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THE USE OF THE MAN-SIEVERT MONETARY VALUE IN 1997

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In order to balance the costs associated with radiological protection options and their benefits in terms of exposure reduction the International Commission on Radiation Protection has suggested the use of cost benefit or cost effectiveness analysis in which options' benefits or effectiveness are given a monetary value according to a monetary reference value of the avoided unit of exposure: the man-sievert value, often referred as « alpha value ».

Twenty five years after the introduction of this concept, it appeared advisable to wonder about its practical usefulness. Therefore, after a request from Electricité de France (EDF), the CEPN (Centre d'Etude sur l'évaluation de la Protection dans le domaine Nucléaire), ISOE (International System on Occupational Exposure) European Regional Technical Centre, tried to answer to that question through a specific international survey implemented, mainly within the ISOE network, among nuclear utilities and national regulatory bodies in charge of radiological protection [1].

This survey has been implemented using questionnaires. Answers to that survey came from 20 countries. In 17 countries, answers were provided by utilities and plants and in 14 countries, by regulatory bodies. Answers from utilities and plants correspond to 282 reactors which represent 80% of the total number of reactors located in the 20 countries and more than 64% of all reactors installed in the world. This survey has been completed through many other exchanges with either utilities or regulatory bodies and through a review of the literature.

Table 1: Answers to the ISOE/ERTC survey on the man-sievert monetary values

Countries	Utilities and NPPs answers	Regulatory body answers
Belgium	X	
Canada	X	X
China	X	X
The Czech Republic		X
Finland	X	X
France	X	X
Germany	X	
Italy	X	
Japan	X	X
Korea	X	X
The Netherlands	X	X
Romania	X	X
South Africa	X	
Slovakia		X
Slovenia	X	
Spain	X	X
Sweden	X	X
Switzerland		X
United Kingdom	X	X
United States of America	X	

Commitment and role of regulatory bodies in charge of radiological protection

Eight regulatory bodies in charge of radiological protection explicitly refer to the concept of monetary value of the unit of collective dose and have defined one value or a set of values (Canada, the Czech Republic, Finland, the Netherlands, Sweden, Switzerland, the United Kingdom, the United States). Five other regulatory bodies are now considering the definition of a such a system (China, Korea, Romania, the Slovak Republic, Spain). It appears therefore that the man-sievert value concept is quite common within the regulatory bodies international community (see values in Annex 1).

In general the values result from a totally internal process within the regulatory bodies without any discussion with representatives of either the public, the managers or the workers. This process often relies on an international survey concerning models and values agreed on at the international level. The final decision leads often to set up values quite close to those that are « agreed on at an international level » by the other regulatory bodies. There is therefore a kind of « international standard », at least within the « Western » countries. Two kinds of man-sievert monetary value systems are considered: either a unique value or a set of values increasing with the individual dose level in order to reduce both collective exposure, the individual doses dispersion and, in priority, the highest individual doses. Single values are in the range of 75 to 200 US$ per man.mSv and when a set of value is agreed on, it leads to use a low basic value of a few tens US$ per man.mSv and higher maximum values up to about 300 US$ per man.mSv.

The radiological protection regulatory bodies generally consider that the alpha value is actually a baseline reference value more than a very operational tool, these values have nearly never had a regulative statute. Therefore these values are never prescript ones and their use is not mandatory; they are only recommended values.

Finally there is a consensus within the regulatory bodies community to consider that the implementation of the ALARA principle within the nuclear industry is mainly the industry concern and that therefore the monetary value of the man-sievert is essentially a « managerial tool ». From the regulatory bodies point of view, the alpha value is then a practical support in their dialogue with the firms, and they use it to check if all « what is reasonable has been (or is expected to be), or not, implemented in the case of important decisions ».

Man-sievert monetary values uses at the level of plants and utilities

In 1997, nearly three quarters of the NPPs and nuclear utilities have set up their own system of monetary values of the man-sievert. The decision concerning the choice of the monetary values is always made by top managers in the firm.

A first group of utilities and plants, corresponding to 56% of the reactors having an alpha value, use a single alpha value (see Annex 2). This group is mainly composed of most US utilities. They dispose of such a tool since the beginning of the eighties, and the values have been upgraded several times to take care of the inflation. The alpha values in this group are 5, 10 or even 20 times higher than the values recommended by the regulatory bodies; they are in average close to US$ 1 000 per man.mSv, and they range between US$ 500 and nearly 3 000 per man.mSv.

Utilities belonging to a second group (44% of the reactors having an alpha value) have more recently (early or mid nineties) established some sets of values (see Annex 3). The utilities have then set up systems with increasing monetary values according to increasing annual individual dose level, i.e. to increasing individual risks. Mean values in Belgium, France and Germany within the second group do not differ drastically from those observed in the first group in the US or in Sweden. However, maximum values in the second group are much more higher (up to US$ 5 000 per man.mSv) than nearly all unique values, while basic values are much smaller (only few tens of US$) as they just rely on the public health component.

Three quarters of the answers from plants-utilities having set up a system indicate that they use it annually less than 10 times. More than one quarter use it only once a year.

In all countries, the use of alpha values concerns mainly important decisions (see Table 2) both in terms of budget and/or impact on the operation and safety of the plant, as about 60% of the uses are clearly connected with ALARA and important modifications, large and expansive repairs, or chemistry of the plant.

Table 2: Types of problems during which alpha values are formally used within utilities

Type of problem concerned	Frequency upon 100% of quotations
Important modification of the plant	26%
Large and expansive repair	13%
Decontamination	13%
Shielding	13%
Work management (incl. automation and remote tools 1/3)	12%
Minor modification (incl. insulation)	9%
Hot spot management (incl. some modifications)	6%
Chemistry modification	4%
Big radiological protection investigation	4%

In nearly all cases, man-sievert values are tools used by health physicists or project engineers (with the help of health physicists) to prepare documents for important financial decisions to be made either by department or general managers. In a few cases they are also used by health physicists to prioritise radiological protection actions within their own budget.

Formalised use of alpha value appears then, but for a few users, not to be part of the day to day life. However, it is confirmed by several European answers that for less important decisions, very often even when there is no formalised procedure, there is an « implicit» reference to what is reasonable; in that case the corporate alpha values are known and it is not necessary to perform a time consuming quantified analysis to make a « reasonable » decision.

Whatever the type of decision underpinned by the use of the alpha value (agreement of an option or prioritisation of options), it is clear from many answers that the alpha value is not used as a « black and white decision tool », it mainly helps in « reducing subjectivity in the decision making process » and it is very often « only one among other criteria within the decision making process »

It is also noticeable that for big decisions, when alpha values have been set up, they are one « transaction tool between different partners » both within the utilities-plants and within the relationships with contractors: about one third of the plants use sometimes that tool to discuss with their contractors.

When the regulatory bodies have set up their own man-sievert value the utilities use it also within their transactional relationships with them: it is the case of one half of the plants which have an alpha value system.

Reference

[1] C. LEFAURE, « The man-sievert value uses in 1997: results of an international survey » in first EC/ISOE international Workshop proceedings, Malmö September 1998.

Annex 1: Adoption by regulatory bodies in charge of radiological protection of a system of man-sievert reference monetary values

Countries	Existence of man-sievert monetary value system	Values per man-mSv in national currency	Values per man mSv in US$ ***
Belgium(*)	No value		
Canada 1997	**ALARA guidelines referring to the concept** to be published	**100 Can$** as an international reference	**75** *1 US$ = 1.33 Can$*
China	under consideration		
The Czech Republic 1997	**decreeted values**	**500-5000 Czech crowns** depending on indiv. dose level and exposure situation	**17-170** *1 US$ = 30 Czech crowns*
Finland 1984 ** **1991 **	**recommended value** **recommended value**	**20 US$** **100 US$**	**20** **100**
France	No value		
Germany(*)	No value		
Italy(*)	No value		
Japan	No value		
Korea	under consideration		
The Netherlands 1995	**recommended value**	**1000 Florins**	**500** *1 US$ = 2 Florins*
Romania	under consideration		
Slovakia	under consideration		
Spain	under consideration		
Sweden 1984 ** **1991 ** SSI **1992**	**recommended value** **recommended value** **recommended values**	**20 US$** **100 US$** 400-2000 SEK	**20** **100** **55-270** *1 US$ = 7.5 Swedish crown*
Switzerland 1994	**recommended value**	**3000 Francs Swiss**	**2000** *1 US$ = 1.5 Swiss Franc*
United Kingdom	**recommended values**	**10-100 UK£** depending on exposure situation	**17-170** *1 US$ = 0.6 UK£*
USA(*)NRC 1993 **1995**	**recommended value** **recommended value**	**US$ 100** **US$ 200**	**100** **200**

* Data not provided in answers to questionnaires

** Nordic countries common value

*** Exchange rate end of 1997

Annex 2: Corporate or plant alpha values for occupational exposure: single values

Countries	Nuclear operator	Date of system set up	Values per man-mSv in national currency	Values per man-mSv in US$ *
South Africa	**Koeberg NPP**	**1993**	**1 000 US$**	**1 000**
Canada	**Gentilly NPP**	seventies	**1 000 Can$**	**750** *1 US$ = 1.33 Can$*
Spain	**Asco NPP** **Vandellos NPP**	**1994** **1982**	**2 000 US$** **100 000 Pesetas**	**2 000** **700** *1 US$ = 150 Pesetas*
United States	**90% of NPPs**	**1990/1991**; but for highest values **1993/1997**	from **500** to **2810 US$** median: **1 000** average: **1 200**	from **500** to **2 810** median: **1 000** average: **1 200**
Slovenia	**Krsko NPP**	**1996**	**700 US$**	**700**
Sweden	same value for all NPPs	**1992**	**4 000 SEK**	**550** *1 US$ = 7.5 Swedish crown*

* Exchange rate end of 1997

Annex 3: Corporate or plant alpha values for occupational exposure: set of values

Country	Operator	System set up date	Values per man-mSv in national currency	Values per man-mSv in US$ *
Belgium	**CEN SCK Mol** *the values of the system depends on **individual** dose level*	**1995**	< 1 mSv: **1 000 FB** 1 - 2 mSv: **2 500 FB** 2 - 5 mSv: **10 000 FB** 5 - 10 mSv: **25 000 FB** 10 - 20 mSv: **50 000 FB** 20 - 50 mSv: **200 000 FB**	< 1 mSv: **27** 1 - 2 mSv: **67** 2 - 5 mSv: **267** 5 - 10 mSv: **667** 10 - 20 mSv: **1 333** 20 - 50 mSv: **5 333** *(1 US$ = 37.5 FB)*
Canada	**Darlington NPP** *the values of the system depends on the type of worker category*	(?)	from few **100** to **2 000 Can$** *(ex: general workers: 200 Can$ reactor maintenance crew: 1500 Can$)*	from few **75** to **1 500** *(ex: general workers: 150 reactor maintenance crew: 1128)* (1 US$ = 1.33 Can$)
France	**EDF** *the values of the system depends on **individual** dose level*	**1993**	0 - 1 mSv: **100 FF** 1 - 5 mSv: **400 FF** 5 - 15 mSv: **2 300 FF** 15 - 30 mSv: **6 700 FF** 30 - 50 mSv: **15 000 FF**	0 - 1 mSv: **17** 1 - 5 mSv: **67** 5 - 15 mSv: **383** 15 - 30 mSv: **1 117** 30 - 50 mSv: **2 500** *(1 US$ = 6 FF)*
Germany	**VGB** proposal agreed on by all utilities for testing *the values of the system depends on **individual** dose level*	**1996**	< 1 mSv: no value 1 - 10 mSv: **300 DM** 10 - 20 mSv: increas. value up to **3 000 DM**	< 1 mSv: no value 1 - 10 mSv: **170** 10 - 20 mSv: increas. value up to **1 695** *(1 US$ = 1.77 DM)*
The Netherlands	**Borssele NPP** *the values of the system depends on **individual** dose level*	**1992**	<15 mSv: **1 000 Florins** > 15 mSv: **2 000 Florins**	<15 mSv: **500** > 15 mSv: **1 000** *(1 US$ = 2 Florins)*
Romania	**Cernavoda NPP** *the values of the system depends on **individual** dose level*	**1994**		<10 mSv: **3** >10 mSv: **5**
Spain	**Cofrentes NPP** *the values of the system depends on the unit collective dose level*	**1994**	< 3 man-Sv per unit per year on a 3 years average: **100 000 Ptas** >3 man-Sv per unit per year on a 3 years average: **150 000 Ptas**	< 3 man-Sv per unit per year on a 3 years average: **667** >3 man-Sv per unit per year on a 3 years average: **1 000** *(1 US$ = 150 Pesetas)*
UK	**Sizewell NPP** *the values of the system depends on **individual** dose level*	**?**	use of the NRPB set **10 to 20 UK£**	use of the NRPB set **6 to 12** *(1 US$ = 0.6 UK£)*
USA	**South Texas NPP** *the values of the system depends on **individual** dose level*	**1993**	<10 mSv: 500 US$ >10 mSv: 2 500 US$	<10 mSv: 500 >10 mSv: 2 500

* Exchange rate end of 1997