Dose constraint in optimisation of occupational radiation protection

Some considerations from the NEA / CRPPH Expert Group on Occupational Exposure

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Expert Group on Occupational Exposure (EGOE)

- Created by the Committee on Radiation Protection and Public Health (CRPPH) of OECD / NEA in 2007
- Scope: Policy and strategic areas of Occupational Radiation Protection (ORP) in the OECD countries with a focus on the nuclear power sector,
- ca. 30 members, observers and consultants from 13 OECD countries and International Organisations
- 3 ‘Case Studies’
  - ORP principles and criteria for designing new NPPs (2010)
  - Dose constraints in optimisation of ORP (2011)
  - Radiological protection policy and operational issues (under elaboration)
    - Management of total risk,
    - Trans-boundary itinerant workers.

Mandate of EGOE

- To analyse experiences with interpretation and implementation of dose constraints following ICRP 60
- To discuss operational and regulatory issues that may arise with implementation as described in ICRP 103
- To provide suggestions regarding operational objectives and uses of dose constraints in light of ICRP 103

Dose constraints in ICRP

- Concept **first introduced by the ICRP – 60**

"*An important feature of optimisation is the choice of dose constraints, the source-related values of individual dose used to limit the range of options considered in the procedure of optimisation".*

Dose constraints in ICRP

- **ICRP 101 (optimisation of RP)**

"The principle of optimisation of radiological protection is defined by the Commission as the ***source- related process*** *to keep the magnitude of individual doses, the number of people exposed, and the likelihood of potential exposure* ***as low as reasonably achievable below the appropriate dose constraints,*** *with economic and social factors being taken into account."*

"

Dose constraints in ICRP

- **ICRP 103. Dose constraint is:**
  - "*A **prospective** and **source-related** restriction on the **individual dose** from a source,*
  - *which provides **a basic level of protection for the most highly exposed individuals** from a source,*
  - *and **serves as an upper bound on the dose** in optimisation of protection for that source.*
  - *For occupational exposures, the dose constraint is **a value of individual dose used to limit the range of options considered in the process of optimisation**.*

Dose constraints in ICRP

Dose Limits	Constraints and Reference Levels
Protect individual workers from occupational exposure and the Representative Person from public exposure	
	
From all regulated sources in planned exposure situations	From a source in all exposure situations

Dose constraints in ICRP

- **ICRP 103**
- "*… A constraint should be **defined at the design stage of a planned exposure situation** for its operation…"*
- "*It will usually be appropriate for such dose constraints to be set at the operational level*
- *"…The source-related dose constraint for occupational exposure in planned situations should be set **to ensure that the dose limit is not exceeded**.*

Dose constraints in the light of the ICRP concept

- **ICRP 103**
- "*…The doses to be compared with the dose constraint or reference levels are usually* ***prospective doses****, i.e., doses that may be received in the future, as it is only those doses that can be influenced by decisions on protective actions.* ***They are not intended as a form of retrospective dose limit****."*

Dose constraints in ICRP

- **ICRP 103**
- *"… **Experience** gained in managing workers exposed to radiation **will inform the choice of a value** for a constraint for occupational exposure…"*
- *« …The overall **responsibility** for setting constraints **lies with those who are responsible for worker exposure**… »*

Dose constraints in ICRP

- In summary, for occupational exposure in planned exposure situation, the dose constraint is:
  - A source related value of individual dose
  - To be used as a prospective tool in the process of optimisation
  - Is intended to satisfy the equity of distribution of exposure among a group of individuals
  - Not an individual dose limit
  - To be set by operators (or those who are responsible for worker exposure)

Dose constraint in regulation

- **Within the European Union:**
  - Mandated for all EU countries in the 1996 Euratom Basic Safety Standard

    "..a restriction on the prospective does to individuals which may result from a defined source, for use at the planning stage in radiation protection whenever optimisation is involved."

- **ERPAN Survey:**
  - No consistency in the terminology used by the countries:

    dose constraints, source related dose values, dose levels, dose objective, …
  - Variation as to whether they apply to tasks (operational) or sources (facility design)
  - Variation in who sets them (employer or regulatory body, or joint decision)
  - Used many at the design stage of facilities (sometimes operationnal values)

Dose constraint in regulation

- **Ireland** *S.I. No. 125 of 2000 (1996 BSS)*
  - Regulatory authority sets values
    - 0.3 mSv/yr – public
    - 1.0 mSv/yr – occupationally exposed workers
    - Design stage, not a limit
  - Applies to all practices
    - Medical (diagnostic, nuclear medicine, radiotherapy)
    - Industrial (NDT, sterilisation facilities , NMDG)
    - Dental, Veterinary
    - Education and Research
    - Discharges (liquid, aerial)
  - Well established, universally accepted and implemented

Dose constraint in regulation

United Kingdom

- IRR99 (1996 BSS)
  - Dose constraint (workers and public)
    - Employer sets the level
  - Dose investigation level (workers)
    - 15 mSv
- RSA 1992 - Disposal of radioactive waste – dose constraint (public)
  - 0.3 mSv from single source
  - 0.5 mSv from single site

Dose constraint in regulation

- **In North America:**
  - In Canada and USA, the concept used is that of an action level (even if it is called ‘dose constraint’ in US), requiring actions to be taken if actual doses exceed the action level
  - Does not correspond to the concept of dose constraint (not a prospective value)

- **In Japan:**
  - Dose limitation and optimisation are viewed as sufficient for the management of occupational exposures
  - No need for uniform introduction of dose constraint as it impedes the flexible and optimum management conducted by individual facilities

Dose constraint in operation of nuclear power plants

ISOE Survey

- Optimisation of RP is applied in all NPPs
- What is used as individual dose values are usually
  - Station administrative dose limit
  - Action / investigation levels
  - Planning values /day, /month, /year
  - Dose values above which specific planning is required
  - …
- No consistency in the values used by the operators
- Not a clear use of individual dose constraint in the sense of ICRP at the planning stage of facilities and/or exposed work.

Dose constraint in operation of nuclear power plants

ISOE Survey – some examples

- **France – EDF goals (2010**), revised every year in order to achieve a decreasing trend of about 5 to 10% per year.
  - Less than 55 workers with a dose higher than 14 mSv on a twelve-month rolling period.
  - Less than 420 workers with a dose higher than 10 mSv on a twelve-month rolling period.

  - Apply for all workers i.e. about 42.000 rad workers – sub contractors can apply their own values but with a dose constraint not higher than 16 mSv on a twelve-month rolling period

Dose constraint in operation of nuclear power plants

ISOE Survey – some examples

- **Sweden - Oskarshamn NPP**
  - Dose/day: Planning value = 3 mSv; Check point = 2.5 mSv
  - Dose/month: Planning value = 10 mSv; Check point =8 mSv
  - Dose/y: Planning value = 20 mSv; Check point = 18 mSv
  - In addition, dose rate constraint < 4mSv/h, that is used as a complement
- **USA - Exelon Nuclear**
  - Guideline: 2 rem/y (20 mSv/y)
  - Work group supervisor and radiation protection manager approval: 2-3 rem/y (20-30 mSv/y)
  - Site vice-president approval: 3-4 rem/y (30-40 mSv/y)
  - Executive vice-president approval 4-5 rem/y,(40-50 mSv/y)
  - Legal limit: 5 rem/y (50 mSv/y)

Issues to be considered for the introduction of dose constraint into regulation

- **Dose constraints in prospective evaluations of new facilities/sources and as one means of initiating investigations of actual operations**
- Initial concept of dose constraint :
  - To be used at design stage of facilities or substantial modification of existing facilities/sources
  - But optimisation process is to be needed and used in daily work planning;
- Planning of maintenance jobs at NPP :
  - If individual dose limits may be approached, then a form of individual dose criteria, target or action level for the workers involved in those tasks is reasonable
- Also useful to check operational doses against the dose criteria to check that the design intent has been properly implemented and action taken if necessary to adjust the level of protection.

Issues to be considered for the introduction of dose constraint into regulation

- **Need for guidance on the use of dose constraints in the process of optimisation**
  - How are individual dose distributions over time used in the optimisation process: evolution; type of industry; how are “outliers” addressed; as an indicator for assessing optimisation results?
  - What constitutes an “inequity” in individual dose and how are such circumstances addressed?
  - Can inequities be addressed by means other than dose reduction for workers with higher dose (e.g., annual compensation) as part of the evaluation of social and economic factors?
  - How are “sample groups” identified and/or defined?

Conclusions

- **Use of Dose Constraints in OECD**:
  - Implementation continues to be discussed and no common understanding currently exists
  - Implementation depends on co-operation between registrant, licensee and regulator

- **The Value of Using Dose Constraints:**
  - Use of dose constraints can limit inequity in individual exposure distributions but radiation exposure is not always the only or predominant workplace risk or consideration

Conclusions

- **Setting of Dose Constraints:**
  - Various approaches are used
  - For occupational exposures, individual dose constraint are not used as defined by ICRP (prospective tool, before an optimisation procedure), but “target values”, “investigation levels”, … used retrospectively.

- **Regulatory Use:**
  - Individual dose constraint have been used as regulatory benchmark values for retrospective evaluation of worker protection measures (by utilities also). Concerns over this approach, which can be seen as establishing a new standard of worker care.

- **Way forward:**
  - Recognise the need for comprehensive explanations and guidance by regulatory authorities

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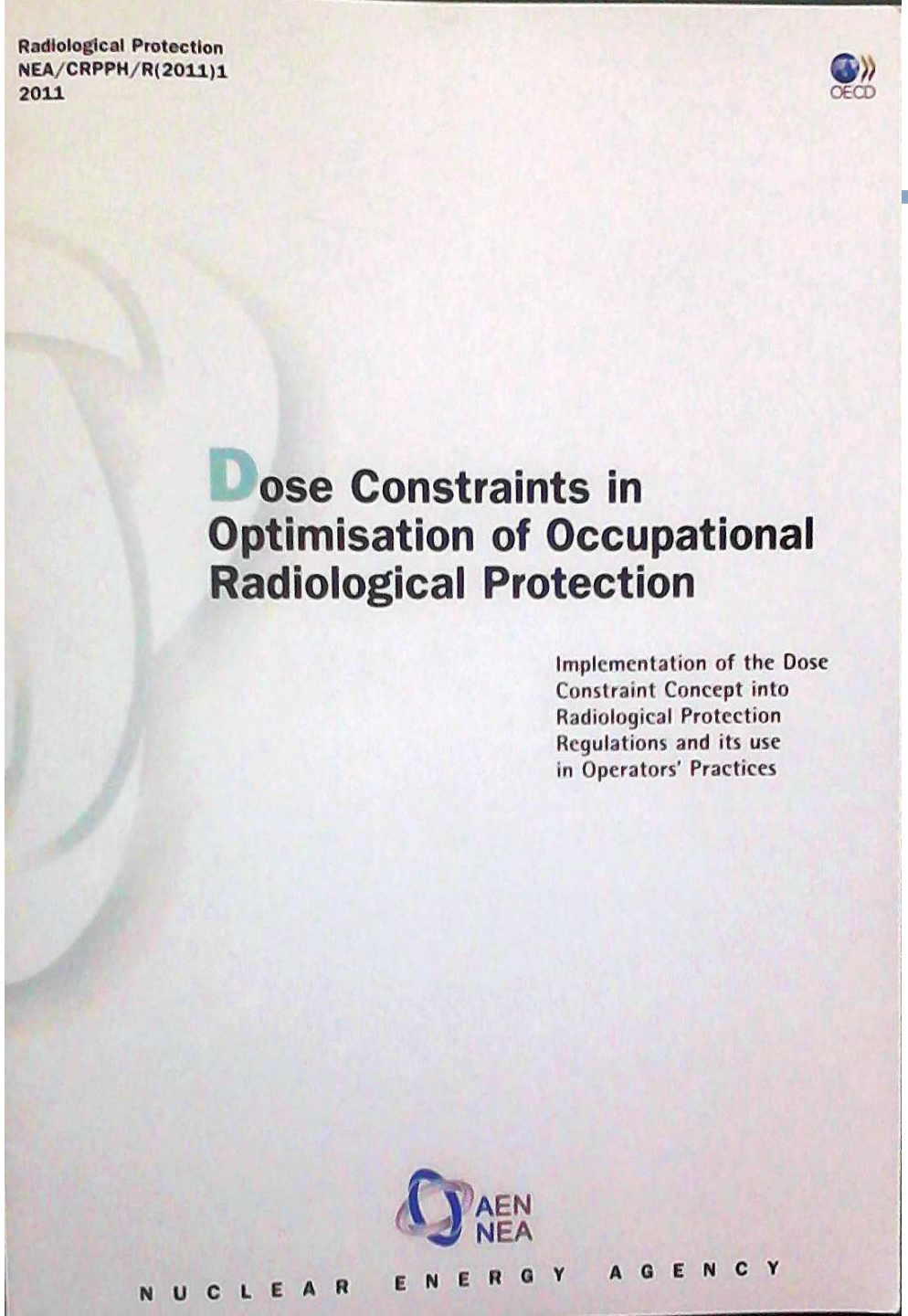
Radiological Protection
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Dose Constraints in Optimisation of Occupational Radiological Protection
Implementation of the Dose Constraint Concept into Radiological Protection Regulations and its use in Operators' Practices
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