Introduction:

In this section, we will review the overall approach and philosophy, or "Conceptual Framework" recommended by the ICRP for radiological protection. Material in these notes is taken mainly from ICRP-60.

General

The key considerations for a system of radiological protection is that it:

- does more good than harm;
- leads to protection arrangements that maximize the net benefit; and
- limits the inequity that may arise from a conflict of interest between individuals and society as a whole.

Human activities leading to overall increases in radiation exposure is known as "practices" while those leading to decreases are "interventions"

Three broad categories of exposure are considered within the framework – occupational, medical and public exposures.

System of Protection in Practices

Justification	No practice involving exposures to radiation should be adopted unless it produces sufficient benefit to the exposed individuals or to society to offset the radiation detriment it causes
Optimization	In relation to any particular source within a practice, the magnitude of individual doses, the number of people exposed and the likelihood of incurring exposures where these are not certain to be received should be kept As Low As Reasonably Achievable, economic and social factors being taken into account. This procedure should be constrained by restrictions on the dose to individuals (dose constraints) or the risk risks to individuals in the case of potential exposures (risk constraints), so as to limit the inequity likely to result from the inherent economic and social judgments.
Dose and Risk Limits	The exposure of individuals resulting from the combination of all relevant practices should be subject to dose limits, or to some control of risk in the case of potential exposures. These are aimed at ensuring that no individual is exposed to radiation risks that are judged to be unacceptable from these practices in any normal circumstances. Not all sources are susceptible of control by action at the source and it is necessary to specify the sources to be included before selecting a dose limit.

System of Protection in Intervention

The following general principles apply:

- The proposed intervention should do more good than harm, i.e. the reduction in detriment resulting from the reduction in dose should be sufficient to justify the harm and costs, including social costs, of the intervention.

- The form, scale and duration of the intervention should be optimized so that the net benefit of the reduction in dose, i.e. the benefit of the reduction of radiation detriment, less the detriment associated with the intervention, should be maximized.

System of Protection for Occupational Exposures

Dose Constraints: A value that limits the range of possible outcomes of a dose optimization process, based on conclusions drawn about he individual doses likely to be incurred in well-managed operations. Source related value.

Dose Limits Required to control occupational exposure both by imposing a limit on the choice of dose constraints and protect against errors in judgment in optimization. Individual related value.

Choice of Occupational Dose Limit

Previously – chosen on the basis of comparing average fatal cancer risk in radiation work with the fatality risk in "safe" industries – assuming a 10:1 ratio between maximum and average risk. No longer judged acceptable.

Three categories of exposure or risk identified – "unacceptable", "tolerable" and "acceptable". The dose limit is the boundary between the "unacceptable" and "tolerable" levels of exposure.

Dose limit must preclude the possibility of deterministic effects and maintain the risk of stochastic effects to "just tolerable" levels.

Note that the choice of "Unacceptable – and of dose limits – is tied to the practice in concept. For example, higher doses are tolerated in space exploration than industry because the alternative is to abandon a beneficial practice – space exploration.

Selection is based on judgment after consideration of a range of possibilities.

Table 5. Attributes of detriment due to exposure of the working population[1]

Annual effective dose (mSv)	10	20	30	50	50 (1977 data)
Approximate lifetime dose (Sv)	0.5	1.0	1.4	2.4	2.4
Probability of attributable death (%)	1.8	3.6	5.3	8.6	2.9
Weighted contribution from non-fatal cancer (%)[2]	0.4	0.7	1.1	1.7	—
Weighted contribution from hereditary effects (%)[2]	0.4	0.7	1.1	1.7	1.2
Aggregated detriment (%)[3]	2.5	5	7.5	12	
Time lost due to an attributable death given that it occurs (y)	13	13	13	13	10–15
Mean loss of life expectancy at age 18 years (y)	0.2	0.5	0.7	1.1	0.3–0.5

[1] The values are all derived from Annex C (see paragraph 155); in Annex B, which deals with a wider range of populations, a somewhat higher estimate is given for the time lost due to an attributable death.
[2] Weighted for severity and loss of lifetime.
[3] The sum of the probability of attributable fatal cancer or equivalent detriment (rounded).

Source – ICRP 60

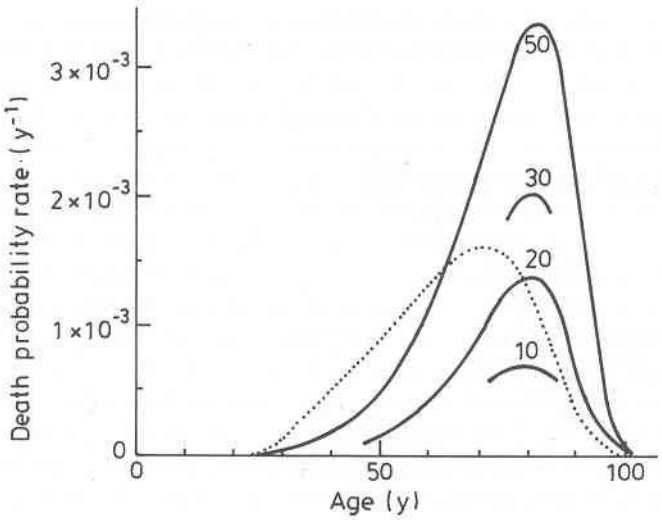

Fig. 2. The unconditional death probability rate (the attributable death age probability density normalised for lifetime risk) for exposure from age 18 to age 65 y. The curves are for females and for present risk estimates.
····· Additive risk projection model (50 mSv y^{-1})
—— Multiplicative risk projection model (showing various annual doses in mSv)

Source – ICRP60

Selected Dose Limits

Table 6. Recommended dose limits[1]

Application	Dose limit: Occupational	Dose limit: Public
Effective dose	20 mSv per year, averaged over defined periods of 5 years[2]	1 mSv in a year[3]
Annual equivalent dose in		
the lens of the eye	150 mSv	15 mSv
the skin[4]	500 mSv	50 mSv
the hands and feet	500 mSv	—

[1] The limits apply to the sum of the relevant doses from external exposure in the specified period and the 50-year committed dose (to age 70 years for children) from intakes in the same period (see paragraph 143).

[2] With the further provision that the effective dose should not exceed 50 mSv in any single year. Additional restrictions apply to the occupational exposure of pregnant women, which is discussed in Section 5.3.3.

[3] In special circumstances, a higher value of effective dose could be allowed in a single year, provided that the average over 5 years does not exceed 1 mSv per year.

[4] The limitation on the effective dose provides sufficient protection for the skin against stochastic effects. An additional limit is needed for localised exposures in order to prevent deterministic effects (see paragraphs 173 and 194).

Source – ICRP60

System of Protection in Medical and Public Exposures

Medical exposures are subject to justification and optimization but **not** dose limits. Practices are inherently beneficial to the patient and application of dose limits to justified and optimized practices may be detrimental.

Public exposures are subject to justification, optimization and dose limits. In practice, public exposures are controlled at the source and are subject to "constrained optimization" for example – in establishing release limits. Public dose limits are required for situations were members of the public are exposed to more than one source and to put an upper limit on the choice of source related constraints. As noted above, an annual limit of 1 mSv is recommended, based on the similarity to (non-radon) natural exposures and an assessment of the consequences of continued additional exposures in the 1 mSv to 5 mSv per annum range.

References:

1. ICRP 60, 1990 Recommendations of the International Commission on Radiological Protection, Volume 21 No. 1-3, 1991.