habitats, loss of lives in working accidents
- ➔ Detriment (personal): people were resettled, some not being satisfied with compensations, victims of accidents during construction.
- ➔ Considering the traffic conditions at the time, the decision was more than justified!

## 2<sup>ND</sup> Principle: Optimisation

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### COUNCIL DIRECTIVE 96/29/EURATOM (Article 6):

*(a) in the context of optimization all exposures shall be kept as low as reasonably achievable, economic and social factors being taken into account;*

### Beginner's questions:

- ➔ Why not **as low as possible**?
- ➔ What has economy to do with my protection and health?  
Isn't it cheaper to protect me than to cure the cancer?
- ➔ Why should my protection depend on social factors? Am I second class citizen?

## 2<sup>ND</sup> Principle: Optimisation (Cont.)

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### Us (problems):

- ➔ How to explain that spending all funds and making every effort for exposure lowering (if doses are below limit!) has no sense, considering the low level of risk and presence of natural background.
- ➔ How to explain that we should use reasoning to keeping the doses As Low As Reasonably Achievable, and not just determination.

## 2<sup>ND</sup> Principle: Optimisation (Cont.)

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In normal life of **a person**, optimisation is when:

- ➔ People travel when needed and just sometimes for fun
- ➔ People use car only for short travels, and public transport for longer distances
- ➔ Drugs are used strictly according to the doctor's instruction
- ➔ People go mountaineering when weather is nice
- ➔ People go skiing when ski trails are in good conditions



## 2<sup>ND</sup> Principle: Optimisation (Cont.)

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Back to highways:

- ➔ Societal optimisation: constructed highway network is **result of needs** (traffic density, transport routes, local number of commuters) and **other factors** (accessible funds, development plans, influence of local politicians...)



## 2<sup>ND</sup> Principle: Optimisation (Cont.)



### Back to highways (Cont.):

- ➔ Personal optimisation: on highway we usually optimise time of travel, and not risk
- ➔ Since risk is approximately inversely proportional to speed, instead of **ALARA** we use **AHARA** principle (As High As Reasonably Achievable)!
- ➔ Here “social and economic factors” heavily outweigh risk!
- ➔ The optimal (also the safest) speed would be the highest uniform speed that all vehicles can achieve.
- ➔ On some roads, you can see traffic sign that suggests “recommended speed”



# 3<sup>RD</sup> Principle: Dose limits



## COUNCIL DIRECTIVE 96/29/EURATOM (Article 6) (Cont.)

*(b) without prejudice to Article 12 (Specially authorized exposures), the sum of the doses from all relevant practices shall not exceed the dose limits laid down in this Title for exposed workers, apprentices and students and members of the public.*

Beginner's questions (OK, I understand, there must be some limits for all "bad" things, but...)

- ➔ Why is the dose limit for occupationally exposed workers so high?
- ➔ Why is dose limit for public twenty times lower?



## 3<sup>RD</sup> Principle: Dose limits (Cont.)

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### Us (problems):

- ➔ How to explain that risk associated with dose limits is lower than other risks they meet in their occupation?
- ➔ How to explain that dose limits were set up considering **societal, but no individual direct benefit** for public, and **direct or indirect benefit to the individual** for occupationally exposed workers?

## 3<sup>RD</sup> Principle: Dose limits (Cont.)



Limits in normal life of a person are imposed by society, or are self-imposed:

- ➔ One can decide to use only public transport
- ➔ Quantity of drugs available to a patient is limited, or manufacturer explicitly indicates maximum quantity that could be consumed in one day,
- ➔ One can stop mountaineering on first sign of bad weather
- ➔ One can decide to stop skiing when ski trails became damaged

## 3<sup>RD</sup> Principle: Dose limits (Cont.)



And highways again:

- ➔ There is **speed limit** (i.e. also **risk limit**), which is not the same in all countries (this is not the case with dose limits!)
- ➔ Speed limit is result of **optimisation** (the same applies for dose limits): lower speed limit would not only reduce risk for drivers and passengers, but also prolong travelling
- ➔ It is up to society (country) to decide!

# Conclusions

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Justification, optimisation and use of risk limits are part of normal life of a person

- ➔ It is easy to understand application when benefits and detriments are on personal level

In radiation protection benefits and risk (also detriment!) relate to society

- ➔ Explanations and examples from „normal life“ should be used in courses, but must reveal and emphasise this difference!



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# Thank You for Your Attention!