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Ethical Foundations of the System of Radiological Protection

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EDITORIAL

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94 *To be drafted.*

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ABSTRACT

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Ethical Foundations of the System of Radiological
Protection

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ICRP PUBLICATION 1XX

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Approved by the Commission in MONTH 20YY

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Abstract-Despite a long recognition that radiological protection is not only a matter of science, but also morality and wisdom, ICRP publications have rarely addressed the ethical foundations of the system of radiological protection explicitly. The purpose of this publication is to describe how the Commission has used ethical values in developing the system of radiological protection with the objective of presenting a coherent view of how ethics is part of this system. In so doing it helps to clarify the inherent value judgements made in achieving the aim of the radiological protection system as underlined by the Commission in its *Publication 103*. Although primarily addressed to the radiological protection community, this publication is also intended to address authorities, operators, workers, medical professionals, patients, the public and its representatives acting in the interest of the protection of people and the environment. The publication provides first the key steps concerning the scientific, ethical and practical evolutions of the system of radiological protection since the first ICRP publication in 1928. It then describes the four core ethical values underpinning the present system: beneficence/non-maleficence, prudence, justice, and dignity. It also discusses how these core ethical values relate to the principles of radiological protection, namely justification, optimisation, and limitation. The publication finally addresses key procedural values that are required for the practical implementation of the system, focusing on accountability, transparency and inclusiveness. The Commission sees this publication as a founding document to be elaborated further in different situations and circumstances.

124

Keywords: Radiological protection system; Ethical values; Procedural values

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129

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130

PREFACE

131 Building on the results of several years of reflection on the ethics of radiological protection
132 within its Committee 4, the ICRP Main Commission established Task Group 94 of Committee
133 4 during its meeting in Fukushima, Japan, in October 2012 to develop an ICRP publication
134 presenting the ethical foundations of the system of radiological protection. In order to achieve
135 this goal, the Commission asked the Task Group to review the publications of the Commission
136 to identify the ethical and social values associated with the system of radiological protection
137 for occupational, public and medical exposures, and for the protection of the environment. In
138 proposing this approach, the Commission recognises that the system of radiological protection
139 has, during its evolution, been informed by ethics and values in society.

140

141 Given the nature of the work, the Commission also encouraged the Task Group to develop its
142 work in close cooperation with specialists of ethics and radiological protection professionals
143 from around the world. With this in mind, a series of workshops was organised by ICRP in
144 collaboration with the International Radiation Protection Association (IRPA) and academic
145 institutions to fully examine, discuss, and debate the ethical basis of the current system of
146 radiological protection with radiation protection professionals and ethicists. These workshops
147 were held in: Daejeon (Korea) and Milan (Italy) in 2013; Baltimore (USA) in 2014; and Madrid
148 (Spain), Cambridge (USA) and Fukushima (Japan) in 2015. Presentations were given to spur
149 discussion in group sessions. Presenters were from a variety of backgrounds and fields of
150 expertise.

151

152 The Task Group also benefited from discussion at an International Symposium on ethics of
153 environmental health in Budweis, Czech Republic in 2014; the fourth Asian and Oceanic
154 Congress on Radiation Protection in Kuala Lumpur, Malaysia in 2014; the UK workshop on
155 the ethical dimensions of the radiological protection system in London, UK in 2014; the third
156 International Symposium on the system of radiological protection in Seoul, Korea in 2015; and
157 the 14th IRPA Congress in Cape Town, South Africa in 2016.

158

159 The membership of Task Group 94 was as follows:

160

161 K-W. Cho (Chair)	M-C. Cantone	S. O. Hansson
162 C. Kurihara-Saio	N. E. Martinez	D. Oughton
163 T. Schneider	R. Toohy	S. Wambani
164 F. Zölzer		

165

166 The corresponding members were:

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168 R. Czarwinski	B. Le Guen	E. Van Deventer
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169

170 The Committee 4 critical reviewers were:

171

172 F. Bochud	J. Takala
---------------	-----------

173

174 The Main Commission critical reviewers were:

175

176 C.M. Larsson

E. Vano

177

178 The Task Group worked mainly by correspondence and met three times on 2 and 3 February
179 2015 at Technical University of Madrid (UPM), Spain, and on 8 to 10 July 2015, and 26 to 28
180 January 2016 at Centre d'étude sur l'Evaluation de la Protection dans le Domaine Nucléaire
181 (CEPN), France. The Task Group wishes to thank the organisations and staff that made
182 facilities and support available for these meetings.

183

184 In drafting the report, the Task Group received significant contributions from ICRP Vice-Chair
185 Jacques Lochard, ICRP Scientific Secretary Christopher Clement, and input from several
186 participants of the workshops organised in cooperation with IRPA and the other organisations,
187 mentioned above.

188

189 The membership of Committee 4 during the period of preparation of this report was:

190

191 (2009–2013)

192

193 J. Lochard (Chair)

T. Homma

A. McGarry

194 W. Weiss (Vice-Chair)

M. Kai

K. Mrabit

195 J-F. Lecomte (Secretary)

H. Liu

S. Shinkarev

196 P. Burns

S. Liu

J. Simmonds

197 P. Carboneras

S. Magnusson

A. Tsela

198 D.A. Cool

G. Massera

W. Zeller

199

200 (2013–2017)

201

202 D.A. Cool (Chair)

M. Doruff

A. Nisbet

203 K-W. Cho (Vice-Chair)

E. Gallego

D. Oughton

204 J-F. Lecomte (Secretary)

T. Homma

T. Pather

205 F. Bochud

M. Kai

S. Shinkarev

206 M. Boyd

S. Liu

J. Takala

207 A. Canoba

A. McGarry

208

209

MAIN POINTS

- 210 • **Despite a long recognition that radiological protection is not only a matter of science,**
211 **but also morality and wisdom, ICRP publications have rarely addressed the ethical**
212 **foundations of the system of radiological protection explicitly.**
- 213 • **Radiological protection started simply with the objective of avoiding harmful skin**
214 **reactions associated with the use of x-ray and radium at the beginning of the 20th**
215 **Century.**
- 216 • **It evolved to be more complex with the recognition of cancer and hereditary effects**
217 **in the 1950's. It was no longer enough to avoid doing harm by keeping exposures**
218 **below threshold doses for acute effects. The main problem shifted from avoiding**
219 **harm to managing the probability of harm.**
- 220 • **From the 2000s, the system of protection expanded its consideration of non-human**
221 **species with an explicit reflection on ethical values, touching on the different**
222 **philosophical worldviews regarding how the environment is valued.**
- 223 • **More recently, the Commission emphasised the need to involve all relevant**
224 **stakeholders particularly in situations where radiation sources are less controlled**
225 **and the associated exposures raise complex societal issues.**
- 226 • **For human health, the present system of radiological protection aims to "manage**
227 **and control exposures to ionising radiation so that deterministic effects are**
228 **prevented, and the risks of stochastic effects are reduced to the extent reasonably**
229 **achievable".**
- 230 • **For protection of the environment the aim is to have a "negligible impact on the**
231 **maintenance of biological diversity, the conservation of species, or the health and**
232 **status of natural habitats, communities and ecosystems".**
- 233 • **Serving the aims of protection of humans and the environment, the three**
234 **fundamental principles of protection - justification, optimisation, and limitation -**
235 **are central to the system and apply to the different types of exposure situations**
236 **(planned, emergency and existing).**
- 237 • **As far as ethics is concerned, the system relies on four core ethical values:**
238 **beneficence/non-maleficence, prudence, justice and dignity.**
- 239 - **Beneficence means promoting or doing good, and non-maleficence means**
240 **avoiding causation of harm. In radiological protection, this involves**
241 **consideration of the direct impacts to human health and the environment as**
242 **well as consideration of economic and social costs and benefits.**
- 243 - **Prudence is the ability to make reasonable choices without the full**
244 **knowledge of the scope and consequences of actions. Prudence encompasses**
245 **the consideration of uncertainties concerning the risks associated with effects**
246 **of radiation for both human and non-human biota. In practical terms**
247 **prudence calls for vigilance and seeking to reduce uncertainties in the**
248 **understanding of radiation risk.**

- 249 - **Justice is the fairness in the distribution of advantages and disadvantages**
250 **among groups of people. It is the role of individual dose restrictions to**
251 **prevent any individual from receiving an exposure that is not deemed**
252 **tolerable by society, and address inequity in the dose distribution in**
253 **optimisation of protection for human and non-human biota. Justice also**
254 **includes fairness in the rules and procedures in the processes of decision-**
255 **making.**
- 256 - **Dignity means that every individual deserves unconditional respect,**
257 **whatever age, sex, health, social condition, ethnic origin and religion.**
258 **Personal autonomy is a corollary of human dignity. The Commission has**
259 **emphasised the promotion of autonomy of those exposed to radiation**
260 **through the participation of stakeholders and the empowerment of**
261 **individuals to make their own informed decisions.**
- 262 • **Applying the principles of radiological protection is a permanent quest for decisions**
263 **that do more good than harm (beneficence/non-maleficence), that avoid**
264 **unnecessary risk (prudence), that establish a fair distribution of exposures (justice)**
265 **and treat people with respect (dignity).**
- 266 • **Procedural values such as accountability, transparency and inclusiveness**
267 **(stakeholder participation), reflect the importance of allocating responsibilities to**
268 **those involved in the radiological protection process and also of preserving the**
269 **autonomy and dignity of the individuals potentially or actually exposed to radiation.**
- 270 • **Just as with science, ethics alone is unable to provide a definitive solution to the**
271 **questions and dilemmas generated by the use or presence of radiation. However,**
272 **ethics certainly can provide useful insights on the principles and philosophy of**
273 **radiological protection and thus facilitate the dialogue between experts and citizens.**
274

275

GLOSSARY

276 Accountability: The obligation of individuals or organisations who are in charge of decision-
277 making to answer for their actions to all those who are likely to be affected, including
278 to report on their activities, to accept responsibility, and to account for actions taken
279 and the consequences, if necessary.

280

281 Autonomy: The capacity of individuals to act freely, to decide for themselves and to pursue a
282 course of action in their life.

283

284 Beneficence: To promote or do good. Beneficence is a key value of biomedical ethics. In
285 radiological protection, it is to increase the direct and indirect benefits for individuals,
286 communities and the environment.

287

288 Deontological ethics: An approach to ethics that judges the morality of an action based on the
289 action's adherence to rules or duties.

290

291 Dignity: The value and respect that every person has and deserves regardless of her/his age,
292 sex, health, social condition, ethnic origin and religion, etc.

293

294 Equity: The quality of being fair and impartial. In radiological protection, equity refers to the
295 fair distribution of risks and benefits of radiation exposures.

296

297 Ethics: The branch of philosophy that explores the nature of moral virtue and evaluates human
298 actions using sets of moral principles and concepts to govern behaviour or the
299 conducting of an activity.

300

301 Fairness: The quality of treating people equitably and in a way that is reasonable.

302

303 Inclusiveness: Ensuring that all those concerned are given the opportunity to participate in
304 discussions, deliberations and decision-making concerning situations that affect them.

305

306 Informed consent: The voluntary agreement to an activity based on sufficient information and
307 understanding of the purpose, benefits and risks.

308

309 Justice: The upholding of what is right, equitable and fair.

310

311 - Distributive justice: fairness in the distribution of advantages and disadvantages among
312 members of communities.

313

314 - Environmental justice: equitable distribution of environmental risks and benefits; fair
315 and meaningful participation in environmental decision-making; recognition of
316 community ways of life, local knowledge, and cultural difference.

317

318 - Intergenerational justice: fairness towards everyone, with attention also to future
319 generations.

- 320
- 321 - Procedural justice: fairness in the rules and procedures in the process of decision-
- 322 making.
- 323
- 324 - Restorative justice: giving priority to repairing the harm done to victims, communities
- 325 and the environment.
- 326
- 327 - Social justice: promoting a just society, by recognition of human rights to equitable
- 328 treatment and assuring equal access to opportunities.
- 329
- 330 Non-maleficence: To avoid doing harm. Non-maleficence is a key value of biomedical ethics.
- 331 In radiological protection, it is to reduce the direct and indirect harm and risk for
- 332 individuals, communities and the environment.
- 333
- 334 Practical radiological protection culture: The knowledge and skills enabling citizens to make
- 335 well-informed choices and behave wisely in situations involving potential or actual
- 336 exposure to ionising radiation.
- 337
- 338 Precautionary principle: A principle in risk management whereby actions are put in place
- 339 measures to prevent or reduce risks, when science and technical knowledge are not able
- 340 to provide certainty, mainly in the field of the environment and health.
- 341
- 342 Procedural values: Set of values to take practical actions that align the conduct of a given
- 343 activity with the ethical principles.
- 344
- 345 Prudence: To make informed and carefully considered choices without the full knowledge of
- 346 the scope and consequences of an action.
- 347
- 348 Reasonableness: To make rational, informed and impartial decisions that respect other views,
- 349 goals, and conflicting interests.
- 350
- 351 Right to know: The right of individuals to be informed about what hazards they are exposed to
- 352 and how to protect themselves.
- 353
- 354 Self-help protection: Informed actions taken by individuals to protect themselves, their family,
- 355 and their communities.
- 356
- 357 Stakeholder participation: The participation of all relevant parties in the decision-making
- 358 processes related to radiological protection. Also referred to as stakeholder involvement
- 359 or engagement.
- 360
- 361 Tolerability: The degree or extent to which something can be endured.
- 362
- 363 Transparency: Accessibility of information about the deliberations and decisions concerning
- 364 potential or on-going activities and the honesty with which this information is
- 365 transmitted.
- 366

- 367 Utilitarian ethics: An approach to ethics that judges the morality of an action based on the
368 action's impact on individual and social welfare.
369
- 370 Value judgement: A subjective assessment based upon available knowledge and a particular set
371 of values and priorities.
372
- 373 Virtue ethics: An approach to ethics that emphasises the role of personal character and virtue
374 in determination of morality.
375
- 376 Wisdom: The quality of having knowledge, common sense, experience and good judgement
377 in order to make reasonable decisions and to act accordingly.
378

379

1. INTRODUCTION

380

1.1. Background

381

382 (1) In an address to the Ninth Annual Conference on Electrical Techniques in Medicine and
383 Biology in 1956, Lauriston Taylor, then incumbent President of the National Council on
384 Radiation Protection and Measurements (NCRP), and Chairman of the International
385 Commission on Radiological Protection (ICRP), declared: “Radiation protection is not only a
386 matter for science. It is a problem of philosophy, and morality, and the utmost wisdom.” (Taylor,
387 1957). By using the term ‘wisdom’, one of the fundamental virtues of many religions and oral
388 traditions, Taylor emphasised that beyond its undeniable and compelling scientific and ethical
389 basis, radiological protection was also a question of insight, common sense, good judgement
390 and experience. Through his formulation, he brought to light three pillars of the system of
391 radiological protection that have been gradually built up for almost half a century, namely
392 science, ethics and experience.

393 (2) Despite a long recognition that radiological protection is not only a matter of science, but
394 also morality and wisdom, ICRP publications have rarely addressed the ethical foundations of
395 the system of radiological protection explicitly. This does not mean that the Commission has
396 been unaware of the importance of such considerations. Protection recommendations
397 inevitably represent an ethical position, irrespective of whether that position is explicit or
398 implied. Therefore, the discussion of ethical considerations is not absent from ICRP
399 publications.

400 (3) Regarding the ethical dimension of radiological protection, it should be pointed out at
401 the outset that there are very few writings devoted to it compared to the vast literature related
402 to the scientific, technical and practical aspects. The first contributions directly addressing the
403 subject only appeared in the 1990s. Among them it is worthwhile mentioning the pioneering
404 contribution of Giovanni Silini who reviewed the ethical foundation of the system during the
405 Sievert Lecture he delivered in 1992 (Silini, 1992). He concluded his lecture emphasising that
406 the system has been developed rationally, but at the same time with the desire to act reasonably.
407 Also interesting to note are the articles published subsequently by academics questioning the
408 ethical theories underpinning the system (Oughton, 1996; Schrader-Frechette and Persson,
409 1997) which ultimately led to the recognition that the system of radiological protection can be
410 seen as being based on the three major theories of philosophical ethics that combine the respect
411 of individual rights (deontological ethics), the furthering of collective interest (utilitarian ethics)
412 and the promotion of discernment and wisdom (virtue ethics) (Hansson, 2007). In turn, inspired
413 by these reflections, eminent professionals of radiological protection have seized the subject
414 (Lindell, 2001; Clarke, 2003; Streffer et al., 2004; Gonzalez, 2011; Valentin, 2013). Most
415 recently a number of authors explored a variety of western ethical theories along with cross-
416 cultural approaches, covering a range of topics from humanistic considerations focusing on
417 vulnerable populations to a wider view including ecosystems (Zölzer, 2013).

418 (4) This relatively recent interest in ethical aspects of radiological protection is certainly not
419 unrelated to the difficulties encountered for decades by radiological protection professionals
420 facing the questions and concerns of citizens. The traditional emphasis on the science of
421 radiation has been shown to be insufficient, and it is now recognised that human and ethical
422 dimensions of exposure situations are important and sometimes decisive in both the decision-
423 making process and in communication.

424 (5) The lessons learned from the management of the consequences from the Chernobyl
425 accident have certainly played a key role in this awareness (Oughton and Howard, 2012;
426 Lochard, 2013), as have challenges from radioactive waste management (NEA, 1995; Streffer
427 et al., 2011) and increasing use of medical applications (Malone, 2013). It is in this context that
428 ICRP initiated a reflection on the ethical foundations of the system of radiological protection
429 in early 2010 and a Task Group in 2012. In order to involve in its reflection ethicists,
430 philosophers, social scientists and radiological protection professionals from different regions
431 of the world, the Commission initiated a series of regional workshops organised in
432 collaboration with the International Radiation Protection Association (IRPA) and academic
433 institutions.
434

435
436

1.2. Scope and objective

437 (6) This publication reviews the Commission's previous publications to identify the ethical
438 values associated with the ICRP system of radiological protection for occupational, public and
439 medical exposures, and for protection of non-human species. It describes key components of
440 the ethical theories and principles prevailing in the fields of safety, health, labour, environment,
441 and sustainable development relevant to radiological protection.

442 (7) This publication aims to emphasise how the Commission has used ethical values in
443 developing the system of radiological protection with the objective of presenting a coherent
444 view of how ethics is part of this system. Ethics cannot provide conclusive solutions but it can
445 help facilitate discussions among those seeking to promote the well-being of individuals, the
446 sustainable development of society, and the protection of the environment. A clearer
447 understanding of the core ethical values and related principles of radiological protection will
448 help individuals and societies to address issues emerging from potential conflicts in decision-
449 making.

450 (8) A particular objective of this publication is to outline to society, what it can reasonably
451 expect from radiological protection. In so doing it helps to clarify the inherent value judgements
452 made in achieving the aim of the system of radiological protection as underlined by the
453 Commission in its *Publication 103* (ICRP, 2007a), and broadly facilitates the decision-making
454 process and communication on radiation risk.

455 (9) Although primarily addressed to the radiological protection community, this publication
456 is also intended to address authorities, operators, workers, medical professionals, patients, the
457 public and its representatives acting in the interest of the protection of people and the
458 environment.

459 (10) The Commission recently adopted a Code of Ethics (ICRP, 2015b) setting out what is
460 expected from its members in the development of its recommendations and guidance. This
461 Code emphasises the need for ICRP members to be committed to public benefit, and to act
462 independently while being impartial, transparent and accountable. Various professional
463 societies have also developed codes of ethics for their members (e.g. IRPA, 2004). These
464 behavioural requirements are beyond the scope of this report, and not discussed further here.
465 However, the ethical values discussed in this report can help to guide radiological protection
466 professionals in the conduct of their duties.

467 (11) The work leading to this publication is the first concerted effort by the Commission to
468 reflect upon and describe the ethical basis of the system of radiological protection in some
469 details. The Commission sees this publication as a founding document to be elaborated further

470 in different situations. Initiating a discussion of both the ethical values and their
471 implementation should make ethical reasoning more accessible to those working in the field,
472 and hopefully encourages them to apply it explicitly in decisions and practices (Martinez and
473 Wueste, 2016).
474

475 **1.3. Structure of this report**

476
477 (12) Section 2 presents the milestones, which marked the evolution of the system of
478 radiological protection since the first ICRP publication in 1928 until today. Section 3 describes
479 the core ethical values that shape the system, and also discusses how these core ethical values
480 underpin the principles of radiological protection, namely justification, optimisation, and
481 limitation. Section 4 discusses key procedural values underlying the requirements for the
482 practical implementation of the system. Section 5 summarises the major implications of ethics
483 and the system of radiological protection. Annexes address respectively ethical theories,
484 biomedical ethical principles and cross cultural values. The Appendix gives the list of
485 participants at the workshops on the ethics of the system of radiological protection.
486

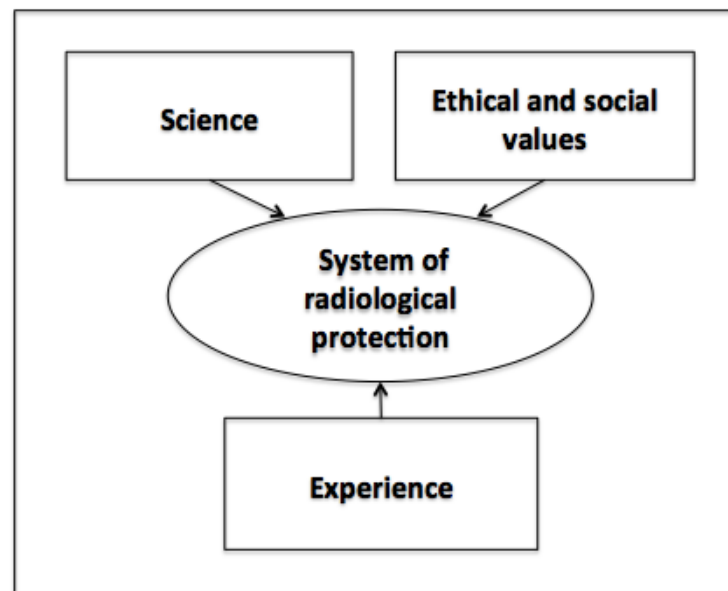
487

2. EVOLUTION OF THE SYSTEM OF RADIOLOGICAL PROTECTION

488

489 (13) The present system of radiological protection is based on three pillars: the science of
490 radiological protection combining knowledge from different disciplines, a set of ethical and
491 social values, and the experience accumulated from the day-to-day practice of radiological
492 protection professionals. This is illustrated by Fig. 2. Explicit guidelines for balanced
493 consideration of these three pillars in decision-making are not often seen, seemingly because
494 there is no direct, quantifiable way to do this: each pillar informs the others, yet has an
495 individual nature that does not lend itself to a straightforward inter-comparison. Moreover, each
496 exposure situation has unique characteristics or circumstances that need to be considered in
497 making a decision. As such, instead of a fixed, universal response, value judgements are
498 required to assess a particular situation or circumstance and determine how the pillars should
499 be combined and applied in that instance.

500



501

502

Fig. 2. The three pillars of the system of radiological protection.

503

504 (14) The present system has evolved with this in mind and has matured to more clearly
505 reflect the necessity of value judgements in interpreting risk and making appropriate decisions:
506 “All of those concerned with radiological protection have to make value judgements about the
507 relative importance of different kinds of risk and about the balancing of risks and benefits.”
508 (ICRP, 2007a). The guiding actions for radiological protection have been governed by the
509 following questions, which necessitate value judgements in their response:

510

- Are the circumstances generating exposure justified?

511

- Are all exposures maintained as low as reasonably achievable under the prevailing circumstances?

512

513

- Are the radiation doses which individuals receive considered tolerable?

514 (15) To make value judgements there must be corresponding knowledge about the
515 circumstance and the possible implications of actions (information about what “is”), and ethical
516 values on which to base decisions for action (a sense of what “should be”). As this publication
517 is concerned with the ethical basis of the system of radiological protection, the focus here is on
518 the pillar of core ethical values, with the intention of providing support for making value
519 judgements. The following subsections describe how the system has progressively evolved
520 during the twentieth century in relation to the development of scientific knowledge of radiation
521 effects and the historical events associated with the use of radiation and radioactivity. Through
522 these considerations one can gain insight into the consistent set of core ethical values that have
523 underpinned the present system since the beginning.
524

525 **2.1. The early days: do no harm**

526
527 (16) The system of radiological protection was born in 1928, with the first recommendations
528 of the International X-Ray and Radium Protection Committee (IXRPC) (IXRPC, 1928),
529 although some advice had been published much earlier (Fuchs, 1896). Nearly three decades
530 had passed since the discovery of x-rays (Roentgen, 1895), natural radioactivity (Becquerel,
531 1896) and radium (Curie, 1898), during which time the use of radiation in medicine had
532 increased significantly.

533 (17) The formation of the IXRPC (renamed ICRP in 1950) at the 2nd International Congress
534 of Radiology, and its first recommendations, were prompted by the international medical
535 community’s desire to address the sometimes serious skin reactions being observed in some
536 medical practitioners and investigators. These 1928 recommendations focused squarely on
537 protection of “x-ray and radium workers” in medical facilities, and provided advice meant to
538 avoid harmful skin reactions and derangements of internal organs and changes in the blood:
539 “the dangers of over-exposure ... can be avoided by the provision of adequate protection”.

540 (18) This advice was based on the best scientific knowledge at the time about the effects of
541 radiation exposure, the experience of nearly 30 years of practice, and the desire to avoid harm.
542 The relatively simple, implicit ethical principle of “doing no harm”, was sufficient, as it was
543 thought that straightforward protection measures could keep exposures low enough to avoid
544 injury entirely. The only type of effects known at that time were deterministic effects, which
545 are considered to have a threshold below which no deleterious effects are seen, although they
546 were not described in these terms until decades later.

547 (19) Over the next two decades the use of radiation continued to increase, not only in the
548 medical field but also in the radium industry. To keep pace, the scope of the system expanded
549 from protection of medical professionals to include radium workers. There was also an
550 increasing understanding of the thresholds for various effects. In the 1934 recommendations
551 (IXRPC, 1934) the concept of a “tolerance dose” of 0.2 roentgens per day was introduced.
552 Scientific advancements resulted in refinements in the measures to be taken to avoid doing
553 harm, but the basic ethical principle remained the same.

554 (20) The 1950 recommendations (ICRP, 1951) saw the first hints of the evolution of the
555 ethical basis of the system beyond avoidance of doing harm, or at least that the practicalities of
556 achieving this aim might be less straightforward than previously thought, recommending that
557 “every effort be made to reduce exposures to all types of ionising radiation to the lowest
558 possible level”.
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2.2. A more complex problem: managing risk, a matter of balance

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(21) The 1950's saw a growing concern about the effects of exposure to radiation, not only to workers but also to the public and patients. This was fuelled by the atomic bombings of Hiroshima and Nagasaki in 1945 and its aftermath: nuclear weapons testing after World War II causing global contamination, highly publicised events such as the serious contamination of the population of the Marshall Islands and the Japanese tuna fishing boat The Lucky Dragon, exposed to fallout from the US atomic bomb test in 1954 (Lapp, 1958).

(22) This growing concern, along with the increasing use of radiation in many fields including the nuclear energy industry, potential hereditary effects suggested by animal experiments, and emerging evidence of increased leukaemia in radiologists and atomic bomb survivors, had a profound influence on the system. The 1954 recommendations (ICRP, 1955) stated that "no radiation level higher than the natural background can be regarded as absolutely 'safe'" and recommended that "exposure to radiation be kept at the lowest practicable level in all cases". Furthermore, it was in these recommendations that the system first incorporated protection of the public.

(23) Cancer and hereditary effects (also referred to as stochastic effects), for which it was now assumed there is no absolutely safe level of exposure (no threshold), presented a much more ethically complex situation than before. It was no longer enough to avoid doing harm by keeping exposures low enough. The main problem shifted from avoiding harm to managing the probability of harm.

(24) It took many years to develop the framework to deal with this complex situation. In *Publication 9* (ICRP, 1966), noting the absence of evidence as to the existence of a threshold for some effects, and in view of the uncertainty concerning the nature of the dose-effect relationship in the induction of malignancies, the Commission saw "...no practical alternative, for the purposes of radiological protection, to assuming a linear relationship between dose and effect, and that doses act cumulatively". By adopting this position, the Commission was fully aware "that the assumptions of no threshold and of complete additivity of all doses may be incorrect" but it considered that there was no alternative given the information available at that time (ICRP, 1966). Consequently, as any level of exposure to radiation was assumed to involve some degree of potential harm, the Commission added the objective of limiting the probability of occurrence of damage associated with stochastic effects.

(25) This was further elaborated in *Publication 26* (ICRP, 1977), where the primary aim of the system was described as "protection of individuals, their progeny, and mankind as a whole while still allowing necessary activities from which radiation exposure might result". As a consequence, protection was constrained to avoid interfering with "necessary activities". This publication also introduced the three basic principles of radiological protection (justification of practice, optimisation of protection, and limitation of individual doses) and was the first attempt to introduce considerations about tolerability of risk to derive individual dose restrictions. In *Publication 60* (ICRP, 1991) the primary aim of the system was reformulated to focus more on balancing the potentially competing priorities of the benefits of protection from radiation and the benefits of the use of radiation, rather than on constraining protection: "to provide an appropriate standard of protection for man without unduly limiting the beneficial practices giving rise to radiation exposure".

2.3. A broader perspective: protecting the environment

(26) More recently the system also expanded from human to non-human species. *Publication 26* (ICRP, 1977) was the first to mention protection of the environment. However, it did not go beyond the assertion that "if man is adequately protected then other living things are also likely to be sufficiently protected". This statement, reworded, was repeated in *Publication 60* (ICRP, 1991) "the standards of environmental control needed to protect man to the degree currently thought desirable will ensure that other species are not put at risk".

(27) Over the next two decades there was a broad increase in environmental awareness, and a rise in societal expectations that protection of the environment must be assured rather than assumed. These ideas took hold globally following the 1992 Rio Declaration on Environment and Development (UNCED, 1992). Reflecting this shift, protection of the environment was treated more substantially in *Publication 91* (ICRP, 2003) which introduced the ICRP framework for assessing the impact of ionising radiation on non-human species.

(28) The elaboration of the framework included an explicit reflection on ethical values, touching on the different philosophical worldviews regarding how the environment is valued (i.e. anthropocentric, biocentric and ecocentric approaches) and presenting a selection of internationally agreed principles concerning environmental protection. These were sustainable development, conservation, preservation, maintenance of biological diversity, environmental justice, and human dignity. The publication also addressed procedural principles and operational strategies, including, amongst others, the precautionary principle, informed consent and stakeholder engagement.

2.4. Considering the diversity of exposure situations

(29) In recent decades, the system has been challenged by the widespread impact of the Chernobyl accident in 1986, the concern of malevolent acts following an increase in terrorist attacks during the last decade as well as the increasing awareness of the legacy of areas contaminated by past activities and of the exposure associated with natural sources of radiation. Later, the Fukushima Daiichi accident in 2011 has challenged the system again in much the same way.

(30) No doubt, the core of the system remains the protection of the public, workers, and the environment from radiation sources introduced deliberately in the medical, industrial and nuclear domains. Fortunately, these circumstances are usually well controlled. However other exposure situations are more difficult to control, leading to complex societal issues arising from the associated exposures. So, *Publication 103* (ICRP, 2007a) introduced the distinction between "existing exposure situations", "emergency exposure situations" and "planned exposure situations" to take account of the degree controllability of sources, exposure pathways and the exposures of people.

(31) This new framework better recognises the distinct natures and associated challenges of the exposure situations resulting from unexpected loss of control of planned sources or intentional misuse of a source, and from natural and man-made sources that exist before the decisions to control them are taken (e.g. cosmic radiation or legacy sites). A critical aspect of these situations is that the public may be faced with significantly higher exposure levels compared to those prevailing with planned sources and it is difficult to manage these situations without directly involving the affected people.

651 (32) As early as 1999, the importance of the participation of relevant stakeholders in making
652 decision about protection was recognised. However it was not until *Publication 103* in 2007
653 that it was explicitly introduced in the general recommendation as “the need to account for the
654 views and concerns of stakeholders when optimising protection” (ICRP, 2007a). This
655 recommendation was illustrated shortly thereafter in *Publication 111* (ICRP, 2009b) with the
656 introduction of self-help protection. This was to recognise the important role of stakeholder
657 participation in the management of post-accident situations in order for individuals to make
658 informed decisions in order to improve the radiological situation for themselves, their family,
659 and their community. Such an approach implies a certain level of autonomy of individuals,
660 relying on information, advice, and support from authorities and radiological protection experts.
661

662 2.5 The system of radiological protection today

663

664 (33) Today, the primary aim of the system remains "to contribute to an appropriate level of
665 protection for people and the environment against the detrimental effects of radiation exposure
666 without unduly limiting the desirable human actions that may be associated with such
667 exposure" (ICRP, 2007a). For human health, the system aims to "manage and control exposures
668 to ionising radiation so that deterministic effects are prevented, and the risks of stochastic
669 effects are reduced to the extent reasonably achievable". Put another way, effects that can be
670 prevented are prevented and effects where the risk cannot be prevented are managed through
671 optimisation of protection, together with the applicable dose restrictions. The current aim for
672 protection of the environment is to avoid having anything more than a "negligible impact on
673 the maintenance of biological diversity, the conservation of species, or the health and status of
674 natural habitats, communities and ecosystems".

675 (34) Serving these aims, the present radiological protection system encompasses three
676 fundamental principles to achieve its objectives:

677

- 678 • The principle of justification, which states that any decision that alters the exposure
679 situation should do more good than harm. This means that, by introducing a new
680 radiation source in planned exposure situations, or by reducing exposures in existing
681 and emergency exposure situations, one should achieve sufficient benefit to offset any
682 costs or negative consequences. The benefits are deemed to apply to society as a whole,
683 to specific individuals and also to biota.
- 684 • The principle of optimisation, which stipulates that all exposures should be kept as
685 low as reasonably achievable taking into account economic and societal factors. It is
686 a source-related process, aimed at achieving the best level of protection under the
687 prevailing circumstances through an ongoing, iterative process. This principle is the
688 cornerstone of the system of protection. Furthermore, in order to avoid inequitable
689 outcomes of the optimisation procedure the Commission recommends restricting
690 doses to individuals and biota from a particular source.
- 691 • The principle of limitation, which declares that individual exposures should not
692 exceed the dose limits recommended by the Commission, and applies only to planned
693 exposure situations other than medical exposure to patients or exposure of biota.

694

695 (35) These three fundamental principles of protection are central to the system and apply to
696 the different types of exposure situations (planned, emergency and existing) and categories of
697 exposure (occupational, public, medical exposure of patients and environmental).
698

699 **3. THE CORE ETHICAL VALUES UNDERPINNING THE SYSTEM OF**
700 **RADIOLOGICAL PROTECTION**

701
702 (36) As described in Section 2, although values were not explicitly referred to in ICRP
703 publications during the development of the principles of justification, optimisation and
704 limitation, they played a key role throughout. In retrospect, four core ethical values may be
705 identified that underpin the current system of radiological protection: beneficence/non-
706 maleficence, prudence, justice, and dignity. These are presented and discussed in the following
707 subsections.
708

709 **3.1. Beneficence and non-maleficence**
710

711 (37) Beneficence means promoting or doing good, and non-maleficence means avoiding
712 causation of harm (Frankena, 1963). These two related ethical values have a long history in
713 moral philosophy, dating back to the Hippocratic Oath, which demands that a physician do
714 good and/or not harm (Moody, 2011). They were formalised in modern medical ethics in the
715 late 1970s following the publication of the so-called Belmont report (DHEW, 1979) and the
716 related seminal work of philosophers Tom Beauchamp and Jim Childress (Beauchamp and
717 Childress, 1979). The Commission has not previously used these terms but doing good and
718 avoiding harm are central to the system of radiological protection.

719 (38) In its most general meaning beneficence includes non-maleficence (Ross, 1930).
720 Beneficence and non-maleficence can also be seen as two separate values. This publication
721 treats them as a single value. By developing recommendations seeking to protect people against
722 the harmful effects of radiation, the Commission undoubtedly contributes to serving the best
723 interest of individuals and indirectly the quality of social life. This is achieved in practice by
724 ensuring that deterministic effects are avoided and stochastic effects are reduced as far as
725 achievable given the prevailing circumstances. Non-maleficence is closely related to
726 prevention, which aims to limit risk by eliminating or reducing the likelihood of hazards, and
727 thus promote well-being.

728 (39) In a narrower sense, beneficence includes consideration of direct benefits, for
729 individuals, communities, and the environment. The use of radiation, although coupled with
730 certain risks, undoubtedly can have desirable consequences, such as the improvement of
731 diagnostics or therapy in medicine, or the production of electricity. These have to be weighed
732 against the harmful consequences.

733 (40) A key challenge for beneficence and non-maleficence is how to measure the benefits,
734 harms and risks. In radiological protection, this involves consideration of the direct health
735 impacts of radiation exposure in addition to economic costs and benefits. From the viewpoint
736 of evidence-based medicine and public health, a more comparative analysis of medical factors
737 that impact health is needed, including not only radiation but also other exposures. In addition,
738 a variety of social, psychological and cultural aspects need to be considered, and there may be
739 disagreement on what matters, or on how to value or weight these factors. Nevertheless, it is
740 recommended that such an assessment be transparent about what was included, recognise
741 disagreements where they arise, and go beyond a simple balancing of direct health impacts
742 against economic costs. In this respect, it is worth recalling the WHO definition of health:
743 "Health is a state of complete physical, mental and social well-being and not merely the absence

744 of disease or infirmity” (WHO, 1948). As discussed in Section 4, involvement of stakeholders
745 other than radiological protection experts is a key part of such a holistic assessment.

746 (41) An evaluation of beneficence and non-maleficence must also address the question of
747 who or what counts in evaluation of potential harms and benefits, including, for example, future
748 generations, non-humans and the environment. As mentioned previously, protection of the
749 environment is now included in the primary aim of the system in *Publication 103* (ICRP,
750 2007a). One could ask whether environmental harm is being avoided for the sake of people (an
751 anthropocentric view), or whether the environment is being protected for its own sake (a non-
752 anthropocentric approach) (ICRP, 2003). ICRP does not endorse any specific approach, and
753 considers both to be compatible with the value of beneficence and non-maleficence. In
754 *Publication 124* (ICRP, 2014a), it is recommended that evaluation of consequences of
755 management practices should include, and integrate, effects on both humans and the
756 environment, in order to ensure that the overall outcome produces more good than harm.
757

758 3.2. Prudence

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760 (42) Prudence is the ability to make informed and carefully considered choices without the
761 full knowledge of the scope and consequences of actions. It is also the ability to choose and act
762 on what is in our power to do and not to do. Prudence therefore has a direct relationship to
763 action and practice.

764 (43) Prudence has a long history in ethics. It is considered to be one of the main virtues
765 rooted in the Western tradition developed by Plato and Aristotle, the teaching of Confucius, the
766 Hindu and Buddhist philosophies, and the ancient traditions of the peoples of Eurasia, Oceania
767 and America. Originally prudence signifies “practical wisdom”, which is the meaning of the
768 Greek word “phronesis”. It describes the wisdom of a person who has the reasonableness and
769 morality to make practical decisions.

770 (44) The system of radiological protection is based on solid scientific evidence, however,
771 there are remaining uncertainties that necessitate value judgements. Decision-making requires
772 prudence as a central value. However, prudence should not be taken to be synonymous with
773 caution, conservatism or never taking risks. It describes the way in which decisions are made
774 and not solely the outcome of those decisions.

775 (45) It is worth noting that prudence appeared in the late fifties (ICRP, 1959) in the
776 Commission’s recommendations in relation with the uncertainties related to stochastic effects.
777 Since then it has been constantly reaffirmed in relation with the linear no-threshold (LNT)
778 model. Thus in *Publication 103* one can read: “The LNT model is not universally accepted as
779 biological truth, but rather, because we do not actually know what level of risk is associated
780 with very-low-dose exposure, it is considered to be a prudent judgement for public policy
781 aimed at avoiding unnecessary risk from exposure” (ICRP, 2007a).

782 (46) More specifically, the term prudence is explicitly used in connection with the different
783 types of effects of radiation exposure considered in the system:

- 784 • Deterministic effects - “It is prudent to take uncertainties in the current estimates of
785 thresholds for deterministic effects into account... Consequently, annual doses rising
786 towards 100 mSv will almost always justify the introduction of protective actions.”
787 (ICRP, 2007a).
- 788 • Stochastic effects in general - “At radiation doses below around 100 mSv in a year, the
789 increase in the incidence of stochastic effects is assumed by the Commission to occur

790 with a small probability and in proportion to the increase in radiation dose... The
791 Commission considers that the LNT model remains a prudent basis for radiological
792 protection at low doses and low dose rate.” (ICRP, 2007a).

793 • For heritable effects in particular - “There continues to be no direct evidence that
794 exposure of parents to radiation leads to excess heritable disease in offspring. However,
795 the Commission judges that there is compelling evidence that radiation causes heritable
796 effects in experimental animals. Therefore, the Commission prudently continues to
797 include the risk of heritable effects in its system of radiological protection.” (ICRP,
798 2007a).

799 (47) Policy makers generally do not refer to prudence. Instead reference is made to the
800 precautionary principle, which was popularised by the Rio Conference on environment and
801 development (UNCED, 1992). This principle has been much debated in connection with the
802 ethics of decision-making in recent years including in the domain of radiological protection
803 (Streffer et al., 2004).

804 (48) Neither prudence nor the precautionary principle should be interpreted as demanding
805 zero risk, choosing the least risky option, or requiring action just for the sake of action. The
806 experience of over half a century of radiological risk management using the optimisation
807 principle can be considered as a reasoned and pragmatic application of prudence and/or the
808 precautionary principle. Interestingly, the Commission mentions in its most recent
809 recommendations that the use of the LNT model remains a prudent basis for radiological
810 protection at low doses and low dose rates considered “to be the best practical approach to
811 managing risk from radiation exposure and commensurate with the ‘precautionary principle’”
812 (UNESCO, 2005; ICRP, 2007a).

813 (49) The implications of this prudent attitude have been significant for the subsequent
814 structuring of the system of radiological protection. A careful study of the evolution of the
815 Commission’s recommendations over the past decades shows that this central assumption led
816 to gradually shaping the system as it stands now (Lochard and Schieber, 2000). This is clearly
817 summarised by the Commission as follows: “The major policy implication of the LNT model
818 is that some finite risk, however small, must be assumed and a level of protection established
819 based on what is deemed acceptable. This leads to the Commission’s system of protection with
820 its three fundamental principles of protection.” (ICRP, 2007a).

821 (50) In addition, the adoption of a prudent attitude induces the duty of vigilance vis-à-vis the
822 effects of radiation, resulting in an obligation to monitor radiological conditions for humans
823 and biota. Specifically, prudence implies the obligation to conduct relevant research in an
824 attempt to reduce existing uncertainties (e.g. epidemiology, radiobiology, metrology,
825 radioecology). Furthermore, for humans, prudence implies support of the exposed population,
826 including if necessary to detect and treat possible pathologies induced by ionising radiation.

827

828

3.3. Justice

829

830 (51) Justice is usually defined as fairness in the distribution of advantages and disadvantages
831 among groups of people (distributive justice), fairness in compensation for losses (restorative
832 justice), and fairness in the rules and procedures in the processes of decision-making
833 (procedural justice). Whereas equity and inequity relate to the state of affairs in distribution of
834 goods, and fairness can be used to describe the degree of equity attained in this distribution.

835 (52) It must be emphasised that the Commission has not explicitly referred to justice in its
836 previous recommendations. However, the idea of limiting individual exposures in order to
837 correct possible disparities in the distribution of individual doses due to radiation among
838 exposed populations appeared as early as *Publication 26* (ICRP, 1977). In *Publication 60*, the
839 term inequity is used for the first time: “When the benefits and detriments do not have the same
840 distribution through the population, there is bound to be some inequity. Serious inequity can
841 be avoided by the attention paid to the protection of individuals.” (ICRP, 1991).

842 (53) Any exposure situation, whether natural or man-made, can result in a wide distribution
843 of individual exposures. In addition, the implementation of protection measures can also induce
844 potential distortions in this distribution that may aggravate inequities. In this context, the
845 protection criteria of the system of radiological protection play a dual role.

846 (54) First, radiological protection criteria aim to reduce inequities in the distribution of
847 individual exposures in situations where some individuals could be subject to much greater
848 exposures than the average. This restriction of individual exposures is done through the use of
849 dose constraints that apply to planned exposure situations, reference levels that apply to
850 existing and emergency exposure situations and derived consideration reference levels that
851 apply for the protection of fauna and flora. These dose criteria are integral parts of the
852 optimisation process and thus must be chosen depending on the prevailing circumstances by
853 those responsible for protection.

854 (55) The second role of protection criteria is to ensure that exposures do not exceed the
855 values beyond which the associated risk is considered as not tolerable given a particular context.
856 This is ensured through the application of dose limits recommended by the Commission for the
857 protection of workers and the public in planned exposure situations. As with dose constraints
858 and reference levels, dose limits are tools to restrict individual exposure in order to ensure
859 fairness in the distribution of risks across the exposed group of individuals. However, given the
860 predictable dimension of the planned exposure situations for which the radiation sources are
861 deliberately introduced by human action, the numerical values of dose limits, unlike dose
862 constraints and reference levels, are generally specified in legal instruments.

863 (56) Thus, through the protection criteria, the system of radiological protection aims to
864 ensure that the distribution of exposures in the society meets the two principles of social justice.
865 First, the principle of equity in the situations reflects the personal circumstances in which
866 individuals are involved. It is the role of dose constraints and reference levels to reduce the
867 range of exposure to individuals subject to the same exposure situation. Secondly, the principle
868 of equal rights guarantees equal treatment for all with regards higher levels of exposure. It is
869 the role of dose limits to ensure that all members of the public, and all occupationally exposed
870 workers, do not exceed the level of risk deemed tolerable by society and recognised in law
871 (Hansson, 2007).

872 (57) Recognition of the right of citizens to participate in decision-making processes is an
873 important aspect of procedural justice, and linked to stakeholder engagement and participation.
874 In environmental justice, this has been ratified in the Århus Convention on Access to
875 Information, Public Participation in Decision-making and Access to Justice in Environmental
876 Matters (UNECE, 2001). There are of course still challenges in achieving this in practice, and
877 stakeholder participation is discussed in more detail in Section 4.

878 (58) Intergenerational justice has been addressed by the Commission for the management of
879 radioactive waste with reference to “precautionary principle and sustainable development in
880 order to preserve the health and environment of future generations” (ICRP, 2013, §14). In
881 *Publication 81*, the Commission recommends that ‘individuals and populations in the future

882 should be afforded at least the same level of protection as the current generation’ (ICRP, 1998,
883 §40). In *Publication 122*, the Commission introduces responsibilities towards future
884 generations in terms of providing the means to deal with their protection: “... the obligations
885 of the present generation towards the future generation are complex, involving, for instance,
886 not only issues of safety and protection but also transfer of knowledge and resources.” (ICRP,
887 2013, §17).
888

889 3.4. Dignity

890
891 (59) Dignity is an attribute of the human condition: the idea that something is due to a person
892 because she/he is human. This means that every individual deserves unconditional respect,
893 whatever age, sex, health, social condition, ethnic origin and/or religion. This idea has a
894 prominent place in the Universal Declaration of Human Rights, which states that “All human
895 beings are born free and equal in dignity and rights.” (United Nations, 1948). Dignity has a
896 long history as the central value in many ethical theories, including Kant’s notion to treat
897 individuals as subjects, not objects: “Act in such a way that you treat humanity, whether in your
898 own person or in the person of any other, never merely as a means to an end, but always at the
899 same time as an end.” (Kant, 1785). Personal autonomy is a corollary of human dignity. This
900 is the idea that individuals have the capacity to act freely (i.e. to make uncoerced and informed
901 decisions).

902 (60) Respect for human dignity was first specifically promoted in radiological protection
903 with regard to the principle of “informed consent” in biomedical research, which is the idea
904 that a person has “the right to accept the risk voluntarily” and “an equal right to refuse to accept”
905 (ICRP, 1992). The concepts of “informed consent” and “right to know” were clearly established
906 in *Publication 84* on pregnancy and medical radiation (ICRP, 2000). Beyond the medical field,
907 human dignity was explicitly introduced as recognising “the need for the respect of individual
908 human rights and for the consequent range of human views” in the elaboration of the ICRP
909 framework for the protection of the environment (ICRP, 2003). The Commission has also
910 emphasised the promotion of autonomy through stakeholder involvement (e.g. ICRP, 2007a)
911 and empowerment of individuals to make informed decisions, whether, for example,
912 confronted with contaminated land (e.g. ICRP, 2009b), to security screening in airports (ICRP,
913 2014b) to radon in their homes (ICRP, 2014c) or to cosmic radiation in aviation (ICRP, 2016).
914 The system of radiological protection thus actively respects dignity and promotion of the
915 autonomy of people facing radioactivity in their daily lives. It is worth noting that the
916 promotion of dignity is also related to a set of procedural ethical values (accountability,
917 transparency, and stakeholder participation), developed in Section 4, which are linked to the
918 practical implementation of the system of radiological protection.

919 3.5. The relationship between the core ethical values and the fundamental principles

920
921 (61) The four core ethical values permeate the current system of radiological protection, but
922 their relationship with the three principles of justification, optimisation and limitation is not
923 straightforward. This is not so much the case for justification, which can be understood as
924 mainly, though not exclusively, referring to beneficence/non-maleficence, or rather the
925 balancing of “doing good” and “avoiding harm”. When it comes to dose limitation (i.e. to
926 maintain risk at a tolerable level) and optimisation (i.e. to keep exposure as low as reasonably

927 achievable taking into account economic and societal factors), these principles depend upon
928 several of the core ethical values.

929 (62) The two key concepts of reasonableness and tolerability, which are central to the second
930 and third principle, respectively, specify how the radiation risk is managed by combining and
931 balancing the core ethical values (Schneider et al., 2016).

932 (63) The concept of tolerability is present from the early publications of the Commission
933 (ICRP, 1959). In *Publication 60*, a conceptual framework was introduced which allows one to
934 determine the degree of tolerability of an exposure (or of the associated risk) and thus,
935 depending on the category of exposure (public or occupational), to distinguish between
936 unacceptable and tolerable levels of exposure (ICRP, 1991). In *Publication 103*, tolerability is
937 referred specifically in each type of exposure situation taking into account not only the risk
938 associated with exposure (and the related value of non-maleficence), but also the practicality
939 of reducing or preventing the exposures (prudence and beneficence), the benefits from the
940 exposure situation to individuals and society (beneficence and justice) as well as other societal
941 criteria (justice and dignity) (ICRP, 2007a).

942 (64) The concept of reasonableness can be traced back to the 1950s when the Commission
943 recommended that ‘it is highly desirable to keep the exposure of large populations at as low a
944 level as practicable’ (ICRP, 1959). This recommendation evolved into the Commission’s
945 introduction of the optimisation principle two decades later (ICRP, 1977). There was first an
946 attempt to define reasonableness using a quantitative approach such as cost-benefit analysis
947 (ICRP, 1983). Later on, the search for reasonableness gradually led to recognise that
948 quantification alone was insufficient to reflect justice, both as fairness in the distribution of
949 individual doses and as consideration for the concerns and views of stakeholders.

950 (65) Applying the principles of radiological protection is a permanent quest for decisions
951 that relies on the core ethical values underlying the system of radiological protection, that is to
952 say do more good than harm, avoid unnecessary risk, establish a fair distribution of exposures
953 and treat people with respect (Lochard, 2016). In this pursuit, the two concepts of tolerability
954 and reasonableness, although supported by quantitative methods, definitively remain of a
955 deliberative nature.

956

957

4. PROCEDURAL VALUES

958 (66) For the practical implementation of its recommendations, the Commission sets out a
959 number of requirements relating to the procedural and organisational aspects of radiological
960 protection. It does not go into details, but merely lays down some broad standards, leaving to
961 other international organisations the task of developing them (IAEA, 2014). Three of these
962 requirements deserve to be highlighted because they are common to all exposure situations:
963 accountability, transparency and inclusiveness (stakeholder participation). All three have
964 strong ethical aspects, which will be considered in this section. It is also important to recognise
965 that these procedural values are interrelated.
966

967

4.1. Accountability

968

969 (67) Accountability can be defined as the procedural ethical value that people who are in
970 charge of decision-making must answer for their actions to all those who are likely to be
971 affected by these actions. In terms of governance this means the obligation of individuals or
972 organisations to report on their activities, to accept responsibility, and to be ready to account
973 for the consequences if necessary. The concept of accountability explicitly appeared in
974 *Publication 60* (ICRP, 1991) and then reaffirmed in much the same terms in *Publication 103*
975 (ICRP, 2007a). Addressing the implementation of the recommendations and in considering
976 organisational features: “In all organisations, the responsibilities and the associated authority
977 are delegated to an extent depending on the complexity of the duties involved. (...). There
978 should be a clear line of accountability running right to the top of each organisation. (...) Advisory and regulatory authorities should be held accountable for the advice they give and any requirements they impose”.

981 (68) The Commission also considered the accountability of the present generation to future
982 generations, which is explicitly mentioned in *Publications 77* (ICRP, 1997b), *81* (ICRP, 1998),
983 *91* (ICRP, 2003) and *122* (ICRP, 2013) related to waste management and the protection of the
984 environment. As an example, *Publication 122* §17 states “... the obligations of the present
985 generation towards the future generation are complex, involving, for instance, not only issues
986 of safety and protection but also transfer of knowledge and resources. Due to the technical and
987 scientific uncertainties, and the evolution of society in the long term, it is generally
988 acknowledged that the present generation is not able to ensure that societal action will be taken
989 in the future, but needs to provide the means for future generations to cope with these issues”
990 (ICRP, 2013). Accountability in this context is part of implementing the value of
991 intergenerational justice discussed in Section 3.
992

993

4.2. Transparency

994

995 (69) Similarly, transparency is part of implementing the value of procedural justice. It
996 concerns the fairness of the process through which information is intentionally shared between
997 individuals and/or organisations. According to the International Standards Organisation (ISO),
998 transparency means “openness about decisions and activities that affect society, the economy
999 and the environment, and willingness to communicate these in a clear, accurate, timely, honest
1000 and complete manner” (ISO, 2010). Transparency does not simply mean communication or

1001 consultation. It relates to the accessibility of information about the activities, deliberations, and
1002 decisions at stake and also the honesty with which this information is transmitted. It is part of
1003 corporate social responsibility, ensuring that decision-makers act responsibly in the social,
1004 economic and environmental domains in the interest of individuals and groups concerned.
1005 Clearly, security or economic reasons can be put forward to justify the control or limitation of
1006 outgoing information from a business or an organisation. This is why explicit procedures must
1007 be in place, and expectations made clear, from the outset to allow for good transparency
1008 (Oughton, 2008).

1009 (70) Transparency on exposures and protection actions for the workers has been integrated
1010 into ICRP recommendations since the 1960s. One can thus read: “Workers should be suitably
1011 informed of the radiation hazard entailed by their work and of the precautions to be taken.”
1012 (ICRP, 1966). This requisite has since been expanded in subsequent recommendations (ICRP,
1013 1991, 2007a). It was not, however, until the 2000s that transparency became a general principle
1014 applicable not only to information about exposures but also on the decision-making processes
1015 concerning the choices of protective actions by policy makers. Moreover it was generalised to
1016 all categories of exposure: occupational, patients, members of the public, and the environment.
1017 This was introduced for the first time in *Publication 101b* dedicated to the optimisation of
1018 protection and bearing the evocative subtitle ‘Broadening the process’: “Due to its judgemental
1019 nature, there is a strong need for transparency of the optimisation process. All the data,
1020 parameters, assumptions, and values that enter into the process must be presented and defined
1021 very clearly. This transparency assumes that all relevant information is provided to the involved
1022 parties, and that the traceability of the decision-making process is documented properly, aiming
1023 for an informed decision.” (ICRP, 2006).

1024 (71) In practice, transparency depends on the category of exposure and the type of exposure
1025 situation. In the medical field, it is implemented according to different modalities and
1026 procedures based on categories e.g. through training for workers (ICRP, 1997a) and informed
1027 consent in the medical field (ICRP, 1992, 2007b). It also appears as the right to know principle
1028 for the public in the case of security screening for example (ICRP, 2014b). In its latest
1029 recommendations, the Commission emphasised that “... scientific estimations and value
1030 judgements should be made clear whenever possible, so as to increase the transparency, and
1031 thus the understanding, of how decisions have been reached.” (ICRP, 2007a). This shows that
1032 the requisite of transparency should apply wherever value judgements are involved in the
1033 system of radiological protection.

1034 (72) Informed consent has been well-developed in the context of medical ethics, for example
1035 biomedical research, radiotherapy or interventional radiology, but is also important outside of
1036 the medical field. Prerequisite elements of informed consent include information (which should
1037 be appropriate and sufficient), comprehension, and voluntariness (avoiding undue influence),
1038 which is associated with the right of refusal and withdrawal (without any detriment). Almost
1039 all of these elements were described in *Publication 62* on biomedical research: “The subject
1040 has the right to accept the risk voluntarily, and has an equal right to refuse to accept.”; “By free
1041 and informed consent is meant genuine consent, freely given, with a proper understanding of
1042 the nature and consequence of what is proposed, ...”, also mentioning that “consent can be
1043 withdrawn at any time by the subjects.” (ICRP, 1992). In *Publication 84* on pregnancy and
1044 medical radiation, informed consent is regarded as ‘doctrine’ and ‘five basic elements’ were
1045 described as “competent to act, receives a thorough disclosure, comprehends the disclosure,
1046 act voluntarily, and consents to the intervention.” (ICRP, 2000). For vulnerable people with

1047 diminished competency; under undue influence; and for pregnant women, additional protection
1048 both in terms of consent and strict risk benefit assessment is required (ICRP, 1992, 2000).

1049 (73) The right to know is another important concept related to transparency. It emerged in
1050 the USA in the 1970s in connection with the efforts of the Federal Occupational Safety and
1051 Health Administration (OSHA) to ensure that workers benefit from safe and healthy working
1052 environments. It has evolved to be defined as a requirement to disclose full information on
1053 hazardous materials disposed, emitted, produced, stored, used or simply present in working
1054 places or the environment of communities (e.g. radon, NORM) (ICRP, 2007b, 2014b, 2016).

1055 (74) In publications on environmental protection (ICRP, 2003, 2014a) transparency, which
1056 enables social control and vigilance of the public, is also emphasised. “The principle of
1057 informed consent, which emphasises the need for communication and public involvement,
1058 starts at the planning stage and well before decisions are taken from which there is no return.
1059 Such transparency of decision-making should enable analysis and understanding of all
1060 stakeholders’ arguments, although decisions against certain stakeholders may not be avoided.
1061 Transparency is usually secured by way of an environmental impact assessment.” (ICRP, 2003).

1062 (75) Finally, transparency and accountability can be mutually reinforcing. Together they
1063 allow citizens to be aware of up-to-date information required to make informed decisions and
1064 also to possibly participate in the decision-making process. These two procedural ethical values
1065 tend to gradually be generalised in all fields and become a key part of a good governance policy
1066 in organisations.

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4.3 Inclusiveness (Stakeholder participation)

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1070 (76) The value of inclusiveness is usually referred to using the phrase stakeholder
1071 participation, which is the way the value is operationalised. Stakeholder participation, also
1072 referred to as stakeholder involvement or engagement, means “involving all relevant parties in
1073 the decision-making processes related to radiological protection” (IRPA, 2008). In recent
1074 decades, stakeholder participation has become an essential part of the ethical framework in
1075 private and public sector organisations. Thus inclusiveness is one of the essential procedural
1076 values, along with transparency and accountability, needed to make ethical decisions in
1077 organisations. Most likely it was Lauriston Taylor who first suggested engaging with
1078 stakeholders in radiological protection. In the Sievert Lecture he gave in 1980 one can read:
1079 “Aside from our experienced scientists, trained in radiation protection, where do we look
1080 further for our supply of wisdom? Personally, I feel strongly that we must turn to the much
1081 larger group of citizens generally, most of whom have to be regarded as well-meaning and
1082 sincere, but rarely well-informed about the radiation problems that they have to deal with.
1083 Nevertheless, collectively or as individuals, they can be of great value ... in developing our
1084 total radiation protection philosophy.” (Taylor, 1980).

1085 (77) Engaging stakeholders in radiological protection emerged in the late 1980s and early
1086 1990s in the context of the management of exposures in area contaminated by the Chernobyl
1087 accident and sites contaminated by past nuclear activities in United States (IAEA, 2000).
1088 Citizens found themselves directly confronted with radioactivity in everyday life, and these
1089 situations posed new questions that the system in place at the time had difficulty in answering.
1090 This in turn led the Commission to replace the process-based approach of using practices and
1091 interventions to a situation-based approach with the distinction between existing, planned and
1092 emergency exposure situations (ICRP, 2007a).

1093 (78) Stakeholder participation was first introduced by ICRP in *Publication 82* - “Many
1094 situations of prolonged exposure are integrated into the human habitat and the Commission
1095 anticipates that the decision-making process will include the participation of relevant
1096 stakeholders rather than radiological protection specialists alone.” (ICRP, 1999) and was
1097 further elaborated in *Publication 101b* – “The involvement of stakeholders is a proven means
1098 to achieve incorporation of values into the decision-making process, improvement of the
1099 substantive quality of decisions, resolution of conflicts among competing interests, building of
1100 shared understanding with both workers and the public, and building of trust in institutions.”
1101 (ICRP, 2006), and became a requisite in *Publication 103* in relation to the principle of
1102 optimisation of protection - “It should also be noted that the Commission mentions, for the first
1103 time, the need to account for the views and concerns of stakeholders when optimising
1104 protection.” (ICRP, 2007a).

1105 (79) Engaging stakeholders in the decision-making process related to optimisation is an
1106 effective way to take into account their concerns and expectations as well as the prevailing
1107 circumstances of the exposure situation. This in turn enables adoption of more effective,
1108 sustainable, and fair protection actions promoting empowerment and autonomy of stakeholders
1109 especially in situations where they must live with radiation. Experience from the management
1110 of the consequences of the Chernobyl accident, and more recently the Fukushima accident
1111 demonstrated that empowerment of affected people helps them to regain confidence, to
1112 understand the situation they are confronted with, and finally to make informed decisions and
1113 act accordingly. In other words, engaging stakeholders is a way to respect those affected, and
1114 in the case of post-accident situations, to help restore their dignity (Lochard, 2004; ICRP,
1115 2015a).

1116 (80) In most existing exposure situations, it is the responsibility of experts and authorities to
1117 ensure fair support of all groups of exposed people. Fairness in this respect refers to the core
1118 values of justice and dignity. The requirement to be treated fairly is a key condition for those
1119 desiring to enter into a dialogue with the authorities with the objective to promote well-being
1120 and self-determination. This dialogue with experts allows citizens to better understand their
1121 individual situations and helps empower them to make informed decisions. This empowerment
1122 process relies on the development of ‘practical radiological protection culture’ among
1123 individuals and communities. This last notion was introduced in *Publication III*, which is
1124 devoted to the protection of people living in long-term contaminated areas after a nuclear
1125 accident (ICRP, 2009b). Practical radiological protection culture can be defined as the
1126 knowledge and skills enabling each citizen to make well-informed choices and behave wisely
1127 when directly confronted with radiation. It is a duty of radiological protection professionals to
1128 support making these choices using science and experience in the spirit of the core ethical
1129 values that underlie the system of radiological protection (ICRP, 2009b).

1130 (81) A recent ICRP publication on protection of the environment gives explicit procedural
1131 recommendations for effectively involving stakeholders: “Guidelines should be established at
1132 the beginning to ensure that the process is effective and meaningful for all parties” and that
1133 “Some of these guidelines include, but are not limited to the following: clear definition of the
1134 role of stakeholders at the beginning of the process; agreement on a plan for involvement;
1135 provision of a mechanism for documenting and responding to stakeholder involvement; and
1136 recognition, by operators and regulators, that stakeholder involvement can be complex and can
1137 require additional resources to implement.” (ICRP, 2014a).

1138

5. CONCLUSION

1139 (82) The system of radiological protection is based on three pillars: science, ethics, and
1140 experience. As far as ethics is concerned, this publication portrays the system as relying on
1141 four core ethical values: beneficence/non-maleficence, prudence, justice and dignity.
1142 Beneficence and non-maleficence are directly related to the aim of preventing or reducing
1143 effects for humans and the environment. Prudence allows taking into account uncertainties
1144 concerning these effects. Justice is the way to ensure social equity and fairness in decisions
1145 related to protection. Dignity is to take into account the respect that one must have for people.

1146 (83) The principle of justification requires that any decision that alters a radiation exposure
1147 situation should do more good than harm. This means that, by reducing existing exposure or
1148 introducing a new radiation sources the achieved benefit to individuals and the society should
1149 be greater than the associated disadvantages in terms of radiation risk but also of any other
1150 nature. Thus, the justification principle combines the ethical values of beneficence and non-
1151 maleficence but also prudence since part of the estimated detriment may be associated with
1152 hypothetical stochastic effects given the no threshold assumption.

1153 (84) The principle of optimisation of protection, in turn, requires that all exposures should
1154 be kept as low as reasonably achievable taking into account economic and societal factors using
1155 restrictions on individual exposures to reduce inequities in the distribution of exposures among
1156 exposed groups. This is the cornerstone of the system. On the one hand, it is a principle of
1157 action, which allows the practical implementation of prudence. On the other hand, it also allows
1158 the introduction of equity, or fairness in the distribution of exposures among people exposed
1159 which refers directly to the ethical value of justice. Ultimately, taking into consideration the
1160 particular circumstances in which people are exposed as well as their concerns and expectations,
1161 the principle of optimisation respects people and treats them with dignity.

1162 (85) Finally, the principle of limitation requires that all individual exposures do not exceed
1163 the protection criteria recommended by the Commission. Like the principle of optimisation, it
1164 refers directly to the ethical values of prudence but more so to justice by restricting the risk in
1165 an equitable manner for a given exposure situation and category of exposure.

1166 (86) The application of the three principles will depend on the exposure situations and the
1167 category of exposure, particularly in medical exposure. Dose limits for example do not apply
1168 to medical exposures because the balance of the risk and the benefit is specific to the patient in
1169 order to provide the best "margin of benefit over harm". However, equity is also part of the
1170 medical practice through the use of diagnostic reference levels aiming at reducing the
1171 frequency of unjustified high or low exposure for a specified medical imaging task. In reality,
1172 the ethical considerations are more complex, as there is also potential for benefit and harm to
1173 others, most notably to the medical staff who also receive some dose, and others such as family
1174 and friends who may receive some dose depending on the type of procedure and who might
1175 also gain an indirect benefit derived from the medical benefit to the patient.

1176 (87) Integrated into the three structuring principles of justification, optimisation and
1177 limitation, the core ethical values allow people to act virtuously while taking into account the
1178 uncertainties associated with the effects of low dose and to evaluate the criteria for judging the
1179 adequacy of these actions. In practice, the search for reasonable levels of protection (the
1180 principle of optimisation) and tolerable exposure levels (the principle of limitation) is a
1181 permanent questioning which depends on the prevailing circumstances in order to act wisely
1182 i.e. with the desire to do more good than harm (beneficence/non-maleficence), to avoid

1183 unnecessary exposure (prudence), to seek for fair distribution of exposures (justice) and to treat
1184 people with respect (dignity).

1185 (88) The system of radiological protection has also integrated procedural values, particularly
1186 accountability, transparency and inclusiveness, reflecting the importance of allocating
1187 responsibilities to those involved in the radiological protection process, to properly inform, and
1188 also to preserve the autonomy and dignity of the individuals potentially or actually exposed to
1189 radiation.

1190 (89) Until now the basic aim of the system of radiological protection for humans was to
1191 prevent deterministic effects and reduce stochastic ones to reasonably achievable levels taking
1192 into account economic and societal considerations. Recent developments have suggested
1193 enlarging this aim to the individual and collective well-being of exposed people to also include
1194 mental and social aspects. This is particularly the case for the management of post-accident
1195 situation as stated in *Publication 111* (ICRP, 2009b, § 23) with the objective to improve the
1196 daily life of exposed individuals.

1197 (90) The inclusion of natural or man-made radiation in existing exposure situations in the
1198 latest recommendations of the Commission have also highlighted the need to foster the
1199 development of an appropriate radiological protection culture within society, enabling each
1200 citizen to make well-informed choices and behave wisely in situations involving potential or
1201 actual exposure to ionising radiation.

1202 (91) Furthermore, the Commission is also concerned with protection of the
1203 environment. Starting with *Publication 91* (ICRP, 2003), a framework has been developed
1204 within which the environment can be considered. The Commission considers now that a
1205 holistic and integrated view of all the benefits and impacts that may result from the introduction
1206 of a new source in planned exposure situations, or consideration of actions in existing and
1207 emergency exposure situations, should include appropriate consideration of protection of both
1208 people and the environment. The Commission's actions are both consistent with, and
1209 supportive of the global desire for sustainable development (United Nations, 2016).

1210 (92) The primary goal and responsibility of the Commission should rest on developing the
1211 science of radiological protection for the public benefit. Nevertheless, the Commission believes
1212 that by eliciting and diffusing the ethical values and related principles that underpin the
1213 radiological protection system both experts and the public will undoubtedly gain a clearer view
1214 of the societal implications of its recommendations. Just as with science, ethics alone is unable
1215 to provide a definitive solution to the questions and dilemmas generated by the use or presence
1216 of radiation. However, ethics certainly can provide useful insights on the principles and
1217 philosophy of radiological protection and thus help the dialogue between experts and citizens.
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ANNEX A. ETHICAL THEORIES

1220 (A 1) This annex provides a brief summary of some of the theories of ethics which have
1221 been referred to in exploring the ethical foundation of the radiological protection system. These
1222 theories can be characterised as “Western”, from ancient Greek to modern German and British
1223 philosophy.

1224 (A 2) Understanding the main points of these theories may help to track some of the conflicts
1225 or dilemmas, which occur in practical radiological protection. Of course, understanding certain
1226 theories does not in itself provide a solution to an issue, and the Commission has never taken
1227 a position of preferring one theory over another. Nonetheless, knowledge of these theories may
1228 facilitate mutual understanding among people advancing different arguments.

1229 (A 3) Ethics is a discipline of philosophy, which discusses virtue and vice (character), good
1230 and bad (quality), or right and wrong (action). The terms “ethics” and “moral philosophy” are
1231 largely used to describe the same exercise. The origin of the former is Greek, that of the latter
1232 Latin. “Morals” is sometimes used to describe culturally and religiously based values and
1233 norms.

1234 (A 4) There are three main levels of ethical theory often referred to in discussions of
1235 radiological protection: Meta-ethics (discussing the general meaning of ideas such as “virtue”,
1236 “good”, or “right”), Normative ethics (discussing how one should act, and which values and
1237 norms should be followed), and Applied ethics (discussing specific issues, e.g. in medicine or
1238 engineering, based on ethical theories or principles).

1239 (A 5) Within normative ethics we can in turn identify three main theories that have been
1240 used to discuss the radiological protection system and these are: Virtue ethics (discussing
1241 virtuous life based on a certain concept of human nature); Deontological ethics (discussing a
1242 set of obligations or rules for human society); and Consequentialist ethics (discussing the
1243 preferability of certain actions on the basis of their outcomes).

1244 (A 6) The ethics of radiological protection has some affinity with other fields of applied
1245 ethics, such as biomedical ethics (see Annex B), environmental ethics, engineering ethics, etc.
1246 The literature on these topics is quite diverse, but only a few publications of ICRP address
1247 similar questions with respect to radiation [e.g. *Publications 62* (ICRP, 1992) and *91* (ICRP,
1248 2003)].

1249 (A 7) There is one ICRP publication [*Publication 109* (ICRP, 2009a)] which provides an
1250 analysis of the recommendations of the Commission from its beginning and comes to the
1251 conclusion that they focused primarily on three theories of ethics: (1) early recommendations
1252 (1928–1950s) focusing on virtue ethics; (2) intermediate recommendations (1960s–70s)
1253 focusing on utilitarian ethics (the most well-known version of consequentialism); and (3)
1254 present recommendations (80s to present) focusing on deontological ethics. The intention of
1255 this analysis is to emphasise the balance which needs to be reached among these theories for
1256 the practical implementation of radiological protection.

1257 (A 8) Following is a short summary of how the three theories of normative ethics are related
1258 to radiological protection.

1259 (A 9) Virtue ethics: Representatives of this theory are the ancient Greek philosophers Plato
1260 (BC427–347) and Aristotle (BC384–322). They based their reasoning on the moral nature or
1261 characteristics of the human being rather than on rules or obligations. Good is what a good or
1262 virtuous person would do. If you consider deterministic radiation effects for instance, this idea
1263 can be simply linked to human nature, which tends to avoid harm. More generally, the
1264 “justification” principle of radiological protection can be understood as expressing the same

1265 idea, as it relies on human nature not only avoiding harm, but also doing good. In other words,
1266 it is the right motivation of a human following his or her moral nature that leads to the right
1267 action (Hansson, 2007).

1268 (A 10) Consequentialist ethics: The most well-known version of consequentialism is
1269 utilitarianism and the representatives of this theory are the English scholars Jeremy Bentham
1270 (1748–1832) and John Stuart Mill (1806–1873). They maintained that the only valid criterion
1271 of the goodness of an act or a rule is its good consequences, rather than the good nature of a
1272 human being or obligations in human society. The most well-known notion of utilitarianism is
1273 that we should strive for “the greatest happiness of the greatest number”. The “optimisation”
1274 principle is often linked to this utilitarian approach, as it seeks to keep radiation exposures “as
1275 low as reasonably achievable, taking into account economic and societal factors”. This
1276 principle is associated with the risk of stochastic effects, especially at low doses. In the past, it
1277 has often been understood to suggest decision-making based on cost-benefit analysis to
1278 calculate the greatest financial gain for society, while allowing only the smallest sacrifice of
1279 individuals. Consequentialist ethics does not always seek to maximise collective gain, but it is
1280 sometimes used to balance risk and benefit for an individual.

1281 (A 11) Deontological ethics: A very important representative of this theory is the German
1282 philosopher Immanuel Kant (1724–1804). Kant argued that human beings possess a rational
1283 nature and have the capacity of self-regulation, which is called autonomy. Good will leads them
1284 to act according to their duty, or the moral law. Kant asserted that one should not treat human
1285 beings merely as means to an end, but rather as ends in themselves. This means that we should
1286 not sacrifice an individual to achieve “the greatest happiness of the greatest number”. At the
1287 same time, it means that we should respect every individual’s free choice. Another version of
1288 deontological ethics discussed in radiological protection is the one developed by the Scottish
1289 philosopher William David Ross (1877–1971). He is well-known as a translator of Aristotle’s
1290 works and wrote much about Greek philosophy, so it is not surprising that his theory also
1291 includes some elements from virtue ethics. Ross provided a set of prima-facie duties (fidelity,
1292 reparation, gratitude, non-maleficence, justice, beneficence, self-improvement) which help
1293 determine what a person ought to do, with the proviso that one or the other may take precedence
1294 in a particular situation. As regards to the principles of radiological protection, “limitation” can
1295 be directly linked to deontological ethics. This notably applies to the idea that individuals need
1296 to be protected in an equitable manner and therefore limits should be set to avoid sacrificing
1297 one person for the sake of others. In addition, “stakeholder involvement” in the decision-
1298 making process is based on respecting each person’s human dignity. Therefore, the idea that
1299 radiological protection today has come to rely more heavily on deontological ethics cannot be
1300 denied, although deriving the principles of radiological protection from Western ethical
1301 theories still requires referring to virtue ethics and utilitarianism as well. In practice the
1302 different perspectives of all three theories have to be brought to bear.

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ANNEX B. BIOMEDICAL ETHICAL PRINCIPLES

1305 (B 1) Much of the discussion about the ethics in radiological protection referred to the three
1306 theories of normative ethics mentioned in Annex A, but there is also some reference to applied
1307 ethics. One of the most widely discussed frameworks in applied ethics is the one developed by
1308 Beauchamp and Childress in 1979 on biomedical ethics. Their initial aim was to find principles
1309 that the former as a utilitarian and the latter as a deontologist could agree to without referring
1310 to a particular single theory of ethics. The resultant system is not based on one unique ethical
1311 framework, but on four principles:

- 1312 • Respect for autonomy (the norm of allowing individuals to decide for themselves)
- 1313 • Non-maleficence (the norm of avoiding the causation of harm)
- 1314 • Beneficence (a group of norms for providing benefits)
- 1315 • Justice (a group of norms for distributing benefits, risks and costs fairly)

1316 (B 2) Beauchamp and Childress argued that both the utilitarian and the deontologist could
1317 fully agree with all four principles, and would find them ethically and morally relevant, albeit
1318 for different reasons. Some discussion may arise when it comes to balancing these principles:
1319 deontologists tend to prioritise “non-maleficence” over “beneficence”, whereas utilitarians
1320 would rather carry out a cost-benefit assessment, maximising benefit and minimising harm.
1321 The Belmont Report (DHEW, 1979) issued by the United States National Commission for the
1322 Protection of Human Subjects of Biomedical and Behavioral Research took on a similar style
1323 and suggested three principles of ethics for research involving human subjects: respect for
1324 persons (instead of autonomy); beneficence (including non-maleficence as a component); and
1325 justice. Beauchamp was one of the main contributors of the Belmont Report.

1326 (B 3) These three or four principles have come to be known as principles of “bioethics”, which
1327 have emerged in the 1960s to 1970s in the United States. These principles have also been
1328 widely adopted in other areas as well, including public and environmental health ethics
1329 (Seedhouse, 1988), technology assessment (Forsberg, 2004), firefighting ethics (Sandin, 2009)
1330 and, within radiological protection, as the basis of an ethical evaluation of remediation
1331 strategies (Oughton et al., 2003).

1332 (B 4) The framework was not originally conceived as a cross-cultural kind of ethics. When
1333 Beauchamp and Childress introduced the term, they just claimed that “all morally serious
1334 persons” (Beauchamp and Childress, 1994), or in a later version subsequently “all persons
1335 committed to morality” (Beauchamp and Childress, 2009), would agree with their four
1336 principles. Only with time they developed the notion that the principles could be rooted in
1337 “common morality”, which is “not relative to cultures or individuals, because it transcends
1338 both” (Beauchamp and Childress, 2009). Attempts have been made to show that the principles
1339 of biomedical ethics can indeed be traced in various cultural, religious, and philosophical
1340 contexts around the world, in particular in their most respected written and oral traditions
1341 (Zölzer, 2013).

1342 (B 5) In this context, of course, arguments against commonality and for cultural variety have
1343 also been put forward. Reflecting the prominent status which these principles have gained, a
1344 number of criticisms have been brought to bear against the “Georgetown Mantra” (so called
1345 because this set of principles was generated at the Georgetown University). We can classify
1346 these criticisms in two types: Some argue that the three or four principles tend to be used
1347 somewhat casually for the analysis of complicated issues without deep deliberation about the
1348 situation which an individual may be confronted with. Critics coming from that perspective

1349 prefer to consider each case by means of a situation-based or narrative approach rather than
1350 one based on principles.

1351 (B 6) Another criticism is that although these principles are contained in Western as well as
1352 non-Western theories, there are some differences. For example, “Autonomy” emphasises the
1353 individual’s right of self-determination for Westerners, but many non-Westerners will prefer
1354 “related autonomy” (Kimura, 2014) such as family or community-based decision-making
1355 (Akabayashi, 2014). Also, “justice” is largely understood as equity in the West, but in some
1356 non-Western cultural contexts equal rights have not been widely established because of a
1357 traditional concern about social hierarchy.

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ANNEX C. CROSS-CULTURAL VALUES

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C.1. The rise of global ethics

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(C 1) Global approaches to questions of values and norms may seem to be fraught with difficulties, but the fact is that people around the world are moving closer and closer together and there is a growing need for common perspectives. A milestone in this development was certainly the “Universal Declaration of Human Rights” adopted by the United Nations General Assembly in 1948 (United Nations, 1948). This was a vow of the international community never again to allow such atrocities as happened during World War II, caused in part because of a lack of shared values and norms among people. It led to two multilateral treaties, the International Covenants on Civil and Political Rights and on Economical, Social and Cultural Rights (United Nations, 1966). In the second half of the 20th century and especially around the turn of the 21st, a number of other international statements on human rights followed, as shown in Table C.1.

Table C.1. A few milestones in the development of global values and norms.

1948	Universal Declaration of Human Rights
1959	Declaration of the Rights of the Child
1966	International Covenant on Civil and Political Rights
1966	International Covenant on Economical, Social and Cultural Rights
1972	Declaration on Human Environment
1992	Declaration on Environment and Development (UNESCO)
1997	Universal Declaration on the Human Genome and Human Rights
2005	Universal Declaration on Bioethics and Human Rights

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(C 2) It should be noted that there are still many countries in the world that have not ratified all of the above set of declarations on human rights. There are also some countries which have ratified them, but human rights have not been sufficiently established in reality. To give assurances that these declarations work in concrete situations, it is still necessary to look for universally accepted values and norms with relevance for particular subject areas. Radiological protection is only just one of them.

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(C 3) With the rise of globalisation over the last few decades, philosophers have addressed the general need for, and possibility of, global ethics from various points of view. A few examples may suffice here. Jürgen Habermas speaks of a “post-national constellation” in which we find ourselves and claims that “world citizenship... is already taking shape today in worldwide political communications.” (Habermas, 1992, 1998). Interested in human flourishing and its global dimension, Amartya Sen has written extensively about the “idea of justice”, which he shows to be central to various cultures around the world, past and present. One of his close associates, Martha Nussbaum has identified a number of “core capabilities” which all individuals in all societies should be entitled to, thus constituting the base of her account of “global justice” (Nussbaum, 2004). Kwame Appiah explores the reasonability of cosmopolitanism, which he defines as “universality plus difference”. While emphasising “respect for diversity of culture”, he suggests there is “universal truth, too, though we are less certain that we have it all already.” (Appiah, 2006). Finally, Sissela Bok suggests that “certain basic values [are] necessary to collective survival” and therefore constitute a “minimalist set of such values [which] can be recognised across societal and other boundaries”. That does not

1397 preclude the existence of “maximalist” values, usually more culture-specific, nor the possibility
1398 that they can “enrich” the debate, and the “need to pursue the enquiry about which basic values
1399 can be shared across cultural boundaries is urgent.” (Bok, 1995).

1400 (C 4) One area in which cross-culturally shared ethical principles, values and norms are
1401 actively discussed is interfaith dialogue. An outcome of such activities was the “Declaration
1402 towards a Global Ethic” signed at the Parliament of the World’s Religions 1993 in Chicago by
1403 the representatives of more than 40 different religious groups. It proceeded from the assumption
1404 that “there already exist ancient guidelines for human behaviour which are found in the
1405 teachings of the religions of the world and which are the condition for a sustainable world
1406 order.” (Küng et al., 1993). Interfaith declarations on more specific topics such as business
1407 ethics and environmental ethics have followed (The Interfaith Declaration, 1996).
1408

1409 **C.2. A short review of the core values in different cultural contexts**

1410

1411 (C 5) In order to validate the assumption that the core values identified as founding the
1412 radiological protection system are shared across cultures, one could, of course, think of
1413 empirical research, but investigations along these lines have not been systematically
1414 undertaken and their results would just reflect people’s current dispositions. Orientation in
1415 matters of ethics has been provided throughout the ages by the religious and philosophical
1416 traditions of the different cultures and in spite of a tendency towards secularisation in many
1417 societies, they continue to have a great influence. It is therefore of interest for the purpose of
1418 this publication to look at a few such sources, and assess (to the degree possible within limited
1419 space) the universality of the values identified as fundamental for the system of radiological
1420 protection. It should be noted that the construction of a set of values which are identified as
1421 core values of the radiological protection system does not mean that this set is universally
1422 applicable to all aspects of life in all cultures. Each of these values can be found in various
1423 cultural contexts, but their weight can certainly vary across cultures and even within one culture
1424 depending on what issue is discussed.
1425

1426

1426 **Beneficence and non-maleficence**

1427 (C 6) “To abstain from doing harm” is one of the central features of the Hippocratic Oath
1428 (Edelstein, 1943), which was later adopted by Jewish, Christian, and Muslim physicians
1429 (Pelligrino, 2008). The principle is also mentioned, albeit indirectly, in similar texts from
1430 ancient China (Tsai, 1999). Of course it has always been understood that sometimes pain has
1431 to be inflicted to achieve healing and thus non-maleficence has to be balanced with beneficence.
1432 To work “for the good of the patient” is part of the Hippocratic Oath as well, and it features
1433 quite prominently in the mentioned Chinese medical texts.

1434 (C 7) More generally, i.e. outside the context of medicine, both beneficence and non-
1435 maleficence can be seen as core principles in any system of religious ethics. A central concept
1436 of both Hinduism and Buddhism is “ahimsa” which means kindness and non-violence to all
1437 living beings. Both the Torah and the Gospel express the same thought in a different way by
1438 exhorting everybody to “love your neighbour as yourself.” And Islamic jurisprudence has the
1439 guideline that “if a less substantial instance of harm and an outweighing benefit are in conflict,
1440 the harm is forgiven for the sake of the benefit.”

1441 (C 8) When it comes to “taking into account economic and societal factors” as stipulated by
1442 the principle of optimisation, the interest of the general public, the “common good” is a related
1443 concept of importance, which is also shared across cultures. All religious writings exhort their
1444 readers to solidarity with the underprivileged in society, as is for instance expressed in one of
1445 the Psalms, “Blessed is the one who is considerate of the destitute.”.

1446 (C 9) More generally, the traditions remind us that we are not just individuals. An African
1447 proverb says “A single tree cannot make a forest” and can highlight that African ethics
1448 privileges the common good and a sense of duty to the public over personal or individualistic
1449 motives. Joe de Graaft in the play ‘Muntu’ demonstrates that the individual’s needs, peace,
1450 freedom, dignity, and security can only be protected and guaranteed by the community. John
1451 Mbiti asserts, “I am, because we are; and since we are, therefore I am.”.

1452

1453 **Prudence**

1454 (C 10) In recent decades, there has been a lot of talks about the “precautionary principle”,
1455 especially in the context of environmental issues. Of course, the principle in its modern form
1456 cannot be expected to appear in the written and oral traditions of different cultures.
1457 Exhortations to prudence, however, are ubiquitous, and they are generally interpreted, by
1458 people referring to those traditions for orientation, as suggesting a precautionary approach.

1459 (C 11) A Hindu text suggests to “act like a person in fear before the cause of fear actually
1460 presents itself,” whereas Confucius simply says that “The cautious seldom err.” In the biblical
1461 Proverbs, we find the following statement: “Those who are prudent see danger and take refuge,
1462 but the naïve continue on and suffer the consequences,” and a representative of the Australian
1463 Aboriginals and Torres Strait Islanders has stated: “Over the past 60,000 years we, the
1464 indigenous people of the world, have successfully managed our natural environment to provide
1465 for our cultural and physical needs. We have no need to study the non-indigenous concepts of
1466 the precautionary principle [and others]. For us, they are already incorporated within our
1467 traditions.”.

1468

1469 **Justice**

1470 (C 12) The “Golden Rule”, the first principle of justice and altruism, claims “Do unto others
1471 what you want them to do unto you.” and is one of the most common ethical guidelines around
1472 the world. It is found in every single tradition one may choose to look at, and even its wording
1473 is strikingly uniform. A few examples must suffice: “Hurt not others in ways that you yourself
1474 would find hurtful.” (Buddhist) “Therefore whatever you want people to do for you, do the
1475 same for them, because this summarises the Law and the Prophets.” (Christian) “If thine eyes
1476 be turned towards justice, choose thou for thy neighbour that which thou chooseth for thyself.”
1477 (Bahá’í).

1478 (C 13) In African ethics this principle has ontological, religious and communal implications.
1479 The main basis of the principle is the concept of empathy. Empathy helps a person to imagine
1480 the effects of an action or of the failure to act on oneself before considering what it would mean
1481 for others, and thus is conducive to “cooperation, solidarity and fellowship.”.

1482 (C 14) Justice as such is verifiably an element of common morality. The Bhagavad Gita
1483 contains the promise that “He who is equal-minded among friends, companions and foes...
1484 among saints and sinners, he excels.” The Psalms observe that, “He loves righteousness and

1485 justice; the world is filled with the gracious love of the Lord,” whereas Muhammad advises his
1486 followers to be “ever steadfast in upholding equity..., even though it be against your own selves
1487 or your parents and kinsfolk.”

1488 (C 15) A look at secular philosophy will also be instructive here, as justice has been of prime
1489 importance since Antiquity. Aristotle, for instance, distinguished between different forms of
1490 justice, and his analysis has exerted decisive influence on later thought. His concept of
1491 “distributive justice” concerns the allocation of goods and burdens, of rights and duties in a
1492 society. About this he states, “The only stable state is the one in which all men are equal before
1493 the law.”

1494

1495 **Dignity**

1496 (C 16) This last core value is expressed in different ways around the world, but the basic idea
1497 is virtually ubiquitous - that of a dignity pertaining equally to all humans. In the Bhagavad Gita,
1498 we find, “I am the same to all beings... In a Brahma ... and an outcast, the wise see the same
1499 thing.” In the Bible, the prophet Malachi asks, “Do we not have one father? Has not one God
1500 created us?” And in the Quran it is expressed in this way: “We have conferred dignity on the
1501 children of Adam... and favoured them far above most of Our creation.”

1502 (C 17) These are just short glimpses from different religious sources, but the broad agreement
1503 on the notion that all human beings share the same dignity is also reflected in the “Declaration
1504 Toward a Global Ethic” of the Parliament of World’s Religions in 1993. It says that “every
1505 human being without distinction of age, sex, race, skin colour, physical or mental ability,
1506 language, religion, political view, or national or social origin possesses an inalienable and
1507 untouchable dignity, and everyone, the individual as well as the state, is therefore obliged to
1508 honour this dignity and protect it.” (Küng et al., 1993).

1509 (C 18) Moreover, human dignity has for centuries been invoked by secular philosophers. This
1510 strand of thought begins with Stoicism, continues through the Renaissance, and leads up to
1511 Enlightenment. In our time, together with the above-mentioned religious traditions, it has
1512 played a very prominent role in the drawing up of the “Universal Declaration of Human Rights”
1513 of 1948 and the “Universal Declaration of Bioethics and Human Rights” of 2005, as mentioned
1514 at the beginning of this Annex.

1515

1516 **C.3. Confucian theory and Asian perspectives**

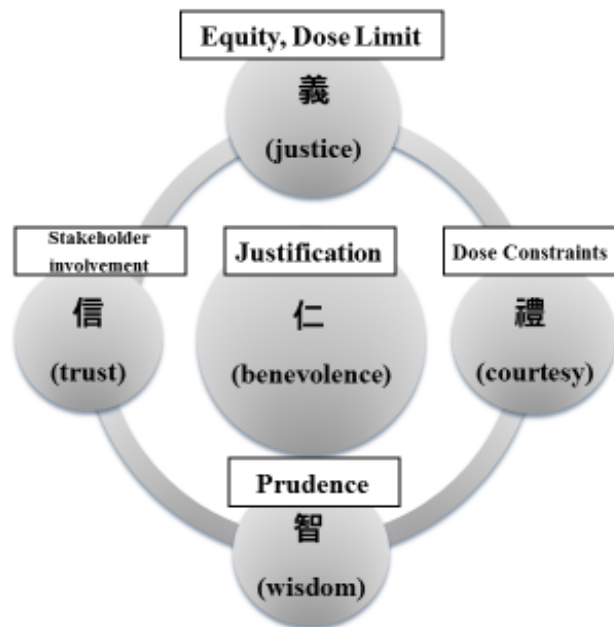
1517

1518 (C 19) It would certainly be interesting to discuss the ethics of different cultures one by one,
1519 understand their internal logic, and then relate them to the ICRP system of radiological
1520 protection. As there is no space to do that here, it was decided to have a closer look at just one
1521 system of non-Western ethics, namely Confucian theory, because there has been some
1522 discussion over the last decades about “Asian perspectives”, and even “Asian values”, which
1523 were allegedly different from those “forced upon the world” by the West.

1524 (C 20) In spite of such claims about fundamental differences between Western and non-
1525 Western moral philosophies, Confucian thought in everyday life emphasises moral values
1526 which are quite compatible with Western ideas. The fundamental standpoint of Confucianism
1527 is that all humans have a disposition towards the good and are naturally inclined to follow the
1528 virtuous model. The five moral values (or virtues) that are embedded in Confucianism are as
1529 follows:

1530 Ren (仁, benevolence), Yi (義, justice), Li (禮, courtesy), Zhi (智, wisdom), Xin (信, trust)
 1531 (C 21) “Ren” is the foremost value, which integrates all the other four and is an obligation of
 1532 altruism and humaneness towards other individuals. “Yi” is a tool for the practice of Ren and
 1533 is the upholding of righteousness and the moral disposition to do good. “Li” is the traditional
 1534 and customary norm, which determines how a person should properly act in everyday life,
 1535 especially when relating to others. “Zhi” is the mental ability to understand quickly and
 1536 correctly the principle of the matter and to make a right and fair decision. “Xin” is the trust that
 1537 should be built among peers.

1538 (C 22) Fig. C.1 shows the relationship of the five Confucian ethical values related to Western
 1539 or globally accepted ethical values and principles embedded in the ICRP system of radiological
 1540 protection.



1541 Fig. C.1. Core value system of classic Confucianism connected to core values of the radiological
 1542 protection system (Kurihara et al., 2016).
 1543
 1544

1545 (C 23) It is obvious that “Ren” (benevolence) is almost the same concept as beneficence, the
 1546 former describing rather a disposition, the latter a way of acting. Both are widely accepted not
 1547 only in Western but also in Asian cultural contexts. In Confucian theory, it is often argued that
 1548 “Ren” is stronger than other values, and this can give rise to a paternalistic understanding of
 1549 the value system. Meanwhile, as mentioned above (see Annex B), there is an international
 1550 consensus not to presuppose a fixed hierarchy between beneficence, non-maleficence, justice,
 1551 and autonomy (or human dignity).

1552 (C 24) “Yi” (justice) is mostly the same as justice in the Western context. However, in
 1553 Confucian theory, it also has the meaning of “royalty” and implies respect for the hierarchy in
 1554 the society, rather than equal rights of individuals.

1555 (C 25) “Li” (courtesy) means respect for the dignity of a person, however it is not usually
 1556 understood to be directly connected to basic human rights of self-determination and equality.

1557 It rather implies to respect for elders or persons of a higher position within the hierarchy, as
1558 well as respect for traditional customs or regulations rather than the individual's freedom.
1559 (C 26) "Zhi" (wisdom) is related to "prudence", but has a wider meaning. It encompasses the
1560 integration of various conflicting values.
1561 (C 27) As described here, the implications of "benevolence/beneficence" and
1562 "wisdom/prudence" are almost the same in Western and Confucian thinking; whereas "dignity"
1563 and "justice" as the basis of fundamental human rights and equality have been developed in
1564 the Western world and the consensus reached there is not necessarily shared by people with a
1565 Confucian background although certainly fundamental aspects of the two concepts are
1566 universal.
1567
1568

1569

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- 1753

1754 **APPENDIX: PARTICIPANTS AT THE WORKSHOPS ON THE ETHICS OF THE**
 1755 **SYSTEM OF RADIOLOGICAL PRTECTION**

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 1757 **1st Asian Workshop on the Ethical Dimensions**
 1758 **of the Radiological Protection System**

1759 August 27-28, 2013

1760 Daejeon, Korea

1761 Organised by the Korean Association for Radiation Protection (KARP)

1762 Hosted by the Korea Institute of Nuclear Safety (KINS)

1763					
1764	Min Baek	1775	Chan Hyeong Kim	1786	Seong-Ho Na
1765	Marie-Claire Cantone	1776	Il-Han Kim	1787	Viet Phuong Nguyen
1766	Kunwoo Cho	1777	Jong Kyung Kim	1788	Enkhbat Norov
1767	Hosin Choi	1778	Kyo-Youn Kim	1789	Hiroko Yoshida Ohuchi
1768	Mi-Sun Chung	1779	Sung Hwan Kim	1790	Woo-Yoon Park
1769	Christopher Clement	1780	Chieko Kurihara-Saio	1791	Ronald Piquero
1770	Moon-Hee Han	1781	Dong-Myung Lee	1792	Sang-Duk Sa
1771	Sungook Hong	1782	Hee-Seock Lee	1793	Sohail Sabir
1772	Seoung-Young Jeong	1783	JaiKi Lee	1794	John Takala
1773	Kyu-Hwan Jung	1784	Senlin Liu	1795	Man-Sung Yim
1774	Keon Kang	1785	Jacques Lochard	1796	Song-Jae Yoo

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1799 **1st European Workshop on Ethical Dimensions**
 1800 **of the Radiological Protection System**

1801 December 16-18, 2013

1802 Milan, Italy

1803 Organised by the Italian Radiation Protection Association (AIRP) and the French Society
 1804 for Radiological Protection (SFRP)

1805					
1806	Marie Barnes	1818	Eduardo Gallego	1830	Guido Pedrolì
1807	François Bochud	1819	Alfred Hefner	1831	Francois Rollinger
1808	Giovanni Boniolo	1820	Dariusz Kluszczyński	1832	Thierry Schneider
1809	Marie-Charlotte Bouessada	1821	Chieko Kurihara-Saio	1833	Michael Siemann
1810	Marie-Claire Cantone	1822	Ted Lazo	1834	John Takala
1811	Kunwoo Cho	1823	Jean-François Lecomte	1835	Richard Toohey
1812	Christopher Clement	1824	Bernard Le Guen	1836	Emilie van Deventer
1813	Roger Coates	1825	Jacques Lochard	1837	Sidika Wambani
1814	Renate Czarwinski	1826	Jim Malone	1838	Dorota Wroblewska
1815	Daniela De Bartolo	1827	Gaston Meskens	1839	Margherita Zito
1816	Biagio Di Dino	1828	Celso Osimani	1840	Friedo Zölzer
1817	Marie-Helene El Jammal	1829	Deborah Oughton		

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**1st North American Workshop on Ethical Dimensions
of the Radiological Protection System**

July 17-18, 2014

Baltimore, USA

Organised by the US Health Physics Society (HPS), Canadian Radiation Protection Association (CRPA), and the Mexican Society for Radiological Protection (SMSR)

Ralph Anderson	Nobuyuki Hamada	Yasuhito Sasaki
Edgar Bailey	Raymond Johnson	Glenn Sturchio
Mike Boyd	Ken Kase	Richard Toohey
Dan Burnfield	Toshiso Kosako	Brant Ulsh
Donald Cool	Cheiko Kurihara-Saio	Richard Vetter
Renate Czarwinski	Ted Lazo	Harry Winsor
Yuki Fujimichi	Jacques Lochard	

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**2nd European Workshop on Ethical Dimensions
of the Radiological Protection System**

February 4-6, 2015

Madrid, Spain

Organised by the Spanish Society for Radiological Protection (SEPR), Italian Society for Radiological Protection (AIRP), French Society for Radiological Protection (SFRP), and UK Society for Radiological Protection (SRP)

Antonio Almicar	Eduardo Gallego	María Pérez
Marie Barnes	Cesare Gori	Volha Piotukh
François Bochud	Klazien Huitema	Thierry Schneider
Francesco Bonacci	Dariusz Kluszczyński	Patrick Smeesters
Marie-Charlotte Bouesseau	Chieko Kurihara-Saio	Behnam Taebi
Marie-Claire Cantone	Jean François Lecomte	John Takala
Pedro Carboneras	Bernard Le-Guen	Jim Thurston
Kunwoo Cho	Jacques Lochard	Richard Toohey
Christopher Clement	Jim Malone	Eliseo Vañó
Roger Coates	Gaston Meskens	Dorota Wroblewska
Marie-Helène El Jammal	Mohamed Omar	Friedo Zölzer
Sebastien Farin	Deborah Oughton	

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**2nd North American Workshop on Ethical Dimensions
of the System of Radiological Protection**

March 10-12, 2015

Cambridge, USA

1867 Organised by the Harvard Kennedy School, Belfer Center, Harvard University, and ICRP
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Kunwoo Cho	Bjørn Morten Hofmann	Gina Palmer
Christopher Clement	Sheila Jasanoff	Laura Reed
Andrew Einstein	Cheiko Kurihara-Saio	Behnam Taebi
Stephen Gardiner	Jacques Lochard	John Takala
Nobuyuki Hamada	Nicole Martinez	Friedo Zölzer

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**2nd Asian Workshop on the Ethical Dimensions
of the System of Radiological Protection**

June 2-3, 2015

Fukushima, Japan

1875 Organised by Fukushima Medical University and ICRP

Tazuko Arai	Mariko Komatsu	Sae Ochi
Kathleen Araujo	Atsuchi Kumagai	Deborah Oughton
Ryoko Ando	Chieko Kurihara-Saio	François Rollinger
Cécile Asanuma-Brice	Ted Lazo	Kiriko Sakata
Marie-Claire Cantone	Jean-François Lecomte	Hisako Sakiyama
Christopher Clement	Jacques Lochard	Yasuhito Sasaki
Aya Goto	Nicole Martinez	Thierry Schneider
Nobuyuki Hamada	Hideyuki Matsui	Lavrans Skuterud
Toshimitsu Homma	Gaston Meskens	Megumi Sugimoto
Audrie Ismail	Michio Miyasaka	John Takala
Wataru Iwata	Makoto Miyazaki	Toshihide Tsuda
Michiaki Kai	Toshitaka Nakamura	Fumie Yamaguchi
Mushakoji Kinhide	Ohtsura Niwa	

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