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Miles Goldstick, 2015-04-30

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SSM diarienummer: 2014-5170*

**Miljörelsens kärnavfallssekretariats, Milkas, kommentar på
”Hantering av använt kärnbränsle och radioaktivt avfall i Sverige
- Nationell plan, Remissversion 2015-03-09”**

Det uppskattas att SSM försöker ta ett helhetsgrepp på ett så stort område.
Rapporten är dock för omfattande för att Milkas ska kunna kommentera alla delar.
Följande är några kommentarer.

- En kontinuerlig uppdatering av kunskap om hälsoeffekterna av lågdosstrålning bör ske. Som ett exempel bifogad är ”The evidence that radiation from nuclear reactors causes childhood leukemia” av Michael Mariotte 29 april 2015 samt ”US EPA Lecture Increased leukemias near nuclear power plants - the European evidence” by Dr. Ian Fairlie april 2015.
- Kommunens vetorätt (sid. 9 och 28) nämns utan att notera undantaget för kärnteknisk verksamhet. Detta är oerhört viktigt med hänsyn till att vetorätten ofta tolkas internationellt som en absolut rätt när det gäller anläggningar för använt kärnbränsle, men så är inte fallet.
- När det gäller principen om avfallsminimering (sid. 28), ska nollproduktion kunna vara ett tydligt mål. Produktionsstopp i existerande anläggningar ska prioriteras.
- Miljöbalkens mål och särskilda krav på alternativa redovisningar ska tydliggöras.
- Torrförvar som allmänt alternativ, samt i stället för utbyggnad av CLAB, ska inkluderas.
- Ett redovisningssystem behövs för import och export av allt radioaktivt material.
- Beskrivning av systemet när det gäller sekretess för friklassning av radioaktivt material generellt och särskilt från Studsvik ska inkluderas, med en lista över isotoper och mängder.

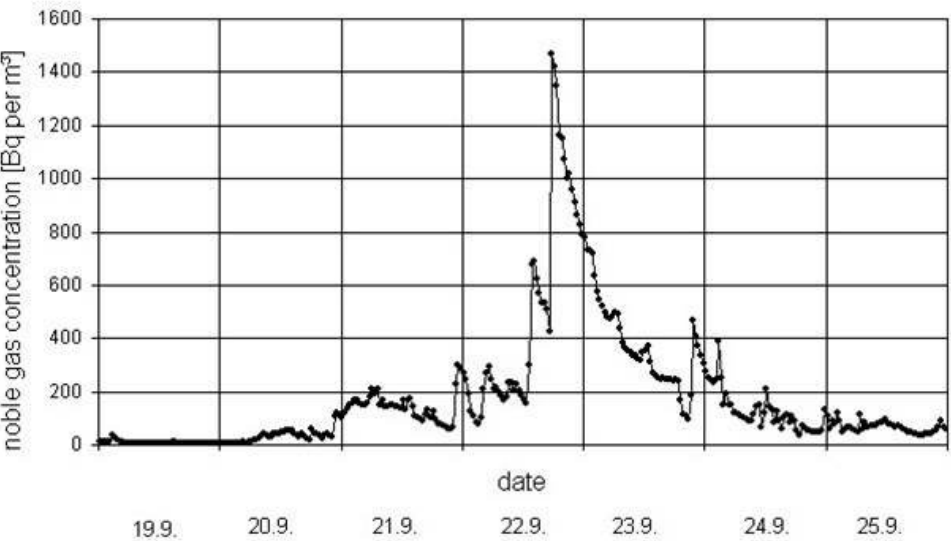
* Se <https://www.stralsakerhetsmyndigheten.se/Yrkesverksam/Radioaktivt-avfall/Nationella-planen-for-allt-radioaktivt-avfall/>

GreenWorld

News, Views & Musings for our nuclear-free, carbon-free energy future

The evidence that radiation from nuclear reactors causes childhood leukemia

7 Replies



Radiation spike caused by refueling at one of Bavaria’s Gundremmingen reactors.

Last July, [we published a piece](#) on recent groundbreaking work from the U.K.’s Dr. Ian Fairlie and the connection between radiation releases from nuclear reactors and childhood leukemia.

We quoted Dr. Fairlie:

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“The core issue is that, world-wide, over 60 epidemiological studies have examined cancer incidences in children near nuclear power plants (NPPs): most (>70%) indicate leukemia increases. I can think of no other area of toxicology (eg asbestos, lead, smoking) with so many studies, and with such clear associations as those between NPPs and child leukemias. Yet many nuclear governments and the nuclear industry refute these findings and continue to resist their implications. It’s similar to the situations with cigarette smoking in the 1960s and with man-made global warming nowadays.”

Today, Ian (full disclosure: an old friend and valued colleague) stopped by NIRS’ office to go over a presentation he made Monday to officials at the U.S. Environmental Protection Agency. The presentation is available in both [Powerpoint](#) and [pdf](#) format on NIRS’ website.

The presentation went over much the same ground as our earlier piece, but it’s often the background behind such a presentation that is the most interesting and revealing. And that’s the case here too.

Dr. Fairlie’s thesis is that childhood leukemia is caused by radiation exposure. Period. The data from several fairly recent European governmental studies show elevated childhood leukemia rates within five kilometers (three miles) of nuclear reactors. Past five kilometers, the elevated rates drop off to normal rates.

This, by the way, may be an indication that most U.S. studies of health effects of reactors have taken place over too large of an area—thus diluting the actual effects that could be expected to be found based on the European studies—at least for childhood leukemia. And, typically U.S. studies have been essentially on a circle around a reactor, rather than confined to areas subject to prevailing wind patterns where the largest exposures would occur as was the case with the European studies.

Dr. Fairlie believes, and shows, that the refueling of nuclear reactors results in large spikes in radiation releases—spikes that when averaged out over a year, as radiation release reporting typically is done, bury the truth.

CATEGORIES

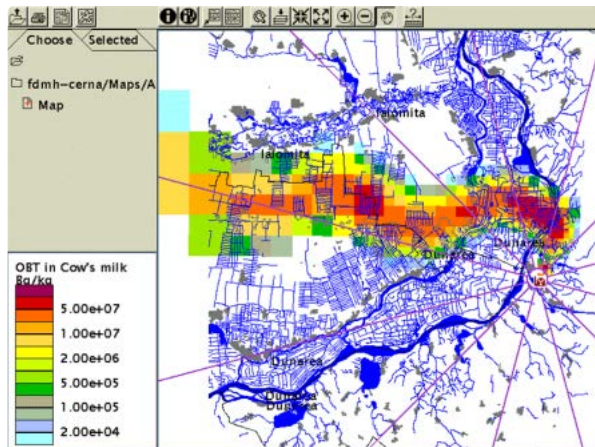
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And that makes sense. When a reactor is refueled, the top of the reactor pressure vessel is lifted off so that operators can take out old fuel rods and put in new ones. When that top comes off, the radiation comes out. Especially tritium, which is released with the steam that rises from the vessel. It's also released into water—and the tritium and the water become inseparable. Ingest that water, and you're also ingesting tritium.

Cows eat vegetation upon which airborne tritium has deposited. They may drink tritium-laced water too. The chart to the right (click to expand) shows expected tritium levels in cow's milk caused by



Elevated tritium levels in cow's milk expected from refueling-related radiation spikes at Romania's Cernavoda nuclear reactors.

releases from

refueling at

Romania's Cernavoda reactors. Children then drink the cow's milk, which itself has become radioactive. Fairlie believes that childhood leukemia begins in utero, by exposure during a woman's pregnancy, and is triggered by additional exposure after birth.

A key point Dr. Fairlie made to us is that this work was only possible because of release of data previously withheld by the nuclear industry and its regulators worldwide. And, in fact, for every reactor in the world save one, that data continues to be withheld.

The exception, which is captured by the chart at the top of the page, is the Gundremmingen reactors in Bavaria, Germany. That chart shows an actual radiation spike during refueling of one of those reactors.

That data was obtained only because a few years back, the German Green Party and Social Democrats together won an election and governed Bavaria. As Fairlie tells it, an official from that government—the head of the department that regulates nuclear power in the region—brought in an official from the

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nuclear power plant and demanded the operator provide information on daily radiation releases from the site.

The reactor official refused. The government official demanded it. The reactor official refused, saying it wouldn't be understood. The government official demanded it. The reactor official said it would take months to compile. The government official told the reactor guy to submit his undated

letter of resignation, which he did. The official then told the reactor guy that if the information wasn't provided within three days, the letter would be dated and made public.

The information arrived in three days—but could only be read by a proprietary computer program held by the utility. But some young Green Party computer geeks succeeded in moving the data through three separate programs and eventually were able to put it into Excel format. And the truth came out.

That's the kind of data that is certainly worth demanding everywhere. It takes political pressure to get it—the nuclear industry will never release it of its own volition. Because, like the radioactive materials released by nuclear reactors, especially during refueling, it is toxic. Toxic to the lie that radiation emissions from nuclear reactors are harmless, and toxic to the lie that tritium is a low-energy isotope that is not particularly hazardous.

In his presentation, Fairlie lists a number of studies on tritium's toxicity. On NIRS' website, [we have provided links](#) to 16 scientific abstracts on the issue. [On our main tritium page](#), there is also more information about tritium and its properties, and links to various other studies and reports about tritium



Bavaria's Gundremmingen reactors. The only reactors in the world that have been forced to reveal their radiation releases during refueling.

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releases—which have occurred to groundwater at a majority of U.S. reactor sites.

Fairlie provides three very simple, no-cost steps the nuclear industry could take to reduce the risks of refueling: “advise NPPs to refuel at night-time, or during windy weather, or when wind is blowing away from high populations.” They won’t do that of course, because even taking those steps would be an admission of the dangers the reactors pose.

A better step would be to require a zero-population zone three miles around every reactor. A still-better step—and the one we work for everyday—is to close them all entirely. Because nuclear power kills. And the evidence grows stronger every day.

Dr. Fairlie’s presentation [ended with one of my favorite quotes as well](#), from then-Senator John F. Kennedy:

It is true that the amount of radiation created by bomb tests so far offers no serious threat to the well-being or existence of mankind as a whole. But it is also true that there is no amount of radiation so small that it has no ill effects at all on anybody. There is actually no such thing as a minimum permissible dose. Perhaps we are talking about only a very small number of individual tragedies—the number of atomic age children with cancer, the new victims of leukemia, the damage to skin tissues here and reproductive systems there—perhaps these are too small to measure with statistics. But they nevertheless loom very large indeed in human and moral terms.

Radiation, in its simplest terms—figuratively, literally and chemically—is poison.

There weren’t many reactors operating in 1960; Kennedy was referring to above-ground nuclear weapons tests. But the effects of radiation are no longer limited to those, they are also caused by the 99 reactors licensed now in the U.S. and the 400+ operating globally. In many realms, we’ve come a long way since Sen. Kennedy spoke those words in 1960, not long before he became President. But in our collective understanding of the dangers of radiation, and thus the dangers not only of Fukushima-style meltdowns but

the regular, routine, ongoing operations of atomic reactors, it doesn't seem like we've come very far at all. The nuclear power industry has been expert and relentless at obfuscating the truth; it's the all-too-few dedicated researchers like Dr. Fairlie who are striving, against tall odds, to expose the reality. It's up to the rest of us to disseminate the information as widely as possible.

Michael Mariotte

April 29, 2015

Permalink: <http://safeenergy.org/2015/04/29/the-evidence/>

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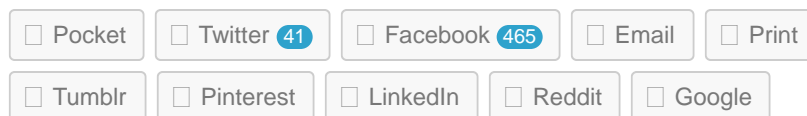
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US EPA Lecture

Increased leukemias near nuclear power plants - the European evidence

Dr Ian Fairlie
Consultant on Radioactivity in the
Environment
London, United Kingdom
www.ianfairlie.org

Childhood leukemias near NPPs: some history

- in UK, in 1980s and early 1990s, increases near several nuclear facilities (incl Sellafield)
- in Germany, near Krümmel NPP
- large public controversies
- UK NRPB said not due to radiation as doses were too low $\times \sim 300 - 1,000$
- debate fizzled out after legal victory for BNFL

KiKK Report in Germany in 2008/9

Kinderkrebs in der Umgebung von KernKraftwerken

Kaatsch P, Spix C, Schulze-Rath R, Schmiedel S, Blettner M. 2008. Leukaemias in young children living in the vicinity of German nuclear power plants. *Int J Cancer* 122:721–726.

Spix C, Schmiedel S, Kaatsch P, Schulze-Rath R, Blettner M. 2008. Case-control study on childhood cancer in the vicinity of nuclear power plants in Germany 1980–2003. *Eur J Cancer* 44:275–284.

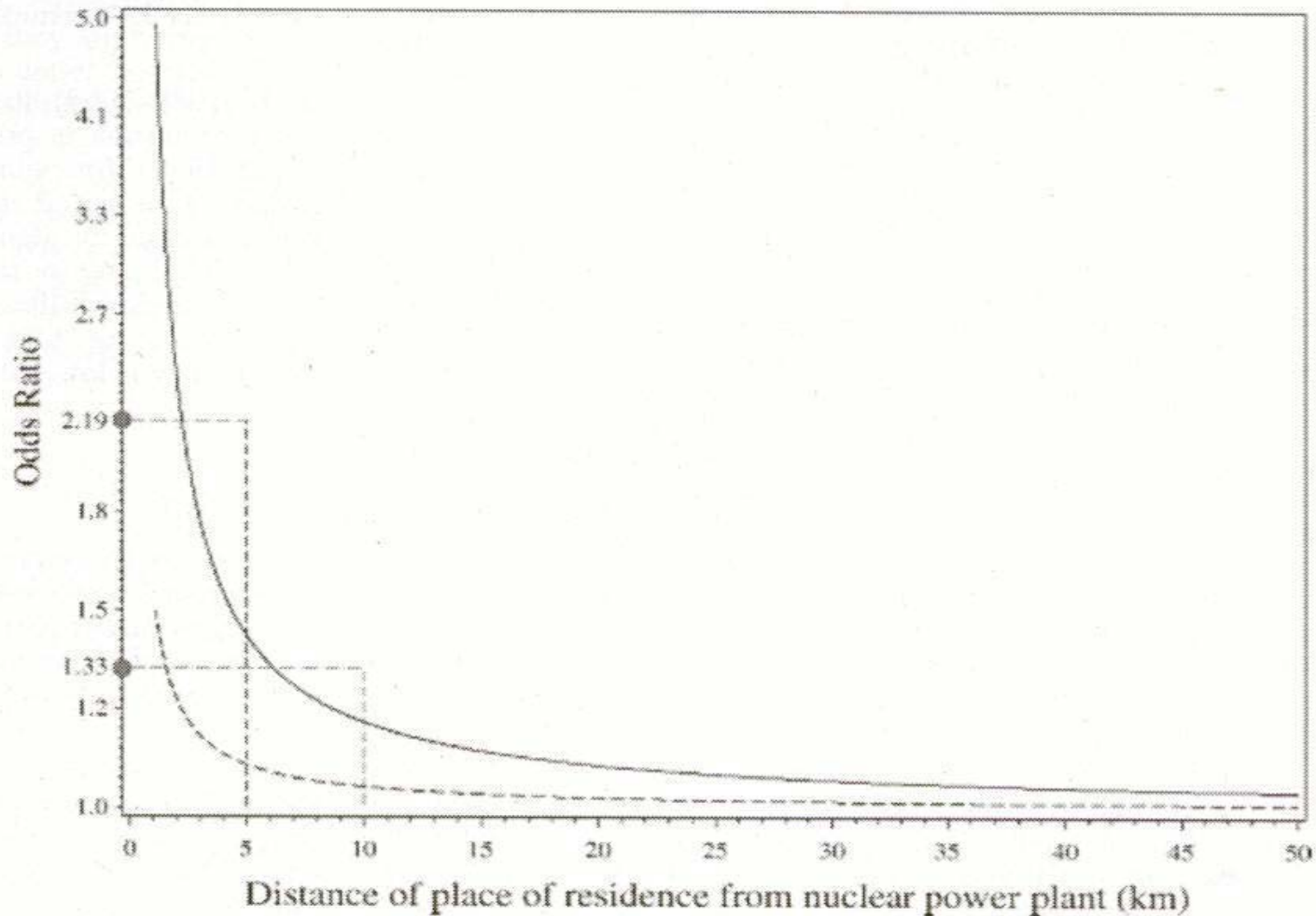
- KiKK reignited leukemia debate
- another large controversy in Europe
- relatively unknown in the US
- resulted in 4 EU states replicating it

KiKK Study: 2008

- very large study of cancer incidence near all 16 German nuclear power stations
- commissioned by German Government
- 120% increase in child leukemias
- 60% increase in embryonal cancers
- strongly linked to proximity to reactors
- validity accepted by German Government

the closer the reactor – the greater the leukemia risk

Kaatsch et al., Int J Cancer, 2008



Do Other Studies Back up KiKK?

(1) Laurier D et al (2008) Epidemiological studies of leukaemia in children and young adults around nuclear facilities: a critical review. Radiat Prot Dosimetry 132(2):182-90. **REVIEWED 26 MULTI-SITE STUDIES**

(2) Laurier D, Bard D (1999) Epidemiologic studies of leukemia among persons under 25 years of age living near nuclear sites. Epidemiol Rev 21(2):188-206.
LISTED 50 STUDIES (36 SINGLE AND 14 MULTI-SITE)

ie over 60 STUDIES worldwide

4 European studies - post KiKK

Körblein A and Fairlie I. French Geocap study confirms increased leukemia risks in young children near nuclear power plants. Int J Cancer. Article published online: 1 Sept 2012. DOI: 10.1002/ijc.27585

Acute leukaemias in under 5s within 5 km of NPPs

Country	Observed	Expected	SIR=O/E	90%CI	p-value
Germany	34	24.1	1.41	1.04-1.88	0.0328
GB	20	15.4	1.30	0.86-1.89	0.1464
Suisse	11	7.9	1.40	0.78-2.31	0.1711
France	14	10.2	1.37	0.83-2.15	0.1506
pooled data	79	57.5	1.37	1.13-1.66	0.0042

Possible explanations

- confounders ? X
- coincidence ? X
- population mixing ? X
- exposure to chemicals ? X
- exposure to viruses/fungi ? X
- exposure to radiation

KiKK: cancer increases strongly associated with proximity to nuclear reactors

- direct radiation from reactors? X
- EM radiation from power lines? X
- cooling tower emissions? X
- reactor emissions and discharges ?

KiKK: radiation exposures too low....

but large uncertainties in the
estimated doses from NPP emissions

CURRENT ESTIMATES OF INTERNAL DOSES MAY
CONTAIN LARGE UNCERTAINTIES

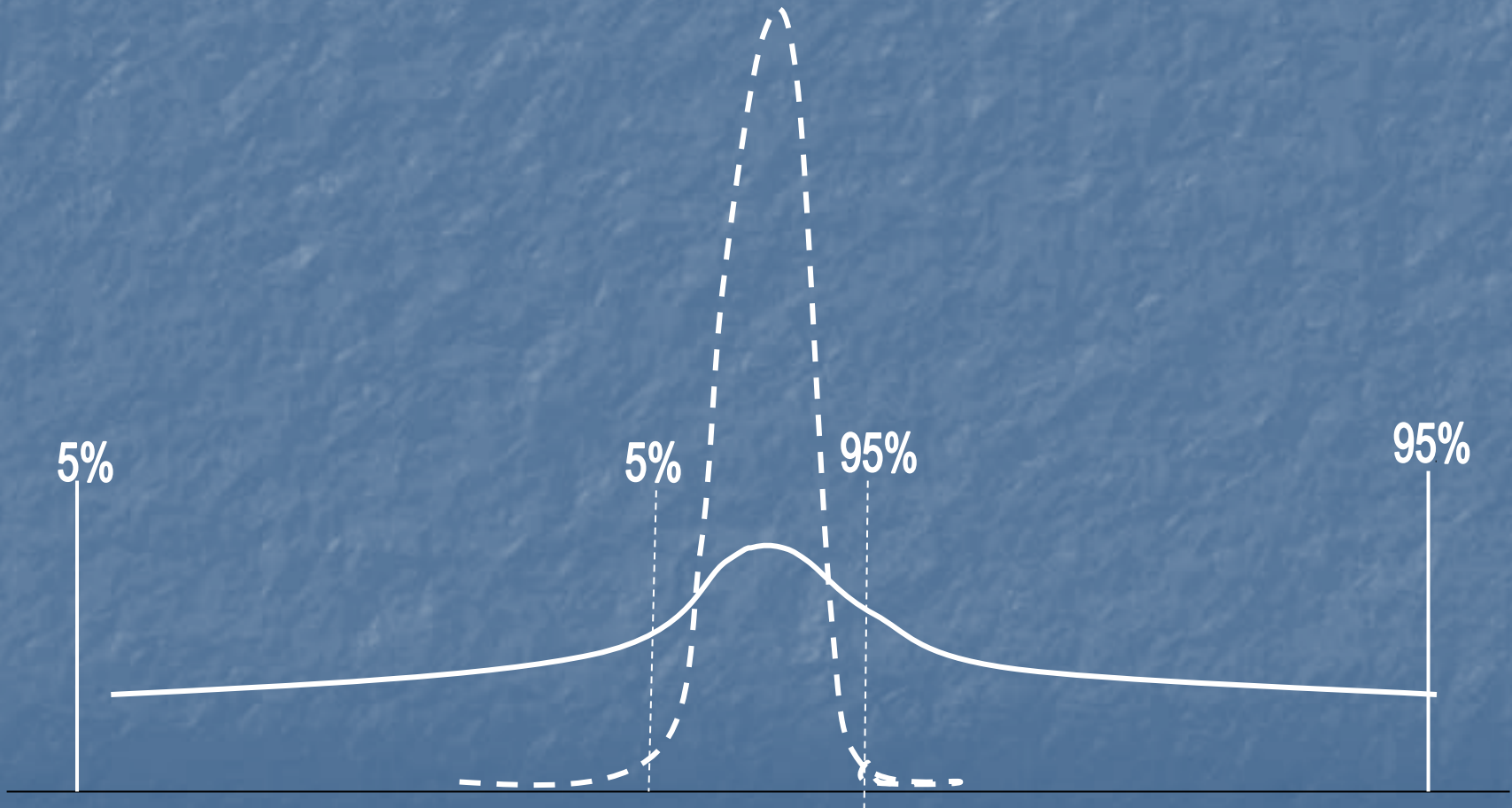
2004 Report by UK Government's Committee
Examining the Radiation Risks of Internal Emitters
(CERRIE) www.cerrie.org

Why large **dose** uncertainties?

Partly because many models and many assumptions

- Source-term models (amounts released)
- Environmental models (behaviour of nuclides in environment)
- Biokinetic models (uptake and retention of nuclides in humans)
- Dosimetric models (convert Bq to mGy: mSv)
- Dose weighting factors (tissue W_T and radiation W_R)

Uncertainty distributions in model estimates



Uncertainties in Dose Coefficients

Goossens LHJ, Harper FT, Harrison JD, Hora SC, Kraan BCP, Cooke RM (1998) Probabilistic Accident Consequence Uncertainty Analysis: Uncertainty Assessment for Internal Dosimetry: Main Report. Prepared for U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, USA. And for Commission of the European Communities, DG XII and XI, B-1049 Brussels Belgium. NUREG/CR-6571 EUR 16773.

Nuclide	Intake	Organ	U Range = (ratio of 95th/5th percentiles)
Cs-137	ingestion	red bone marrow	4
I-131	inhalation	thyroid	9
Sr-90	ingestion	red bone marrow	240
Pu-239	ingestion	red bone marrow	1,300
Sr-90	inhalation	lungs	5,300
Ce-144	inhalation	red bone marrow	8,500
Pu-239	ingestion	bone surface	20,000

Also large **risk** uncertainties,
because of inappropriate model

- BEIR VII risk model based on data from 1945 Japanese bomb survivors: LSS study
- Is this appropriate for environmental exposures from NPPs?
- Higher risks in infants?
- Even higher risks from *in utero* exposures?



Contents lists available at ScienceDirect

Journal of Environmental Radioactivity

journal homepage: www.elsevier.com/locate/jenvrad

A hypothesis to explain childhood cancers near nuclear power plants

Q4  Ian Fairlie*

Q1 115 Riversdale Road, London N5 2SU, United Kingdom

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Relative risk

ABSTRACT

Over 60 epidemiological studies world-wide have examined cancer incidences in children near nuclear power plants (NPPs): most of them indicate leukemia increases. These include the 2008 KiKK study commissioned by the German Government which found relative risks (RR) of 1.6 in total cancers and 2.2 in leukemias among infants living within 5 km of all German NPPs. The KiKK study has retriggered the debate as to the cause(s) of these increased cancers. A suggested hypothesis is that the increased cancers arise from radiation exposures to pregnant women near NPPs. However any theory has to account for the >10,000 fold discrepancy between official dose estimates from NPP emissions and observed increased risks. An explanation may be that doses from spikes in NPP radionuclide emissions are significantly larger than those estimated by official models which are diluted through the use of annual averages. In addition, risks to embryos/fetuses are greater than those to adults and haematopoietic tissues appear more radiosensitive in embryos/fetuses than in newborn babies. The product of possible increased doses and possible increased risks per dose may provide an explanation.

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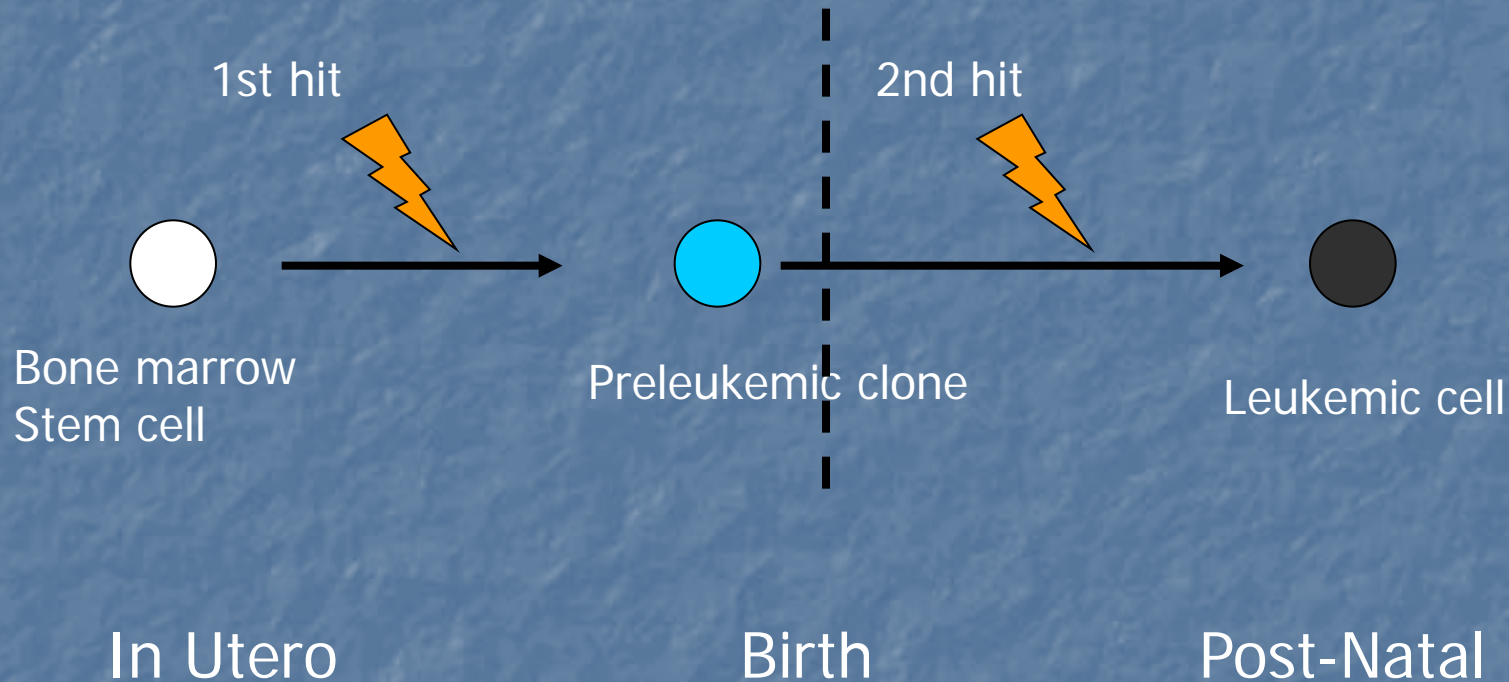
Hypothesis to explain KiKK findings

Fairlie I Journal of Environmental Radioactivity 133 (2014) 10-17

- episodic spikes in reactor releases
 - high concentrations in pregnant women
 - high exposures to embryos/fetuses
 - resulting babies are born pre-leukemic
 - in 1-2 years, develop full leukemia
- ie teratogenic effect of radiation exposure

Leukemogenesis in Children

(after Professor Rössig, 2008, Radiat Prot Dos, 132, 114-118)



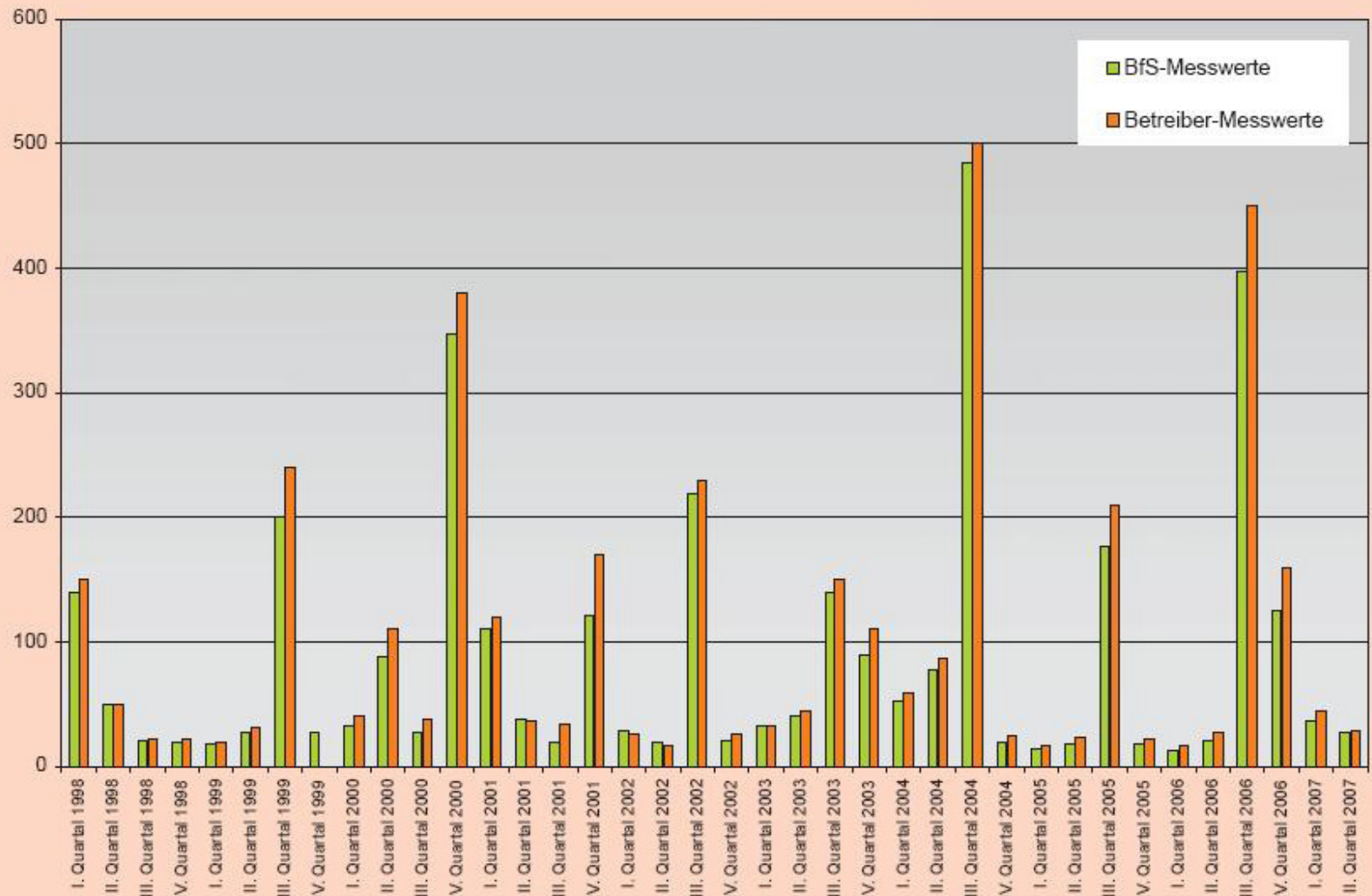
All childhood leukemias arise from in-utero radiation exposures

- I.e including spontaneous leukemias –
resulting from background radiation
- O'Neill KA, Bunch KJ, Murphy MF Intrauterine growth
and childhood leukemia and lymphoma risk. Expert Rev
Hematol. 2012 Oct;5 (5):559-76

1st Stage – Environmental Emissions

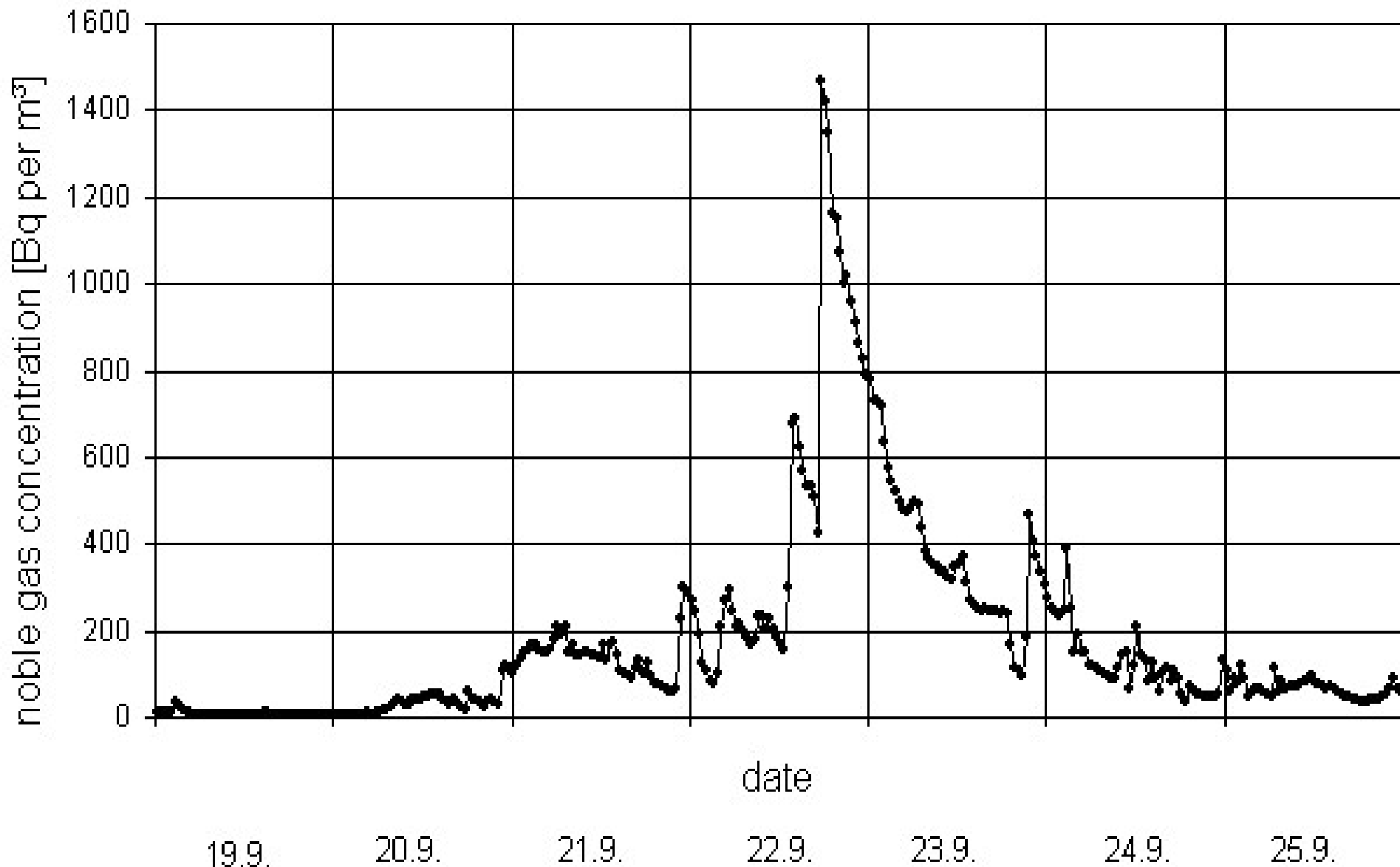
- NPP refuelling ~once a year
- reactors opened - large spike of radioactive gases

Anorganische C-14-Aktivitätskonzentration in der Fortluft
einer deutschen kerntechnischen Anlage in Bq/m³



Vergleich der vom Betreiber und dem BfS ermittelten Kohlenstoff-14-Aktivitätskonzentrationen in der Fortluft am Beispiel eines süddeutschen Druckwasserreaktors (KKW Neckarwestheim 2)

Spikes in NPP releases



Unit Conversions

$$1500 \text{ Bq/m}^3 = \sim 40 \text{ nCi/m}^3$$

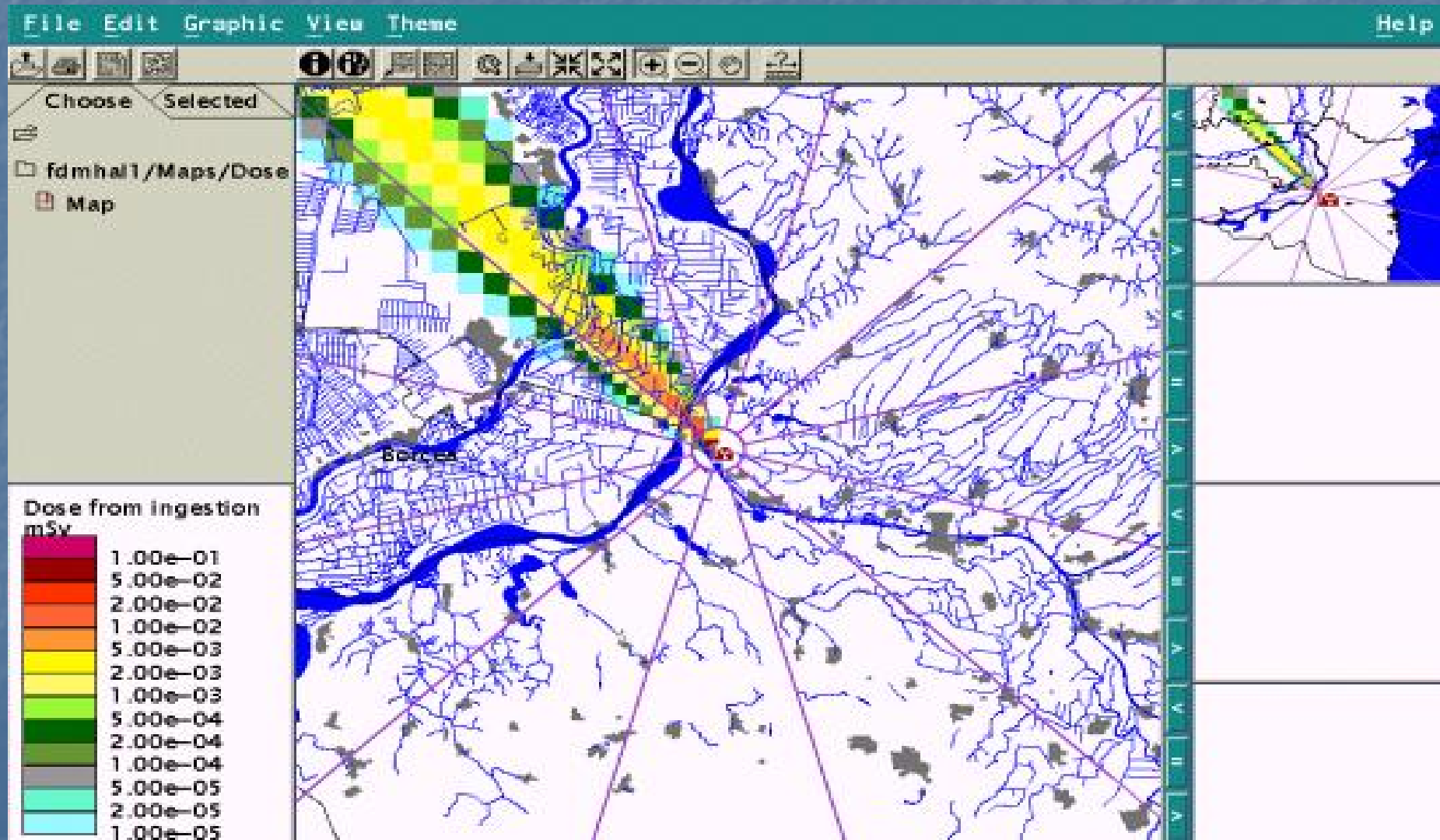
$$1 \text{ Bq} = 1 \text{ disintegration/sec}$$

$$(1 \text{ MBq} = \sim 27 \text{ } \mu\text{Ci})$$

$$(1 \text{ Ci} = \sim 37 \text{ GBq})$$

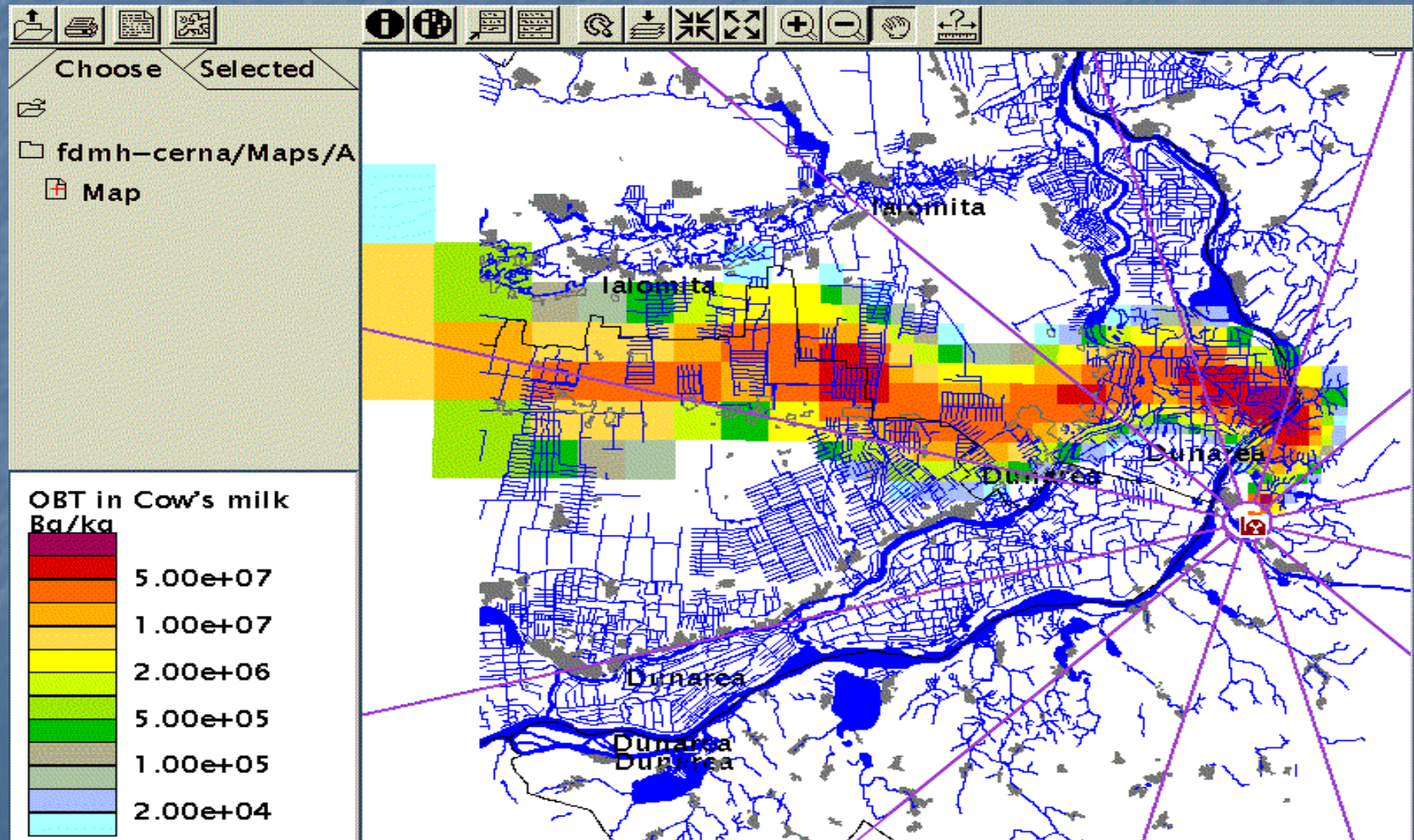
Tritium doses from ingestion (EU RODOS Model) in mSv

8th Meeting of the IAEA (EMRAS) Tritium & C-14 Working Group
May 30 - June 1, 2007 - Bucharest, Romania (<http://www.nipne.ro/emras/>)



Estimated tritium levels in cow's milk (EU RODOS Model) **OBT** Bq/kg

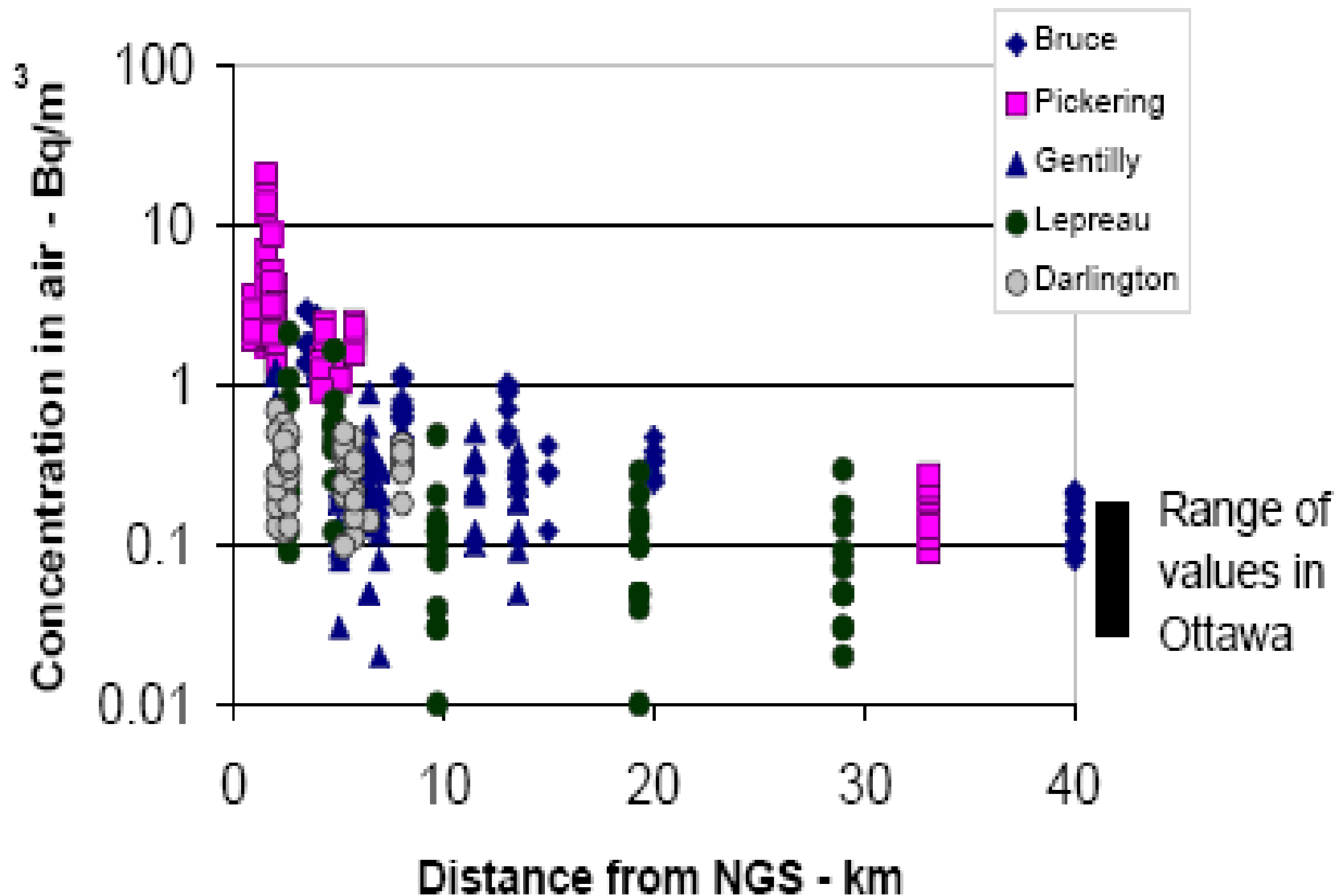
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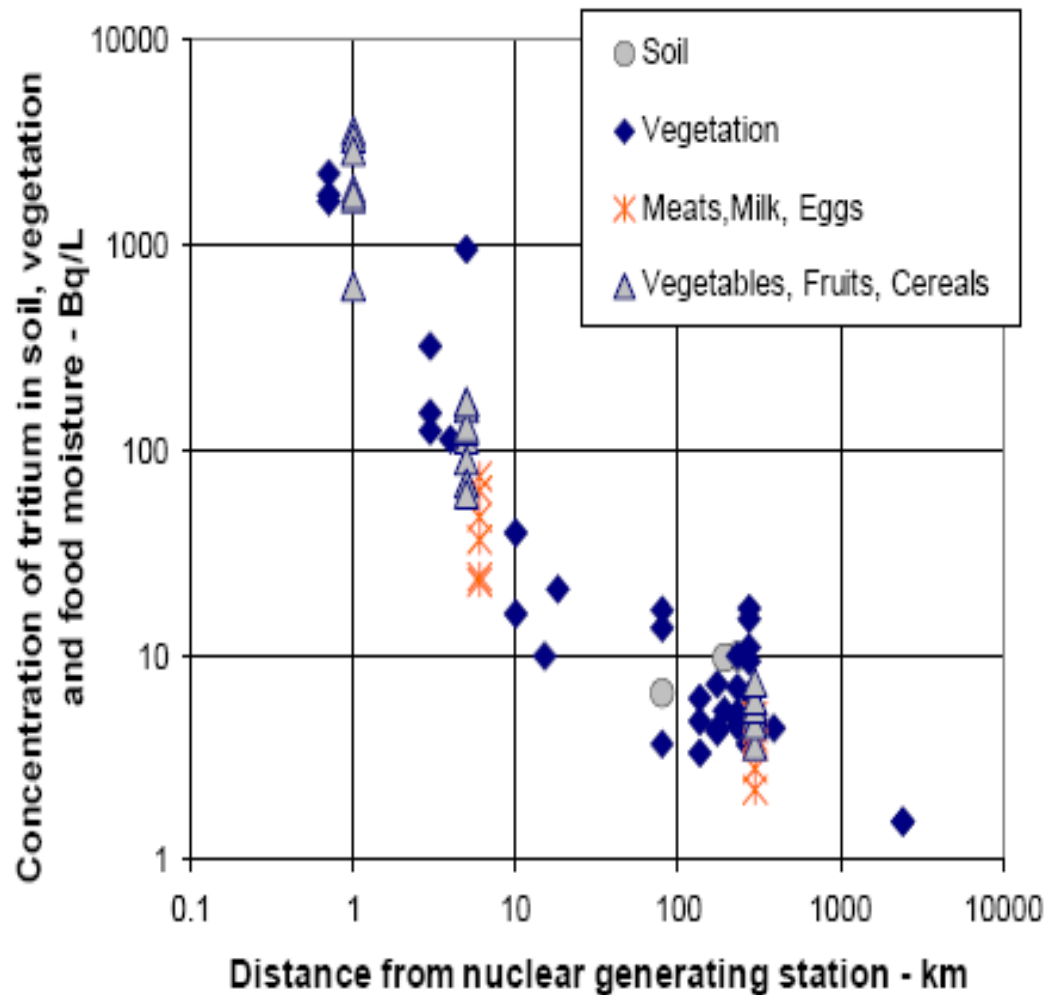
Main emissions from US nuclear facilities

- noble gases (Kr, Xe, Ar etc)
- tritium (HTO and HT forms)
- plus smaller amounts of C-14, I-131, I-129 ...
- and very small amounts of other nuclides

Tritium conc's in air



Tritium conc's in food



What is tritium?

- the radioactive isotope of hydrogen
- half-life = 12.3 years
- beta emitter, av energy 5.7 kev
- mostly in the form $^3\text{H-O-H}$, ie radioactive water
- but, many misconceptions

Unusual Tritium Properties

- extreme mobility and cycling
- high rates molecular exchange
- builds up as OBT, sticks inside us
- very short range, so damage depends on location in cell, eg DNA?
- often described as "weak", but higher RBE than "strong" emitters

RESULT: Official models significantly underestimate its doses and risks

Hazardous Properties

(after G Kirchner, 1990 J Environ Rad 11, pp 71-95)

tritium = ✓

1. large releases to environment ✓
2. rapid nuclide transport, cycling in biosphere ✓
3. high solubility ✓
4. many environmental pathways to humans ✓
5. rapid molecular exchange rates ✓
6. high uptake to blood after intake ✓
7. organic binding in biota ✓
8. long biological half-life in humans ✓
9. long radiological half-life ✓
10. global distribution ✓
11. long decay chains + toxic daughters
12. high radiotoxicity (ie high dose coefficient)

Reports discussing tritium

1. AGIR HPA Report (2007) Review of Risks from Tritium
2. Melintescu A, Galeriu D and Takeda H (2007) Reassessment Of Tritium Dose Coefficients For The General Public. Radiat Protect Dosim June 2007, pp. 1–5
3. Fairlie I (2007) RBE and w_R values of Auger emitters and low-range beta emitters with particular reference to tritium. Journal of Radiol Prot. Vol 27 pp 157-168
4. US EPA draft White Paper. Modifying EPA Radiation Risk Models Based on BEIR VII. August 1 2006
5. Makhijani A, Smith B, and Thorne MC (2006) Science for the Vulnerable: Setting Radiation and Multiple Exposure Environmental Health Standards to Protect Those Most at Risk. See chapter 7 on tritium.

<http://www.ieer.org/campaign/report.pdf>

More recent reports discussing tritium

AGIR. Review of risks from tritium. Documents of the Health Protection Agency: Radiation, Chemical and Environmental Hazards, REC-4. November 2007.

ASN (2010) White Paper on Tritium. Autorite de Securite Nucleaire (French Nuclear Safety Authority). Paris France.

CNSC (2010) Health Effects, Dosimetry and Radiological Protection of Tritium. Canadian Nuclear Safety Commission. INFO-0799. Ottawa, Canada.

Fairlie I (2008) The hazards of tritium revisited. *Medicine, Conflict and Survival*. Vol 24:4. October 2008. pp 306 -319.

IRSN (2010a). Sources of production and management of tritium produced by nuclear plants. Institute de Radioprotection et Surete Nucleaire. Fonteney-aux-Roses, Paris France

IRSN (2010b). Tritium in the Environment - Review of the IRSN. Institute de Radioprotection et Surete Nucleaire. Fonteney-aux-Roses, Paris France.

IRSN (2010c). Tritium in the Environment - A View from the IRSN on the key issues and avenues of research and development. Institute de Radioprotection et Surete Nucleaire. Fonteney-aux-Roses, Paris France

Precautionary Principle

- (a) uncertainty not excuse for inaction
- (b) if reasonable evidence, take precautionary steps
- advise NPPs to refuel at night-time, or during windy weather, or when wind is blowing away from high populations

John F. Kennedy: April 2, 1960

"Radiation, in its simplest terms - figuratively, literally and chemically - is poison there is no amount of radiation so small that it has no ill effects at all on anybody. There is actually no such thing as a minimum permissible dose. Perhaps we are talking about only a very small number of individual tragedies - the number of atomic age children with cancer, the new victims of leukemia, the damage to skin tissues here and reproductive systems there - perhaps these are too small to measure with statistics. But they nevertheless loom very large indeed in human and moral terms."

http://www.jfklibrary.org/Research/Research-Aids/JFK-Speeches/Milwaukee-WI_19600402-Wisconsin-Assoc-of-Student-Councils.aspx

Credits

Dr Alfred Körblein, Germany

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