

Research Shows Beneficial Effects of Low Doses of Radiation

By Jerry Cuttler

Summary of the Work

Ron Mitchel, Senior Scientist in the Radiation Biology and Health Physics Branch at Chalk River Laboratories and three co-workers have just published an outstanding paper in the journal *Radiation Research*.[†] It presents evidence that a single radiation dose of 10 or 100 milliGray* (mGy) (1 or 10 rad) cobalt-60 gamma rays to cancer-prone, radiation-sensitive young (~50 day old) mice delayed cancer death substantially. The dose of 10 or 100 mGy is approximately 4 to 40 times the average natural radiation dose per year, but it was delivered at 0.5 mGy/min.

The research employed genetically modified Trp53^{+/-} mice whose cells lack the cancer-fighting gene Trp53 in one of their two chromosomes. Such mice get cancer in middle age instead of old age, as would happen in normal mice (Trp53^{+/+} ones). Not only are Trp53^{+/-} mice cancer prone, they are also radiation sensitive. Such mice do model cancer-prone and radiation-sensitive people including those who would be part of a workforce.

Normal mice have a mean life span of 578 ± 138 days (1.6 ± 0.4 y). Exposure of these normal mice to the large dose of 4 Gy (400 rad) at a high dose rate results in a life-span loss of 125 days or 22% of their normal life. In comparison, Trp53^{+/-} mice with a life span of 375 ± 103 days (1.0 y), when exposed to 4 Gy, have their life reduced by 148 days or 40%. Trp53^{+/-} mice are therefore more sensitive than normal mice to a high dose.

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The Importance of This Work.

Hormesis is an adaptive response of living organisms to low levels of chemical, biological or radiological stress or damage – a modest overcompensation to a disruption – resulting in improved fitness. Observations of this reproducible phenomenon (low-dose stimulation and high-dose inhibition) have been widely reported in the scientific biomedical literature since the 1880s, and form the basis for all immunology treatment. Despite the growing body of evidence for adaptive response to low-level radiation, however, epidemiological (population) studies are generally inconclusive. The reason given is that the dose-response is lost against the noise of background cancer incidence. Public and occupational health policies, which rely on such studies, therefore revert to the Linear-No-Threshold (LNT) hypothesis. Unfortunately, misinterpretation of the LNT hypothesis, that it implies proof of a negative health effect at any level of radiation exposure, has contributed to societal radiophobia and anti-nuclear propaganda. This Chalk River paper reports on quality research carried out on radiation-sensitive animals, and demonstrates that a low dose of radiation, while neither increasing the average life span nor reducing the frequency of tumor initiation in the sample population, did provide protection against spontaneous cancer by delaying death due to cancer. This, and other related research, suggest the need to reconsider the conventional “ever lower is better” criterion for low-dose radiation limits. Such a policy shift would also enable the possible use of low-dose radiation therapy in many important medical applications.

Jerry Cuttler



CNEWS which appears here in its second edition is intended as an informal, forward looking communicator of information on the interests and upcoming events and activities of the CNS. It is a guide to courses, conferences and seminars organized by the various divisions of CNS and to its publications, web sites and other information programs. CNEWS is directed to what we could think of as the broader CNS constituency including the participants and supporters of its various programs, and users of its information resources.



The CNS Bulletin is the news and technical magazine of the Canadian Nuclear Society and is published four times per year by Bulletin editor Fred Boyd, (fboyd@sympatico.ca). The Bulletin is distributed primarily to CNS members and is therefore a benefit of CNS membership. The Bulletin reports on CNS and other related conferences etc. and presents selected technical papers. It also includes the calendar of the upcoming events of the CNS and sister organizations. Be a member and benefit from receiving the Bulletin.



Looking for a “one-stop shopping” on-line resource that provides general information on the Canadian nuclear industry, with links to all other relevant websites? Check out “The Canadian Nuclear FAQ” (Frequently-Asked Questions) at www.nuclearfaq.ca

an unofficial information website created in 1996 by CNS member and AECL employee Jeremy Whitlock. The website includes links to the major Canadian and international nuclear websites and the educational nature of the website makes it attractive to teachers and to students planning research projects.

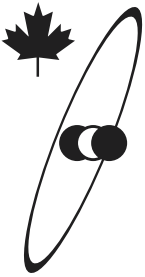


For the most comprehensive educational and reference library on CANDU technology including work by industry and academic contributors on plant design, construction, management, maintenance, materials and engineering, sponsored by CANDU Owners Group Inc., see the website <http://canteach.candu.org>



Canadian Nuclear Society Website

Access the CNS website at www.cns-snc.ca for a wealth of information about CNS programs and activities including the current Events Listing.



Canadian Nuclear Society **Events Calendar**

See the CNS website at <http://www.cns-snc.ca> for current listing of events.

2003

2003 February 17 - 18

CNS CANDU Chemistry Course
Babcock & Wilcox Training Centre
Cambridge, Ontario
Organized by: CNS

Contact: W. Schneider
Babcock & Wilcox Canada
581 Coronation Boulevard
Cambridge, ON, Canada N1R 5V3
Tel: 519-621-2130 x 2269
Fax: 519-622-7222
e-mail: wgschneider@babcock.com

The CANDU Chemistry Course was presented in February 2003 as well as in 2001 as a newly developed course. The course is directed primarily at designers of systems, components and controls, operators and maintainers of nuclear power plant systems and those involved with regulatory requirements and all who need to understand the relationship among process system chemistry, materials selection and degradation generally. This course qualifies for EIC CEU (Continuing Education Unit) credits.

2003 March 18 & 19

Canadian Nuclear Association
Nuclear Industry Seminar
Fairmont Château Laurier
Ottawa, Ontario
Organized by: CNA

Contact: Ms. Sanela Turkanovic
Canadian Nuclear Association
130 Albert Street, Suite 1610
Ottawa, ON K1P 5G4
Tel: 613-237-0640
Fax: 613-237-0989
e-mail: sanelat@cna.ca

The Canadian Nuclear Association holds its annual seminar in Ottawa, with support from the CNS. This location is selected to encourage a greater participation by those involved in the business, political and policy aspects of nuclear energy. The CNA is an organization of corporate members; the CNS is a society of individual, primarily technical members. The seminar addresses issues of interest to the nuclear industry generally. The seminar is free of charge for all Canadian government participants.

2003 April 7-9

CNS CANDU Reactor Safety Course
Holiday Inn
2125 North Sheridan Way
Mississauga, Ontario
Organized by: CNS

Contact: Dr. E.M. (Dorin) Nichita
AECL
Tel : 905-823-9060 x 2221
e-mail: nichitae@aec.ca

The CANDU Reactor Safety Course is offered once or several times per year. The course discusses design strategies and analysis methods for addressing various accident scenarios. Presentation formats/venues can be made available to complement the in-house training programs of specific organizations.

This course will qualify for EIC Continuing Education Unit credits which will be awarded to those completing the course. CEU's may then be used as evidence of continuing education credits by the participants.

2003 June 8-11

24th Annual CNS Conference &
28th Annual CNS/CNA Student
Conference – Nuclear Revival: An
Environmentally Responsible Option
Marriott Eaton Centre
Toronto, Ontario
Organized by: CNS

Contact: Denise Rouben
Canadian Nuclear Society
480 University Avenue, Suite 200
Toronto, ON, Canada M5G 1V2
Tel: 416-977-7620
e-mail: cns-snc@on.aibn.com

The CNS annual conference features a wide ranging program of individual technical papers, plus plenary session keynote speakers who bring a broader perspective to the discussions. It is attended by people from operating nuclear stations, engineering and service support operations, research and education. A number of awards are presented at the conference in recognition of contribution to the industry and to this society. Also the Student Conference is held in conjunction with this annual conference on the opening Sunday; registration rates are very attractive. NA-YGN (North American Young Generation in Nuclear) holds a meeting at this conference. Contact Mark McIntyre at MMcIntyre@nbpower.com re NA-YGN.

2003 Autumn

CNS CANDU System Life
Management Workshop
Ontario

Contact: J. Nickerson
AECL-SP
Tel : 905-823-9060 x2114
e-mail: nickersj@aec.ca

The achievement of long and efficient nuclear plant operation requires the management of life affecting factors including establishing life cycle objectives, assessment and management of degradation, cleaning, repair and upgrade programs. This workshop deals with these issues.

2003 September 21-24

8th Int'l Conference on CANDU Fuel
Delawana Inn
Honey Harbour, Ontario

Contact: Brock Sanderson
AECL – CRL
Chalk River, ON K0J 1J0
Tel: 613-584-8811 x3368
e-mail: sandersonb@aec.ca

CANDU nuclear fuel which has been central to the success of the CANDU program continues to accumulate operating experience as well as ongoing research. In addition conditions, designs and requirements change. This conference addresses the design, manufacturing, qualification and operating experience with CANDU nuclear fuel in order to discuss such change.

2003 Autumn

CNS Quality Assurance Course
Toronto, Ontario
Organized by: CNS

Contact: Dr. E.M. (Dorin) Nichita
AECL
Tel : 905-823-9060 x 2221
e-mail: nichitae@aec.ca

The aim of the course is to provide an understanding of Quality Assurance and its implementation in the nuclear industry. It is aimed at all nuclear industry professionals and it will provide an overview of Quality Systems, Management, Auditing, Improvement, ISO 9000, Nuclear QA Standards, QA for R&D, QA for Manufacturing, Probabilistic Safety Analysis QA and Software QA. Ask about EIC CEU (Continuing Education Unit) credits.

2003 November 16-18

6th CNS International Conference
on CANDU Maintenance
Holiday Inn on King
Toronto, Ontario
Organized by: CNS

Contact: Denise Rouben, CNS Office
Tel: 416-977-7620
email: cns-snc@on.aibn.com
M. Reid
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The 6th International Conference on CANDU Maintenance will take place in November 2003 in Toronto. Plant maintenance and reliability are a top priority in the industry and previous conferences have always been well attended with representation from throughout the international CANDU community. This conference features a full technical presentation program along with extensive vendor exhibits and offers an excellent opportunity for CANDU owners and their key suppliers to discuss the latest maintenance strategies, techniques and experiences. In addition to covering maintenance of all major plant components the conference also deals with issues such as human performance, environmental qualification, and plant life management. Plenary sessions featuring leaders from the nuclear industry provide a higher level view of current operation and maintenance issues and future challenges.

2004

2004 Winter

Canadian Nuclear Association
Nuclear Industry Seminar
Ottawa, Ontario
Organized by: CNA

Contact: Ms. Sanela Turkanovic
Canadian Nuclear Association
130 Albert Street, Suite 1610
Ottawa, ON K1P 5G4
Tel: 613-237-0640
Fax: 613-237-0989
e-mail: sanelat@cna.ca

The course is directed primarily at designers of systems, components and controls, operators and maintainers of nuclear power plant systems and those involved with regulatory requirements and all who need to understand the relationship among process system chemistry, materials selection and degradation generally this course will also qualify for EIC CEU (Continuing Education Unit) credits.

2004 Spring

CNS Containment Conference
Ontario
Organized by: CNS

Contact: Denise Rouben
CNS office
Tel: 416-977-7620
e-mail: cns-snc@on.aibn.com

Reactor containment is a subject of renewed interest as a result of the current security climate. There is also ongoing experience and research and the changing requirements which evolve from that. The conference addresses containment design, qualification and experience in operation.

2004 Spring

ROP Course
Reactor Overpower Protection
Organized by: CNS

Contact: Dr. E.M. (Dorin) Nichita
AECL
Tel : 905-823-9060 x 2221
e-mail: nichitae@aecl.ca

This course will address the design, analytical simulation and experience with reactor overpower protection systems.

2004 Spring

Reactor Physics Course
Organized by: CNS

Contact: Dr. E.M. (Dorin)
Nichita
AECL
Tel : 905-823-9060 x 2221
e-mail: nichitae@aecl.ca

This course will address reactor core physics characteristics, analytical simulator and parameter control.

2004 Spring

CNS CANDU Reactor Safety Course,
ON
Mississauga
Organized by: CNS

Contact: Dr. E.M. (Dorin) Nichita
AECL
Tel : 905-823-9060 x 2221
e-mail: nichitae@aecl.ca

This is the 2004 edition of the CNS CANDU Reactor Safety course. The course discusses design strategies and analysis methods for addressing various accident scenarios. Presentation formats/venues can be made available to complement the in-house training programs of specific organizations.

This course will qualify for EIC Continuing Education Unit credits which will be awarded to those completing the course. CEU's may then be used as evidence of continuing education credits by the participants.

2004 May 9-13

3rd Int'l Youth Nuclear Congress
(IYNC)
Toronto, Ontario
Organized by: IYNC

Contact: IYNC website: www.iync.org
IYNC/CNS website: www.cns-snc.ca/branches/toronto/iync
Adam McLean
IYNC2004 Local Chair
Tel: 416-977-7620
e-mail: adam.mclean@utoronto.ca

The International Youth Nuclear Congress meets in Toronto in 2004. Go to the website for information on this exciting event involving young people from around the world.

2004 June 6-9

25th Annual CNS Conference & 29th
Annual CNS/CNA Student Conference
Marriott Eaton Center
Toronto, Ontario
Organized by: CNS

Contact: Denise Rouben
Canadian Nuclear Society
480 University Avenue, Suite 200
Toronto, ON, Canada M5G 1V2
Tel: 416-977-7620
e-mail: cns-snc@on.aibn.com

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2004 Fall

Waste Management
Conference
Toronto, Ontario
Organized by: CNS

Contact: Denise Rouben
CNS office
Tel: 416-977-7620
e-mail: cns-snc@on.aibn.com

This symposium is a discussion of the issues and technology relating to storage and disposal of low, intermediate and high level radioactive wastes.

2004 Fall

CNS CANDU Fuel Technology Course
Toronto, Ontario
Organized by: CNS

Contact: Denise Rouben
CNS office
Tel: 416-977-7620
e-mail: cns-snc@on.aibn.com

This course addresses the development, manufacturing, operation and reliability of CANDU nuclear fuel. In addition to the presentations of the technical material, the participants receive a series of questions with the course material which are collected and graded. The questions enhance the level of interest and understanding of the participants. This course will also qualify for EIC CEU (Continuing Education Unit) credits. Registration is limited to 55 people.

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Radiation in low doses does not significantly affect the normal life span of these radiation-sensitive, cancer-prone mice; however, the effect on cancer latency (the time between spontaneous initiation and progress to malignant tumors which cause death due to cancer) is significant. Trp53+/- mice spontaneously develop a variety of cancer types. Two types that provide a good measure of latency are bone cancer in the spine (indicated by the onset of paralysis) and lymphoma (leading rapidly to death). The research demonstrated that the radiation exposures had little effect on tumor frequency, indicating no effect on tumor initiation. The 10 mGy exposure reduced the risk of both cancer types by increasing latency (by up to ~120 days for spine cancer); i.e. it reduced the rate at which spontaneously initiated cells progressed to malignancy. The effect of this adaptive response persisted for the entire life span of all the animals that developed these tumors. Exposure to 100 mGy delays lymphoma latency longer than the 10-mGy dose, however, the 100 mGy dose increased spinal cancer risk by decreasing latency compared to unexposed control mice. The higher dose is in the transition zone between reduced and increased risk; the dose at which the transition occurs varies with tumor type.

Stated more concisely, a small dose (10 mGy) did increase the latency period for lymphoma and for bone cancer; i.e., it did reduce the rate at which spontaneously initiated cells progressed to malignancy and the effect of this adaptive response persisted for the entire life span of all the animals that developed these tumors.

† Mitchel RE, Jackson JS, Morrison DP, Carlisle SM. Low Doses of Radiation Increase the Latency of Spontaneous Lymphomas and Spinal Osteosarcomas in Cancer-Prone, Radiation-Sensitive Trp53 Heterozygous Mice, *Radiat Res* 159 (3):320-7, 2003 March

* A measure of radiation dose per unit animal weight (1 Gray is 1 Joule radiation energy per kg)

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Issue 2

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