

SUMMARY OF EVIDENCE

IN THE CASE OF

CANCER VICTIM

AND

ATOMIC VETERAN

BJARNIE HANNIBAL PAULSON

PRESENTED TO

THE PENSION REVIEW BOARD

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PREPARED BY

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BACKGROUND INFORMATION

On May 24, 1958, an intensely radioactive metallic fuel rod caught fire, releasing enormous quantities of mote-like radioactive particles into the atmosphere of the NRU reactor building at Chalk River.¹ These dangerously radioactive particles were so tiny that a great many of them remained airborne for weeks after the accident.² As they adhered to walls, floors, ceilings, and other exposed surfaces, the radioactive ashes completely contaminated the entire reactor building.³

The fire was extinguished by dousing the burning fuel fragments with wet sand carried in from outside, and within 24 hours of the accident, most of the visible debris had been removed. The fiercely radioactive fuel fragments were hoisted out by an overhead crane⁴ while most of the contaminated sand was shovelled into metal cans using special tools.⁵ This material was trucked away to a burial site.⁶ Even so, radiation fields remained extremely high in the area where the fire had occurred.⁷ Within a week, an improvised vacuum system -- essentially a commercial Vacublast unit with an exceptionally long hose -- was being used to remove as much of the remaining debris as possible.⁸

About 600 men were employed in the subsequent clean-up operation, which involved carefully scrubbing all exposed surfaces in an attempt to decontaminate them.⁹ For two weeks following the accident, this work was done by civilian employees; however, it soon became apparent that their cumulative radiation exposures could become excessively high unless they had outside help.¹⁰ Therefore, during the last six weeks of the clean-up, most of the routine mopping and scrubbing was done by others. Sixteen instructors were brought in from the Civil Defence College in Arnprior, as well as fifty-eight RCAF men from Ground Defence Units across Canada, all of whom had had experience in handling radioactive sources and reading radiation monitoring equipment.¹¹ These older, more experienced men supervised the work of hundreds of young army recruits from Camp Petawawa, escorting them in groups of fifteen into the contaminated area.¹²

During the cleanup operation, there were two quite different types of radiological hazards to be considered. First, there was the inevitable exposure of the men to penetrating gamma radiation while inside the contaminated building; this exposure was recorded on film badges and monitored by pocket dosimeters worn by the workers.¹³ Secondly, there was the ever-present

possibility of direct bodily contamination, resulting from inadvertent skin contact or from breathing or swallowing some of the myriad radioactive particles which were still airborne inside the reactor building and which clung tenaciously to the protective clothing worn by the men.¹⁴ Although many precautions were taken to minimize the chances of such contamination of the person from occurring, and although efforts were made to detect such cases when they did occur, nevertheless it is important to note that no records were kept of radioactive exposures resulting from such incidents.¹⁵

The Pension Commission has already acknowledged the possibility of bodily contamination leading to radiation-induced cancer in the case of Ken McCormand, who was granted entitlement for sarcoma of the left tonsil attributable to radiation exposure to the throat during the clean-up operation.¹⁶ The exposure in question occurred when Corporal McCormand entered the contaminated area without having the charcoal filter properly inserted in his respirator.¹⁷ This circumstance allowed Corporal McCormand to inhale airborne radioactive particles, which could have caused his cancer.¹⁸

CIRCUMSTANCES OF MR. PAULSON'S CASE

When the NRU accident happened, Corporal Paulson was an RCAF instructor of Ground Defencemen in matters related to Atomic, Biological and Chemical Warfare.¹⁹ He was summoned from St. Jean, Québec, to assist in the cleanup, and spent two weeks at Chalk River, from June 6 to June 18.²⁰ At that time, airborne contamination was still significant.²¹ During his stay, Corporal Paulson entered the contaminated area on numerous occasions (at least once a day for a total of ten days).²²

All workers leaving the contaminated area were instructed to strip and shower. Inevitably, some of them touched their contaminated clothing or equipment to their bare skin.²³ After showering, each worker was given a cursory inspection with a hand-held radiation monitoring device to check for possible skin contamination.²⁴ In some cases, men were sent back to the showers one or more times, because evidence of skin contamination did exist.²⁵

On one particular occasion, Corporal Paulson and Corporal McCormand were sent on a special mission into an exceptionally "hot" area where the Vacuum-blast unit had been temporarily stored.²⁶ The overhead crane was unable

to load the Vacublast unit onto a truck that was standing by, because of the long, dangling hose attached.²⁷ Corporal Paulson used the hacksaw which was provided for that purpose to cut through the hose of the intensely radioactive Vacublast unit, close to the main body of the machine.²⁸ During this episode, Corporal Paulson exposed himself to an unusually concentrated source of radioactive dust and debris.²⁹ On that same day, Corporal Paulson was sent back to the showers three times.³⁰

Six years later, in 1964, a malignant growth (later diagnosed as basal cell carcinoma) was removed near Mr. Paulson's rectum.³¹ It is extremely rare to find basal cell carcinoma in this part of the body.³² Since then, Mr. Paulson has suffered from multiple basal cell carcinomas occurring in many parts of his body, including his pubic area and various sites on his nose, lip, cheek, scalp and eyelid.³³ Although basal cell carcinoma is quite a common ailment, Mr. Paulson's case is highly unusual and does not fall into any recognizable medical pattern.³⁴ There is no evidence of any genetic predisposition on Mr. Paulson's part to this kind of disease.³⁵ Ultraviolet radiation must be ruled out as a causative factor because of the location and unusual depth of many of the carcinomas.³⁶ There is no evidence of arsenic poisoning in Mr. Paulson's case, which has been implicated as a possible cause of basal cell carcinoma in the medical literature.³⁷ The only other known causative factor for basal cell carcinoma is ionizing radiation.³⁸ Since Mr. Paulson's skin is known to have been contaminated with radioactive particles at some point in time (in connection with the NRU cleanup), it is reasonable to suppose that this highly unusual exposure to radioactive contamination of the skin is the cause of Mr. Paulson's bizarre pattern of multiple basal cell carcinoma.³⁹

ENTITLEMENT TO A PENSION

In the main, Corporal Paulson's case is similar to that of Corporal McCormand. The former was exposed to an unknown and unrecorded dose of radiation to the skin, resulting from contamination by radioactive particles, and subsequently developed numerous cancers on the skin. The latter was exposed to an unknown and unrecorded dose of radiation to the throat, resulting from contamination by the same radioactive particles, and later developed cancer of the tonsil. Yet Corporal McCormand was granted entitlement and Corporal Paulson was denied entitlement. This seems unjust and inconsistent.

It is understood that Mr. Paulson is not obliged to prove that his cancers were caused by radiation, but only to establish a reasonable doubt that such is the case. The burden of proof, in Mr. Paulson's case, should not be more onerous than it was in Mr. McCormand's case. Under Section 85 of the Act, the Board is required to draw from all the circumstances and all the evidence presented to it, every reasonable inference in favour of the veteran, to accept as proof of any fact, any credible, uncontradicted evidence submitted by the veteran, and in weighing the evidence submitted to it, to resolve any doubt in favour of the veteran. This the Board has failed to do.

In addition to the circumstantial evidence described above, a great deal of additional corroborating evidence has been presented in support of Mr. Paulson's claim. None of this corroborating evidence is essential to the case, which has already been presented, but it does greatly strengthen the case. For the record, the salient features of this corroborating evidence are summarized below.

CORROBORATING EVIDENCE

1. Radioactive particles probably lodged in Mr. Paulson's pores and in his hair follicles, thereby contributing a substantial dose of radiation to the skin over a period of weeks, months, or even years following the accident.

This suggestion, which was first advanced by Mr. Paulson in a letter dated April 16, 1979, has since been corroborated by the testimony of several expert witnesses.⁴⁰

Mark Goldberg cited published scientific evidence indicating that over 90 percent of the radioactivity released into the atmosphere during the fire would be expected to consist of particles smaller than one micron in diameter.⁴¹ Dr. Eric young, M.D., pointed out that the average diameter of a human pore is about 70 microns, and that some hair follicles are even larger; he indicated that the mote-like radioactive particles described by Mr. Goldberg could easily lodge in these recesses.⁴² Dr. Karl Morgan, an experienced health physicist, confirmed on the basis of his own professional experience that radioactive skin contamination can and does penetrate into human pores and into hair follicles.⁴³ Dr. Srolovitz, a pathologist specializing in skin disorders, testified that an unusual number of Mr. Paulson's cancers seem to originate from the bottom of hair follicles.⁴⁴ Dr. Srolovitz also pointed

out that Mr. Paulson has unusually large pores and hair follicles, and that these are easily clogged with foreign matter, so that if a radioactive particle were to lodge there, it could remain undisturbed for a very long time.⁴⁵

Each tiny radioactive particle would act as a source of alpha, beta and gamma radiation, in about the same proportion as in the fuel rod which caught fire.⁴⁶ Using calculations derived from published scientific data, Mark Goldberg estimated the cumulative dose to the basal cells of the skin resulting from a "permissible" level of skin contamination⁴⁷ based on alpha radiation only (ignoring beta and gamma), and found that this dose would be in excess of 1000 rems per year, despite numerous conservatisms which tend to underestimate the true dose.⁴⁸ Quite independently, Dr. Karl Morgan estimated an alpha dose of 270 rems resulting from a single radioactive particle, weighing only one hundredth of a microgram, lodged in the skin for only thirty days.⁴⁹ In a dramatic demonstration using a geiger counter, Dr. Morgan showed that the presence of such a particle would be virtually undetectable in any cursory examination of the skin using a hand-held monitor.⁴⁹

This evidence, which is all mutually reinforcing, strongly suggests that mote-like radioactive particles did lodge in Mr. Paulson's hair follicles producing large localized doses of thousands of rems to the basal cells, and eventually causing the basal cell carcinomas with which Mr. Paulson is now afflicted. It is significant to note that all parties agree that significant skin contamination could have occurred and could have escaped detection.⁵⁰

2. The total radiation dose to the skin experienced by Mr. Paulson was never measured or recorded, and the skin monitoring that was done was carried out by men who were not expert in the field of skin contamination.

Dr. Art Marko, Director of the Health Sciences Division at Chalk River, confirmed that the film badges worn by Mr. Paulson were incapable of measuring his "skin dose" because they did not have "open windows" which are necessary for this purpose.⁵¹ Moreover, one of the most significant exposures experienced by Mr. Paulson was not recorded at all because of a defective film badge.⁵²

There was no monitoring at all for alpha contamination of the skin, but only for beta-gamma contamination.⁵³ Nevertheless, alpha contamination is known to be potentially far more damaging to the skin than beta-gamma contamination.⁵⁴

Skin monitoring of military personnel was not carried out by AECL experts, as erroneously assumed by Dr. Marko.⁵⁴ It was done by RCAF Ground Defence Instructors.⁵⁵ The RCAF men did not have experience comparable to that of the AECL men in dealing with skin contamination problems.⁵⁶ In particular, procedures which were in common use at U.S. nuclear laboratories in cases of serious skin contamination -- cutting off all the hair and checking contaminated workers on a daily basis over a period of weeks -- were never followed at Chalk River during the NRU cleanup.⁵⁷ It is questionable whether the men who did the monitoring were ever briefed on such procedures.⁵⁸

Skin doses which were measured by the monitors and used as an indicator for sending men back to the showers were not recorded.⁵⁹

3. Both the nature and the distribution of carcinomas in Mr. Paulson's case are entirely consistent with the hypothesis that they were caused by tiny radioactive particles which lodged in his hair follicles and pores.

Mr. Paulson's first carcinoma occurred in the peri-anal region, which is almost unheard-of in medical circles.⁶⁰ However, it is known that cuts, scrapes and abrasions are particularly vulnerable to contamination by radioactive particles,⁶¹ and that Mr. Paulson had a previous history of lesions and sores in the anal region.⁶² Moreover, no medical examination was given to the men who participated in the NRU cleanup prior to their involvement.⁶³ If Mr. Paulson had contaminated hands, and if he touched them to his anal region before or during showering, he could have spread the contamination to sores already existing in that region.⁶⁴

Pathological examination of his peri-anal carcinoma is consistent with this interpretation, revealing that the main tumor mass contains no fewer than three sites of origin, apparently all of them hair follicles.⁶⁵ The hair follicles are the most likely places where radioactive particles might lodge, particularly in Mr. Paulson's case, because his hair follicles are so large and so easily clogged.⁶⁶

The distribution of Mr. Paulson's other carcinomas is also highly unusual.⁶⁷ An extraordinarily large number of them originate near the bottom of hair follicles.⁶⁸ A disproportionate number occurs on the scalp, despite the fact that Mr. Paulson has a full head of hair and the scalp is not a favored site for basal cell carcinoma in such people.⁶⁹ The supra-pubic region is also most unusual as a site for basal cell carcinoma.⁷⁰ Moreover, the distribution of carcinomas is highly unsymmetric, most of them occurring on the right side of the head.⁷¹ Since Mr. Paulson removed his respirator with his bare right hand, this distribution of carcinomas is largely consistent with the hypothesis that he contaminated himself with radioactive particles which clung to his hand and were thence communicated to his face, as well as his pubic and anal regions.⁷²

Pathological examination also reveals that some of Mr. Paulson's carcinomas are very deep -- much too deep for ultraviolet radiation from the sun to reach.⁷³ Moreover, there is no evidence of sun-damaged skin in Mr. Paulson's case, even for those carcinomas which are not too deep for ultraviolet radiation to reach.⁷⁴ These observations, coupled with the fact that some of the carcinomas occurred in areas which are not exposed to the sun, would seem to rule out ultraviolet radiation as a causative factor.⁷⁵ The same observations tend to reinforce the hypothesis of skin contamination.

4. Mr. Paulson had no particular predisposition toward multiple basal cell carcinoma, either in terms of genetic makeup or in terms of pre-cancerous lesions, according to the best available medical evidence.

It is extremely rare for a single individual to have more than five basal cell carcinomas, let alone more than sixteen as in the case of Mr. Paulson.⁷⁶ The only medically known situations giving rise to such multiple occurrences (in the absence of ionizing radiation) are two genetic syndromes called the basal cell naevus syndrome and xeroderma pigmentosa.⁷⁷ Mr. Paulson does not fall into either of these categories.⁷⁸

Although there is no single test which will identify the basal cell naevus syndrome, there are numerous unusual conditions which generally accompany the syndrome, and Mr. Paulson displays none of these.⁷⁹ This fact, combined with Mr. Paulson's age and the distribution of his carcinomas, argues very strongly against the hypothesis that his multiple basal cell carcinoma is of genetic origin.⁸⁰ There simply isn't any evidence whatsoever to support such a conjecture.⁸¹

Xeroderma pigmentosa is a very severe, extremely debilitating disease, which is hereditary; it is obvious that Mr. Paulson does not suffer from this disorder.⁸²

Similarly, although Mr. Paulson did experience problems in the anal region prior to the NRU cleanup operation -- including hemorrhoids, a bilateral epithelial naevus, and papilloma -- none of these can plausibly be interpreted as a precancerous lesion.⁸³ Nor is there any medical evidence to suggest that these conditions are associated with or precursors to basal cell carcinoma of the peri-anal region.⁸⁴

5. There is ample evidence that ionizing radiation can cause basal cell carcinomas, and that, in particular, protracted exposure to alpha radiation resulting from skin contamination can significantly increase incidence of basal cell carcinomas.

All parties agree that ionizing radiation can cause cancers of many different kinds, including basal cell carcinoma.⁸⁵ Indeed, several examples of individuals who have suffered from radiation-induced basal cell carcinomas have been cited by expert witnesses.⁸⁶ In general, these people experienced large cumulative doses of radiation.⁸⁷

A careful study of several thousand uranium miners in Czechoslovakia revealed a large increase in the incidence of basal cell carcinoma, which has been attributed to skin contamination by alpha-emitting substances known as "radon daughters".⁸⁸ Doses were estimated to be in the thousands of rems.⁸⁹ Animal experiments, in which small quantities of plutonium were injected under the skin, resulted in a highly elevated incidence of skin cancer.⁹⁰ Doses were estimated to be in the hundreds to thousands of rems.⁹¹

The mote-like radioactive particles which contaminated Mr. Paulson's skin contained at least two alpha-emitting substances (uranium and plutonium) as well as beta-emitting and gamma-emitting substances (the fission products).⁹² No effort was made during the NRU cleanup to monitor for alpha contamination of the skin.⁹³ Nevertheless, Mark Goldberg estimated the dose to the basal cells of the skin which would result from a "permissible" level of alpha contamination of the skin,⁹⁴ and found it to be more than a thousand rems per year.⁹⁵ Independently, Dr. Morgan estimated the alpha dose from a single minute par-

ticle lodged in the skin and found it to be 270 rems per month.⁹⁶ At the same time, Dr. Morgan demonstrated that such a particle would very likely escape detection even by a very scrupulous and very skilled person using a hand-held beta-gamma monitor.⁹⁷ Since the alpha-emitting substances continue to irradiate the surrounding tissue at a constant rate forever, unlike the beta- and gamma-emitting substances which gradually diminish in intensity, there is no practical limit to the cumulative dose that could be experienced if insoluble particles lodged in the hair follicles, as seems likely in Mr. Paulson's case.⁹⁸ Nevertheless, this potentially very large dose was totally ignored by Drs. Muller and Létourneau when they formed their judgments on the case.⁹⁹ Nor was it taken into consideration by the Pension Commission.¹⁰⁰

Circumstantial evidence also exists which indicates that Mr. Paulson received much larger doses of radiation to the genital-anal area than is admitted by the authorities. Pathological examination of tissue removed from the penis reveals what appears to be extensive radiation damage.¹⁰¹

6. Probability estimates purporting to show that Mr. Paulson's condition was not caused by radiation exposure associated with the NRU cleanup are unreliable and unscientific, because they are not rooted in reality.

Regulatory agencies and major scientific bodies have all concluded that there is no scientific basis for believing in a "safe dose" of radiation -- that is a dose so low that no risk of radiation-induced cancer exists.¹⁰² Whenever there is radiation exposure, cancer induction is always within the realm of probability.¹⁰³ For example, Dr. Marko reported on the cases of two ex-AECL employees whose cancers were attributed to radiation exposure, even though neither of the men was ever "over-exposed" to radiation.¹⁰⁴ In the context of radiation exposure, therefore, words such as "safe", "insignificant", "negligible", "decontaminated", and the like, unless accompanied by precise and accurate measurements, cannot be regarded as meaningful.¹⁰⁵

On the basis of evidence provided to them, both Dr. Létourneau and Dr. Muller estimated an extremely low probability that Mr. Paulson's condition was caused by radiation exposures associated with the NRU cleanup.¹⁰⁶ However, their assumptions are highly questionable, and in fact bear very little relationship to the actual circumstances of the case.¹⁰⁷ A short critique follows.

- (1) Both experts have assumed that "significant" skin contamination did not occur, even though they admit the possibility that "significant" skin contamination did occur.¹⁰⁸ They do not seem to be familiar with the specifics of the case: that Mr. Paulson was the man who cut through the hose of the vacuum cleaner, that he touched the outside of his garments with his bare hands, that he was sent back to the showers three times, that his pores and hair follicles are exceptionally dilated, that he may have had sores in the anal region, et cetera.¹⁰⁹
- (2) Both experts assume that "negligeable" levels of skin contamination are not likely to cause cancer, and therefore they ignore skin contamination altogether in their calculations.¹¹⁰ Again, they do not seem to be familiar with the specifics of the case: that alpha contamination of the skin was not monitored, that even permissible contamination levels could give cumulative doses in the thousands of rems, that dangerously radioactive particles can escape detection, that monitoring of the skin was cursory and that it was not carried out by men expert in the field of skin contamination.¹¹¹
- (3) Both experts assume that 905 millirems, as recorded on Mr. Paulson's film badge, was the only radiation exposure which Mr. Paulson received.¹¹² In fact, no effort was made to measure the "skin dose" received by Mr. Paulson, which would have necessitated an "open window" reading.¹¹³ No mention is made of the fact that Mr. Paulson was sent into a very "hot" area on a special mission, that he overstayed his time on that occasion, and that his film badge reading was discarded because it was over-exposed.¹¹⁴ No information about apparent radiation damage to penile tissue was available to the experts either.¹¹⁵
- (4) Both experts drastically overestimate the likelihood that Mr. Paulson's condition could have resulted from other causes (unrelated to radiation exposure) by disregarding the specifics of his case.¹¹⁶ The probability of one basal cell carcinoma developing cannot be compared with the probability of 16 developing at 16 different sites; the latter probability is several orders of magnitude smaller.¹¹⁷ The distribution of Mr. Paulson's cancers also makes it extremely improbable that they are spontaneous occurrences resulting from a genetic predisposition or from ultraviolet solar radiation.¹¹⁸

In short, both experts seem to have made their calculations based on the wrong kind of radiation exposure, an incorrect understanding of the circumstances, and relative to the wrong kind of ailment. The question is not "How likely is it that 905 millirems of whole body gamma exposure resulted in a single basal cell carcinoma?" but rather "How likely is it that skin contamination occurred and escaped detection, leading to a large unrecorded radiation dose over a period of time, and resulting in an extremely unusual pattern of multiple basal cell carcinomas?"

In the absence of precise measurements, we are forced to rely on circumstantial evidence to make a judgment. We know that Mr. Paulson's skin was contaminated. Through repeated showerings, some of this contamination was removed. However, there is no reason to believe that surface contamination can ever be completely removed once it has occurred.¹¹⁹ At some point, it is assumed that the levels of contamination are "negligeable" or "safe enough enough".¹²⁰ The question is, how safe is "safe enough"? In an attempt to answer this question, we are led to consider the epidemiological evidence -- to examine the medical histories of people who have been exposed to radiation in order to determine whether "permissible" levels of exposure can result in "significant" increases in cancer levels later on.

In Canada, there have been major epidemiological studies relating radiation exposure to cancer incidence in the case of underground miners from Ontario and Newfoundland.¹²⁰ These studies, and similar ones conducted in other countries, indicate that the present "permissible" levels of alpha exposure for uranium miners can more than double the incidence of lung cancer.¹²¹ Dr. Thomas, who recently co-authored a report on this subject for the Atomic Energy Control Board, estimates that the maximum permissible exposure for miners corresponds to a quadrupling of lung cancer rates, and that the maximum permissible exposure for residents of radon-contaminated homes corresponds to a 40 percent increase in lung cancer rates.¹²² Dr. Young, M.D., who co-authored a report on this subject for the B.C. Medical Association, suggests that the available medical evidence all points to the fact that chronic exposure to low-level alpha radiation is far more damaging than was previously thought.¹²³ In addition, a recent study from Czechoslovakia indicates an eight-fold increase in basal cell carcinoma associated with routine alpha exposures to the skin which were previously considered to be innocuous.¹²⁴

When we turn to the NRU cleanup at Chalk River, we find that the best available evidence of an epidemiological nature is a preliminary study undertaken by the CBC.¹²⁵ This study is restricted to the RCAF and Civil Defence people who participated in the NRU cleanup, and it indicates a substantial increase in cancers over what would normally be expected.¹²⁶ Although not conclusive, the results suggest a significant probability that some of these cancers were radiation induced.¹²⁷

For all the reasons outlined above, expert opinions as to the "improbability" that Mr. Paulson's cancers were caused by radiation should be viewed with skepticism. The NRU accident itself was very improbable. The type of contamination which resulted was unique in Canadian history. Mr. Paulson's role in cutting the vacuum hose was improbable, and his resulting cancers are extremely unusual. It is improbable that permissible levels of skin contamination are "safe enough" to rule out the possibility of massive cumulative doses to the skin, leading to radiation-induced cancers. And it is improbable that the excess cancers revealed by epidemiological studies are unrelated to the radiation exposures with which they are correlated.

Indeed, the language of probability theory is inappropriate and unscientific in this context, because there are too many unknowns: initial levels of skin contamination were not recorded; residual levels of skin contamination were not detected; cumulative doses due to skin contamination are unknown; and the risk factor for basal cell carcinomas induced by skin contamination may be quite different from that resulting from whole-body radiation using X-rays.¹²⁸

7. Available scientific evidence does not support the Pension Commission's contention that Mr. Paulson's cancers appeared too soon after the NRU accident to have been caused by associated radiation exposures.

Radiation can cause cancers of many different kinds.¹²⁹ In general, many years will elapse after radiation exposure before any excess incidence of cancer is observed; this "waiting time" (which depends on the type of cancer under consideration) is commonly referred to as the "latency period".¹³⁰

Dr. Létourneau indicated that "the latent period is usually quite long (20 + years) for radiation induced basal cell carcinoma."¹³¹ He argued that Mr. Paulson's cancers began appearing too soon (6 years) after the NRU accident to be attributable to radiation exposures experienced on that occasion.¹³²

However, the latency period is highly variable and is not always clearly defined.¹³³ Expert witnesses confirmed that the average latency period for basal cell carcinoma is about 20 years (in cases of gamma exposure or X-ray exposure), but it was also pointed out that individual cases could vary from a minimum (as little as 7 weeks) to a maximum (as much as 56 years).¹³⁴

There is some evidence to suggest that the latency period for basal cell carcinoma may be shorter when alpha radiation rather than gamma or X-radiation is the causative factor; in the Czechoslovakian study mentioned earlier, the average latency period was 14.2 years.¹³⁵ There is also reason to believe that larger radiation doses result in shorter latency periods.¹³⁶ Since Mr. Paulson could have accumulated doses of more than 5000 rems in the 6 year period following the NRU accident, which is more than double the average dose experienced by the Czech miners, it is perhaps not surprising that his latency period is less than half as long.¹³⁷

In any event, it is incorrect to assert that Mr. Paulson's cancers could not have been caused by radiation, simply because they developed in so short a time. The only person who has made this claim -- Dr. Létourneau -- has never actually testified at an Entitlement Board Hearing or made himself available for questioning. His evidence should not be given undue weight, particularly in view of the clarifying evidence offered by other expert witnesses on this subject.